READINESS FOR ENSURING SAFE DRINKING WATER IN SMALL COMMUNITY SYSTEMS

by

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DEDICATION

To the springs of Cape Breton. To the wells of Vancouver Island.

To Mor, Dad, and Nadine, who are always in my thoughts.

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ABSTRACT

All communities face challenges with respect to making water safe to drink and ensuring that it reaches consumers without decreasing in quality, yet these challenges are often amplified in small communities (<5,000 pop.). Best practices established by the World Health Organization emphasize proactive risk management in a water supply, guided by a Water Safety Plan (WSP) framework. While WSP-style management presents a more robust approach for managing risk in a water supply, uptake is often contingent on community capacity. New water policies can highlight gaps between the capacity to develop policies for ensuring safe drinking water, and the capacity of some communities to comply with these policies. Small communities in particular may require additional support to implement and maintain certain water policies such as WSPs effectively, and over the long term. The focus of this research is to understand how to best support these small communities.

This dissertation addresses a unique gap in WSP literature by considering community readiness for change as a potential barrier to policy uptake, implementation and maintenance. Community readiness considers a range of factors or 'dimensions' within a community that may support or hinder uptake of a new program or concept. There are four phases to this research: (1) a literature review to understand global experiences in implementing a WSP-style framework; (2) an investigation of seven small communities across Canada to understand experiences of upgrading a drinking water supply; (3) the validation of a modified community readiness assessment tool for use in the water policy – small community context; and (4) a baseline assessment of readiness in eight small communities in Alberta. By examining challenges associated with water policy uptake through a readiness lens, this research highlights a number of underlying socio-political factors that may significantly impede the trajectory of otherwise effective water management policies. A community readiness lens provides a practicable approach for addressing these socio-political factors, and may help better prepare communities for change. A community readiness approach shows potential as both a community pre-screening tool or as standard procedure during policy implementation.

LIST OF ABBREVIATIONS USED

BWA	Boil Water Advisory
CRM	Community Readiness Model
DWSP	Drinking Water Safety Plan
WSP	Water Safety Plan

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CHAPTER 1 INTRODUCTION

1.1 INTRODUCTION

Between 2000 and 2001, two isolated waterborne contamination events brought to light major inadequacies in how Canada's public drinking water supplies were being managed. The first event was when the water system serving the small, rural community of Walkerton, Ontario (pop. <5,000) became contaminated with *Escherichia coli* (*E. coli)* O157:H7 and *Campylobacter*. Eleven months later and two provinces over, the water system serving the town of North Battleford, Saskatchewan (pop. <14,000) became contaminated with *Cryptosporidium parvum*. In Walkerton, the outbreak caused over 2,300 cases of gastroenteritis, seven people died, and over a decade after the outbreak, many residents continue to suffer from health-related consequences (Hrudey 2011). While no deaths were reported as a result of the outbreak in North Battleford (Health Canada 2001), it is estimated that between 5,800 and 7,100 people in the town became ill as a result of drinking contaminated water (Stirling et al. 2001; Laing 2002). Both events helped draw attention to major knowledge gaps with respect to Canada's most important resource: drinking water. Specifically, these outbreaks raised questions such as: where does drinking water come from, how and why is it treated, how is it distributed to customers, and how vulnerable are these processes to failure?

The inquiries that followed both the Walkerton and North Battleford outbreaks identified not any one person or event but a series of failures contributing to the overall vulnerability of the water system and its eventual contamination (Hrudey et al. 2003; Woo & Vicente 2003; Prudham 2004). Further, the management approach guiding activity in these water utilities was (as in most utilities across Canada) was one that failed to identify and address risk before an impact on water quality could occur. In examining past failures, experts now urge a more robust and proactive approach for managing risk in a drinking water supply, specifically one that considers multiple barriers throughout a water system (O'Connor 2002; Laing 2002; Hrudey et al. 2003; Huck 2015). A multiple

barrier approach includes the following five barriers: source water protection, effective treatment processes, a secure distribution and storage system, ongoing monitoring, and effective responses to adverse events (Hrudey & Hrudey 2002). As a paradigm for addressing longstanding challenges within public water supplies a proactive, multiple barrier approach is considered the best way to ensure safe drinking water, and brings together the technical, financial and managerial aspects critical for ensuring a safe water supply (O'Connor 2002; Huck 2015), and echoes best management practices endorsed by the World Health Organization (World Health Organization [WHO] 2004; WHO 2011). However, across Canada, surprisingly few jurisdictions have applied the lessons learned from major outbreaks, including shifts in management practices to include multiple barriers. As a result of these and other shortcomings, many water supplies remain as vulnerable to contamination today as they were 15 years ago (Schwartz & McConnell 2009; Plummer et al. 2010; Christensen 2011; Hrudey 2011).

For any community, making water safe and ensuring that it reaches consumers without a decrease in quality can be a significant and ongoing challenge. Small community drinking water systems (small systems, those serving fewer than 5,000 customers) often face greater difficulty in supporting the technical, financial and managerial aspects required to ensure safe drinking water, and are thus more likely to experience an outbreak of waterborne illness than a larger community (Peterson & Torchia 2008; Hrudey 2008; Moffat & Struck 2011; Environment Canada 2014). While there is no national database for documenting waterborne disease outbreak events in Canada, a national study found 75 percent of these events occurring between 1993 – 2007 took place in small systems (Wilson et al. 2009). In recognition of this gap, there is increased attention from expert groups on addressing the small systems challenge (see, e.g., the National Collaborating Centers for Public Health (NCCPH 2014) for a list of recent Canadian initiatives). Today, a gap remains between the capacity to regulate for safe drinking water, and the capacity of small communities to comply with these regulations.

1.2 Research Purpose and Objectives

In response to the issues introduced above, this dissertation aims to understand improvement challenges within the water policy – small community context. This is guided by the following research question:

What capacity building supports are required to help Canada's small communities ensure a supply of safe drinking water over the long term?

Four objectives are addressed within this question:

Research objective #1 – Investigate and understand how utilities worldwide have implemented the multiple barrier approach, with a particular focus on drinking water safety plans;

Research objective #2 – Identify the processes through which small communities in Canada mobilize resources and build capacity in order to achieve and maintain regulatory compliance for drinking water;

Research objective #3 – Explore community readiness as a tool for understanding and strengthening community capacity to adopt best practices such as water safety plans; and

Research objective #4 – Recommend practical applications for supporting policy and practice in Canada's small systems.

Having introduced the research problem and identified the study purpose and the objectives, the remainder of this chapter focuses on grounding the study in relation to the existing academic research and theory, and provides a brief explanation of the chapters that follow.

1.3 BACKGROUND

This research adopts an interdisciplinary approach, and is informed by the disciplines of human geography, civil engineering, and public administration. A closer look at the disciplinary contributions is provided in Chapter 2. The following section situates the research in the broader literature and focuses on the concepts underlying the research topic.

1.3.1 Safe drinking water in Canada

Without freshwater, the economic, social and environmental sustainability of most (if not all) communities would be under threat (Parkes et al. 2010). The Federation of Canadian Municipalities defines a sustainable community as one focused on three key areas: social well-being of the community, including public health and safety; environmental integrity of the region, including protection of natural resource values and functions; and financial/economic viability of the community (Federation of Canadian Municipalities 2002, p. 1-2). Water is integral to all three of these areas; it is central to the health of the community as it relates to safe drinking water, it is central to the health of the surrounding ecosystem, and it is central to industry in terms of its capacity to operate and thus contribute to community self-sufficiency. As such, Bakker (2003) notes the achievement of a sustainable water system is the "cornerstone" (p. 3) of any sustainable community.

Despite this critical role, water remains a marginalized resource in Canada (Bakker & Cook 2011). The 'myth of abundance' (Sprague 2003), a popular vision of Canada's freshwater supplies, directs many of the decisions made about water use and allocation at national, provincial and local levels. A number of recent events have challenged this view, showcasing the vulnerability of - and limit to - Canada's water supplies. For example, between 1994 and 1999, 25 percent of Canadian municipalities experienced water shortages, resulting from overuse, drought conditions, infrastructure constraints or a combination of factors (Environment Canada 2002). With respect to water quality, the

outbreaks in Walkerton (in 2000) and North Battleford (in 2001) remain symbols of what can go wrong in a public water supply, and serve as reminders of health risks for governments, water operators, and the Canadian population in general (Driedger & Eyles 2003; Woo & Vincente 2003; Kot et al. 2011; Hewitt 2012).

One clear indication of unsafe drinking water is the boil water advisory (BWA); however, it is important to note that not all contamination in a water system can or will be detected (Richardson & Ternes 2011), while definitions of what is 'safe' can vary significantly between jurisdictions (Bakker & Cook 2011; Dunn et al. 2014). BWAs are not intended as placeholders or long-term 'solutions' to the challenge of non-compliance, yet some communities do not have the resources to address problems as they arise (Eggertson 2008; Grover 2011). Publically accessible information on BWAs in Canada is limited, and there is no central database or reporting requirement in place across all jurisdictions. However, a 2015 report identified 1,838 boil water advisories across the country, many of which are in small communities (Lui 2015). BWAs can be costly to individuals and to communities (Gilman & Skilicorn 1985; Wagner et al. 2005; Ryan et al. 2013), and can erode trust between community members and service providers (Slovic 1993; Kot et al. 2011; Dupont et al. 2014). In areas with longstanding or reoccurring BWAs, message fatigue and subsequent non-compliance with the advisory among community members can occur, leading to use and consumption of unsafe water supplies (Grover 2011). Identifying feasible solutions for communities prone to BWAs can, therefore, have significant, positive, and long-term impacts.

Conceptualizing unsafe drinking water through BWAs alone is, however, insufficient for understanding the scope of the water quality challenge in Canada. There are strong indications that given past failures, and that similar failures continue to occur, major changes are required in how water resources are governed. This includes, but is not limited to, better stakeholder engagement, better awareness of risks to a water supply, and a proactive approach to addressing these risks (O'Connor 2002; Hrudey & Hrudey 2004; Christensen 2011; Straith et al. 2014). While water resource management has devolved to the local level, it may be the case that provinces and territories are better positioned to

lead the adoption of new governance frameworks. Unfortunately, the willingness to exercise this capacity remains, thus far, limited (Morris et al. 2007; de Loë, 2009; Hrudey 2011).

1.3.2 Water governance

Governance describes interactions beyond government, referring to "all processes of governing, whether undertaken by a government, market, or network; whether over a family, tribe, corporation, or territory; and whether by laws, norms, power, or language" (Bevir 2013, p. 1). It is the continuing process through which conflicting or diverse interests may be accommodated and co-operative action may be taken. Governance is the result of iterative interactions between any number of actors, and through which the results are either formally entrenched, or "expressed through subtle norms of interaction" (Lebel et al. 2006, p. 2). Models for governance, and ultimately models of good governance for managing water resources, are challenging to define as they can mean different things to different people (Rogers & Hall 2003).

Globally, the challenges associated with managing freshwater have been referred to as a "crisis of governance" (Global Water Partnership 2000), and this is echoed in the Canadian context (Bakker 2003; de Loë 2008; Bakker & Cook 2011; Dunn et al. 2014). Here, approaches to water governance are fragmented between different jurisdictions, territories and scales, making the water sector the most decentralized utility in Canada (Bakker & Cook 2011; Cohen & Davidson 2011). As such, water regulations – and, as a result, water quality – can vary significantly depending on location (Hrudey 2008; Cook et al. 2013). Further, the decentralization of responsibility for water has left municipal agents, many with varying degrees of capacity to address drinking water challenges, with the majority of the legal responsibility for providing safe water to consumers.

This variability in capacity has left some communities more vulnerable to poor water quality than others (Moffat & Stuck 2011; Cook et al. 2013). Within Canada's provinces, urban communities have significant advantages over rural communities when it comes to

making - and keeping - water safe, a problem often evident in water quality at the tap (Hrudey 2008; Kot et al. 2011; Dunn et al. 2014). Small communities are more likely to have difficulties recruiting and retaining qualified operators (Kot et al. 2011), maintaining a backup supply of resources in case of emergency (Hrudey 2011), and mitigating impacts related to climate change (Maal-Bared et al. 2008). The divide is greater still when it comes to First Nations communities. Although outside the scope of this research, it is important to recognize that as part of Canada's water quality 'patchwork', First Nations communities fall under federal jurisdiction, and thus are subject to a different set of regulatory and administrative requirements than other communities in the same province (see, e.g., Hill et al. 2008). First Nations communities experience a rate of water-borne infections 26 times higher than the Canadian average (Patrick 2008), and many of Canada's long-term boil water advisories are found in these communities (Swain et al. 2006; Dunn et al. 2014; Lui 2015).

Globally, best practices for water management have shifted in reaction to new and complex human-driven challenges that cannot be reconciled through traditional, technically focused solutions (see, e.g., Pahl-Wostl et al. 2002; Moore et al. 2014). In response, there is growing consensus on the need for policies and institutional frameworks for water governance with the capacity to develop and draw support from a broader range of stakeholders. These policies should not only seek to ensure the sustainable use of water resources, but ensure these can be achieved through informed stakeholder input and participation (Rogers & Hall 2003; Pahl-Wostl et al. 2007; Biswas & Tortajada 2010; Hrudey & Hrudey 2014; Moore et al. 2014). In this way, the devolution of responsibility for drinking water to the lowest appropriate scale has the potential to support principles of 'good governance' (discussed below), and to allow for better management of local resources by local stakeholders (Bakker & Cook 2011; de Loë 2008).

Across Canada, water management practices at the provincial and municipal levels are undergoing rapid change (Dunn et al. 2014) with each jurisdiction taking on its own "unique, largely independent experiment in water governance" (de Loë & Kreutzwiser

2007, p. 91). However, the necessary financial resources, human and decision-making capacities must be in place if it such changes are to be successful (Rogers & Hall 2003; Furlong 2012). Notes Hrudey (2011), "… throwing money at a problem without having the money guided by those who understand what is required will achieve little, or may even be counter-productive" (p. 17). Thus positive innovations in water management may serve to widen the water quality gap between small, under-resources communities and their larger counterparts.

1.3.3 Good governance

In governance literature 'good governance' is described as being context dependent (Plumptre & Graham 1999; Weiss 2010; Bakker 2003; Hill 2013). Common principles of good governance include the need for recognition of stakeholder and decision-maker legitimacy, the acceptability of the decision-making process by stakeholders, and the adaptability of decision-making structures (Weiss 2000; Bakker 2003). Today, understanding and facilitating conditions for good governance emerges as a core challenge for ensuring the sustainable use of water resources (Pahl-Wostl et al. 2007; Biermann et al. 2009; Lebel et al. 2010). Because each jurisdiction, community, and situation is unique, good governance cannot be described in a 'one size fits all' approach (Bakker 2003; Rogers & Hall 2003). In developing a management approach that follows principles of good governance, subtle nuances understood only by those who associate closely with a particular issue, whether these are ecological, hydrological or social in nature, should be integrated and addressed (Bakker 2003; de Loë 2005).

Where governance is poor, community sustainability and community health are at risk (Bakker 2003; Pahl-Wostl et al. 2007; Hill 2013). At its most extreme, poor governance has led to tragic results; yet, even with legacies such as Walkerton and North Battleford, resistance to change persists. For example, Canadians still pay some of the lowest rates in the world with respect to treated water supplies (Organization for Economic Co-operation and Development 2010). This makes treated water a "remarkable bargain" (Hrudey et al. 2006, p. 957), undermining efforts aimed at securing meaningful conservation, and

creating challenges for communities seeking to improve infrastructure, meet regulatory requirements, and hire and train competent operators (Olmstead & Stavins 2009). At the same time, customers' expectations for water quality are rising, and along with changes in technology and more stringent regulation, the costs associated with providing safe drinking water continue to increase (Renzetti 1999; Hrudey 2008). Balancing these costs with the perceived value of water services and the willingness to pay for these services is a key challenge for communities (Canadian Water Network 2014, 2015).

1.3.4 Moving forward

All Canadians deserve access to safe drinking water, and there is opportunity for innovation in how drinking water is managed (Plummer et al. 2010; Hrudey 2011). For some jurisdictions, limited resources have resulted in new configurations of water management, including municipally owned corporations (e.g., EPCOR Water Services serving the city of Edmonton and region) and public-private partnerships (e.g., Moncton, New Brunswick) (Bertels & Vredenburg 2004). More broadly, legislation such as Ontario's *Clean Water Act* and Alberta's *Water for Life Strategy* reflect a recognition that certain aspects of water management, such as source water protection, are better shared between a range of stakeholders, including members of the public (de Loë & Kreutzwiser 2007; Nowlan & Bakker 2010).

More recently, the province of Alberta required all public water utilities to implement drinking water safety plans[1] (DWSPs), becoming the first province in Canada to fully operationalize a multiple barrier approach as recommended by the World Health Organization and in the Walkerton Inquiry (O'Connor 2002; Reid et al. 2013). A DWSP approach is guided by four principles: collecting and evaluating the best information available about a water supply; analyzing and understanding potential risks; assessing approaches for risk mitigation; and, determining resources and actions to reduce those risks (AESRD 2014). Once in place, a DWSP is customized to suit local capacity,

[1] The term 'water safety plan' used by the World Health Organization and 'drinking water safety plan' used by the province of Alberta describe similar frameworks for water management.

includes input and cooperation from multiple stakeholders, and encompasses many of the principles identified as part of a good governance approach to water management (see Reid et al. 2013). However, such an approach is not without the risk of failure, particularly among communities who lack the capacity to respond effectively (de Loë & Kreutzweizer 2007; Hrudey & Hrudey 2014). As a result, ensuring the long-term success of promising frameworks such as the DWSP emerges as an important concern.

In the literature on innovation adoption, communities that are 'ready' are viewed as being better able to implement and sustain a change over the long term (Oetting et al. 1995; Plested et al. 1998; Chilenski & Greenberg 2007; Crooks et al. 2010). Community 'readiness' is the capacity of a community to accomplish certain goals, and is an important concept for ensuring success in areas of research outside of the water-related literature. Studies of readiness for change among individuals (DiClemente & Prochaska 1998), groups (Warren 1978), and more recently communities (Oetting et al. 1995; Edwards et al. 2000; Chilenski et al. 2007; Crooks et al. 2010) show that higher readiness is associated with better long-term outcomes, and that without readiness, efforts made to implement a change may fail or fall short of expectations because the capacity to support that change does not exist (Goodman et al. 1998; Macri et al. 2002). By focusing on readiness, community strengths and weaknesses can be better understood and appropriate adjustments during the implementation phase can be made. In a drinking water context, a community readiness approach may be a critical step in facilitating what are widely recognized as being good solutions to persistent water quality problems (Moore et al. 2014).

1.4 Organization of Dissertation

This dissertation is organized into seven chapters. Chapter One has provided the rationale for this study, the research purpose and objectives, and a review of background literature used to inform the study. Chapter Two provides a detailed description of the disciplinary contributions of the dissertation, as well as the methodological approaches used in data collection and data analysis throughout the research process. Chapters Three, Four, Five

and Six were prepared as independent manuscripts intended for scholarly publication. They each highlight study findings and include discussions relevant to the research objectives and background literature. Their contributions are as follows:

Chapter Three provides a brief history of the global application of the WSP framework. The benefits and challenges associated with WSPs are also examined. Community readiness is highlighted as an approach for addressing some of the common challenges associated with WSP uptake challenges discussed in the chapter. This chapter is published in the journal *Environmental Reviews* (Kot et al. 2014).

Chapter Four details an investigation into how seven small community water systems from across Canada, each with in its own set of unique physical, social, economic, and political contexts, achieved regulatory compliance. Data analysis, based on qualitative semi-structured interviews, shows that each community approached the challenge of safe drinking water differently, with decisions made based on both regulatory requirements and local factors, such as history, preferences, financial and human capacity. These findings contribute to our scholarly understanding of complexity that guides decisions made about drinking water Canada's small communities. This chapter is published in the journal *Water Policy* (Kot et al. 2015).

Chapter Five introduces a community readiness model (CRM) and validates the model's six readiness dimensions for use in evaluating readiness in a water policy – small community context. The six dimensions are submitted for evaluation by a panel of experts from across Canada using a two-round Delphi technique. The findings suggest a CRM approach is suitable for evaluating community readiness this context.

Finally, in Chapter Six an assessment of community readiness is used to establish benchmark readiness among eight small communities in the province of Alberta. The assessment evaluates early DWSP uptake drawing from a primary and a retrospective analysis. These findings provide an understanding of the variability between communities

and between readiness dimensions, and demonstrate the utility of a CRM approach to elucidate and address community-specific barriers to change.

Chapter Seven provides a synthesis of the research findings and their theoretical, methodological, and substantive contributions, offers recommendations to policy makers, and highlights study limitations. Recommendations for further studies are also provided.

CHAPTER 2 METHODOLOGICAL APPROACH AND METHODS

2.1 INTERDISCIPLINARY APPROACH

This dissertation adopts an interdisciplinary approach, as the challenges facing Canada's small water utilities are not bound by a single discipline. Understanding these challenges requires a study of interactions, which may themselves be influenced by local culture and history, socio-economic and environmental factors. Where the goal is to develop effective management regimes in order to ensure safe drinking water, an understanding of these interactions is required (Pahl-Wostl et al. 2011; Moore et al. 2014). To accomplish the objectives set out in Chapter 1, this research integrates and provides valuable contributions to three academic disciplines: human geography, civil engineering, and public administration. A summary of the contributions to each discipline is provided in Chapter 7.

Human geography is "the study of the interrelationships between people, place, and environment, and how these vary spatially and temporally across and between locations" (Castree et al. 2013, p. 223). For this research, a lens of human geography provides the approach for examining how the lives and activities of people are shaped, and how these people interact with the places and nature that surrounds them (Winchester & Rofe 2010; Castree et al. 2013, p. 223). This lens provides an understanding of how place-based or community-based knowledge influences policy and management decisions (O'Toole et al. 2009).

In contrast, civil engineering is concerned with the design and construction of public works, including drinking water systems (Wood 2012). In relation to drinking water, civil engineers focus on maintaining and improving water safety, taking into account regulatory factors, the characteristic and availability of raw water, and local factors such

as the needs of the population served, location of the population and capacity to pay for and maintain a particular system. Traditionally, the water industry has attributed the engineered aspects of a water system with drinking water safety, however, these views are changing to favour a more holistic approach that includes multiple influences, including human factors (see, e.g., Schuster et al. 2005; Hrudey et al. 2006; Wu et al. 2009).

Finally, this research draws from public administration literature, specifically aspects of governing public services, which determine how local governments manage a drinking water supply. Decisions surrounding service regionalization, establishing user fees for water (and other) services, and determining who is involved and how decisions are made about water management fall under the public administration realm (Slack & Bird 2013). It is here where innovative governance structures can be formed to address and overcome challenges due to community location, population size or resource availability (Martin et al. 2012).

An interdisciplinary approach brings together two or more academic fields in order to address a particular problem through collaboration and integration (Darbellay et al. 2014), and is aligned with specific learning outcomes. In an examination of interdisciplinary learning outcome goals set out in the literature for graduate students in the humanities, science and engineering fields, Borrego and Newswander (2010) identified four overarching outcomes: disciplinary grounding, integration, communication and translation, and critical awareness. The first, *disciplinary grounding* seeks to ensure the student comprehends, to a degree, each of the contributing disciplines to their area of study in order to be able to "reflect on the nature of disciplines and make meaningful connections" (Borrego & Newswander 2010, p. 68). The process of *integration* describes the synthesis and integration of various disciplines, uncovering common ground between the disciplines, and revealing a new, holistic understanding about a particular issue. *Communication and translation* throughout the research develops the notion of a common ground, develops a mutual understanding about the problem among those involved, and establishes how the quality and credibility of

research outcomes will be measured. Lastly, *critical awareness* describes how well a researcher understands his or her own limitations in conducting and interpreting research findings, the development of 'bigger picture' thinking, and whether perceptions other than one's own have been assigned value (Borrego & Newswander 2010; Mansilla & Duraising 2007).

The exploratory nature of the research led to the selection of a qualitative research approach. A qualitative approach is useful when seeking to understand how people give meaning or interpret the world around them (Patton 2002; Krauss 2005; Denzin & Lincoln 2011;), often placing the researcher in the natural setting in which a particular phenomenon is occurring (Creswell 1998). Qualitative research means "many things to many people" (Denzin & Lincoln 2003, p. 13), and is, therefore, broadly interpreted as any research taking a naturalistic and interpretive approach.

Qualitative research falls along a spectrum of positivist, post-positivist, critical theory, constructivism, and participatory paradigms (Denzin & Lincoln 2011). The conceptual framework guiding this dissertation is part critical theory and part constructivism. With respect to constructivist influences, this research is guided by the concept that knowledge is socially constructed and that multiple realities must be understood in order to understand the complete problem or issue being studied (Denzin & Lincoln 2011; Creswell 2012). This research captures input from a range of individuals, including decision-makers, water operators, researchers and water customers in order to understand the multiple realities that inform the choices made about drinking water within Canada's small communities, and the outcomes that result from these choices. Drawing from critical theory, this research seeks to go beyond knowledge acquisition and to be used to create positive social change, to increase awareness of injustices, and to present a voice for those in a position of lesser power (Guba & Lincoln 2005; Creswell 2007). In this research, the documentation of seldom-heard voices from those in rural communities, decision-makers and water operators in particular, as well as contributions to the literature on the subject of community readiness for change, has the potential to make a positive contribution across Canada's water management landscape.

2.2 Research Methods Across Four Phases

This dissertation was conducted over four phases. The majority of the fieldwork was conducted in Phase 1, where between 2009 and 2011 interviews with water operators ('operators'), water users ('customers') and decision-makers were conducted in seven small communities across Canada. Phase 2 was a literature review of water safety plans (WSP) and the challenges associated with their application in various jurisdictions around the world. In Phase 3 an existing Community Readiness Model (CRM) was identified and the assessment tool within the model was modified to reflect the water policy – small community context. The applicability of the model's six readiness dimensions in the water policy context was evaluated using a two-round Delphi technique. In Phase 4, eight small communities required to implement a WSP-style framework were assessed for readiness using the modified assessment tool. The specific research methods used during each phase of the research are described in detail below.

2.3 Procedural Ethics and Licencing

A number of approvals were required in order for this research to occur. In Phase 1, ethical approval was given by the Dalhousie University Social Sciences and Humanities research Ethics Board (REB # 2007 – 1684), the Health Canada Research Ethics Board (REB # 3 2008 – 0057), and the Aurora Research Institute (REB # 14682), which provides a research license for the portion of the research conducted in the Northwest Territories. Two more ethical approvals were issued by the Dalhousie University Social Sciences and Humanities Research Ethics Board, one for Phase 3 (REB # 2013 – 2924) and one for Phase 4 (REB # 2013 – 3047) of the study. No ethical issues were encountered over the course of this research.

2.3.1 Phase 1: Overcoming compliance challenges in Canada's small systems

Phase 1 was designed in collaboration with Health Canada starting in early 2009. The goal of the study was to examine the financial, social, environmental and governance factors influencing the choices made by small communities when engaging in projects to improve their water quality and/or quantity. The goal of this phase was to focus on recent cases identified by relevant (i.e. local) water quality regulators as being 'success stories', and which could serve as inspiration to other small communities across the country. A list of criteria, described below, was developed to facilitate community selection. The interview guides were developed between the research team at Dalhousie University and Health Canada. Members of the Small Community Water Supplies Task Group, a consortium of water research organizations convened by Health Canada in 2007, were also consulted for input. Funding to conduct this phase was secured from the Canadian Water Network.

The criteria for a community's inclusion in this study was as follows:

1. The community must be willing to participate in the research. This was secured through the 'Community Consent' form signed prior to starting any research. In most communities the consent form was presented at a council meeting and then signed by the Mayor. In addition to complying with the ethical requirements set out by the Dalhousie University Social Sciences and Humanities Research Ethics Board, securing community consent helped to raise local awareness and interest in the project prior to commencing with fieldwork.

2. The drinking water system must have undergone an improvement. An improvement may be one of many achievements, including but not limited to: the regionalization of a water supply, major changes in treatment technologies or distribution approaches, source water protection initiatives, increasing water rates to reflect the cost of providing water, public awareness campaigns, or a combination of improvements. Because the goal was to gather information on these improvements through interviews, only recent improvements (defined as

occurring in the past five years) were selected as a way of ensuring this information remained 'fresh' and that those involved were still in the community.

3. The community must have been involved (to some extent) in the decision-making process regarding the improvement. This criterion was determined in initial conversations with a contact person in the community prior to seeking community consent.

4. The improvement must be viewed within the community as being a success. Success was considered based on a number of factors, including the improvement's technical functionality, the delivery of adequate water quality and quantity consistently and over the long-term, the use and acceptance of the water by the community (e.g., following a period of non-use), or the sustainability of the water system through secure and long-term funding initiatives. This criterion was determined in initial conversations with a contact person in the community prior to seeking community consent.

In September 2009 a pilot study was completed in Springford and Otterville, two neighbouring communities located in southern Ontario. The pilot study involved two researchers (myself and a Health Canada employee). We each conducted interviews and examined historical documents related to both water systems, which had been joined via pipeline in order to resolve ongoing water quality and quantity issues. The pilot study showed there were no major issues with the research approach, selection criteria or the interview guide. In total, seven communities agreed to participate in this study (Table 2-1).

Table 2-1 Communities included in survey

Name	***Province or Territory***	***Population (est.)***
Arcola	Saskatchewan	504
Aspen Regional Water Services Commission	Alberta	3,967
Honeymoon Creek Water Users Community	British Columbia	9
Donkin	Nova Scotia	445
St. Lawrence	Newfoundland & Labrador	1,349
Springford & Otterville	Ontario	400 and 1,000
Ulukhaktok	Northwest Territories	400

The process for community recruitment was as follows. Using e-mail a representative from Health Canada would contact the provincial or territorial regulator responsible for drinking water. The email would outline the purpose of the study and would ask if there were any communities in that province or territory that met the selection criteria defined by the research group. In most cases, the regulator would provide a list of communities (usually one to five communities) and a justification of why they thought each community fit the selection criteria. In some cases the regulator would forward the email on to regional representatives and these representatives would provide suggestions to Health Canada. Once this information was obtained the research group would convene to discuss each option and a decision would be made to contact one or more community. In most cases, only one community stood out as an ideal candidate. The research group was unsuccessful in identifying potential participants for this study in the provinces of Manitoba, New Brunswick and Prince Edward Island, as well as in the Yukon. Because community recruitment and planning each site visit took considerable time, and because overall time to complete this study was restricted, communities in the province of Quebec and the territory of Nunavut were not able to be included in this study.

Initial contact was made by myself with the community by phone. I would ask to speak to someone who was familiar with the water system in that community and I would describe to the individual the purpose of the study and the criteria for inclusion. After the phone call, the same individual would be sent (via email or facsimile) a Letter of Information and Community Consent form (Appendix A). After reviewing the letter, and if the individual thought their community would be suitable for the research, the individual (who often became the key contact in the community for the remainder of the research period) would bring the Community Consent form to the appropriate signing authority (e.g., the Mayor or CAO). In most cases, the study and the consent form were presented at a council meeting. This posed a challenge as some councils met infrequently, meaning that in all communities the time between initial contact and receiving community approval for the project was at least one to two months.

Once community consent was obtained I would work with the key contact to determine a suitable time to conduct the community visit and interviews. The key contact would also provide names of key individuals in the community (e.g., operator, public works supervisor, council members) who would be suitable as interviewees based on occupational responsibilities, length of time in the community, or involvement in recent water-related improvements. To avoid selection bias I used stratified purposeful sampling (Creswell 2002) to identify other information rich cases (individuals) once I was in the community. Such recruitment took place by word-of-mouth (e.g., from other interviewees) and by speaking with individuals that I encountered in public areas, including municipal offices and other public buildings and spaces. In one community I attempted to use community access television to recruit respondents, however, I had limited success. Overall, a flexible approach taken in recruiting additional interviewees falls in line with the supposition: "who and what comes next depends on who and what came before" (Baxter & Eyles 1997, p. 513), indicating that recruitment is an ongoing process.

All interviewees (including the key contact) were grouped in three categories (Table 2-2): Operators (individuals who worked at the municipal water utility), decision-makers

(individuals in a decision-making position with respect to the municipality and/or the water utility), and customers (water users such as community members and business owners). Potential interviewees were provided with a Letter of Information (Appendix B). Verbal consent from each participant was sought at the time of the interview (Appendix C). Interviews were conducted in-person, using a semi-structured interview process which allowed for interviewees to provide detailed descriptions of their experiences within the community relating to water services (Kvale 1996).

Table 2-2: Interviews in the survey

Category of interviewee	***Number of interviewees***
Operator	20
Decision-maker	35
Customers	27

Individuals were asked a series of open-ended questions using an interview guide. A different interview guide was used for operators (Appendix D), customers (Appendix E) and decision-makers (Appendix F), as different groups were anticipated to have access to different types of information and insights. Individuals were interviewed by myself in person, in a place in the community that was mutually agreeable to both myself and to the interviewee (often this was at their place of work or residence). When possible (i.e. where the individual consented and where the surroundings permitted) interviews were recorded digitally, otherwise notes were taken by hand. All interviews were transcribed verbatim. The use of mechanically recorded data contributed to the overall dependability of the findings, as this reduces researcher inference over an observed construct (Baxter & Eyles 1997). Other forms of data, such as consultants' reports, community flyers and newspaper accounts were also gathered. These served to triangulate the findings gathered through the interview process, lending to the credibility and dependability of the research (Baxter & Eyles 1997).

Visits to each community lasted between two and nine days. The length of time was dependent on how many interviews were scheduled, when interviewees were available,

and in some cases due to transportation challenges to and from the community. Spending a number of days in a community made it possible to experience elements of community life and speak with a wider range of individuals than would have otherwise been possible had I conducted these interviews by phone.

For this study the process of data collection and analysis were informed by grounded theory. Grounded theory presents a systematic approach suitable for examining the actions and interactions of individuals, and the challenges to which they must adapt (Corbin & Strauss 2007). During the data collection phase, new interviewees were sought until saturation occurred, and further interviews failed to yield any additional insights into the issue under investigation in that particular community (Glaser & Strauss 1967; Seale 2011). Following each community visit, interviews were transcribed verbatim, and, along with the grey literature collected, were reviewed and analyzed. This iterative and comparative approach to data collection and analysis was instrumental in shaping the study and study outcomes, including the pursuit of new lines of inquiry as novel information emerged (Charmaz 2007; Denzin & Lincoln 2011). Ultimately, by drawing on the principles of grounded theory, what emerged was the concept of readiness as a mediating factor in water policy uptake at the community level, a concept pursued in the subsequent research phases. NVivo 8^{TM}, a qualitative software tool, was used to manage the data process and discover concepts and themes using a constant comparative analysis (Glaser & Strauss 1967).

To help ensure the credibility of the findings, each community was provided with a ten-page research summary of the findings (Baxter & Eyles 1997). Each summary detailed the purpose of the research, a brief overview that community's water supply, a summary of the findings supported by anonymous quotes from the interviews, and illustrated with images from the community. The community was invited to provide feedback on the report. Of the seven communities only one provided feedback and this was incorporated into the study's final outcomes. Peer examination, the provision of feedback on findings from those familiar with the research (in this case both of my supervisors) was used to

identify potential sources of misinterpretation or the suppression of themes or voices (Baxter & Eyles 1997; Creswell & Miller 2000).

2.3.2 Phase 2: Literature review of WSP implementation

A review of the current peer-reviewed English literature was conducted on global experiences with WSP implementation. The purpose of this review was to identify documented experiences, benefits and challenges of WSP implementation in a variety of settings, including in small and large communities. Several databases (i.e. Web of Science, PubMed, and Google Scholar) were used to identify relevant examples from around the world.

2.3.3 Phase 3: Understanding community readiness for DWSPs

From the findings gathered in Phases 1 and 2, community readiness for change emerged as a potentially influential factor in how (and how well) small communities are able to achieve regulatory compliance, including adopting new water policies such as DWSPs. To develop an understanding of community readiness in this context, an existing Community Readiness Model (CRM) model was identified. The CRM was originally developed by Oetting and colleagues (1995) to address readiness challenges around health programming and health prevention at the community level. The model identifies six readiness dimensions: knowledge about an issue, existing efforts, knowledge of efforts, leadership, resources and community climate (Oetting et al. 1995; Edwards et al. 2000). These dimensions are assessed within communities through interviews with one or more informed individual. Qualitative responses to an assessment questionnaire are converted to a quantitative scale in order to identify a stage of readiness for change. This stage provides a platform upon which strategies for building readiness are developed. To render the existing CRM applicable in the water policy – small community context, the six readiness dimensions were revised (Appendix G) and a new assessment questionnaire was developed drawing from the findings in Phase 1 and 2 of this research (Appendix H).

A panel of experts from across Canada were recruited to participate in a two-round Delphi technique, the purpose of which was to assess the validity of the six readiness dimensions in the water policy – small community context. These individuals were familiar with water policy implementation challenges faced by small communities, either through experiences developing or studying water policy or facilitating policy implementation at the community level. Individuals were furthermore familiar with the types of actions required by communities under a WSP-style water management approach. A Delphi technique provides a structured, systematic approach designed to help facilitate consensus among individuals about a problem or question over a series of iterations (Lindstone & Turroff 2002). For this study, an email (Appendix I) containing a Letter of Information (Appendix J) was sent to recruit potential participants. The letter described the study, and had within it a link to an online survey. In total, 10 panelists consented to participate in both rounds. In Round 1, panellists were provided with a list of modified definitions describing the six readiness dimensions (Appendix G). Panellists were asked to review the definitions, and to provide responses to three questions (Appendix K). In Round 2, panellists were provided with group responses (mean score and confidence interval for each question – Appendix L) and if desired could re-evaluate their responses from the first round. The result was used to confirm the validity of the readiness assessment portion of a CRM approach in the water policy – small community context.

2.3.4 Phase 4: Understanding community readiness for DWSPs in Alberta

To test the CRM assessment tool, eight small communities were selected from locations across Alberta, Canada. These communities were each in the process of developing and implementing DWSPs. The eight communities had previousl involvement in research projects with Dalhousie University related to DWSP implementation (i.e. Perrier et al. 2014). I contacted the community via telephone and spoke with a key informant (either an operator or a decision-maker). I described the purpose of the research and asked if there was interest in participating (Appendix M). A letter of information was provided to the individual via email (Appendix N), while consent to participate was verbally received

at the time of the interview (Appendix O) which occurred by phone. The assessment consisted of a revised questionnaire (Appendix H), and each question related to the six readiness dimensions vetted by the expert panel in Phase 3. Each completed assessment was scored using CRM methodology, described by Edwards and colleagues (2000). The scores were used to determine a 'stage' of readiness for each community. As an independent step, interviews conducted in the same eight communities independently of this research were assessed retrospectively using the same assessment tool. A second stage of readiness was determined using these results and the two results were combined to determine overall readiness.

2.4 Researcher Reflexivity

My decision to pursue a PhD was influenced by my positive experience as a Master's student, during which I explored the regulatory burden placed water operators working in small communities in Atlantic and Northern Canada, and the coping strategies employed by these operators to achieve compliance with water quality regulations. During this time I became aware of the many daily challenges associated with making water safe in small communities, and how community attributes can either help or hinder this accomplishment. Most interesting was the influence of broader socio-political issues on local drinking water matters. Through my PhD research, I sought to further elucidate the role of these community-level socio-political influences on drinking water quality outcomes.

The findings of this study are largely the result of interviews and interactions between myself and study participants, and as such, my personal characteristics may have had an influence (Fontana & Frey 1994). I am a Caucasian Canadian female who was raised in close proximity to a medium sized capital city (Victoria BC). In most cases, I was younger than many of those who I was interviewing, many of whom were older, white males. As someone who had never performed any processes relating to water treatment, lived in a small town, worked as a member of local government, or lived in a particular

province or territory, I was often required to ask numerous clarification or background questions of my interviewees. This was particularly the case with operators. In doing so however, I believe my own ignorance helped to close the gap between the operator and myself, a university researcher, and build a level of trust necessary to better understand the range of challenges and strengths present within a particular community. One of the benefits of the research approach used in Phase 1 was the identification of key community informants with whom I could discuss aspects of the research both before, during and after fieldwork had occurred. In addition, the length of time spent in each community, which varied from two to nine days allowed me to seek out qualified interviewees, join operators on daily errands, sit in on community events, and conduct follow up interviews if required. While working within a social constructivist paradigm acknowledges the influence of the researcher's background on the final interpretation of study results, other mechanisms as mentioned in the above sections were used to help ensure the quality and rigor of the research (Baxter & Eyles 1997).

CHAPTER 3 THE HUMAN DIMENSION OF WATER SAFETY PLANS: A CRITICAL REVIEW OF LITERATURE AND INFORMATION GAPS

This Chapter is published in *Environmental Reviews* (Appendix P):

Kot, M., Castleden, H., and Gagnon, G.A. (2014) The human dimension of water safety plans: A critical review of literature and information gaps. *Environmental Reviews* 23 (1), 24 – 29.

3.1 ABSTRACT

A safe supply of drinking water is a cornerstone of public health and community well-being. Complacency among those responsible for the provision of safe drinking water (e.g., water suppliers, operators, and managers) has led to numerous and otherwise avoidable waterborne outbreaks. Water safety plans present a risk-based, proactive framework for water management, and when properly implemented, virtually eliminates the option for complacency. However, the uptake of water safety plans remain limited worldwide. This paper reports on the experiences of early water safety plan adopters and identifies a number of non-technical operational and human factors that have undermined previous efforts. Specifically, it identifies these factors as a gap in the water safety plan implementation literature and suggests incorporating the broader community in water safety planning through a community readiness approach. Assessing and building community readiness for water safety plans is suggested to be a critical pre-implementation step, and a potential tool for use by water suppliers and by policy makers.

3.2 Introduction

Safe drinking water is a cornerstone of community health and well-being, making it a critical political, economic, environmental, and human health objective (Bakker 2003; Maras 2004). Globally, much of the onus for providing safe drinking water is given to local-level municipalities (Lee et al. 2002; Prudham 2004; Hrudey 2011). While most water systems in affluent nations produce safe water, outbreaks of waterborne illness can and do still occur (Craun et al. 2006; Hrudey and Hrudey 2007; Reynolds et al. 2008). For example, in 1989 more than 400 000 people became ill following an outbreak of cryptosporidiosis in the municipal water supply serving Milwaukee, Wisconsin (United States). In 2000, microbial contamination of water supplies in Walkerton, Ontario (Canada), led to illness among 2300 people as well as seven deaths (Hrudey et al. 2003; Auld et al. 2004). *Legionella*, a chlorine resistant bacteria that causes acute respiratory illness, is one of the fastest growing causes of waterborne outbreaks in the United States today (Craun et al. 2006). With climate change, microbial evolution, and new technologies leading to better detection of contaminants, more pathogens presenting a human health concern are being identified in municipal drinking water supplies (Greer et al. 2008; Sherchand 2012).

Generally, interventions designed to reduce the risks present in drinking water focus on technology and hardware, and include infrastructure, water treatment technologies, and strengthened water quality regulations (Sobsey 2006). Unfortunately, such interventions do little to address the human element inherent in making water safe. One of the major challenges undermining the safety of a water supply system is the "pervasive culture of complacency", as described by Hrudey et al. (2003). To move beyond this culture, future interventions that seek to foster "a culture of personal accountability and vigilance" (Hrudey et al. 2002) will be required. Support for a new water safety culture requires significant commitment from operators and regulators alike.

An alternative framework to current water management is a water safety plan (WSP) approach (Davison et al. 2005; Bartram et al. 2009; WHO 2011). This approach involves

a comprehensive assessment of present and potential risks throughout a water supply, from water source to the consumer's tap, and the development of a plan for reducing these risks to an acceptable level. While most conventional water management approaches seek to mitigate risks already present in a water supply, a WSP approach is focused on preventing these risks from entering, thus reducing the likelihood that a negative impact on human health will occur (Bartram et al. 2009). To accomplish this, a WSP extends the responsibility of safe drinking water to multiple stakeholders, including landowners in the watershed area, community residents, and decision-makers (Davison et al. 2005; WHO 2011; Hrudey 2011; Chang et al. 2013). The approach can be adapted to suit any water supply system regardless of size or level of sophistication (Rinehold et al. 2011), and is considered "the most effective means of consistently ensuring the safety of a drinking water supply" (WHO 2004).

In this paper, we examine the peer-reviewed literature related to WSP implementation efforts. The literature is based on those WSP efforts that have occurred or are occurring around the world, and the factors that either impede or enable their uptake. We then critically examine the role that community leadership has on WSP adoption. Finally, we explore the concept of community readiness as complementary to a WSP approach. Throughout the paper, we focus on the human elements recommended for water suppliers and policy makers to facilitate WSPs and ensure better management of water supplies over the long term.

3.3 WSP Implementation Efforts (1997-Present)

Although WSP uptake is relatively limited worldwide, our examination of the existing peer-reviewed literature identified a number of efforts underway to applying the WSP framework. Starting with Iceland in 1997 (Gunnarsdóttir and Gissurarson 2008) and Australia in 1999 (Byleveld et al. 2008), WSPs can be found in some form or another in utilities and regions worldwide. Bartram et al. (2009) provided case studies of numerous jurisdictions where WSPs have been implemented, including, for example Australia,

Latin America and the Caribbean, and the United Kingdom. But, as stated earlier, they are by no means universally located despite their significant reported benefits.

3.4 Benefits of Undertaking a WSP

Tangible outcomes following a WSP approach in the short term include changes in organizational structure or daily procedures within a water supply (Gelting et al. 2012), better risk awareness among water operators (Mullenger et al. 2002; Gelting et al. 2012), more efficient water management practices (Medema et al. 2001; Davison and Deere 2007; Jayaratne 2008), improved compliance with water regulations (Metge et al. 2003; Dyck et al. 2007; Gunnarsdóttir and Gissurarson 2008; Gunnarsdóttir et al. 2012), and a reduction in customer complaints (Mullenger et al. 2002; Parker and Summerill 2013). As noted in the Introduction, the intent of a WSP is ultimately to protect public health, and while many water suppliers naturally anticipate improvement in this area as a result of adopting a WSP approach, clearly identifying specific public health benefits associated with WSP implementation in the short term remains a major challenge for many early adopters (Mullenger et al. 2002; Parker and Summerill 2013). Gunnarsdóttir et al. (2012) observed a 14% reduction of clinical cases of gastrointestinal illness over a 10 year period for Icelandic regions adopting a WSP approach. At this time, our exhaustive literature review of several databases (including Web of Science, PubMed, and Google Scholar) did not reveal any other peer-reviewed publications that have linked changes in public health to WSP implementation. It is worth noting, though, that one major challenge in comparing pre- and post-WSP public health benefits for many utilities is the lack of accurate baseline data on gastrointestinal issues related to past water quality failures (Rinehold et al. 2011).

Because WSP benefits to public health and utility management increase over time, interim goals are recommended as a way for utilities to track progress and quantify accomplishments (Bartram et al. 2009; Mudaliar 2012). By identifying these goals at the outset of WSP implementation, utilities can "build a body of evidence" (Mudaliar 2012) that the approach is working towards an intended outcome, including improved public

health. At the same time, interim goals can help to maintain interest and motivate water suppliers over the long term, while enhancing the confidence of policy makers and stakeholders regarding the validity of a WSP approach (Foster-Fishman et al. 2006; Bartram et al. 2009; Summerill et al. 2010a; Rinehold et al. 2011).

One example of interim goal-setting occurs in Alberta (Canada), where as part of a WSP approach all utilities are required to identify short- and long-term interventions for each risk identified within a water supply (Reid et al. 2013; Alberta Environment and Sustainable Resource Development [AESRD] 2014). For example, a risk could be significant human activity occurring in a watershed area (e.g., wastewater discharge from private septic systems in the watershed area). A short-term intervention for this risk could be to post informational signs indicating that the area is a source of drinking water, while a long-term intervention could include a range of actions from fencing to implementing bylaws that would limit human activity in the area, or governmental purchasing (and protection) of watershed lands (AESRD 2014). In establishing and achieving these incremental goals, utilities can begin to address risks immediately after they are identified, while limiting the demand these changes place on resources (Davison et al. 2005; Seghezzo et al. 2013).

3.4.1 Barriers to Implementing a WSP

Water suppliers may view a WSP approach as creating additional and otherwise unnecessary work for already over-burdened water operators and managers (e.g., Williams and Breach 2012). For example, utilities already meeting water quality regulations may be unmotivated to adopt WSPs, seeing little incentive in proactively seeking out new or additional risks (Zimmer and Hinkfuss 2007; Mayr et al. 2012). Where water suppliers already have quality management programs in place, the shift to a WSP approach can be viewed as redundant. In a study of five German water utilities, Schmoll et al. (2011) found between 70% and 90% of these utilities' current practices aligned with those suggested within a WSP framework. While this did not create a barrier for WSP integration per se, the authors noted that the utilities expressed concern about

the possibility that transitioning to WSPs might be both a financial and a time burden. More generally, utilities may perceive WSPs as a burden in terms of having to "step up their game" in response to some of the more rigorous aspects inherent in a WSP approach (Summerill et al. 2010b; Mayr et al. 2012).

One of the first steps for any water utility in a WSP approach is to undertake a full system assessment. This includes a physical assessment of the water distribution system — and the identification of specific risks — from water source to consumer tap. In some systems, factors such as high operator turnover, poor record keeping, and a history of ad hoc repairs can make the assessment a challenge (Godfrey et al. 2005; Mahmud et al. 2007; Bartram et al. 2009; Viljoen 2010). To address the absence of data within a particular water supply, Godfrey et al. (2005), for example, combined local knowledge and socio-demographic data in a water supply to help identify past and present risks. Importantly, the authors found that access to limited data did not rule out the opportunity to undertake and benefit from a WSP approach.

Some water suppliers may associate a WSP approach with an increase in spending requirements. In practice, this is often true at the front end; that is, much of the cost associated with WSPs are incurred early in the implementation period, and largely as a result of repairs required to address significant risks within a system (Gregor and Winstanley 2005; Chang et al. 2013). Over the long term, however, a WSP approach is more of a tool for reducing costs associated with providing safe drinking water, resulting from improved operational practices, better managerial efficiency, and efficient water use as a result of infrastructure improvements and better leak detection (Dyck et al. 2007; Tabesh et al. 2009; Parker and Summerill 2013). Further, utilities engaging in an improved water management practice are more likely to provide the type of water that has the trust of consumers (Contu et al. 2005; Hrudey et al. 2006), and this can impact on how policies and projects affecting the water supply are perceived (Doria 2010). While the financial burden incurred as the result of an outbreak of waterborne illnesses should be viewed as considerable enough to warrant that all available efforts to protect water safety have been taken (Corso et al. 2003; Halonen et al. 2012; Huovinen et al. 2013),

this remains a difficult link for some utilities, particularly among those where outbreaks have not previously occurred and motivation for change is limited (Hrudey 2011).

Small, rural, and remote communities[2] can face additional challenges in implementing policies such as WSPs. For example, a survey of small water utilities in Iceland found the original WSP approach to be too extensive and time consuming given the resources available (Gunnarsdóttir and Gissurarson 2008). As a result, a modified five-step WSP approach was developed. In Bangladesh, small utilities are provided with examples and a template of a WSP to speed up their own implementation (Mahmud et al. 2007), while in Austria, small utilities are provided with a software-supported WSP guide (Mayr et al. 2012). Small, remote, and indigenous communities in Australia have access to a customizable online tool that facilitates the development of WSP approach (National Water Commission 2014). In seeking to implement WSPs in remote Pacific Island countries, Hasan et al. (2011) found many individuals lacked experience with formal education and had limited understanding of the technical aspects of a water supply system. To overcome this gap, local facilitators were trained to carry out instruction on WSP implementation in a culturally appropriate manner and in the local dialect. In recognition of the challenges faced by these and other small, rural, and remote communities, a number of guides have recently been published aimed specifically at facilitating WSP uptake under constrained circumstances (e.g., WHO 2012).

3.5 Roles and Responsibilities in WSP Implementation

Long-term WSP maintenance is best supported by a complementary management culture that is in line with WSP goals and values (Hrudey et al. 2002; Bartram et al. 2009; Vieira 2011; Rinehold et al. 2011; Tang et al. 2013). Two types of individuals — external and

[2] A definition of small, rural, and remote is subjective and can vary between countries and jurisdictions. For example, nationally in Canada a small system is recognized as one serving fewer than 5000 individuals, however in the United States a small system serves drinking water to fewer than 3300 individuals. Internationally, small systems serve up to 4000 individuals (National Collaborating Centres for Public Health [NCCPH] 2009).

internal leaders — are identified in the literature as having a significant impact on WSP uptake, how a WSP is managed over the long term, and whether a WSP reaches its full potential in a given water supply (Bartram et al. 2009; Summerill et al. 2010a, 2010b; Herrick and Pratt 2012). Community decision-makers and other political figures are considered to be external leaders; their role can be seen as one that supports WSP implementation by providing the appropriate incentives, resource, and oversight. Those working more closely with water operators, such as those in management positions, are considered internal leaders. These leaders are well positioned to assist and support water operators with their own decision-making, such as where additional resources may be required. Overall, the way in which both types of leaders approach a WSP requirement is reflective of the overall water culture in a community (Jayaratne 2008). Without the presence or development of such a culture, the risk lies in a "ceremonial" adoption of a WSP, one that has little benefit towards the long-term maintenance of a water supply and protection of public health (Summerill et al. 2010a, 2010b).

In addition to leaders, operators play an important role in WSP implementation, particularly as some of the earliest changes following WSP uptake include changes to infrastructure and operational procedures (Gelting et al. 2012). As a result, the impetus for change early on largely falls to operators, who must identify and make recommendations for infrastructure repairs as well as make other adjustments (to, for example, monitoring or sampling tasks) in response to the risks identified in the WSP assessment phase. As such, there is a need to support operators at this stage. Summerill et al. (2010a) found leadership practices through which operators "are afforded the status, training and remuneration commensurate with their responsibilities as guardians of the public's health" (p. 392) helped to develop the type of environment capable of supporting a WSP approach. Others have recognized the need to formally acknowledge the additional work taken on by operators as a result of a WSP approach, including changing the operator's job title and description to reflect changes in expectations or additional tasks (Gunnarsdóttir and Gissurarson 2008; Summerill et al. 2010a; Herrick and Pratt 2012). While a minor step, recognizing the role of the operator can provide the

groundwork necessary to support the type of long term commitment required in WSP culture.

3.6 Community Readiness for WSP Implementation

Policy, regardless of intent, is influenced by the social, political, and economic context in which it is applied. Communities that lack the capacity to devote resources — including human and economic resources — require more than economic support to facilitate policy uptake; they must undergo an internal shift in attitudes, motivation, and beliefs towards what can and what should be devoted to make a specific change (Gilbert and Cordey-Hayes 1996; Jeffrey and Seaton 2004; Mankad and Tapsuwan 2011). The concept of "community readiness" is one approach that, according to the literature (see, for example, Foster-Fishman et al. 2006; York and Hahn 2007; Durlack and DuPre 2008), is well-suited to preparing communities for policy implementation. Community readiness is considered the cognitive precursor to whether there will be support or resistance to a particular change (Armenakis et al. 1993), and helps describe "the ecological context and organizational system in which the implementation of community change efforts takes place" (Chilenski et al. 2007). In response to some of the challenges outlined in the previous sections, applying a community readiness lens in advance of implementing WSPs could help determine whether (and when) a community is ready for a change in how a water supply is managed.

A community readiness lens suggests that if a community is not ready for a particular change, that early implementation is likely to result in failure or otherwise unintended (negative) outcomes (Plested et al. 1998; Slater et al. 2005; Chilenski et al. 2007; Wandersman et al. 2008). To assess and build readiness for change in a community setting, Oetting et al. (1995) developed the community readiness model (CRM). The CRM, which draws on theories from psychology and the community development literature (Plested et al. 1998), recognizes that communities differ in their interests, willingness, and competence to engage in certain change efforts, and provides a flexible method for assessing and building readiness for change (Oetting et al. 1995; Jumper-

Thurman and Plested 2000; Engstrom et al. 2002). Psychological readiness for change was the first theory to identify that change occurs over a series of stages. The theory offers an approach for viewing the processes through which individuals become motivated to adopt new behaviours and close the gap between their current situation, and an ideal one (Prochaska and DiClemente 1983). The problem with this, in the context of communities, is that individual psychology does not reflect inherent group processes required for accomplishing change (Engstrom et al. 2002), thus CRM scholars identified the need for including community development theory. Rogers' (2003) diffusion innovation model and Warren's (1978) social action processes filled the gap by describing the decision-making process through which new innovations are taken on by individuals or groups. Together, these theories explore the incremental nature of decision-making required to bring communities closer to the adoption and internalization of a new innovation or practice (Warren 1978; Engstrom et al. 2002; Oetting et al. 1995).

In using the CRM, community readiness is evaluated in an assessment focusing on six areas or "readiness dimensions": (*i*) community efforts, (*ii*) community knowledge of the efforts, (*iii*) leadership, (*iv*) community climate, (*v*) community knowledge about the issue, and (*vi*) resource related to the issue (see Table 3-1) (Oetting et al. 1995). Each readiness dimensions is assessed through a series of questions answered by one or more knowledgeable individual in the community. This assessment determines the community's stage of readiness. The stages range from "no awareness" to "very aware". Determining a community's stage of readiness forms the basis for future action by drawing on stage-specific strategies to build readiness for making a change.

Table 3-1 Six dimensions of community readiness (adapted from Jumper-Thurman et al. 2003).

Dimensions of readiness	***Description in Relation to Readiness***
1. Community efforts	Efforts, programs, and policies related to ensuring safe drinking water in the community.
2. Community knowledge of efforts	Community awareness of and involvement in local efforts related to safe drinking water.
3. Leadership	Involvement, support, and awareness of community leadership related to safe drinking water.
4. Community Climate	Attitudes held by individuals in the community towards safe drinking water.
5. Community knowledge about the issue	Awareness of drinking water challenges, consequences, and impact on the community.
6. Resources	The people, time, space, and financial support available to support safe drinking water.

The stage-specific strategies are loosely defined within the model, and as a result these can be adjusted to reflect what is culturally appropriate and desirable within the community in light of a desired change (Foster-Fishman et al. 2006; Plested et al. 1998). For example, in a small community with low readiness for WSP implementation, building awareness of WSP basics among all community members is considered by the model to be a good first step in building capacity for change. The awareness campaign could be as simple as a well-crafted message spread via word-of-mouth, or by placing informational posters in areas used frequently by the target audience (i.e., consumers). These messages would ideally provide information on the purpose of source water protection and how it benefits the community, how activities near source water areas can be linked to environment and human health, and what can be done to minimize risks in a source water area. Once this information is understood within the target audience, then it is time to take action and implement tangible solutions. The foundational knowledge provided in the early stages of a readiness building campaign can help to support future requirements of a successful WSP approach. As the CRM is an iterative tool,

communities are also encouraged to conduct multiple assessments over time to help the community identify successes and determine whether any new barriers have emerged as a result of the changes made (Oetting et al. 1995).

A community readiness lens has been applied to various health programs, including tobacco cessation programs (York et al. 2008), HIV prevention interventions (Aboud et al. 2010), and obesity prevention programs (Findholt 2007; Sliwa et al. 2011). However, it has not been used specifically to examine readiness for a water management intervention, specifically in terms of WSPs at the municipal level. But we see promise for doing so. In adopting a CRM approach, the potential exists to alleviate some of the challenges associated with WSP adoption identified earlier in this paper. In particular, a CRM approach can be used to ensure that the awareness, understanding and capacity to take on a new water management approach is in place prior to implementation. Given the use of a CRM approach to address a range of foundational community capacity issues, and recalling that Hrudey et al. (2002) have called for interventions that foster "a culture of personal accountability and vigilance" (p. 16), we see the CRM approach as having the potential to respond to this call.

Further research is, therefore, required to see if the approach is suitable for adopting a policy of using WSPs at the municipal level. For example, researchers might explore whether a CRM approach can be used to reframe the challenge of water management in a manner that adds clarity and meaning for stakeholders, especially those with a limited history of involvement (e.g., leadership issues). Other questions that seem pressing include investigating whether ensuring community readiness prior to WSP implementation can actually remove some of the major challenges identified by early WSP adopters, and finally, if the increased awareness gained through a CRM approach can help foster change at the community level regarding how water is managed. The success of a CRM approach in the improved implementation of water policy could have a significant impact for all municipalities, particularly those that are small, in overcoming common implementation challenges. Modifying the model to address specific WSP challenges and testing this model within the community context are logical next steps.

3.7 Conclusions

Public health is at risk when water supply systems are poorly managed and (or) maintained. To reduce the risk, water utilities are being encouraged to adopt management practices that remove the option for complacency and work to prevent contamination from entering into a water supply. While a WSP approach is considered the best method for achieving safe drinking water, the potential impact of such an approach is often overshadowed by implementation challenges. This review examined non-technical operational and human factors impacting WSP implementation. The review identified that in the absence of readiness, communities face significant challenges in making and maintaining change. The literature points to the potential of undertaking an evaluation of a community's level of awareness about drinking water safety and overall readiness as an important precursor for advancing WSPs. In this paper, we have suggested that a CRM approach could be effective for advancing future WSP implementation efforts, and that this yet untested approach could be explored in future studies.

3.8 Acknowledgements

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CHAPTER 4 WATER COMPLIANCE CHALLENGES: HOW DO CANADIAN SMALL WATER SYSTEMS RESPOND?

This Chapter is published in *Water Policy* (Appendix Q):

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4.1 ABSTRACT

Fundamental to community health and well-being is the capacity to access a sustainable supply of safe drinking water. Small community drinking water systems are the most vulnerable to contamination, and struggle to secure the funds necessary to improve water treatment and delivery systems, and meet increasingly stringent drinking water quality regulations. Little is known of the contextual and cultural differences between communities and the impact this has on regulatory compliance. This study explored the experiences and impact of individual actors within seven small community drinking water systems in locations across Canada. Qualitative, in-person interviews were conducted with water operators, consumers, and decision-makers in each community, and these findings were analysed thematically. Findings from the study show that communities approach and align with compliance challenges in three distinct ways: by adopting regulator-provided or regulator-driven solutions, by adopting an existing improvement framework (i.e. regionalization), or through reinvention to address a new issue or concern. Policy-makers looking to align small communities with appropriate water quality goals may benefit from a consideration of these contextual and cultural differences.

4.2 Introduction

In Canada, municipalities and regional districts are responsible for providing drinking water of an acceptable quality to consumers (Renzetti & Dupont, 2004; Bakker & Cook, 2011; Hrudey, 2011). For regulators, water that meets an acceptable quality is based on specific standards that limit the presence of various contaminants (e.g., microbiological, chemical, and radioactive contaminants) in a water supply. Many regulations also identify aesthetic issues (i.e. taste, odour, colour, and temperature), although these are considered unenforceable and are at the discretion of each utility (Adamowicz et al., 2004; Dietrich, 2006). Consumers, however, have a tendency to rely on drinking water's aesthetic qualities to form an opinion of water quality and in some cases associate these with a human health risk (Anadu & Harding, 2000; Johnson, 2003; Doria et al., 2009; Doria, 2010). Ensuring alignment between both regulator and consumer views of drinking water quality is an important consideration for managers of water utilities (Chapelle et al., 2009).

Smaller communities (i.e. those serving populations of fewer than 5,000 individuals) are known to face numerous challenges related to supplying safe drinking water. These challenges include the capacity to evaluate and maintain drinking water systems, secure the funds necessary to make necessary upgrades, and manage the increasingly sophisticated technical systems required to achieve new and emerging regulations (Kot et al., 2011; Haider et al., 2014; Forrer et al., 2013; Regnier, 2014). As a result, these systems are at a higher risk of providing consumers with unsafe drinking water (Eggertson, 2008; Bakker & Cook, 2011; Moffat & Struck, 2011), and often struggle to meet the rising expectations of regulators (Rizak & Hrudey, 2008; Roberson, 2011; Kot et al., 2011) and of consumers (Chapelle et al., 2009). As more than 80 per cent of drinking water systems in Canada are small (Wilson et al., 2009), addressing challenges within this cohort can yield a significant, positive impact on public health across the country.

Limited attention has been paid to the social and contextual aspects of achieving safe

drinking water in Canada. While some studies have focused on understanding consumer preferences for water quality (e.g., Dupont et al., 2014), and differences in the governance approaches to water resources (e.g., Bakker & Cook, 2011), the emphasis 'on the ground' remains focused largely on strengthening and enforcing water quality regulations. As such, these regulations focus on a relatively small segment of the factors contributing to failure in water treatment systems (Hewitt, 2013). One notable exception was the report that followed an outbreak of Escherichia coli in the town of Walkerton, Ontario. In this report, numerous human, financial, governance, and technical failings were identified as the cause of the outbreak (O'Connor, 2002; Hewitt, 2013). Despite these findings, and in the months and years following the outbreak in Walkerton, many Canadian jurisdictions continue to focus on adopting more stringent drinking water quality regulations, without including a broader range of conditions. In the 14 or more years since the outbreak in Walkerton, many communities – in particular, those that are small – remain constrained in their capacity to avoid a potentially similar event (Eggertson, 2008; Hrudey, 2011). A better understanding of the interactions between human, financial, governance, and technical factors in a small community setting would shed light on critical forces that enable (or deter) the provision of safe drinking water.

The purpose of this study was to explore improvements to drinking water services in small communities from the perspective of water operators, community decision-makers, and water consumers. Drawing on input from these individuals, this study seeks to develop an understanding of the human, financial, governance, and technical factors that underlie decision-making in small communities and of how these four factors contribute to improved drinking water quality and/or quantity. It is important to recognize that throughout this study, these factors were analysed through a cultural and contextual lens to better understand community perceptions and how decisions are made. Policy-makers and regulators looking to align small communities with appropriate water quality goals may benefit from a consideration of the findings presented in this paper.

4.3 METHODS

Across Canada, seven communities were included in this study. Communities were selected based on their size (i.e. those with a drinking water system that serves fewer than 5,000 consumers), and whether a recent change in the drinking water system has resulted in improved water quality, or in the quality of service to consumers. This information was gathered through discussions with regulatory personnel in the Canadian water industry and other informed individuals (e.g., health authorities) at the provincial or territorial level. The research team contacted these individuals to solicit a list of potential candidate com- munities (i.e. those who best exemplified the goals of the project) from across six provinces and one territory[3]. From the initial list of 20 potential communities, seven (one from each jurisdiction) were selected. To ensure a range of responses, unique cases were selected based on the type of improvements made.

A key informant was purposefully recruited in each community, with selection based on the individual's knowledge of their community's drinking water system. The key informant was an administrator or decision-maker, and helped the research team identify resources and contacts once on-site. Signed consent from the community to conduct the study and to identify the community by name was received prior to the start of the study.

The first drinking water system included in this study served to test a semi-structured, open-ended interview guide. Testing the guide before beginning the study in full allows for informed changes to be made if necessary (Barriball & While, 1994). Two drinking water systems serving the towns of Springford and Otterville (Ontario) were selected as the test communities. During the trial run, no significant issues were raised by the research team or by participants in the community. The findings from these drinking water systems were included in the full-scale study.

[3] For this study, a community from each jurisdiction across Canada would have been ideal. However, regulators and other informed individuals in a number of jurisdictions were unable to identify communities matching the research objectives.

A total of 82 interviews were conducted: 20 operators, 35 decision-makers, and 27 consumers (Table 4-1). Interview participants were recruited using both purposive and convenience sampling. The purposively recruited participants were selected based on the roles and responsibilities held in the community related to the drinking water system (Patton, 1990; Marshall, 1996), including those in water operations and responsibilities for decision-making related to the water supply. A convenience sample of consumers (residents and business owners), individuals who lived or worked in the community and had consumed the tap water both before and after the improvement, was selected (Marshall, 1996). A combination of sampling techniques was employed to avoid bias, while collecting responses from the largest number of 'information-rich cases' present in each community (Baxter & Eyles, 1997). Consumers in each community were recruited until responses became repetitious in that community, signifying saturation of the data (Morse, 2000).

Table 4-1: Community study interview and demographic data

		Interviews			
Community	**Population (2011 est.)**	**Operator**	**Decision-maker**	**Consumer**	**TOTAL**
Arcola, Saskatchewan	649	4	5	3	**12**
Aspen Regional Water Services Commission, Alberta	3,967	3	11	None	**14**
Honeymoon Creek Water Users Community, British Columbia	9	1	1	1	**3**
Donkin, Nova Scotia	445	3	3	4	**10**
St. Lawrence, Newfoundland	1,244	4	3	10	**15**
Springford & Otterville, Ontario	400 (S), 1,000 (O)	2	8	7	**17**
Ulukhaktok, Northwest Territories	402	3	4	2	**9**
TOTAL INTERVIEWS					**82**

All interviews were conducted in-person, and pertained to drinking water in the community both before and after the improvement. Open-ended and semi-structured questions in the interview guide gave participants the opportunity to elaborate on insights they perceived to be meaningful to the study but which may not have been anticipated during study design (Denzin & Lincoln, 2005; Creswell, 2007). Categories of questions directed at participants included: a history of the water supply before the improvement; their knowledge of, and involvement in, the decisions leading up to the improvement; information about implementing the improvement; and any lingering issues following the improvement they may have experienced or were aware of. The interview guide varied slightly between categories of participant depending on the anticipated area of expertise (e.g., operator training was not discussed in detail with consumers; however, they were asked if they knew anything about the training undergone by their town's water operator). The interviews were supplemented with secondary data from public municipal reports (e.g., engineering reports, newspaper articles, educational information), and from provincial and/or territorial documents (e.g., water strategies, regulatory documentation).

Each interviewee provided verbal consent to participate, and to have the interview digitally recorded to ensure accuracy (Baxter & Eyles, 1997). Depending on the nature of the information available to the participant, interviews ranged in length from 15 to 90 minutes. When a participant did not provide con- sent for the interview to be digitally recorded, or when the setting in which the interview took place was not conducive to digital recording (e.g., due to noise from nearby machinery), the interviewer took notes by hand. Of the 82 interviews, 13 were recorded by hand.

Interviews were transcribed verbatim and entered into NVivo 9^{TM}, a qualitative data management software program. Thematic analysis was used to identify patterns in the data, and these patterns (or themes) became the categories used for analysis (Aronson, 1994). The findings were used to create a summary report for each community, and these were provided via email to the community for review and to verify the accuracy of findings (Lincoln & Guba, 1985; Creswell & Miller, 2000).

4.4 Study area

The following describes the seven case communities (Figure 4-1), the main challenges faced by each community related to drinking water, and the solution(s) in place. The communities are presented in geographic order, from west to east. A summary of these findings is provided in Table 4.2.

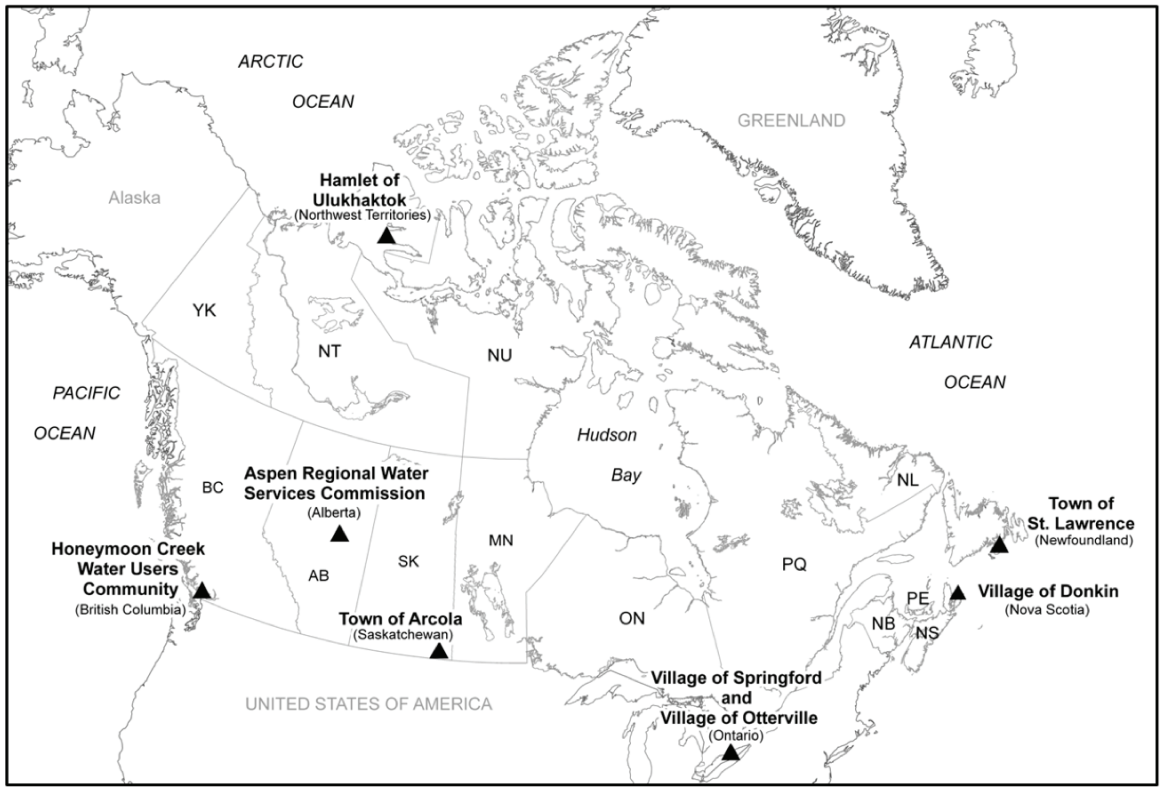

Figure 4-1 Geographic location of the seven communities (Data: ESRI (2011), DMT (2010))

Table 4-2 Community study summary profile

		Arcola, Saskatchewan	*Aspen Regional Water Services Commission, Alberta*	*Honeymoon Creek Water Users Community, British Columbia*	*Donkin, Nova Scotia*	*St. Lawrence, Newfoundland*	*Springford & Otterville, Ontario*	*Ulukhaktok, Northwest Territories*
Population served (2011 est.)		649	3,967 (includes 3 communities)	9	445	1,244	400 (S), 1,000 (O)	402
Management structure		Mayor and town council	Water commission	Water community users group	Regional municipality	Mayor and town council	County	Town council and various territorial organizations
Properties before improvement	**Age of system**	1904, most recently 1980s	2010, various ages	1970s	1920s, various ages	Various ages	Various ages	1990s
	Water source	Shallow and deep wells	Surface water (river)	Surface water (creek)	Surface water (dug lake)	Surface water (stream)	Groundwater (shallow aquifer)	Surface water (lake)
	Type of treatment	Chlorination	Chlorination, filtration	No chlorination	Chlorination	Chlorination	No chlorination (S), chlorination (O)	Chlorination
Impetus for change		- Shallow wells may be vulnerable to groundwater (GUDI) - Boil water advisory issued	- Regulations	- Regulations - Boil water advisory issued	- Aesthetic - Ageing infrastructure	- Aesthetic	- No chlorination (S) - Changes to regulations - Water quantity issues (O)	- Regulations

	Arcola, Saskatchewan	*Aspen Regional Water Services Commission, Alberta*	*Honeymoon Creek Water Users Community, British Columbia*	*Donkin, Nova Scotia*	*St. Lawrence, Newfoundland*	*Springford & Otterville, Ontario*	*Ulukhaktok, Northwest Territories*
Innovation	- Filtration - UV disinfection - Source water protection measures	- Regionalization - Membrane treatment	- Point-of-Entry (POE) - POE use agreement(s) with province	- Regionalization - Community education initiatives	- Potable Water Dispensing Unit	- Regionalized	- Coarse filtration - UV disinfection
Funding the improvement	- Municipal Rural Infrastructure Fund (50%) - Loan - User fee ($15/mo.) - Rate increase	- Provincial grant (90%) - Rate increase	- Each user pays for own POE unit	- Rate increase	- Provincial grant (90%) - Rate increase	- Provincial grant - User fee ($10/year.) - Rate increase	- Municipal Rural Infrastructure Fund (50%) - Territorial funding (50%)
Ongoing challenges	- Ageing distribution system - Percentage of population prefers bottled water	- None noted	- Success in future dependent on continued cooperation within the water users community	- None noted	- Ageing infrastructure - Ageing treatment facility - Percentage of population prefers bottled water	- Percentage of population prefers bottled water	- Percentage of population prefers untreated (raw) water

4.4.1 Honeymoon Creek Water Users Community, Bowen Island, British Columbia (BC)

The Honeymoon Creek Water Users Community (Honeymoon Creek) comprises nine households (pop. 20) and is located on Bowen Island, off the coast of British Columbia. Since it formed in the 1970s, the Community has maintained a gravity-fed drinking water system sourced from a nearby stream; however, as the system does not include treatment, consumers relied on bottled water for drinking. Following a regulatory change in 2001, all water user communities were required to supply their members with drinking water capable of meeting provincial standards. This meant for many groups (such as Honeymoon Creek) that treatment would be necessary.

4.4.2 Aspen Regional Water Services Commission, Town of Athabasca, Alberta (AB)

The Aspen Regional Water Services Commission was established in 2007 to help address water-related issues among the region's communities. The Commission includes the town of Athabasca (pop. 2,500), the Village of Boyle (pop. 1,000), and the Hamlet of Colinton (pop. 252). Many of these communities face water treatment or quantity challenges, as well as challenges related to ageing infrastructure.

4.4.3 Hamlet of Ulukhaktok, Northwest Territories (NWT)

Ulukhaktok (pop. 402) is a remote community accessible a few times a week by air (weather dependent). A barge delivers goods to the community once a year by sea. Responsibility for drinking water is shared between numerous stakeholders: various territorial departments who work with local governments to install or maintain water treatment facilities and train operators; the local government who manages drinking water on a daily basis; and citizens who are responsible for cleaning the water tanks in their own homes where treated water is stored. The community draws raw water from a small lake near the town. Water is treated with chlorine at a water treatment plant located at the source and delivered by tanker truck to each household and business in the community. New water regulations introduced in 2002 initiated a number of changes,

including upgrades to the water treatment in Ulukhaktok.

4.4.4 Town of Arcola, Saskatchewan (SK)

The original drinking water system for Arcola (pop. 649) was installed in 1904. At that time, the system comprised a series of shallow, spring-fed wells. In the mid-1980s, two deep wells were added to address drinking water system shortages in the summer months. The deep wells yield water that is high in iron and manganese, making the water unpleasant in colour and smell to consumers. After testing positive for contamination in 2005, the town's drinking water system was placed under a boil-water advisory.

4.4.5 Towns of Springford and Otterville, Ontario (ON)

Springford (pop. 400) and Otterville (pop. 1,000) are neighbouring communities. In 1995, the County of Oxford assumed responsibility for water supplies in all communities under its jurisdiction, which included Springford and Otterville. At the time, water in Springford was not being adequately chlorinated, and there were challenges with achieving an adequate supply of water for residents in Otterville.

4.4.6 Village of Donkin, Cape Breton Regional Municipality, Nova Scotia (NS)

In 1996, amalgamation brought Donkin (pop. 445), along with a number of other communities and their water utilities, under the administrative jurisdiction of the CBRM. At the time, the drinking water supply for Donkin was a shallow lake. Treated water in the community had a distinctive taste and would become darker following heavy rainfall.

4.4.7 Town of St. Lawrence, Newfoundland and Labrador (NL)

The town of St. Lawrence (pop. 1,244) is home to a large fish-processing plant, which is both the town's largest employer and largest user of treated water. The town relies on surface water as its water supply. This water is disinfected using chlorine, and there are concerns with disinfection by-products, discoloration, and turbidity. This is particularly the case in the summer and after heavy rainfall, when the water becomes dark in colour. As a result of these quality issues, many consumers had come to rely on bottled water.

4.5 RESULTS

To organize the thematic analysis, findings are presented in chronological order from before the improvement to lingering issues following the improvement. They are summarized in Table 4-3. Sub- themes are then discussed under each subheading. Direct quotations from consumers (C), operators (O) and decision-makers (DM) are used to support and illustrate these themes.

Table 4-3 Solutions to water quality challenges and their adoption in each community.

Community	***Solution(s)***	***Adoption***
Honeymoon Creek Water Users Community, Bowen Island, British Columbia (BC)	The geography of the area did not lend itself to traditional water treatment and the community did not want chlorination. A point-of-use (POE) water treatment was selected. POE is an existing legislative option for small systems. At the time it was not yet being used by other small systems in the province.	Residents who had a legal background developed a series of administrative tools and agreements for POE implementation in the community. These outlined roles and responsibilities for the regulator, the contracted water operator, and the community members.
Aspen Regional Water Services Commission, Town of Athabasca, Alberta (AB)	Financial incentive provided by the Province's 'Water for Life' programme steered the Commission towards a regionalization option.	The timing of the project coincided with the twinning of a portion of the highway; this led to a cost savings. Conflict (local politics) meant some delay in project implementation.
Hamlet of Ulukhaktok, Northwest Territories (NWT)	Pre-approved designs were provided to a contractor. Five water treatment utilities were ordered in bulk ('bundled approach') at a cost saving to the territory. The utilities were constructed offsite and shipped to the community by barge.	Operators were involved in the final stages of construction and received hands-on training from the contractor. Support is offered through a direct phone line from the utility to offices in Yellowknife. Video was used to capture the utility's set up. Video is also used to inform residents about their water supply.
Town of Arcola, Saskatchewan (SK)	The town hired an engineering consulting firm, and installed ('common-sense') well head	Extreme climates (both hot and cold) required a number of adjustments to be made to the

Community	*Solution(s)*	*Adoption*
	protection, an ultra-violet (UV) disinfection system, and an above-ground treated water storage tank, among other improvements.	water utility once in place. To repay the loan required for the improvement, a user fee of $15 per month was applied to each consumer household in the community. Once this loan is repaid, income from the user fee will be applied towards funding for future water and wastewater improvements.
Springford and Otterville, Ontario	A number of options were presented. Joining the two communities via a 4 kilometre-long pipeline was determined to be the most cost-effective and best overall option.	Water users contribute to a County-wide Community Servicing Assistance Plan (CSAP) – $10 for water and $10 for sewage per year. The money gathered in this account goes towards improving water or wastewater services in the County.
Village of Donkin, Cape Breton Regional Municipality, Nova Scotia	A systems assessment conducted in 2004 identified a number of options to improve aesthetic and overall water quality in Donkin. Joining the village via a pipeline to an existing water treatment plan in the adjacent community of Glace Bay was determined to be the most cost-effective and best overall option.	The Regional Municipality works with local outdoors groups and a non-profit organization to provide education on illegal dumping, and watershed protection, and to develop an understanding among water users of the water resources in the region.
Town of St. Lawrence, Newfoundland and Labrador	A financial incentive offered by the province led the community to select the potable water dispensing unit (PWDU) option.	Extreme rainfall in the region required a number of adjustments over the first year of the system's operation. The PWDU draws users from outside the community.

4.5.1 The drinking water system before an improvement

Out-migration and smaller family sizes led to a declining population in the majority of the communities profiled in this study. The resulting declining tax base made it difficult for many utilities to properly invest in and maintain water treatment and delivery systems. In the past, six of the seven systems included in this study had experienced one

or more boil-water advisories.

Decision-makers and operators were likely to focus on the health concerns associated with poor water quality. On the other hand, consumers focused more on the aesthetic quality of their drinking water. Many consumers described their tap water as cloudy or dark in colour, often with a strong taste. One consumer noted: '*you can't tell apple juice from water*' and that one could '*taste bog in your water*' (NL C). Of the water, one consumer noted: '*we definitely weren't associating it* [the water] *with disease, or being dangerous to drink; we were definitely just associating it with taste*' (NS C). Other water quality issues most commonly noted by consumers and by decision-makers included the discoloration of house- hold fixtures (e.g., bath and toilet fixtures) and of (e.g., white) laundry. Dissatisfaction with the tap water quality meant that many consumers relied on alterative drinking water supplies, including in-home filtration systems and bottled water.

4.5.2 The impetus for change

Changes to drinking water regulations or a persistent, unsatisfactorily aesthetic water quality provided the motivation for communities to make improvements to their drinking water systems. The outbreak of waterborne illness that occurred from the drinking water system in Walkerton, Ontario, in 2000 was reported as having a significant impact on the way that many individuals viewed their own tap water supplies. For example, one operator noted that following the outbreak: '*you look around and wonder how many potential Walkertons you'd had*' (ON O). Several individuals noted Walkerton as a catalyst for changes to provincial and territorial water regulations, the formation of new organizations and departments with responsibilities for water, and changes to operator training requirements. One operator explained: '*Holy cow, I mean, everyone jumped on the band wagon* [after Walkerton] *I guess it's right across Canada ... the demands for quality and water treatment* [now] *is right up there*' (NS O). Operators who had been working in the water treatment field prior to the outbreak in Walkerton were particularly aware of how rapidly the field had changed.

Many of the operators and decision-makers interviewed had difficulty self-identifying

weaknesses present within their own drinking water systems. One decision-maker described this as a form of '*tunnel vision*' (ON DM). After addressing existing obligations, many communities had few resources left with which to identify and address future or less-obvious risks to the water supply. As a result, some issues were likely to go undetected until a serious problem occurred.

A number of interviewees noted that the impetus for change in their communities arose from a growing awareness of the role water plays in protecting human health:

> *I think a recognition of how important safe water is, blame it on Walkerton, blame it on what you like, it has been somewhat of a natural evolution…there is recognition that we need to be more involved, more informed as a society* (ON DM).

4.5.3 The options available for change

Costs were viewed as a limiting factor for many communities, often restricting the number of options available to address drinking water system challenges. One decision-maker explained: '*when there's no funding available what the heck do you do?*' (SK DM). Many participants viewed regulators (e.g., provincial employees) as having the capacity to play a role in community decision-making. This included having access to information about available funding options and water quality solutions. Many participants believed that as a result of this knowledge, regulators should play a greater role in informing and assisting communities with decision-making. Some participants also viewed regulators as being the best suited to conveying the consequences of inaction to key individuals in the community – however, despite their influence, regulators did not often act in this capacity. One decision-maker noted that the absence of regulator involvement was an issue, saying: '*Council needs to understand the impacts ... sometimes regulators don't help* [them] *understand*' (SK DM). The exception in this study was Ulukhaktok (NWT), where territorial regulators worked closely with the community during all stages of the improvement. Without support, many decision-makers were required to make decisions based on a limited understanding of water treatment, the types of technologies available, and what would be a reasonable cost for ensuring safe drinking water. One decision-maker described being called upon to make an important decision

regarding their town's water supply: '*I'm not a technical person, so I'm parsing through all this stuff and they said: "OK, all in favour of 14 million dollars" and my hand went up and I thought: "I don't know what I'm doing"* ' (AB DM).

Decision-makers reported feeling trapped between the need to make an improvement and the financial burden of doing so: '*they* [the community] *had to jump this regulatory hoop and they had no idea how*' (SK DM 3). Even if a solution could be found, there remained the challenge of gaining its acceptance among all decision-makers. One decision-maker closely involved in water operations explained: '*We knew this was the vision that we wanted ... but we couldn't get people to approve*' (NS DM). As a result, some communities saw improvements offering only temporary solutions (e.g., that which would lead to lifting a boil-water advisory).

4.5.4 Regionalization

Three communities profiled in this study opted to consolidate their drinking water systems (through regionalization). Here, the autonomy of each drinking water system was exchanged for economies of scale, and a cost saving for those involved. The appeal of regionalization was greatly increased when supported by a grant: '*if the plant is a regional plant,* [it would be] *fully funded ... municipalities then have a very strong carrot to start consolidating and putting together regional systems*' (AB DM). Regionalized systems allow communities to share the cost of improvements, as well as pool resources dedicated to retaining operators and enhancing operator capacity through training. The pipeline running between two or more regionalized systems meant that properties located between communities would also benefit. One decision-maker explained: '*people love piped water* [and] *they want to get off their wells ... this* [pipeline] *was the opportunity to pick up one hundred or so extra customers*' (NS DM).

Regionalization required many communities to work together more closely than in the past. As a result, some communities experienced setbacks and other delays as these new relationships developed. One decision-maker explained: '*the politics* [here] *don't get along, they haven't for generations ... So they* [councillors] *blocked, locked horns*' (AB

DM). One decision-maker described the need for trust: '*there has to be an underlying trust* [between communities] *if you don't have regional cooperation, you know, spirit, then it's pretty tough to deliver a regional service*' (AB DM).

4.5.5 Regulator-driven option

The community of Ulukhaktok (NWT) provides the sole example of a truly regulator-driven approach to solving a water quality challenge. Here, the regulator was responsible for coordinating the construction of five water treatment plants for five communities across the Northwest Territories. The regulator used a 'bundled approach', providing all five contracts to the same contractor, which resulted in two advantages. First, there is a cost saving involved in ordering water treatment plants in bulk. Second, the contractor was able to offer valuable insights to the challenges of operating a drinking water treatment plant in arctic conditions and apply these as the project progressed. One decision-maker explained how this approach ended a common problem experienced in the past when contracts were awarded separately: '*They* [the contractor] *first figured out how to build the facility* [water treatment plant] *and then it's over, and we had to start all over again with a new contractor*' (NWT DM).

4.5.6 Innovative solutions

Three communities pursued innovative solutions: Honeymoon Creek (BC), St. Lawrence (NL), and Arcola (SK). In British Columbia, members of Honeymoon Creek were required to upgrade their drinking water system as a result of changes to the province's regulations. Because the community was too small for a traditional water treatment facility, and because the community did not want to chlorinate their water supply, a different approach was required. The province permits, but had not at the time yet used, point-of-entry (POE) systems within small water user communities. Those in Honeymoon Creek noted that they were not directed to the POE option by the regulator. Instead, they uncovered this option through their own investigative work. One member explained:

> *we were not guided to the use of Point of Entry or Point of Use options…Even in the most recent documentation circulated by the BC government to small water user communities, the option of POEs is not addressed or referred to* (BC C).

To make the implementation of POEs feasible, documents outlining the legal obligations of those involved, and the associated operation and maintenance duties were all required. Drawing on local capacities (several individuals affiliated with Honeymoon Creek have legal training), the necessary documents were drafted and approved by the regulator.

A second innovative approach to water treatment was employed in St. Lawrence (NL). Here, the community faced significant challenges with the aesthetic quality of their drinking water, yet they lacked the financial capacity to upgrade the entire water treatment system. The town chose to construct a bottle-fill station, known as a 'potable water dispensing unit' (PWDU) or '*community well*' (NL DM), to be placed in a central location for all residents to use. Lastly, extreme temperatures in the summer and winter months required a number of modifications to be made to the water treatment system after it was installed in the town of Arcola. The operator led the majority of these design changes.

4.5.7 Cost and funding concerns

Locating the funds necessary to support an improvement was reported as a significant challenge for many communities. Where this was the case, decision-makers and operators reported having to address problems in the water supply on a '*worst first*' (NS DM) basis, or settle on a solution other than the community's '*ideal system*' (NL DM). Available funding for water-related infrastructure and upgrades also varied significantly between provinces and territories. Many communities reported feeling trapped between the need to make the necessary improvements and their financial capacity to do so.

Many communities received funding of up to one-third of project costs through the Federal Municipal Rural Infrastructure Fund. Other communities received funding through provincial or territorial programmes. These programmes were often conditional

grants valid for a specific type of improvement. A number of communities supplemented the funding they received with loans, while for some communities taking out a loan was the only option.

In many communities, improvements coincided with an increase in the rate customers paid for their water as well as an additional user fee. This was less effective in communities with a declining population. One decision-maker explained:

> *we have to invest all this money, and we don't see any growth, we don't see our tax base, we don't see our water rate* [increase] *there's no growth* [to support] *industry, there's no growth to augment, and help out with some of those extra costs that we have to incur to provide this high level of service* (NS DM).

In many of the communities included in this study, water rates were reported as being below a cost- recovery level prior to the improvement. When water rates were raised, many decision-makers experienced push-back from their customers. One decision-maker described this as a source of frustration: '*Look at your cell phone bill, look at your cable bill,* [water is] *a bargain actually, but people don't quite get that yet*' (NS DM). Similarly: '*you were doing this* [raising the price of water] *for the health and safety and development of your community. It wasn't because you wanted a new dance floor in your town hall. It was something that you needed to do*' (ON DM).

4.5.8 Implementation

Setbacks were experienced in a number of communities during improvement implementation. Many of these were often the result of a poor understanding of local conditions by those responsible for system design. In some cases, the operator indicated that had the system's designer been more aware of local climate variations (e.g., extreme weather conditions including rainfall), some of these setbacks could have been avoided. Instead, in the early weeks and, in some cases, months, following an improvement, the quality of water was the same or worse than its original 'pre-improvement' quality. These setbacks were especially problematic for decision-makers, many of whom dealt directly

with consumer com- plaints. One decision-maker explained: '*We had the system working for say, a few weeks, then all of a sudden we have mechanical problems, then it's down for a few weeks*' (NL DM). On the other hand, some decision-makers thought setbacks should be anticipated during such an improvement: '*there's a misconception that engineers are, or engineering is, perfect, that projects are perfect, that's just, there's no such thing.* [When] *you expect that things are going to be perfect ... that's unrealistic*' (NWT DM).

New technologies or procedures for treating drinking water created some challenges for operators. In Ulukhaktok (NWT), the operator reported that upon seeing the new water treatment system: '*I took one look and nearly walked out*' (NWT O). As a result of an extended hands-on training programme, the operator gradually became comfortable working alone on the new system. Similarly, in Arcola (SK) the operator of the water treatment system noted challenges in using certain manufacture-supplied components: '*They* [these components] *work fine in the lab, in a controlled environment* [but out here] *you'd need six hands*' (SK O). To render these components useful, the operator designed a number of practical customizations based on those sent from the manufacturer.

4.5.9 Outcomes from the change

Consumers gave mixed reviews of the improvements made to the water supply. While interviewees were often positive in their responses, one consumer explained: '*different people say, "oh, the water's terrible", and others say, "the water's great"*' (ON C). Similarly, decision-makers perceived satisfaction among consumers: '*They don't care, one way or the other. They know they can drink the water and that's all there is to it*' (SK DM). Consumers' concerns were more likely to centre on the presence of chlorine in the water supply, particularly in communities where chlorine had not previously been used or where concentrations had been very low. One decision-maker noted: '[now] *you turn on the tap and you'd think you've opened the Javex bottle. So now we drink bottled water*' (ON DM). Other consumers started drinking their tap water as a result of the improvement: '[the] *decision to go from using the water that we bought to using the tap water was probably me saying "we're on a new treatment plant, let's just drink it"* ' (NS

C).

Providing consumers with better information on the process, costs, and purpose of water treatment was an essential part of the improvement process in four communities. Here, educational videos, outdoor programmes, photo contests, and lesson plans for use in classrooms were provided. Several participants perceived greater success in these initiatives if delivered to school-age populations. One operator explained: '*you can spend all the money you want, but you've got to educate. It's the kids ... same with recycling. The adults without kids, they're the ones who are behind'* (NS O). Similarly: '*Out of all this I've learned ... you can teach children, they will listen to you and they will learn ... The children will listen, the adults will not*' (AB DM). The need to start with education within communities early on was echoed by some decision-makers. One individual noted:

> *there was at least a portion of the population who did appreciate the fact that we really have been sitting on a time bomb…It doesn't mean they're happy about paying the increased rates. They accept at least that without this we live in danger, and I think that's hindsight. I think maybe we should have been doing a whole lot more selling of that*' (ON DM).

Decision-makers, operators and some customers expressed pride in the improvements made in their communities. One operator noted: '*I'm proud of what we've accomplished*' (NL O). As a result of improvements made, many communities reported becoming role models in their region. One decision-maker explained: '*The administrator [of the adjacent town] kept phoning and would say "We're just about in the same situation as you – what'd ya do, what'd ya do, what'd ya do?"*' (SK DM). Similarly: '*the rest of the province was watching this system*' (BC DM).

4.5.10 Lingering issues

In most communities, bottled water remains a major competitor of tap water for drinking purposes. Many consumers had come to rely on bottled water during the months or years leading up to the improvement and, despite the much higher cost of bottled water, continue to purchase it out of habit, for reasons of convenience, or because they prefer

the taste over that of tap water. In some communities, gathering water from roadside springs, rivers or lakes, or by melting ice has a historical or traditional significance and remains popular despite an improvement to the central supply. In Ulukhaktok (NWT), one consumer noted: '*younger people ... will drink the water from the tap, they understand better why it* [treatment with chlorine] *is done. But they will never stop getting it* [untreated, raw drinking water] *from the land*' (NWT C).

4.5.11 The lessons learned

Interviewees were asked to describe some of the lessons they learned during the improvement process. Seeking support from sources outside the community emerged as an important lesson. One decision-maker noted:

> *First of all, you don't have the manpower* (sic), *you don't have the staff in the village, even in a town, a small town. So hire the expertise and get good staff, good consultants – there's lots of them out there. Get professionals that can do the job* (AB DM).

Respondents commented on the need to be open to alternative solutions, noting that many traditional approaches are not feasible for a small community. In some cases, the non-traditional approach was met with some uncertainty. One decision-maker explained:

> *this is not the way we'd handled* [things in the past]. *I suppose it made me think about…what the intent of the legislation was in the first place. You know…what your end goal is: safe drinking water for everybody on that particular system*' (BC DM).

Getting multiple parties to agree on how to achieve a mutual goal was often the most significant challenge.

Operators and decision-makers supported efforts to provide customers with the knowledge to understand the link between their drinking water and maintaining public health. Because the majority of water-related information that consumers receive comes from television and print advertising for bottled water, effective messaging was seen as being a critical component of the improvement process. '*Educate your residents, your*

businesses, well in advance. They may not want to hear it, but still send it out. Do your pamphlets, do your meetings, do your school, do all that' (AB DM). Respondents also emphasized the need to understand how information is shared within a community prior to any information campaigns being launched. This could include knowing which newspapers were popular among consumers, where flyers were most likely to be placed and noticed, who within the community was a trustworthy source of information, and whether consumers would attend public meetings or information sessions.

4.6 Discussion

This study profiles seven small systems from across Canada and explores the processes through which safe drinking water is achieved. This study complements the current literature on the outcomes of compliance challenges within small systems by offering insights into the social and contextual processes of decision-making within a small community. These findings highlight the diversity of responses to the safe water challenge, and the diversity of perceptions within communities relating to drinking water supplies (Table 4-4). Three distinct categories of approach are identified and detailed in the sections below. These are regulator-driven, regionalization, and innovative solutions to water quality challenges. The practical implications of this study are then discussed.

Table 4-4: Findings from consumers (C), operators (O), and decision-makers (DM) that summarize the eight key themes

Theme	***Findings***
Water supply before the improvement	• 'you can't tell apple juice from water' (NL C) • 'Especially this time of year [spring] there was a swampy smell' (NS C). • 'In the summer, end of July, all of August, and until the leaves fall off the trees in the park, we were having to pump water [from the deep wells]. They have two wells over here and they were just horrible.' (SK DM)
Impetus for change	• 'you look around and wonder how many potential Walkerton's you'd had' (ON O) • 'from [an] investment point of view, municipalities then have a very strong carrot [with "Water for Life" funding] to start consolidating and putting together regional systems' (AB DM).

Theme	*Findings*
	• 'The biggest drive for it [the improvement] was the guideline which basically states that surface water has to be filtered' (NWT DM)
Options available for change	• 'it made me suddenly think about…different options…one of the things we've got to consider is what the intent of the regulation was in the first place…what your end goal is: safe drinking water for everybody on that particular system' (BC DM). • '[The system] had run for about 90 years with nothing [i.e. few improvements], so they [the town council] really didn't want to spend the money, but they [the government] made us spend the money. And this was the cheapest thing we could do, and it seems to work good.' (SK DM).
Cost and funding concerns	• 'you were doing this [raising the price of water] for the health and safety and development of your community. It wasn't because you wanted a new dance floor in your town hall. It was something that you needed to do' (ON DM). • 'Look, all these communities have 100 year-old stuff, they have to have access to some grants, they can't do it all on their own' (SK DM). • 'Our approach is very service-oriented rather than product sales…You're paying me for the water coming out of your tap that's going to be of the quality that we've agreed to meet' (BC O).
Implementation	• I was so happy working with this council. The council understood I needed to be involved because I had to run it [the facility]' (SK O). • 'there's a misconception that engineers are, or engineering is perfect, that projects are perfect, that's just, there's no such thing.' (NWT DM)
Outcomes from change	• 'They [residents] don't care, one way or the other. They know they can drink the water and that's all there is to it' (SK DM) • 'People were for the improvement. For St. Lawrence, it's the only option; the best option is what they [the council] went with' (NL C). • 'Everybody hates the chlorine and the taste. Doesn't taste like Otterville water used to and stuff like that. But times are changing you know. A lot of things to worry about in a water system.' (ON C).
Lingering issues	• 'To tell you the truth unless they have a Brita [filter, to remove chlorine] they come get their own water from the lake' (NWT O) • 'There's way too much chlorine in it [the water]. Lots of time you turn on the tap and think you've opened the Javex bottle. So we now buy bottled water' (ON C).
Lessons learned	• 'Educate your residents, your businesses, well in advance. They

Theme	*Findings*
	may not want to hear it, but still send it out. Do your pamphlets, do your meetings, do you school, do all that' (AB DM). • '[T]hese projects are significantly complex, they're expensive, and it's unreasonable to expect that community governments are going to go from not having responsibility to implement capital to having the responsibility to do it overnight, and being able to handle the technical complexities associated with these water treatment plants' (NWT DM). • If another town was to do this they'd be crazy not to sit down with the town of St. Lawrence' (NL DM).

The community of Ulukhaktok (NWT) provides a unique perspective, as the responsibility for safe drinking water in the territory is shared between the community and a number of territorial agencies. In this example of a regulator-driven solution, economies of scale were leveraged through a 'bundled contract', ordered by the territorial government, for five separate drinking water systems. Although the community viewed the improvement positively, many residents noted a preference for untreated water for consumption purposes. While no data was collected in this community on the quality of untreated water supplies, or on the health implications of drinking untreated water, others (see, for example, Martin et al., 2007; Harper et al., 2011) have raised concerns over the lack of monitoring of raw water in the north, and the impact of climate change on water quality and human health. At the same time, the gap between the intended outcome of an improved supply of drinking water and the acceptance of that water by consumers signals a failure of policy translation (Jeffrey & Seaton, 2004), and indicates the need for better education on the role of treated drinking water in protecting public health.

Small systems across North America are being encouraged to regionalize water supplies as a means of creating the economies of scale necessary to provide a supply of safe drinking water, maintain infra- structure, and ensure the sustainability of a region through a reliable drinking water system (Miller & Hamilton, 1988; Haque et al., 1999; Rizak & Hrudey, 2008; Langford et al., 2012; Hansen, 2013). Three systems included in this study followed a regionalization approach: the Aspen Regional Water Services Commission (AB), the Springford and Otterville drinking water system (ON), and the Donkin/Glace

Bay (NS) water supply. In each community, the process of negotiating a regionalization agreement raised a number of challenges. Long-standing issues between individuals in decision-making positions have contributed to a number of delays in the regionalization process. These issues may arise as a result of different municipal operating budgets or over fears of what losing the autonomy of a drinking water system could mean for the community. That overcoming these challenges requires an '*underlying trust*' (AB DM) among stakeholders, and in particular among decision-makers, is echoed elsewhere (Braden & Mankin, 2004; Bielefeldt et al., 2012).

Communities facing unique challenges or constraints may opt for more solutions. In the communities of St. Lawrence (NL), Arcola (SK), and Honeymoon Creek (BC), the solutions sought differ from standard responses, reflect the practical experiences of living in the community, and are well aligned with the local culture and stakeholder expectations (Wolfe, 2009). By focusing on desired outcomes – safe drinking water – communities and their stakeholders are better placed to select the best solution available (Head, 2010). The findings of this study agree with those of others that a prescriptive, 'one size fits all' solution to common water quality challenges can be unsuitable for many communities, and that a flexible approach is better able to resolve complex water issues (Holme, 2003; Ivey et al., 2006; Jardine et al., 2003). However, communities pursuing innovative solutions do not act solely on their own; they require considerable support from stakeholders, including regulators, to design the best possible solution. Interestingly, while regulators appear to be best positioned to offer insights and advice to communities on how to resolve a particular issue, they were also reported as being less flexible and less involved in promoting non-traditional solutions. Smith (2008) points to the need to embrace the inherent complexity of water resource management by combining top-down expertise, and financial and technical assistance with a bottom-up understanding of what is culturally, economically, and socially appropriate within a particular setting. This study highlights the complexity of achieving safe drinking water in seven communities where a recent change in the drinking water system had resulted in improved water quality or in the quality of service to consumers – and the challenges that may accompany even successful approaches. From the lessons learned in this study, next steps could include a

comprehensive review of the challenges facing small system water suppliers across Canada.

This study identifies a disconnect between regulator-perceived notions of an improved drinking water system and the needs of those consuming water in the community. For regulators, the distinction between an unsafe and an improved drinking water system is clear; water that meets water quality regulations is safe, and drinking water suppliers have implemented changes to meet these regulations. In reality, the suitability of drinking water is more complex, with local context and culture playing a significant role in determining the acceptability of a particular water supply, especially when consumers place greater emphasis on the aesthetic quality of drinking water over that of its capacity to achieve compliance (Turgeon et al., 2004; Doria et al., 2009; Dupont et al., 2010). Small communities across Canada draw from limited resources to produce drinking water that meets, in general, their respective provincial standards. When they can, these communities will adopt methods for producing safe drinking water in a way that best reflects the culture and context in which the community operates. The meaningful and successful improvement of water quality within small communities is contingent on achieving and nurturing ongoing collaboration between regulators and local stakeholders beyond the formal achievement of regulatory compliance.

4.7 Conclusions

This study allowed for an in-depth investigation of seven communities across Canada and the efforts made to meet both regulatory compliance and consumer needs. While each community achieved regulatory compliance, many experienced, and continue to experience, difficulty in satisfying consumer demands for water quality. Understanding the contextual and cultural challenges communities face in providing safe drinking water is critical for policy-makers looking to better align small communities with water quality goals, and protect public health through the consumption of safer drinking water. If this study reflects the general experience of many small communities, then regulators and small communities would benefit from entering into more consultative discussions prior

to prescribing a particular change. In balancing community perceptions and opinions with fiscal, technical, and governance factors, regulators and other key stakeholders need to respond to water quality challenges with practicable solutions.

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CHAPTER 5 COMMUNITY READINESS FOR EMERGING WATER POLICY: USING EXPERT CONSENSUS TO VALIDATE SIX COMMUNITY READINESS DIMENSIONS

5.1 ABSTRACT

International best practice for limiting contamination in public water supplies suggest a preventative risk management approach such as water safety plans. In Canada, small systems serving fewer than 5,000 customers are more likely to experience water quality challenges. However, adopting a novel risk management approach can be in itself challenging without the appropriate support. While past support efforts have generally focused on technical, financial and managerial gaps, we propose that underlying socio-political dimensions also need to be addressed in the water context. These dimensions underlie a community's 'readiness' to implement a particular policy, which can influence how a policy is maintained over the long term. This research examines the concept of community readiness, and the utility of a Community Readiness Model (CRM) approach, in water policy – small community context. Six 'dimensions' of readiness are discussed: community efforts, community knowledge of efforts, leadership, community climate, community knowledge about the issue, and resources. Using a two-round Delphi technique, a national panel of experts assessed the relevance of these six dimensions in relation to the water policy – small community context. Findings indicate the six dimensions are relevant for understanding and addressing underlying critical socio-political dimensions and their influence on water management decisions. These findings are presented and the opportunities for further research are discussed.

5.2 INTRODUCTION

Numerous approaches to water management exist worldwide. Since 2004, the World Health Organization (WHO) has championed the multiple-barrier water safety plan (WSP) approach as the best way of ensuring safe drinking water (WHO 2004; WHO 2011). WSPs are a source-to-tap risk management approach focused on contaminant prevention, and provide a framework for effective surveillance of drinking water quality and system performance. In water utilities where WSPs have been implemented, known benefits include a reduction in regulatory non-compliance (Gunnarsdottir et al. 2012), improved operation and management (Jayaratne 2008; Gunnarsdottier et al. 2014; Perrier et al. 2014), and reduced operating costs over the long term (Gregor & Winstanley 2005; Chang et al. 2013). Although a growing number of jurisdictions have made WSPs mandatory (e.g., Iceland, Australia, New Zealand and Uganda), their adoption remains limited.

In Canada, the contamination of public water supplies can and does still occur, often for reasons that are avoidable through better and more consistent monitoring, preventative maintenance, and improved operator and manager training (Thomas et al. 2006; Maal-Bared et al. 2008; Hrudey & Hrudey 2014). Small water utilities (those serving fewer than 5,000 people) are typically at a greater disadvantage in complying with water regulations and experience the majority of documented waterborne disease outbreaks (Bakker & Cook 2011; Environment Canada 2014). Major outbreak events (e.g., Walkerton, Ontario in 2000, and North Battleford, Saskatchewan in 2001) have prompted recommendations for improving how drinking water is managed in Canada, with a focus on preventative management through multiple barriers (O'Connor 2002; Hrudey et al. 2003; Hamilton et al. 2006; Summerscales & McBean 2011). Past outbreaks also highlight major challenges within the current culture of water management, including how various stakeholders assume (or ignore) responsibility for safe drinking water in their own community (Hurdey & Hrudey 2014; Moore et al. 2014; Kot et al. 2015). This signals the need to shift to approaches to water management that prioritize risk management, favours accountability, and that support a proactive response to issues as

they arise (Hrudey 2004; Jayaratne 2008). Yet despite calls for change, many jurisdictions across the country have yet to respond.

In 2011, the province of Alberta became the first jurisdiction in North America to require all public water suppliers to adopt a multiple-barrier, WSP-style management, called 'Drinking Water Safety Plans' (DWSPs) (Reid et al. 2013). As in other jurisdictions where WSPs are required, the Alberta experience suggests adjustment challenges both within small water utilities and within the water industry culture (Kot et al. 2014; Perrier et al. 2014). With the adoption of WSP-style policies being recommended for communities across Canada (see e.g., Hrudey et al. 2012; Health Canada 2013), addressing these underlying challenges is an important undertaking.

A community readiness lens provides a useful tool for understanding the process through which a community supports, and then implements, a specific regulatory or policy change (Donnermeyer et al. 1997; Chilenski et al. 2007). Readiness describes the motivation of a group of individuals to take action in a way that will benefit the group (Goodman et al. 1998; Foster-Fishman et al. 2007). In the absence of readiness, any change implemented has the potential to fail; in some cases resulting in negative consequences for the community. By first understanding a community's readiness in the context of a desired change, barriers with the potential to undermine the success of an otherwise effective program can be preemptively addressed (Oetting et al. 1995; Chilenski et al. 2007). In Alberta, where the goal is to implement an effective DWSP regime across all public water supplies, an assessment of community readiness may be a useful first step for identifying potential barriers.

This paper proposes a practical assessment tool for assessing community readiness in a water policy context. Drawing from Oetting and colleague's Community Readiness Model (Oetting et al. 1995), the six dimensions of readiness that form the basis of a community readiness assessment are modified to describe characteristics and challenges inherent in small systems. We report on the validity of these dimensions vis-à-vis a two-round Delphi technique comprised of a panel of experts from across Canada.

5.3 Background

As noted in the introduction, in 2011 the province of Alberta became the first jurisdiction in North America to require all public utilities to develop and implement DWSPs (Reid et al. 2013). A DWSP is a proactive approach for assessing risk in a drinking water system and is dependent on four key principles (from AESRD 2014):

1) Collecting and evaluating the best information available about the water system;
2) Analyzing and understanding potential risks;
3) Correctly assessing risk mitigation; and
4) Determining what resources and actions are necessary to ensure identified risks are reduced.

The DWSP tool provided to water utilities is a form-fillable Excel spreadsheet that is pre-loaded with a number of common risks present in Alberta's water systems. Utilities must complete the form and enter updates as old risks are addressed and new ones appear over time. In this way, the DWSP tool is considered as a 'living document' (DWSP 2014). To facilitate DWSP uptake, the province provided utilities with a two-year implementation window from 2011 – 2013. Operators working in small communities were also provided with a number of hands-on training opportunities (Perrier et al. 2014; Reid et al. 2013), and a series of email and web-events were made available to managers of water utilities and other local decision-makers (Closer to Home 2014).

The two-year implementation period and additional training measures gave communities some of the tools and understanding required in order to implement DWSPs and effectively begin the transition to a proactive water management approach. However, community readiness for this type of change was not considered as a factor. A recent study examining the experiences of early DWSP adopters identified a lack of readiness-related capacity in some communities (see Perrier et al. 2014). For example, communities included in the study reported socio-political dimensions including a lack of support from the community and from community leadership as barriers to DWSP uptake (Perrier et al.

2014). These findings warrant the inclusion of socio-political dimensions when considering how water management decisions are made and how change occurs within a community.

In a public water system, 'capacity' generally describes "the ability to plan for, achieve, and maintain compliance with applicable drinking water standards" (United States Environmental Protection Agency 1998, 8). Community capacity to implement new water-related policies is both scale and issue–specific, and thus is difficult to address using a 'one size fits all' approach. For example, local capacity for groundwater protection has been assessed using the following capacity factors: technical, financial, institutional, social and political (de Loë et al. 2002). Alternatively, to better support municipal water treatment infrastructure (e.g., wastewater), Louis and Magpili (2007) identified institutional, human resource, technical, economic/financial, environmental/natural, resource, energy, social/cultural, and service capacity as critical factors. Louis and Magpili (2007), along with others (e.g., Blanchard & Eberle 2013; Balaz & Ray 2014) note smaller communities require specific capacity building measures if desired outcomes are to be achieved and maintained over the long term. Understanding the role of capacity in water compliance at the community level, and current socio-political challenges inherent in water management, stands out as a critical, yet under-researched area of drinking water research (Ivey et al. 2006; Plummer et al. 2010; Blanchard & Eberle 2013; Straith et al. 2014; Moore et al. 2014).

5.4 Community readiness model (CRM)

Understanding and facilitating changes related to health in the community setting has benefited from a CRM approach. The model itself entails four steps (Figure 5-1): a community assessment, identifying a stage of readiness, developing approaches for building readiness, and re-evaluation (see, for example, Plested et al. 2006; York et al. 2008; Chazdon & Lott 2010). The model developed by Oetting and colleagues (1995) improves upon existing readiness and innovation adoption models by describing the

processes through which communities transition with the result being a lasting change or improvement (Oetting et al. 1995). A CRM approach is flexible and can be applied to a number of scenarios as well as to communities of different sizes (i.e. a community of individuals, a geographically-defined community, or other community constructs) (Oetting et al. 1995).

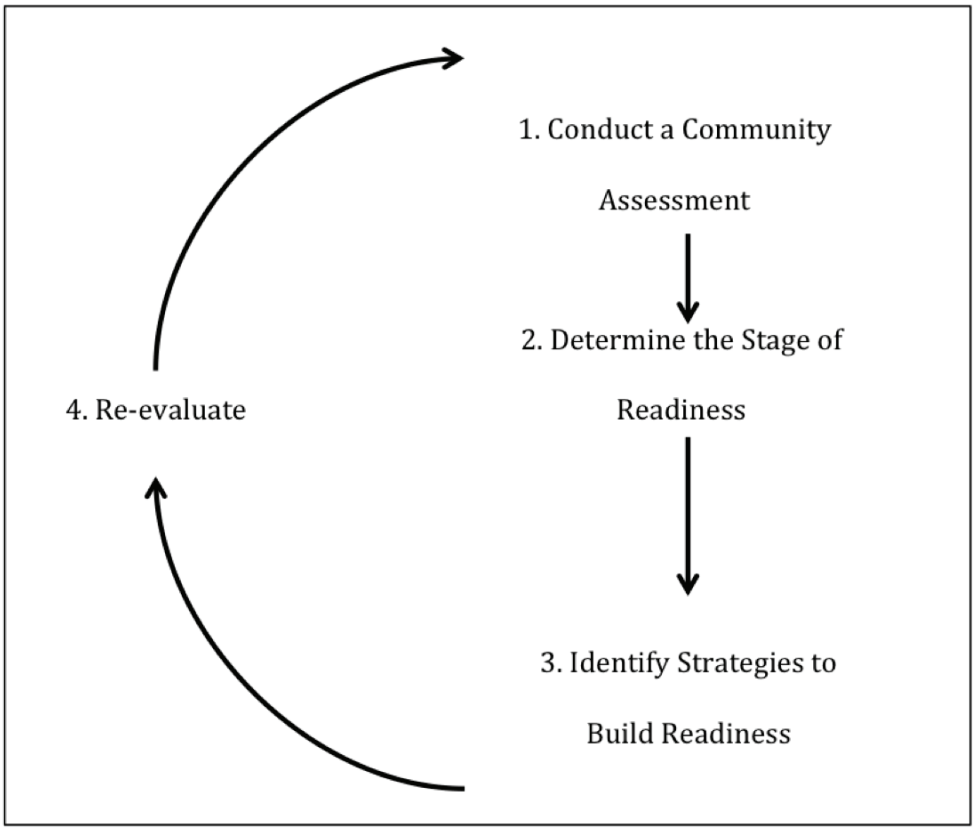

Figure 5-1 The Community Readiness Model (adapted from Oetting et al. 1995)

The CRM model identifies six readiness dimensions, and these form the basis of the initial assessment. The six dimensions, community efforts, community knowledge of efforts, leadership, community climate, community knowledge about the issue, and resources, each support a different aspect of change in the community setting. To assess readiness around a specific issue, a cohort of informed individuals in the community are asked to complete a questionnaire. The content of the questionnaire reflects the six readiness dimensions, and places these in context of a desired change. Once the questionnaire is completed an anchored rating scale is used to score responses. The

anchored rating scale helps to 'translate' the qualitative questionnaire responses into a quantitative readiness score for each of the six dimensions, which can then be used to compare and contrast responses across participants. Scores are then used to determine the overall stage of readiness for the community using a calculation of the mean (Oetting et al. 1995; Plested et al. 2006). The information gathered through a CRM approach is useful for understanding areas of strength and weakness in a community in relation to a specific change. The stage of readiness is further useful for shaping strategies for building readiness in a manner that is appropriate for that particular community.

Following an assessment, it is unlikely a community will be equally ready across all six dimensions. As such, the lowest-scoring dimensions should be addressed individually before proceeding on to addressing the six dimensions as a whole (Oetting et al. 1995; Donnermeyer et al. 1997; Slater et al. 2005). For example, weak leadership (indicated by a low leadership dimension score) could be addressed by targeting specific individuals in leadership roles in order to provide education around why a particular change is desired or necessary. This could be accomplished through one-on-one meetings between leaders and water operators, or with regulators working in an outreach position. Once all dimensions are considered to be at a similar stage of readiness, broader, community-wide readiness building activities become appropriate (Oetting et al. 1995).

A CRM approach has not been applied to the water policy – small community context, however it has been applied in similar contexts such as health-based prevention efforts and health awareness programs (e.g., see Kelly et al. 2003; York et al. 2008). As a first step towards modifying the CRM approach, new descriptions were developed for each of the six readiness dimensions drawing from the relevant literature on water policy, small communities, and multiple-barrier, WSP-style water management. The following details the revised readiness dimensions.

5.4.1 Dimension 1 – Community efforts

The 'community efforts' dimension describes existing local programs and applicable policies related to ensuring safe drinking water. These can include compliance with water

quality regulations, by-laws around water use (i.e., restrictions in summer months) (Ivey et al. 2006), source water protection planning, citizen engagement activities (Timmer et al. 2007), and accurate water pricing (Renzetti 2009). In general, this dimension identifies what measures already exist in the community to ensure safe drinking water.

5.4.2 Dimension 2 – Community knowledge of efforts

'Community knowledge of efforts' describes water customers' familiarity with, and acceptance of, current 'community efforts'. This includes whether customers are complying with water use by-laws (i.e., restrictions in summer months) (Castledine et al. 2014), customer engagement in source water protection committees and related activities (Duram & Brown 1999; Vivek & Barry 2008), and general awareness and understanding of water treatment (i.e., participating in water utility tours or seeking out information on water quality parameters) (Johnson 2008; Fremery & Bogner 2014). Customers that are informed and engaged in local water issues are better positioned to support new policies and interventions and to support the diversion of resources necessary to provide meaningful improvement (Keen et al. 2010; Hrudey & Hrudey 2014).

5.4.3 Dimension 3 – Leadership

'Leadership' describes the extent to which appointed leaders and influential community members support and are engaged in matters related to the water system. This includes support and buy-in among managers of a new water policy (Bartram et al. 2009; Summerill et al. 2010b), willingness or capacity to seek out new (i.e. alternative) funding mechanisms (Kitchen & Slack 2003; Forrer et al. 2013; Zhang et al. 2013; Kot et al. 2015), or the creation of policies or by-laws that benefit drinking water quality and quantity (Craun et al. 2010; Plummer et al. 2010), including support for programs such as source water protection planning (Ivey et al. 2006; Kot et al. 2014). Leadership readiness focuses on the attitudes of those in the community who have an influence on what or how changes are being made regarding the local water system.

5.4.4 Dimension 4 – Community climate

The 'community climate' dimension describes the prevailing attitudes and awareness in the community regarding water supplies and the production of safe drinking water. This considers the level of interest within the community in engaging in water-related issues, from 'it is what it is' (issue avoidance) to a high level of action and involvement (safe and sufficient water as the cornerstone of a healthy and prosperous community). Community climate identifies current preferences towards tap or bottled water (Doria 2006; Jones & Joy 2006), and whether customers have access to information about local water quality and quantity that is easy to understand (Johnson 2008; Keen et al. 2010).

5.4.5 Dimension 5 – Community knowledge about the issue

'Community knowledge about the issue' refers to community awareness of the need to continuously improve how water is being treated and managed. A general understanding of the role of the operator in protecting public health, the role of treatment in preventing outbreaks of waterborne illness, and the rationale for increasing the cost of water, all support this dimension (Turgeon 2004; Jalba 2010; Hrudey 2011; Bartram et al. 2009; Hrudey & Hrudey 2014). Building this type of awareness is considered to be a key requirement for taking on more robust water management practices.

5.4.6 Dimension 6 – Resources related to the issue

'Resources' are necessary to support readiness, and include the availability of trained and committed personnel (Bartram et al. 2009), access to adequate information about a water system (Mahmud 2007), and access to the financial capacity required to implement a variety of desired changes (Vieira 2011; Chang et al. 2013). Resources can further include, for example, a coordinated volunteer base, the availability of public space in which to hold meetings, and information on funding programs or support for applying to these programs (Oetting et al. 1995). This definition of resources draws the focus away from a narrow monetary definition commonly included in capacity definitions.

5.5 METHODS

The Delphi technique was used to validate the six modified readiness dimensions for their relevance in the context of water policy uptake in small communities, as it is a structured, iterative approach for generating consensus among a panel of experts (Linstone & Turroff 2002). The Delphi technique is characterised by four key features: (1) anonymity of participants, (2) iterations of questioning (in two or more sessions), (3) controlled feedback, and (4) statistical aggregation of group responses (Linstone & Turroff 2002). Interquartile range, an indication of variation between responses given in the first and second rounds, was used to measure convergence of the experts' opinions over the course of the study (Linstone & Turroff, 2002).

While the Delphi technique can include upwards of four rounds, numerous factors may warrant fewer rounds being required. This includes cases in which the purpose of the study is to evaluate an existing set of concepts instead of generating new ones, and where participants are provided with context in which to consider their responses (Snyder-Halpern 2001; Lindstone & Turroff 2002). As this was the case for our study, two rounds was considered to be adequate.

The panel comprised individuals from across Canada and from academia, government, and non-government backgrounds. Selection was done through an online search of relevant academic and non-academic websites, and by exploring personal networks. The 'expert panel' (Baker et al. 2006) comprised individuals with relevant and related experience (Hasson et al. 2000) as well as current knowledge of the topic under investigation (Jairath & Weinstein 1994).

Representativeness using the Delphi technique is assessed based on the qualifications of those that make up the panel rather than on the number of panellists involved (Powell 2003). A panel of 12 – 15 individuals is often considered to be sufficient for this type of study (Ludwig 1997). At the same time, Murphy and colleagues (1998) note the number of participants does not appear to have an impact on the reliability and validity in a

Delphi study, but a more homogeneous result can be expected where fewer participants form the panel (Skulmoski et al. 2007).

The research team identified an initial group of 20 individuals as being eligible for this study. Efforts were made to include panel members actively working with small communities on matters related to DWSP implementation in Alberta at both the policy level and 'on the ground' (i.e. those providing in-person implementation support). Each individual was invited to recruit others who they thought might have expertise relative to the purpose of the research (Walker et al. 2000). Although a number of panellists did try to recruit peers for this study, the rate of return from this cohort was limited to two out of eight known additional recruits. Each eligible panellist received an email with a recruitment letter soliciting their informed consent to participate in the study and a timeline for the project. The email also contained a copy of the first round of questions, along with instructions for completing the questions.

A total of 13 individuals volunteered for the expert panel. Panel response rates for the two survey rounds were 13 (100%) and 10 (77%), respectively. Panel profile characteristics (based on place of work) were comparable across Round 1 and Round 2 (Table 5-1).

Table 5-1 Delphi expert panel place of work

Place of work	***Round 1***	***Round 2***
Provincial government	6	4
Academic institution	2	2
Municipality	2	2
Consulting	2	1
Non-government organization	1	1
Total	13	10

5.5.1 Round 1

In Round 1 the expert panel was asked to review the six readiness dimensions modified for the water policy – small community context. Experts were then asked to respond to the Round 1 questionnaire (in Excel). A reminder email was sent out after the first week to all those who had not provided their response (Dillman 1978). Because the intent of the survey was to validate a set of revised dimensions, experts were not provided with an opportunity to suggest new dimensions.

In Round 1, panellists were asked to respond to three questions:

> Q1: Rate the importance of each readiness dimension in order from 1 (least important) to 6 (very important)
>
> Q2: Provide a relative value (weight) for each dimension, using a scale of 1 (least important) to 10 (very important)
>
> Q3: Indicate the confidence of the response to Q2 using a scale of 1 (least important) to 5 (very important)

Question 1 sought to rate each dimension. The scale used in Questions 2 and 3 allowed each expert to quantify a degree of agreement with each particular question (Matell & Jacoby 1971; Cummins & Gullone 2000; Allen & Seaman 2007). The maximum value in each question was varied in an attempt to encourage careful thought and to avoid repetition of response. A low score in Questions 1 and 2 would indicate that a dimension is of limited importance in the water policy – small community context, while in Question 3 a low score indicated the respondent's own lack of confidence in their response to Question 2. Conversely, a high score in Questions 1 and 2 would indicate the dimension is of high importance for ensuring water policy implementation, and in Question 3 would indicate a high degree of confidence in the Question 2 response. In this way, Questions 2 and 3 are linked.

5.5.2 Round 2

The questions posed in Round 2 were the same as in Round 1. A summary report from the Round 1 results was included along with the Round 2 questionnaire form (in Excel). The information letter provided a description of the goals for Round 2, directions for completing the questionnaire, and instructed panel members to return the completed questionnaire by email. The summary report contained the group's mean scores and confidence intervals for each of the three questions. Individuals were invited to contrast the group's responses to their own responses from Round 1, and to reconsider their original responses in light of these findings. A reminder email was sent after one week to those who had not yet provided responses (Dillman 1978). Panellists who participated in both rounds were eligible to win a $200 cash prize.

5.6 RESULTS

Respondents were asked to indicate a rate of importance for all six dimensions by assigning numbers to each dimension from 1 – 6, with 1 being the least important and 6 indicating the most important dimension. The results (presented as a mean score) show respondents rated 'Leadership', 'Resources' as the most important dimensions followed by 'Community knowledge about the issue'. 'Community climate' received a high rating as well. Both 'Community efforts' and 'Community knowledge of the efforts' were rated as the least important dimensions (Table 5-2).

Table 5-2 Q1: Importance of each dimension rated from 1 - 6

Dimensions	***Importance of Dimension (mean score)***
Community Efforts	2
Community Knowledge of the Efforts	1.5
Leadership	5
Community Climate	3.5
Community Knowledge about the Issue	4
Resources	5

The responses from the interrelated Questions 2 and 3 were standardized to a range of 1 – 5, in which 1 is the least important and 5 is critically important. Respondents assigned high scores to 'Resources', 'Leadership', and 'Community knowledge about the issue', while lower scores were given to the dimensions of 'Community efforts', 'Community knowledge of the efforts', and 'Community climate' (Figure 5-2). In comparing the responses, dimensions that received lower value scores also received lower confidence scores.

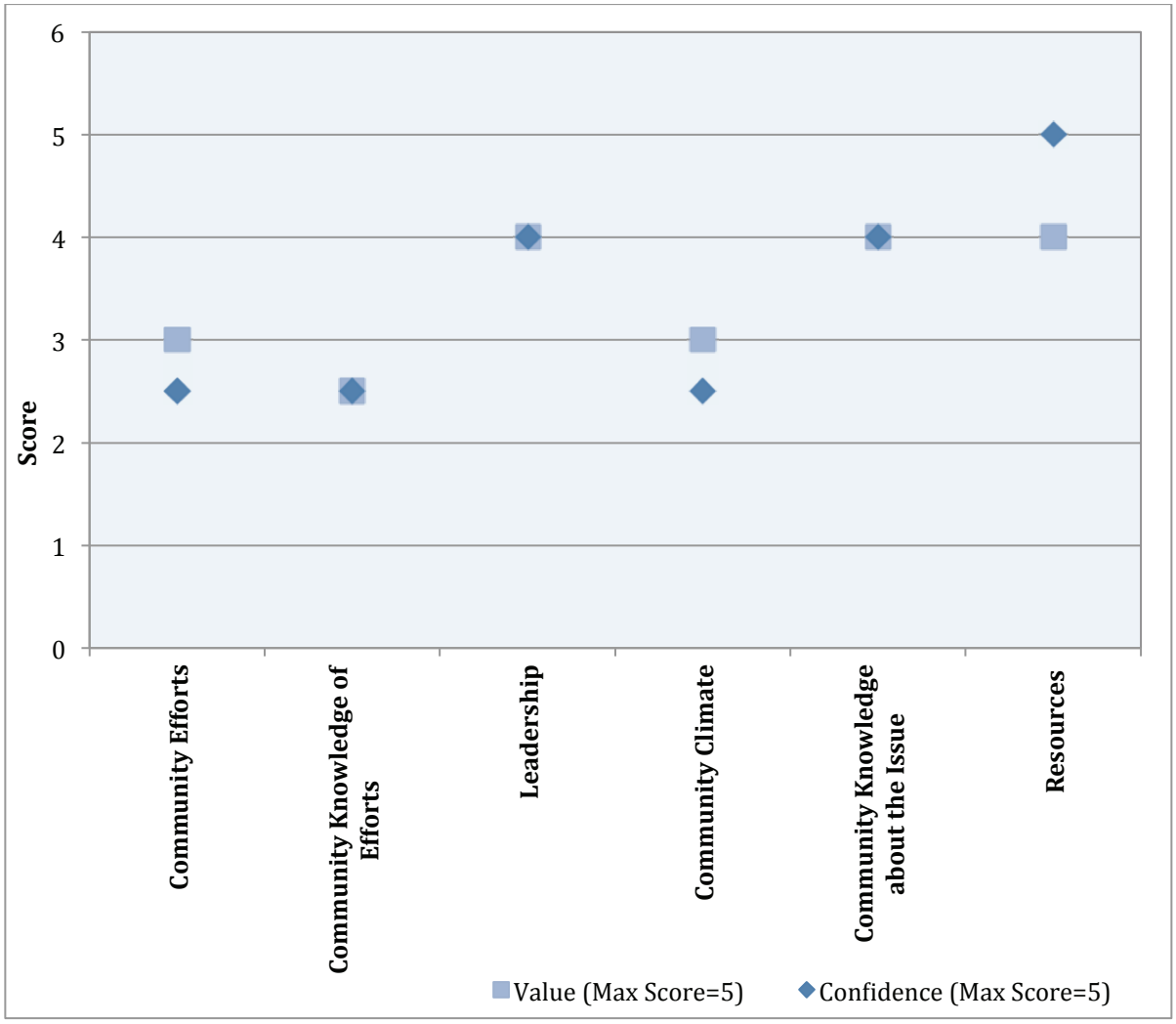

Figure 5-2 Q2: Mean value for each dimension and Q3: Confidence of the response to Q2

The results were checked for convergence using a measure of interquartile range. From the responses to Questions 2 and 3 only one dimension (Q3. Confidence of the response

to Q2: ‘Community knowledge of the issue’) decreased in convergence, while all other dimensions either increased or remained the same between rounds.

5.7 Discussion

This paper situates six readiness dimensions for assessing community readiness in the water policy – small community context. A panel of experts were surveyed to determine the validity of the six dimensions in this context using a two-round Delphi technique. The readiness assessment is an integral part of a CRM approach for understanding and facilitating readiness for change.

Results of the Delphi survey saw medium to high scores provided for the six dimensions in Questions 2 and 3, across both rounds. A similar pattern emerged in Question 1, which rated the relative importance of each dimension. While a homogeneous response is anticipated where fewer participants inform the panel, this does not diminish the validity of the findings (Skulmoski et al. 2007). Because all dimensions generally received scores of 50 percent or higher (at least 2.5 out of a potential score of 5 in Figure 5 - 2), all six were determined to be valid for assessing readiness for WSP-style management. Further studies may be required to determine if the six readiness dimensions should be revised, or if new dimensions should be added.

The panel gave ‘Resources’, ‘Leadership’ and ‘Community knowledge about the issue’ the highest value (Question 2) and highest confidence (Question 3) ratings (Figure 5-2). Resource availability, strong leadership and awareness of the need for change are commonly linked with the internal capacity of an organization or utility to make water-related improvements (e.g., Summerill et al. 2010a, 2010b; Hrudey 2011; Straith et al. 2014), and the panel’s confidence in scoring these dimensions reflects this link. ‘Community climate’, ‘Community efforts’ and ‘Community knowledge of the efforts’ each received lower scores, and medium to high confidence ratings. The importance of these last three dimensions is reflected in the recent literature on customer-community

knowledge and attitudes towards drinking water, and the impact these can have on water utility operations and on operators themselves (see Genius et al. 2008; Kot et al. 2011; Bratanova et al. 2013; Hrudey & Hrudey 2014). In general, these findings indicate that communities with access to resources, strong leadership, and a concerned and aware citizen base are best prepared to respond to water policies such as DWSPs.

The panel indicated 'Community efforts', 'Community knowledge of efforts' and 'Community climate' as the dimensions of least importance for ensuring readiness. At the same time, the panel was less confident in rating these dimensions (Figure 5-2). Interestingly, these dimensions describe the baseline community environment into which any new water policy is implemented. Past experiences have shown that communities with existing water quality challenges will likely identify a greater number of risks during a risk assessment, and thus face greater costs in addressing these risks (Breach 2011; Chang et al. 2013). In such communities, the challenges associated with implementing water policies such as DWSPs, could benefit from a CRM approach. Further studies will be required to test these expert opinions on the importance of baseline community environment on long-term water policy implementation.

In the original CRM, each dimension is considered to be of equal value when calculating the overall stage of readiness (Oetting et al. 1995). In this study, we asked participants to assign a relative value (weight) to each of the six readiness dimensions in Question 1. The purpose for determining a value for each dimension was to understand whether a specific dimension might have greater influence over outcomes in the community, according to the expert panel. The dimensions given the highest value were 'Leadership', 'Resources' and 'Community knowledge of the issue'. The indication here is that strength in these three areas may be more important than other community dimensions captured within a CRM approach. Attention and resources to these dimensions alone could shorten the amount of time and effort spent on building readiness in a community. More research will be required to determine if using a value (weight) score is effective in this context, or if in doing so important factors are being ignored.

A CRM approach supports the development of a risk-averse, proactive culture of compliance by addressing factors that underlie common failures in public water systems. By highlighting opportunities for engagement among a range of stakeholders, a CRM approach strengthens community efforts for safe drinking water by drawing attention away from a small cohort of individuals, namely water operators. In general, the utility of a CRM approach is twofold. For communities, a low score on the readiness scale provides valuable insights as to how local characteristics may have an impact on policy outcomes. For regulators, the CRM approach shows potential as a screening tool for allocating stage-specific funding, training, or other forms of support. Future studies will be required to determine how effective the CRM approach is in identifying deficiencies.

The two-round Delphi technique used in this study enabled engagement and collaboration among a geographically dispersed group of experts. The use of email to administer the survey was cost effective, and allowed each panellist to proceed at their own pace within the constraints of the study period. Some of the limitations of this study include the small number of participants, and restrictions on how the panel could contribute to the study. For example, panellists could not suggest new dimensions or adjust the parameters of existing dimensions to better suit the types of challenges they had in their own experience observed within a small water system. Future studies may also seek to experiment with panel composition in order to better understand differences and similarities between those in policy-making positions, and those enacting those policies ‘on the ground’. This research provides a starting point for those studies.

5.8 Conclusions

An expert panel validated six community readiness dimensions for use in assessing uptake potential for new management policies in small water systems. Findings indicated that all six dimensions are valid in this context; however, further research is required to determine how these dimensions manifest in actuality ‘on the ground’. Further research would also help clarify whether those dimensions that received a higher rating, value and

confidence scores (for example, ‘Resources’) are more critical to water policy uptake than those receiving a lower rating, value and confidence scores (for example, ‘Community climate’).

A CRM approach can help facilitate an understanding of community strengths and weaknesses prior to implementing new water management policy. The CRM approach provides a practical framework, both as an assessment and as a guide for action. This approach can help close the gap between the intent of a particular policy and outcomes in the community setting. Furthermore, a lens of community readiness addresses many of the socio-political challenges identified as having an impact on drinking water management across Canada, while supporting a culture of compliance among water providers and a sense of value among customers who depend on them.

CHAPTER 6 BENCHMARKING READINESS FOR DRINKING WATER SAFETY PLANS: AN EXPLORATORY SURVEY OF EIGHT SMALL WATER SYSTEMS IN ALBERTA (CANADA)

6.1 ABSTRACT

Canada, having a long history of regulating drinking water quality, is not immune to water-related disease outbreaks. Small communities (those with water systems serving fewer than 5,000 customers) are more likely to have difficulty maintaining compliance with water quality regulations than large urban centres. In some cases, these smaller communities require additional training and support to help with compliance. International best practice suggests a proactive and risk-based approach as the most effective means of protecting a public water system from contamination, and in 2011, Alberta became the first Canadian province to require a multiple barrier, 'Drinking Water Safety Plan' (DWSP) approach based on these international recommendations. This study explores the 'readiness' of eight small communities in Alberta with respect to implementing and maintaining such plans. Using a modified Community Readiness Model, communities were assessed across six dimensions: community efforts, community knowledge of efforts, leadership, community climate, community knowledge of the issue, and resources. Findings suggest the eight communities had a low baseline readiness for drinking water safety plans, and that perceptions of readiness differ between water operators and community decision-makers. A Community Readiness Model approach can provide critical insights for those seeking to assess the ability to implement programs such as DWSPs in smaller communities.

6.2 INTRODUCTION

Ensuring drinking water safety is the priority goal for any water provider. Although the majority of Canadians have access to safe drinking water, the risk of contamination and waterborne illness remains. Small communities[4], which comprise 80 per cent of the public water systems in Canada (Wilson et al. 2009), are particularly at risk for failures that can result in contaminated drinking water (Bakker & Cook 2011; Environment Canada 2014). The technical, financial and managerial capacity absent in many small communities can undermine efforts to produce safe drinking water and lead to otherwise preventable failure (Hrudey & Hrudey 2004; Blanchard & Eberle 2013). These challenges have led to calls for approaches to management that balance the need for regulatory compliance with the capacity of a small water system (O'Connor 2002; Kot et al. 2011; Dunn et al. 2014).

Conventional water management focuses on monitoring treated water, a largely reactive practice in which any contamination entering the water system may go undetected for hours, even days (Rizak & Hrudey 2007; Dunn et al. 2014). This approach is limited in its capacity to protect public health as water quality is only assured at one point within the water system, and, because microbial testing does not produce instantaneous results, the length of exposure is prolonged (Medema et al. 2003; Jalba et al. 2010). The need to improve conventional water management practices has resulted in a shift towards prevention, with a focus on multiple barriers as the best way to protect a public water system (O'Connor 2002; WHO 2011; Islam et al. 2011; Baird et al. 2014). One framework for implementing a multiple barrier approach is the water safety plan (WSP). A WSP is a systematic preventive and risk management approach that covers all stages of drinking water production and distribution from water source to the consumer's tap (WHO 2011; Hrudey & Hrudey 2014). Because WSPs are both flexible and adaptable they have been applied to water systems of all service sizes (Bartram et al. 2009; Kot et al. 2014; for research on WSP frameworks in Canada, see Perrier et al., 2014).

[4] Small communities are characterized as those serving water to fewer than 5,000 customers (Health Canada 2005)

Adopting new water management approaches can be challenging, particularly where stakeholders (those involved directly or indirectly with the water system) have competing priorities for a limited supply of resources; this is especially so for small communities (Canadian Council of Ministers of the Environment 2004). Individuals in a community, whether water users, landowners, decision-makers, or operators, have influence over regulatory compliance (Bodin & Crona 2009). Over the past decade, experiences with WSPs implementation have highlighted numerous instances where such stakeholders have had an impact on overall outcomes. For example, Summerill and colleagues (2010a) found that without commitment from management, operators were more likely to implement WSPs as one-time, "token gesture" (p. 387), rather than as a framework for resolving longstanding water management challenges. Similarly, Perrier and colleagues (2014) found that poor operator attitudes and a weak relationship between operators and community decision-makers had a negative impact on the adoption of WSP principles. To address these challenges, and to ensure WSPs are implemented in a way that is beneficial to communities and to stakeholders, an approach beyond a traditional water management framework may be required.

Social marketing provides one potential approach to support long-term behaviour and attitudinal change among individuals, yet here engagements with water-based initiatives are limited (Kotler 2011; Lowe et al. 2014). A related approach is that of community readiness, which, like social marketing, is concerned with the social context in which individual behaviours influence decision-making and makes use of community resources and influences to accomplish a desired change (Slater et al. 2000; Kelly et al. 2003). Community readiness is similar to community capacity in that it embodies a potential state that can lead to action (Goodman et al. 1998). Unlike capacity however, community readiness refers to the commitment to change made through the collective action of many individuals, each one operating out of their own desire to do so (Chilenski et al. 2007; Weiner 2009). In examining past examples of WSP implementation, Kot and colleagues (2014) found evidence of the need for communities to be 'ready' prior to implementing new water management policies. To explore readiness for uptake of WSP-style water

policy in Canada's small communities, this paper applies a Community Readiness Model (CRM) approach. The province of Alberta was selected for this research as recently all public water utilities were required to implement Drinking Water Safety Plans (DWSPs). The model and the DWSP approach are described below.

6.3 BACKGROUND

6.3.1 The Community Readiness Model

The original CRM was developed to address barriers impeding the implementation of community-based health interventions, specifically drug and alcohol prevention programs (Oetting et al. 1995). The model has since been applied to a number of issues that can impact community health and wellbeing, including obesity (Sliwa et al. 2011), environmental issues (Edwards et al. 2000), and the uptake of smoking cessation policies (York et al. 2008). CRM practitioners posit that without being ready, any community that implements a new program or policy is at risk of not being able to fully implement or sustain a program or policy over the long term. Worse, communities that are not ready may fail outright to benefit in any way from an otherwise effective program or policy (Oetting et al. 1995).

A CRM approach comprises four steps: an assessment, determining a stage of readiness, determining strategies to build readiness, and re-evaluation (Figure 6-1). The assessment stage examines a community in the context of a desired change across six dimensions: current community efforts, community knowledge of the efforts, leadership in the community, community attitudes, community knowledge of the issue, and available resources.

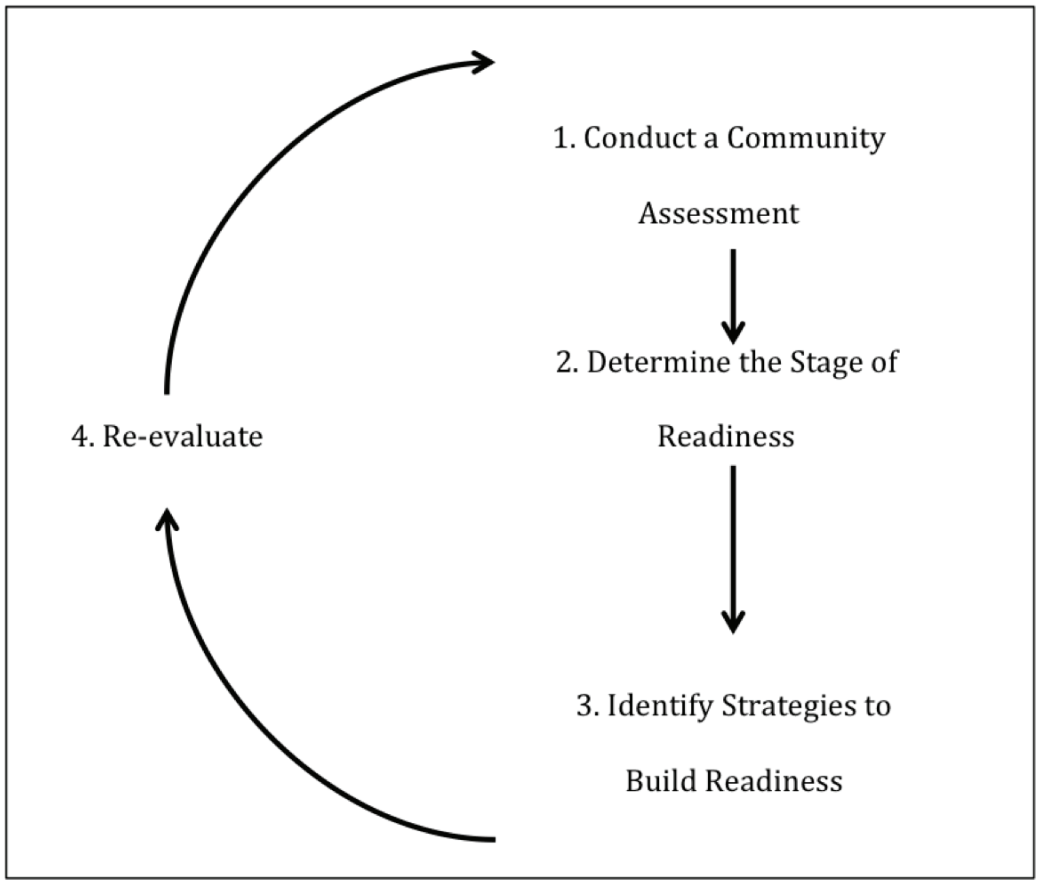

Figure 6-1 The Community Readiness Model (adapted from Oetting et al. 1995)

To start an assessment, one or more individuals with a close understanding of the problem or issue in question is required to complete an in-depth questionnaire (Oetting et al. 1995; Edwards et al. 2000). Where numerous individuals are included in the assessment phase a broader perspective of the challenges and opportunities emerges. The original questionnaire was modified to reflect uptake challenges related to water policy, using 'tap water' as the metric for assessing awareness and response in the community (Table 6-1). While tap water by no means captures the range of action required as part of a WSP-style management approach, here it is intended to represent the overall end-goal of an improvement policy from the perspective of all users.

Once the assessment is complete the findings are used to identify a stage of readiness, which ranges from one ('no awareness') to nine ('professionalization') (Table 6-2). Using the community readiness stage as a starting point for action, appropriate strategies for

building readiness are developed and carried out (Edwards et al. 2000). When communities rate higher for readiness among some dimensions, the model's developers suggest building readiness in these areas first before focusing on broader readiness goals (Oetting et al. 1995).

Table 6-1 Revised Dimensions of Community Readiness with Selected Questions to Key Informants (adapted from Oetting et al. 1995; Edwards et al. 2006; York et al. 2008).

Dimensions of Community Readiness for Water Policy (e.g., DWSPs)
Community efforts: What is being done to make water safe?
How much of a concern/priority is tap water in the community?
What formal or informal policies and practices related to tap water quality are in place in the community?
What are the primary concerns related to tap water in the community?
Community knowledge of efforts: How much is known about safe water?
Do people in the community talk formally (or informally) about tap water quality?
How aware are people in the community of the policies and practices in place for ensuring safe drinking water?
How are people in the community informed of these policies and practices?
Leadership: How supportive are leaders?
How much of a concern is tap water quality to the leadership in the community?
What opportunities are there for leaders to become engaged or involved?
When would the leadership agree to devote additional resources and/or efforts towards improving tap water in the community?
Community climate: What is the prevailing attitude?
What is the overall feeling among community members regarding tap water?
Do community members provide any support for ensuring tap water quality?
Do people in the community drink tap water?
Community knowledge of the issue: What do people know about the issue?
How knowledgeable are community members about tap water quality or quantity?
What information is available in your community regarding the tap water?
Who can community members contact to obtain information regarding their tap water?
Resources related to the issue: What resources are available to support efforts?
Is there a volunteer base in the community with an interest in water issues?
How are current efforts related to tap water quality funded?
Are there plans to seek out additional funding?

Table 6-2 Revised Stages of Community Readiness (adapted from Oetting et al. 1995; Edwards et al. 2006; York et al. 2008).

Stage of Readiness	*Description*
No awareness	Current water system management approach not viewed as a concern by community or by leaders
Denial/Resistance	Some recognition of concern, but the problem is not be viewed as a local problem
Vague awareness	Many are aware there is a local problem, but the motivation to address this problem is not there
Preplanning	There is a clear recognition that a new management approach is required
Preparation	Leaders begin taking action, and the community may offer some support
Initiation	A new management approach is implemented
Stabilization	Activities under the new management are supported by community members and leaders
Confirmation/expansion	Activities are underway and progress is being monitored
Professionalization	The community becomes a leader in DWSP application

Strategies for building readiness will vary between communities, however, in general low readiness is addressed through awareness building among an increasingly wider range of stakeholders (Oetting et al. 1995; Edwards et al. 2000). Awareness refers to basic assumptions, such as awareness that an issue exists or that unaddressed, the issue will have a negative impact on the community. Communicating with community leaders, arranging public information sessions, and distributing information are simple yet effective ways in which almost any community can begin to awareness gaps (Edwards et al. 2000). Once general awareness of a problem is achieved, options for addressing the problem should be introduced, to be followed by action (i.e. implementation of a program or policy). This runs contrary to many current approaches, in which initial awareness-building steps are overlooked in favour of outright implementation. As communities work to increase readiness for change, periodic re-evaluation using a CRM approach is recommended in order to monitor progress and adapt readiness building strategies if required. A CRM approach is low-cost and flexible, and works on a community-by-community basis to accommodate variation between locations. Importantly, the model affords communities the option to build readiness independently of the progress (or setbacks) experienced in other neighbouring or similarly-sized communities (Oetting et al. 1995; Edwards et al. 2000). Community readiness presents a first step for

understanding community-specific strengths and weaknesses in relation to specific goals, and provides a customizable approach for building readiness in light of these limitations (see, e.g., Hahn et al. 2013; Ehlers et al. 2013).

6.3.2 Case Study: Alberta's Drinking Water Safety Plan Approach

In 2011, the province of Alberta announced that all public water utilities would be required to develop a Drinking Water Safety Plan (DWSP) and use this plan to guide water management and decision-making (Reid et al. 2013). The two-year implementation period accompanying this announcement meant utilities had time develop the plan, which follows a multiple-barrier approach in which risks are identified and addressed proactively from the source to the consumer's tap. The plan itself is a standalone Excel spreadsheet, the contents of which are to be updated as improvements are made, risks are mitigated, and/or new risks emerge (AESRD 2012; Reid et al. 2013). A number of programs were launched to help facilitate uptake of the DWSP approach among the province's smaller communities. These included training sessions, hands-on training, and web-based information sessions aimed at clarifying the intent of the DWSP approach among decision-makers in small communities. A study of early adopters in 15 of these communities identified challenges with DWSP uptake including time constraints, limited resources for addressing identified risks, and communication challenges (Perrier et al. 2014). These findings underline the gap between policy intent and reality, a critical gap in water regulation (e.g., Kot et al., 2011; Pons et al. 2014).

The potential, positive impact of a well-established DWSP management approach, and the reality of DWSP implementation 'on the ground' is, we believe, a difference of readiness. To understand the influence of readiness in the DWSP context, this study examined eight small communities in Alberta. Community readiness has not been explicitly considered in previous studies examining water management or water policy, thus the novelty of this approach is worth investigation.

6.4 METHODS

6.4.1 Tool development and validation

An existing CRM approach was evaluated for use in the water policy – small community context. A version of the readiness assessment tool (step one in the CRM approach) was modified using the relevant literature. The appropriateness of the tool's constructs (characterized by six readiness dimensions) were assessed using a two-round Delphi technique, where members of 13 person expert panel from academic, consulting and government backgrounds provided input on each dimension (see Chapter 5). Panel consensus indicated that each of the six readiness dimensions were important factors relating to water policy uptake in small communities. Based on these findings, a questionnaire (comprising 37 questions) was developed and used to carry out the assessment.

6.4.2 Data collection and analysis

Data collection occurred over two phases: primary and retrospective. In the primary phase a small communities from across Alberta were assessed in order to establish baseline readiness. A list of sixteen communities from across Alberta, each serving fewer than 5,000 customers, were purposefully selected from a larger list of communities developed as part of two related projects being led by a team of Dalhousie University researchers (see Perrier et al. 2015 for an example of project outcomes). Nine of these communities agreed to participate in a readiness assessment, however due to scheduling issues one community later declined their participation. From the eight final participant communities, one 'expert' (either a community decision-maker or an operator) per community was selected to complete the 37 question assessment, to be carried out by phone. These experts were selected based on their knowledge of the DWSP requirement in the context of their own community, a standard protocol established in the original CRM approach (Oetting et al. 1995). It is important to note that the original model

recommends more than one expert per community is recruited to partake in the assessment phase. While this is done to achieve a greater range of perceptions on community readiness it was not feasible within the time constraints of this study to survey more than one individual. However, an example of the benefit gathering multiple insights on readiness from within a single community is provided in 6.5.4, using a retrospective analysis (see below). The assessment itself gathers qualitative responses to a questionnaire, with each question relating to one of the six readiness dimensions (Table 6-1). Interviewees responded to questions to the extent of their knowledge, and all responses were recorded by hand (Oetting et la. 1995; Edwards et al. 2000).

To facilitate a retrospective analysis, transcripts gathered as part of an independent study from the same eight communities were analyzed using the readiness assessment questionnaire. These data were collected by two different members of the research team, some in 2012 and some in 2013, and sought similar information on DWSP implementation. These data provide an independent step to confirm the analysis from the 37 question survey from the primary phase.

The retroactive analysis provided one additional benefit: multi-party response. In three of the eight communities, interviews were carried out with both an operator and a decision-maker. This allowed for analysis of intra-community response variation and an understanding of how readiness perceptions differ between key individuals in the same community. A timeline of data collected from the eight communities is described in Table 6-3.

Table 6-3 Primary and retrospective expert interviews by role

	Primary Analysis	***Retrospective Analysis***	
Community	*2014 interview*	*2012 interview*	*2013 interview*
1	Operator	Operator	
2	Operator	Operator	
3	Operator	Operator	
4	Operator	Operator	
5	Operator		Operator, decision-maker
6	Decision-maker		Operator, decision-maker
7	Decision-maker		Operator, decision-maker
8	Decision-maker		Decision-maker

Using an anchored rating scale, the qualitative data from the primary and retrospective research phases were converted to a quantitative score using an anchored rating scale (Plested et al. 2006). An anchored rating scale of one to nine was used to determine a community's position in relation to a desired outcome, with each readiness dimension having its own anchored rating scale (Oetting et al. 1995). On each scale, a unique description is used for each point and it is against these points that the findings from the assessment are matched. For example, a community would score low (a score of 1) for the 'leadership' dimension if the interview data indicated: "leadership has no recognition of the issue" (Plested et al. 2006, p. 25). Alternatively, a community would score high (a score of 9) if the interview data indicated: "leaders are continually reviewing evaluation results of the efforts and are modifying support accordingly" (Plested et al. 2006, p. 25). This process was repeated for each readiness dimension and across each data set.

A mean score from each of the six readiness dimensions in a community was used to determine an overall stage of readiness. CRM protocol recommends the mean score be rounded down to the nearest whole number to ensure communities are sufficiently 'ready' before moving on to the next stage (Oetting et al. 1995). A community might place anywhere from a readiness stage of one ('No awareness'), indicating the community is unprepared to start making a particular change, to nine

('Professionalization), indicating the community has the desired change in place and acts as a leader and a resource for others trying to implement similar programs.

To explore intra-community response variation, data from three of the eight communities was analyzed. Because the goal was to cross-compare perceptions between two interviewees in the same community, only those communities where one decision-maker and one operator had been interviewed could be included (see Table 6-3). Transcript analysis was used to extract information-rich quotations illustrating similarities and differences in readiness perceptions between the participants (Patton 2005).

6.5 Results

6.5.1 Readiness dimensions: Primary phase

Readiness dimension scores for each dimension are presented below (Table 6-4). Here, communities varied most significantly in the dimension of 'community efforts' (mean = 3.5, standard deviation (S.D.) = 1.6), which explored the degree to which programs, activities and policies regarding safe drinking water were already in place in the community. This included whether communities were consistently meeting provincial water quality guidelines, and whether there were any programs or activities in the community to help connect water customers with water resources (e.g., through watershed tours). Overall, the highest rated dimension was 'community knowledge of efforts' (mean = 3.75, S.D. = 1.28) indicating the degree to which individuals were knowledgeable about existing programs, activities and policies. This included community members' knowledge of the operator's role in the community, an understanding of basic water treatment processes (e.g., the purpose of chlorination), how water treatment relates to public health protection, and whether customers participated in any available programs or activities.

Table 6-4 Primary Analysis of Community Readiness for Drinking Water Safety Plan Development (n = 8)

Dimension	*Mean*	*SD*	*Actual Range*
Community efforts	3.5	1.60	2 to 6
Community knowledge of efforts	3.75	1.28	2 to 6
Leadership	3.5	1.41	2 to 6
Community climate	2.5	0.76	1 to 3
Community knowledge of the issue	2.75	0.71	2 to 4
Resources related to the issue	3	1.41	1 to 6

Communities were most similar in their responses for 'community knowledge about the issue' (mean = 2.75, S.D. = 0.71), which measured awareness of tap water related challenges by customers. This includes what type of information is available to the customers and how accessible this information is to them. In general, all eight communities offered some form of publically available water quality test results; however, there was variation as to whether this was physically available in the community or whether it was posted online on a provincially-operated webpage. A higher score would be awarded if water quality test results were clarified for customers using plain-language, however most of the experts interviewed indicated these results were presented numerically 'as is'. Some communities used a monthly newsletter to keep customers updated on the water system, and these communities received a higher score.

The lowest rated dimension was 'community climate' (mean = 2.5, S.D. = 0.76), a measure of prominent community attitudes towards drinking water. This includes whether the customers and the leadership consider safe drinking water to be something that can (and should) be locally controlled, or whether dealing with water challenges falls to the operator alone or someone outside of the community (Kot et al. 2011; Perrier et al. 2014). Most respondents indicated low levels of community ownership towards local water issues. For example, in four of the eight communities surveyed, interviewees reported that customers preferred bottled water over tap water and that few, including

members of the leadership, had any understanding of local water issues (e.g., location of the source).

6.5.2 Readiness dimensions: Retrospective analysis

The retrospective analysis yielded similar results to those in the primary phase (Table 6-5). As in the primary phase, 'community efforts' (mean = 4.4, S.D. = 1.06) was the most variable dimension. This dimension also rated the highest across all eight communities. 'Community climate' (mean = 1.9, S.D. = 0.57) received the lowest score, similar to the primary phase.

Table 6-5 Retrospective Analysis of Community Readiness for Drinking Water Safety Plan Development (n = 8)

Dimension	*Mean*	*SD*	*Actual Range*
Community efforts	4.4	1.06	3 to 6
Community knowledge of efforts	2.8	0.75	2 to 4
Leadership	3.3	1.00	2 to 5
Community climate	1.9	0.56	1 to 3
Community knowledge of the issue	2.4	0.57	2 to 3
Resources related to the issue	3.1	0.96	2 to 5

6.5.3 Stage of readiness: primary phase and retrospective analysis

Final readiness scores from the primary and retrospective phase, as well as the combined results from both phases, are shown in Table 6-6. In the primary analysis, communities were found to be in the lower stages of readiness, with half of the communities at the denial/resistance stage (readiness score = 2), and three communities at the vague awareness stage (readiness score = 3). One community was at the preplanning stage (readiness score = 4). Similar findings were determined from the retrospective analysis. A combined score of the primary phase and the retrospective analysis places four communities at the denial/resistance stage (readiness score = 2), and the other four communities at the vague awareness stage (readiness score = 3).

Table 6-6 Primary, retrospective and combined readiness results

Community	***Primary assessment***	***Retrospective assessment***	***Combined results***
Community 1	2	3	2
Community 2	2	3	3
Community 3	3	2	2
Community 4	2	3	2
Community 5	3	3	3
Community 6	3	3	3
Community 7	2	2	2
Community 8	4	3	3

6.5.4 Intra-community response variation: Qualitative insights to DWSP Barriers

The original CRM approach recommends that, when possible, the readiness assessment should include responses from multiple individuals in the same community. This is intended to capture variations in perceptions about particular readiness dimensions, resulting in a more robust understanding of readiness across the community. For this research, intra-community response variation was analyzed using qualitative data drawn from the 2013 dataset (Table 6-3). Three communities (5, 6, and 7) had data available from both a decision-maker (DM) and an operator (O), and responses were extracted from these transcripts in using the readiness assessment tool. Similarities and differences between responses are described below, with differences being most pronounced for the community climate, leadership and resource dimensions.

In relation to the community climate dimension, interviewees in all three communities noted limited engagement between customers and local water issues: '*Ninety percent of the people have no idea what is done with the water. They don't have a clue*' (DM - 5). Both decision-makers and operators noted a portion of their customers preferred bottled water, and that bottled water was often present in many municipal buildings: '*We've got bottled water at the water treatment plant. We've got bottled water in the office* […] *I don't agree with it.* […] *we're the people making this water; if it's not good enough for*

us…' (O - 5). In one community, past water quality was associated with customer's preference for bottled water: '*some of them got onto it* [bottled water] *when we had the water problems and they just never got off it*' (O - 6). In contrast, a decision-maker in the same community believed the aversion to tap water was the result of ongoing aesthetic issues with the town's drinking water: '*there's probably about 40% that probably drink the bottled water.* […] *I think if we could get the odour and taste issue under control* […] *I think the bottled water drinking will go down'* (DM - 6). Across the three communities, engagement with customers was limited, often arising when a complaint about water quality was being made to the operator.

Under the dimension of leadership, it was clear that decision-makers were both aware of the DWSP requirement and that they held some responsibility for ensuring its implementation. However, decision-makers did not clearly define what this responsibility entailed. One decision-maker explained '*we're the ones that, in the end, can be in trouble if everything goes bad and we're not paying enough attention'* (DM - 5). In contrast, that community's operator noted: *'I think they trust us* [to complete the DWSP] *pretty good here* […] *which is ok*' (O - 5). Two of the three operators though current efforts by decision-makers to address water quality issues were inadequate. For example, one operator noted: '*we're* (operators) *all overlooked* […] *It makes it hard for the operators. Of course management doesn't see it that way but that's just the way it always is, right? They're always trying to save money and we're trying to spend it*' (O - 7). Part of the challenge for leadership is the prevalence of competing community priorities, including the construction and repair or roadways, that can impact daily community life in ways that are more tangible for residents (when compared with drinking water).

Resources play an important role in DWSP implementation and a readiness assessment is useful for capturing the range of resources that may be required. Respondents from the three communities focused primarily on financial resources: "… *to implement some of these things it's going to take a lot of financial resources, and I don't think we have that ability"* (DM - 7). Similarly, "*if there's anything that we have to do that's going to cost us money, then those things may have to wait until next year's budget*" (DM - 6). However,

in some communities other resources were mentioned, including time, computer access, and computer knowledge, each essential for completing and maintaining a DWSP. One operator noted: '*Time's a big thing* […] *when we're shorthanded'* (O - 7). Operators who did not previous need computer access to complete their job or did not have access to a computer also struggled, in many cases looking to decision-makers for assistance in completing the DWSP form.

6.6 Discussion

Based on an assessment of community readiness for DWSP uptake in eight small communities in Alberta, Canada, we conclude that readiness may be a limiting factor deserving further research. The findings suggest that a CRM approach is useful for broadening the discussion of capacity for change within a community setting across multiple dimensions, and provides insights to barriers that may otherwise go unaddressed. As a first step, and by incentivizing community-driven support for change, a CRM approach is helpful for negotiating the types of challenges that often arise at the community level in response to a new water policy or management framework. Among the communities included in this study we found examples where low readiness may already be impacting on DWSP uptake and implementation. While a DWSP approach is intended to shift existing water management practices towards robust, proactive approaches, key barriers such as the absence of customer and decision-maker support, and limited resources, have the potential to undermine beneficial outcomes. Barriers to change are discussed below followed by a critique of the model in the water policy – small community setting and a discussion on study limitations. The section concludes with recommendations for policy direction and further research.

Customers value access to safe drinking water, yet its availability at the tap is often underappreciated (see, e.g., Kot et al. 2011; Dupont & Jahan 2012). In this study, 'community climate' received the lowest readiness scores (Table 6 - 6). Coupled with high scores for existing 'community efforts', the indication here is that although efforts

are being made to ensure safe drinking water, customer capacity to value these efforts is underdeveloped. Analysis across the eight communities identified relatively few opportunities for customers to become engaged in or informed about the local water issues. With customers willing to pay more for 'better' drinking water (through bottled water), there is opportunity to channel this effort into improving the water system. Developing customers into customers that care and take ownership for local water resources will require efforts on the part of operators and their allies. A CRM approach highlights how these changes could occur.

Although leaders and operators indicated drinking water was top priority and concern in their own communities, the translation of this concern into action beyond basic compliance appeared to be limited. A DWSP approach places significant emphasis on being proactive when addressing risks in a water system, but for those working with a restricted budget, a proactive approach may not always appear to be feasible. Significant outbreaks of waterborne illness in Canada help illustrate the role that community leaders play in making sure the water is safe (O'Connor 2002; Hrudey 2011; Dunn et al. 2014). Yet, the results of this study show there remains a gap between how leaders think they should act and the extent to which action is taken. While operators may have the best understanding of what is required within a drinking water system, translating this information to leaders requires clear communication pathways and a receptive audience (Perrier et al. 2014). Past examples show that ensuring buy-in from leadership is critical for DWSP-style policy uptake and long-term success at the utility level (Summerill et al. 2010). One strategy for increasing successes here may be to focus on building customer awareness and motivation for action, as leaders are more likely to take action in response to the demands of their constituents.

Respondents frequently cited a lack of financial resources as a barrier to DWSP implementation. While a detailed, anticipated cost-breakdown was not sought in this survey, respondents noted improvements to current treatment practices, repairing and replacing ageing infrastructure, and hiring more operators as being the most cost-intensive requirements. Unfortunately, some decision-makers may lack the knowledge or

political will to prioritize spending on water-related infrastructure and management, instead choosing to allocate what limited resources area available elsewhere (e.g., roads). This lack of awareness is effectively assessed using the leadership and community awareness dimensions.

While the financial requirements of a DWSP approach are well documented, they relate pertain for the most part to initial start-up costs in communities where longstanding neglect has left a water system vulnerable to risk (see, e.g., Chang et al. 2013). Once these risks have been addressed, a DWSP approach is more likely result in a long-term cost savings, both by improving operational efficiency throughout the water system and by minimizing the potential that an outbreak will occur (Mahmud et al. 2007; Gunnarsdottir & Gissurarson 2008; Bartram et al. 2009). A CRM approach is useful for resolving resources-related gaps as critical non-monetary assets are also considered. For example, a strong volunteer base becomes a resource for source water protection, monitoring, and public (customer) education—if the proper training can be provided. A second non-monetary resource, time, is needed to complete and maintain the DWSP document itself, something best carried out by operators. Options for creating more operator time would vary by community, but for those in which operators hold numerous responsibilities beyond water treatment alone (see, e.g., Kot et al. 2011; Perrier et al. 2014), temporary seasonal staff could be hired to complete some tasks. Any costs associated with this approach are considerably lower than hiring and training a full-time water operator.

6.6.1 Model critique and further research needs

This research applied an existing CRM to water policy uptake in the small community setting. In Chapter 5, the model's six readiness dimensions were validated by a panel of experts from across Canada using a two-round Delphi study. In this chapter (Chapter 6), a modified version of the model's questionnaire was used to assess community readiness and determine a stage of readiness for change among eight small communities in Alberta. In both chapters, the uptake of a WSP-style management policy was identified as the

desired change. In the first application of the CRM in this context only minor adjustments were made to the original model. Doing so yielded a number of useful insights into the utility of the model, while also highlighting limitations of the model in the water policy – small community context. Further studies will be required to ensure the model accurately and adequately captures the range of readiness challenges in this context, as well as the applicability of the model in this context. We discuss the strengths and weaknesses of the CRM approach and provide recommendations for further research.

A major strength of the CRM approach is its utility as a tool for extracting detailed information relative to a specific change desired in a particular community. Here, multiple dimensions are used to develop a robust understanding of ongoing or potential barriers to change, which are in turn used to inform targeted readiness-building strategies. For example, this study revealed that decision makers in some communities lack the water literacy required to understand and react appropriately to issues present in their own water supply system. As such, the onus falls to operators to educate or otherwise convince key individuals of the need for changes, many of which have financial consequences for already resource-constrained communities. In lieu of relying on operators to fulfill this task (business as usual), a CRM approach highlight the value in providing decision makers with the background information required to make better decisions regarding the water supply for which they are ultimately responsible.

A weakness of the model as presented above was the use of the original six readiness dimensions in lieu of developing new, water policy – small community specific dimensions. While it is anticipated that some dimensions would carry over between the original and the new model, novel dimensions are likely to provide beneficial and issue-specific insights (see York et al. 2008 for a similar conclusion). For example, the current model assumes that in any community there are a number of individuals who a) have responsibility for implementing a change and b) are supportive of that change. However, in examining early uptake of DWSPs, Perrier and colleagues (2014) found operators themselves often pose a unique barrier to policy uptake as a result of their own attitudes or opinions on how water should or can be managed. Because operators are tasked with

the majority of the responsibility for developing and implementing a DWSP, operator buy-in becomes critically important if DWSPs or any other WSP-style management policy are to successful over the long term. Further studies may consider adding a dimension similar to one exploring 'Operator attitudes and understanding'. Identifying new dimensions, as well as further refine existing ones, will require consultation with experts from different backgrounds.

A second weakness was identified in the model's scoring approach, which favours increasing degrees of both awareness and action across all six readiness dimensions. Unfortunately, this may not be feasible or even necessary across all communities and for all dimensions. For example, there is a chance that readiness in one dimension may adequately compensate for weaknesses in others. This raises two important questions. First, are some dimensions more important than others when it comes to community readiness for change related to a specific action? Second, will all communities respond similarly, or would different dimensions have a greater benefit in one community over another? While an attempt was made to identify this variability using the Delphi panel to rate each dimension in Chapter 5, further research will be required. The benefit to communities here would be the development of a more targeted and efficient assessment.

Lastly, the model relies on a two-stage process, qualitative assessment and quantitative stage of readiness, from which strategies for further actions are determined. A weakness here may be the loss of valuable insights and information gained during the qualitative assessment phase. Instead, it may be prudent to preserve this information and make it available to those in the community, or those developing strategies for action based on assessment findings. In particular, where multiple individuals within the same community are assessed, a study of the variation in responses may be adequate in highlighting and subsequently addressing discrepancies or misunderstandings underlying dimensions with low readiness. Whether this is done complimentary to or instead of readiness building strategies may be dependent on the type of information obtained during the assessment phase, the opinion of those tasked with building readiness in the community, and the type of change being sought.

6.6.2 Recommendations

DWSPs require a proactive approach to risk management in a water system and can provide better public health protection if properly implemented and maintained over time (Gunnarsdottir & Gissurarson 2008; Bartram et al. 2009). While a number of factors may impede DWSP progress, we identify readiness for change as a critical limitation. By integrating CRM practices as part of a DWSP approach, communities have access to a simple tool for identifying and addressing a range of barriers to implementation. Further research will be required to determine whether the existing CRM model is adequate for the water policy – small community context, or whether a revised approach is needed. Regardless the final format, an approach drawing from that outlined within the CRM could help to negate some of the unintended consequences brought on by new water policies, and which are exacerbated at the community level by pre-existing resource constraints, communication and knowledge gaps.

6.7 Conclusions

In this study we sought to understand how community readiness could shape a community's response to a new water policy. Using the example of a multiple-barrier DWSP management approach, we examined readiness for uptake in eight small communities in Alberta, Canada, using a CRM assessment. In each community we identified low to medium readiness across all six readiness dimensions: community efforts, community knowledge of efforts, leadership, community climate, community knowledge of the issue, and resources. The readiness lens is unique in water policy research as it offers a detailed understanding of major barriers that can be applied on a community-by-community basis.

The health and safety of a community is at risk of being undermined when leadership and customers are uninformed and unengaged in water issues, and where there is a chronic absence of resources to support safe drinking water. A CRM approach is a cost-effective

way to identify these challenges, their underlying causes, and uncover approaches for resolution. For small communities in particular, building awareness around local water issues provides foremost a solid platform for decision-making, including better capacity among those responsible for making informed decisions related to water and community-health. Given the overall findings of this study, water suppliers, regulators, or other entities seeking to implement DWSPs or similar frameworks are encouraged to take into account community readiness as a first step. The CRM provides one opportunity for applying such a lens, however refinement of the model is recommended.

CHAPTER 7 CONCLUSIONS

7.1 INTRODUCTION

This dissertation integrates the fields of human geography, civil engineering and public administration to understand challenges impacting small community water systems Canada. The central question guiding this research sought to identify the regulatory and capacity building approaches best suited for ensuring safe drinking water in small systems. Findings indicate that readiness for change can play a major role in whether a community can adapt to a changing regulatory environment and thus should be considered early on in the change process. This research spanned three phases of investigation: 1) A literature review to understand the experience of water utilities worldwide in implementing water safety plans (WSPs); 2) In-person interviews to identify challenges and opportunities guiding small communities in Canada towards compliance with new and emerging drinking water regulations; and 3) A community readiness approach as a lens to assess and address the gap between water policy and community capacity to take on that policy. The key findings from these three phases of research are summarized in Table 7-1.

Table 7-1 Key Findings

Chapter	*Research objective*	*Key findings*
3	Investigate and understand how utilities worldwide have implemented WSPs	• Benefits of a WSP approach can be overshadowed by perceived upfront challenges, including cost. • Community and managerial buy-in is critical and remains a challenge to achieve. • Resource-constrained and small communities face unique challenges when adopting WSPs. • Where these challenges are present, novel adaptations, including simplification of the WSP approach may be required. • Aspects of low community readiness were identified in a number of the case studies.
4	Identify the processes through which small communities in Canada mobilize resources and build capacity in order to achieve and maintain regulatory compliance for drinking water	• Local factors influence a community's capacity to make decisions and implement new policies. • Socially-rooted factors impact decision making, including the allocation of financial resources. • Communities achieved compliance in one of three ways: regulator-provided or driven solutions, through existing solutions such as regionalization, or by adopting a novel approach. • Many communities lack the momentum to address other challenges beyond compliance alone that could impact water quality in the future.
5, 6	Modify and test a Community Readiness Model (CRM)	• A two-round Delphi technique found agreement between the six readiness dimensions proposed in the original CRM and common policy readiness challenges in small communities. • A CRM approach provides useful insights and specific suggestions for building readiness for change. • A community readiness assessment was used to identify low readiness for DWSP uptake among eight small communities in Alberta. • A CRM approach could help elucidate and address common challenges related to the water policy – small community context.

7.2 Research Summary

Small communities often require support to achieve safer drinking water, yet current efforts may not address critical underlying factors such as the lack of readiness for change. This research explores community readiness as a multi-dimensional gap in water policy uptake, and suggests that readiness can a) vary between communities, b) vary between dimensions in a community, and c) be assessed and addressed using an approach such as the CRM. Community readiness was selected as it compliments the efforts implicit in a multiple-barrier, holistic water management approach such as the DWSP requirement in Alberta, and presents a practicable option for community-level assessment. Small communities are particularly at risk of wasting valuable time and resources – while also placing public health at risk – where underlying barriers are ignored. Therefore, understanding and addressing barriers such as readiness emerges as a potentially beneficial lens for assessing and addressing change at the community level.

This dissertation identified examples of readiness, both explicit and implied, in an international review of WSP uptake (Chapter 3), within small communities addressing regulatory compliance issues (Chapter 4), broadly in the water context (Chapter 5), and among a small cohort of communities in Alberta at the beginning stages of adopting DWSPs (Chapter 6). The findings of this research suggest that a focus on readiness for change prior to and throughout policy implementation has the potential to help ensure the type of support communities require is in place to avoid failure, or otherwise adverse or unintended consequences. With a WSP-style management framework, successful implementation has been linked to changes in water management and safety culture, where readiness and the involvement of multiple stakeholders play a particularly important role (Kot et al. 2015; Hrudey and Hrudey 2014). A CRM approach is assessed as a first step in developing a tool that can facilitate closing the gap between the present capacity to regulate for safe drinking water, and the capacity of small communities to comply with these regulations.

Chapter 3 provides an overview of how communities around the world have implemented WSPs. The findings show that the path to WSP adoption is not always straightforward, and that in many cases the WSP framework requires adjustment to comply with local-level barriers, many of which were capacity-related. The findings in Chapter 4 highlighted the results of a pan-Canadian survey of seven small communities, each one having addressed a significant challenge to water quality and, despite a range of limitations, achieving regulatory compliance. Despite compliance, however, lingering issues were identified. For example, these communities often lacked the financial support necessary to address future threats to water quality, repair aging infrastructure, or hire and train new water operators. Thus, despite being successful in eliminating immediate threats, the momentum to secure safe drinking water over the long term did not exist. Among operators, decision-makers, and customers, establishing a culture centered on safe drinking water is supported by a focus on readiness. To incorporate community readiness in the discussion on public water quality, Chapters 5 and 6 introduced the readiness concept and the CRM, as a starting point for identifying and facilitating the strengths and weaknesses in the water policy – small community context. Community readiness is considered in this research to be complementary to current interests seeking to encourage change in water industry culture, while supporting good governance in a public water system.

This research contributes to a small but growing area of interest at the intersection of community and water policy, one that seeks to understand how local factors influence community change (Straith et al. 2014) and how community change in turn is influenced by readiness (Moore et al. 2014). One benefit of a community readiness assessment across multiple dimensions is the emergence of detailed information about a community in relation to a particular change. This information can be used to form strategic plans for future action, while developing grounds for dialogue within a community about pertinent water issues. The CRM approach introduced in this dissertation provides a foundation for future tool development that may be useful for decision-makers and/or individuals in the community, or by other outside parties. For example, regulators may find the assessment useful for ensuring more effective allocation of limited or specific funding, operator or

leadership training programs or mentoring opportunities, while individuals in a community may use the assessment to develop new programs or community events centered on water awareness.

Previous studies examining drinking water among small communities have focused on financial, operational and decision-making capacity, while ignoring many larger socio-political dimensions. Rarely are other stakeholder groups included or considered as having the potential to support (or undermine) water quality improvements. Significant waterborne disease outbreaks (e.g., Walkerton and North Battleford) as well as ongoing water quality challenges across the country (e.g., Eggertson 2008; Environment Canada 2014) have underscored the need for an alternative approach to water management, while also highlighting the opportunity to include a broader range of stakeholders (O'Connor 2002; WHO 2011; Kot et al. 2014, Kot et al. 2015; Hrudey & Hrudey 2014; Reid et al. 2013). This dissertation highlights the influence of socio-political dimensions over decision-making in a drinking water context (Chapters 3, 4). For small communities, a more inclusive water management approach would help to address many of the common challenges related to water quality, including support for operators, long term funding arrangements for improving water delivery, and public awareness and education (Eggertson 2008; Kot et al. 2011; Dunn et al. 2014; Perrier et al. 2014). The desired shift to a culture of compliance (Hrudey 2004; Jayaratne 2008), one that can support the requirements of a WSP-style management approach, demands more from communities than financial resources alone. Thus, readiness to commit to change, to support implementation, and to facilitate ongoing improvement is needed. A CRM approach is one framework to facilitate such a shift.

7.3 Contributions

The findings presented in this dissertation suggest that readiness is an important characteristic for determining on-the-ground outcomes of water policy implementation and uptake in a small community over the long term. Here, readiness is understood as a

series of dimensions, not one single factor. In implementing specific water policy, in particular multiple barrier frameworks such as WSPs, a CRM approach may be a useful step in avoiding previously documented challenges and setbacks. For small communities in particular, avoiding these challenges can have significant financial and social benefits.

The findings described and discussed in Chapter 3 through 6 provide methodological, theoretical and substantive contributions to the overall field of drinking water and small community research and practice. This study used qualitative approaches to create an in-depth understanding of the experiences of those living and working within small communities and to document local perceptions of drinking water services. The findings gathered through the in-person interviews (Chapter 4) were useful for conceptualize individual perceptions about a community's drinking water system, as well as illuminated the impact of socio-political factors on decision-making. Drawing from these findings, an existing CRM was examined and the model's assessment tool was modified to reflect unique characteristics of the water policy – small community context. The modified assessment tool, its subsequent validation via Delphi technique, and its application in eight small communities is the unique methodological contribution of this study. As community response to water policies can vary, the six readiness dimensions provide a framework for characterizing these differences (Chapter 4 and Chapter 6). In this way, a CRM approach offers a novel method for characterizing challenges and strengths in order to move communities forward in addressing a particular problem.

Theoretical contributions from this research were twofold. First, it introduces community readiness as having the potential to significantly influence the outcome of water policies 'on the ground', and suggests that readiness provides a critical lens for evaluating and facilitating change capacity in a community setting. Without readiness, the gap between existing capacity and a desired (or required) change remains challenging to define, with no clear pathway developing the capacity required to support that change. This research supports findings from other fields on the value of readiness as an intermediate step between problem recognition and policy uptake (York et al. 2007; Crooks et al. 2010). Second, the interdisciplinary approach adopted in this research contributes a socio-

political perspective to the traditionally technical field of drinking water. The socio-political perspective expands options for problem solving within the community-water provision dynamic to include a wider range of individuals (e.g., beyond water operators and a small cohort of decision-makers), each of whom have an under-utilized capacity to contribute in a positive way.

Finally, this research contributes in a substantive way towards a better understanding of the type of support required by small communities to address water quality challenges. Because the CRM is inherently flexible, this approach could be applied to larger communities, including regionalized water systems. Most importantly, a CRM approach is useful for designing locally appropriate and effective capacity building programs focused on a specific water management goal. This research provides the first practical tool for facilitating the uptake of WSPs at the community level. The findings of this research are being shared with communities that participated in this research and relevant provincial governments, along with a wider audience though the Canadian Water Network's Municipal Consortium (Gagnon et al. 2015).

Contributions made to the three fields included in this interdisciplinary study are as follows. To the field of human geography, the concept of community readiness expands the existing literature examining how local factors, including place-based knowledge, influence decision making, and places these findings in the water policy – small community context. To the field of civil engineering, the findings reconceptualize water quality challenges as outcomes of human action at the community level, lending support to a small but growing body of research that seeks to go beyond technical capacity and technical solutions to water quality problems (see, e.g., Schuster et al. 2005; Hrudey et al. 2006; Wu et al. 2009). Finally, while good governance has been extensively explored in the public administration literature, this research introduces community readiness as a practical approach for applying these principles in a water policy – small community setting. It further draws links between WSP-style management of a water supply and principles of good governance as present in the literature.

7.4 Study Limitations

The research design and approach used for this dissertation yielded two key limitations. The first limitation was jurisdictional; both the small community surveys (Chapter 4) and the CRM baseline assessments (Chapter 6) were applied to a relatively small cohort of communities. This was in part due to the study being conducted by a single researcher utilizing time and resource dependent in-person or phone-in survey methods. The selection of the communities was based on a set of specific factors, each of which may have had an impact on the overall outcome and quality of the findings. As an exploratory study, this research provides a first look at the socio-political as an opportunity for facilitating change. Future studies could employ more researchers or use time-saving data collection methods such as paper or online surveys distributed to a greater number of communities, and include communities viewed as having 'failed' to successfully implement a change and achieve regulatory compliance (Chapter 4). A second limitation of the research was the timeframe during which the readiness model was tested (Chapter 6). In practice, a CRM approach should include both an assessment and the development and use of subsequent capacity building strategies. In this research, only the assessment portion of the CRM approach was conducted, meaning that the full model has yet to be tested. Establishing the process for assessing readiness in the water policy context is, however, an important first step, and further studies will be required to refine and improve the existing CRM approach.

7.5 Recommendations

The central question guiding this research sought to explore capacity building supports capable of helping Canada's small communities ensure safe drinking water over the long term. Findings indicate that community readiness could be a critical factor that either supports or hinders a community's efforts to implement current or new water policies. This suggests that where best management practices require substantive change, a community that exhibits characteristics of being 'ready' is better positioned to respond

successfully to that change. To illustrate readiness in the water policy – small community context, an existing CRM approach is used to describe readiness on a community-by-community basis. The outcomes find that a CRM approach shows potential as a tool for addressing persistent policy uptake and implementation challenges.

Given their oversight, regulatory bodies, including provincial regulators, are best positioned to integrate assessments such as a CRM into existing policies. As part of a pre-implementation process, a CRM approach applied in this way could help communities identify and address pre-existing barriers to change. Alternatively, regulatory bodies could use a CRM approach to inform decision-making to direct appropriate and timely funding or training programs. Communities that do not meet a pre-established readiness threshold could be allocated more in-depth assistance than those with a higher level of readiness. It is important to note that a CRM approach is not intended to limit or delay community advancement; rather, the intent is to improve the quality and longevity of a change once put in place. Thus, the advantage of such an approach for regulatory agencies is found both in cost savings and in effective policy uptake.

While regulators may be best positioned to facilitate uptake of a CRM approach, individual communities, regardless of size, also have the capacity to implement a CRM on their own. For both regulator and community-led CRM use, it is recommended that a review of the model presented herein is completed to ensure that the questions guiding the assessment, the anchored rating scale, and the readiness dimensions themselves are appropriate for local or jurisdictional factors and the type of change being sought. This review should include input from target audiences including decision-makers and water operators, as well as regulatory representatives when applicable.

Many communities are required to overcome a range of limitations to ensure that safe drinking water is available over the long term. Some of these limitations are socio-political in nature, and if not addressed, can undermine otherwise effective means of making water safe. Despite their prevalence, these challenges are poorly understood and rarely addressed. At the same time, there is frustration over the lack of uptake of best

management practices for water safety, such as WSPs. This research suggests that to better facilitate WSP adoption an intermediate factor must first be addressed: community readiness. This is particularly the case for small communities. As a pre-implementation intervention, a CRM approach can help identify intra-community variability in readiness, as well as local strengths and weaknesses that influence readiness, and facilitate the design of strategies required to make improvements. As a policy advancement tool, a CRM approach may be useful in directing regulators and communities to key barriers where additional resources are required in order to support a particular policy. As a community support tool, a CRM approach can help eliminate the gap between a recognized need for a change, and the readiness of a community to take on that change. In the absence of such an approach, the risk is that an effective concept, once implemented, may result in limited or even negative outcomes for those it is intended to help.

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Appendix A Letter of Information and Consent Form

Dr. Graham Gagnon, Ph.D. P.Eng.
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Tel: (902) 494-3268
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DATE

Letter of Information and Consent Form:
Success Factors for Sustainable Small Drinking Water Systems

Dear Members of Council/Mayor

On behalf of the Canadian Water Network, we would like to invite [Community] to participate in a research project entitled, **"Success Factors for Sustainable Small Drinking Water Systems".** The primary goal of this project is to identify the success factors and best practices for planning and implementing major improvements within small community drinking water systems. This will be used to inform other small communities and to assist with their decision making and planning. Data will be gathered through the use of a series of simple interviews. Your community's participation in this study is voluntary and may be withdrawn at any time. The following paragraphs describe the project, the outcomes, and anticipated benefits and risks to your community as a participant.

Purpose of the Study

This project will provide insight into the factors influencing the successful implementation and sustainability of measures of improvement to the safety and quality of drinking water in small communities across Canada. To initiate this work, the Canadian Water Network is looking to compile case studies of successful efforts made to improve the safety and quality of drinking water in small communities, and identify the steps taken to manage social, economic, governance and cultural challenges. The results of this research will provide new information for regulators, utilities and industrial partners which can be directly applied to other small-scale systems in Canada who are looking to achieve improvements in finished water quality.

Study Design and Who Can Participate

Small communities are being selected across Canada to participate in this project. This will enable the research group to gain a broad perspective of the efforts being made and challenges being faced in communities across the country. Communities participating in the study will be selected by the research team based on size, the presence of a recent improvement to the drinking water system, and the involvement of community members in the improvement process. Within each community a wide variety of individuals will be interviewed, including decision-makers, managers, operators, business owners and household water users.

Who Will be Conducting the Research

A graduate student in Civil Engineering from Dalhousie University (Megan Kot) will conduct the interviews. Interviews will be transcribed, and results will be compiled into a summary report and other materials by the research team. A copy of the final report will be available upon completion.

What you will be asked to do

To grant community participation in this study we ask that you read this letter and sign the consent form on the following page. Individuals within your community will be asked to sign a separate form of consent. If you would like your community to be identified by name in the final report you may indicate so on the following page. Otherwise the community will remain anonymous to everyone but the researchers.

Possible risks and discomforts

This study is expected to involve minimal risk. Should any participant experience distress they will be asked to contact a local health association.

Possible benefits

Your community's participation in providing insight into the success factors for successful improvements to small community water supplies will be used by a range of individuals and organizations, including other small communities, and assist to expand the body of knowledge surrounding small systems in Canada. While the identification of your community in the study is not required, granting permission to use the community name may greatly assist other communities who find themselves in similar situations and are looking for a contact with which to discuss potential solutions.

Compensation

There will be no monetary compensation for participants taking part in the study.

Confidentiality and anonymity

Permission to use the community names for the purposes of this study is being sought however it is not necessary to successfully complete this research. Granting permission to use the community names has no bearing on the use of individual names, which will not be sought for the purposes of this research. Without permission to use the community names, only the researchers will know the identity of the communities studied.

Documents and files which identify the community will only be accessible by the researchers. Audio files will be destroyed once they are transcribed. The written transcripts of the interviews from this study will be kept in a locked filing cabinet at the Civil Engineering Office of Dalhousie University for at least five years before being destroyed as required by the Dalhousie University Policy on Research Integrity.

Questions

If you have any questions regarding your participation in the study or the study itself, please contact Dr. Graham Gagnon at (902) 494-3268.

Problems or concerns

If you have any difficulties with, or wish to voice concern about, any aspect of your community's participation in this study, you may contact Patricia Lindley, Director of Dalhousie University's Office of Human Research Ethics Administration, for assistance at (902) 494-1462, patricia.lindley@dal.ca.

We would like to thank you for your time and we look forward to working with you in the near future.

Sincerely,

Dr. Graham Gagnon
Professor
NSERC/Halifax Water Industrial Research Chair

Community Consent Form:
Success Factors for Sustainable Small Drinking Water Systems

1. Consent to participate in the study:

I hereby give consent for the study "Success Factors for Sustainable Small Drinking Water Systems" to take place in the community of _____.

Date: _____

Name: _____ Signature:_____

Witness Name:_____Witness Signature:_____

2. Consent to use the name of the community in the final report:

I hereby give consent to identify the community by name in reports generated as a result of this study.

Date: _____

Name: _____ Signature:_____

Witness Name:_____Witness Signature:_____

Appendix B Information Letter: Individuals

Dr. Graham Gagnon, Ph.D. P.Eng. Associate Professor
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DATE

Individual Letter for Information: Success Factors for Sustainable Small Drinking Water Systems

Dear Sir/Madam,

On behalf of the Canadian Water Network, we would like to invite you to participate in a research project entitled, **"Success Factors for Sustainable Small Drinking Water Systems".** The primary goal of this project is to identify the success factors for planning and implementing major improvements within small community drinking water systems and use the findings to inform other small communities to assist with decision making and planning. Data will be gathered through the use of a series of simple interviews. Your participation in this study is voluntary and you may withdraw from the study at any time. The following paragraphs describe the project, the outcomes, and anticipated benefits and risks to you as a participant.

Purpose of the Study

This project will provide the researchers with insight to the factors affecting the successful implementation and sustainability of measures of improvement to the safety and quality of drinking water in small communities across Canada. To initiate this work, the Canadian Water Network is looking to compile case studies of successful efforts made to improve the safety and quality of drinking water in small communities, and identify the steps taken to manage social, economic, governance and cultural challenges. The results of this research will provide new information for regulators, utilities and industrial partners which can be directly applied to other small-scale systems in Canada who are looking to achieve improvements in finished water quality.

Study Design and Who Can Participate

Small communities are being selected across Canada to participate in this project. This will enable the research group to gain a broad perspective of the efforts being made and challenges being faced in communities across the country. Communities participating in the study will be selected by the research team based on size, the presence of a recent improvement to the drinking water system, and the involvement of community members in the improvement process. Within each community a wide variety of individuals will be interviewed, including decision-makers, managers, operators, business owners and household water users.

Who Will be Conducting the Research

A graduate student in Civil Engineering from Dalhousie University and a representative from Health Canada (the researchers) will conduct the interviews. Interviews will be transcribed, and results will be compiled into a summary report and other materials by the research team. Upon completion, a copy of the final report will be available at the municipal office (insert address).

What you will be asked to do

To participate in this study, we ask that you read this letter and sign the consent form on the following page. The personal interview will take no more than 1 hour of your time to complete.

Possible risks and discomforts

This study is expected to involve minimal risk. You may experience some distress if talking about frustrating experiences. If you feel discomfort at any time, you may decline to answer questions and you may withdraw from the study at any time without being required to provide a reason as to why you wish to withdraw. In the event that you experience any stress or discomfort from your involvement in this study, we ask that you contact xxxxxxx (a local counseling service or mental health professional, which will vary for each community) to discuss the situation.

Possible benefits

No direct benefits are anticipated for this study. However, by participating in this survey you are contributing to a growing body of knowledge aimed at improving drinking water in small community water systems through the provision of relevant information and guidance.

Compensation

There will be no monetary compensation for taking part in the study.

Confidentiality and anonymity

The researchers will make sure that the anonymity of all interviewees is protected throughout their participation in this study. With your permission, anonymous direct quotations will be included in the presentation of final results. Direct quotations may be associated with your gender *or* age group *or* position, but no names will be used. Direct quotations included in the final results will not contain information that may identify you

as the speaker. There is a chance that given your position within the community your anonymity will be difficult to ensure, particularly where direct quotes or direct information regarding the water treatment system is being used in the final report (i.e. if you are the sole water operator, there will be certain information only you will know). We will make the best efforts to keep your identity anonymous; however please do take this into consideration during the interview.

Only the researchers will have access to electronic files containing transcribed interviews. Your name will not be associated with the audio files or transcripts of the interviews. Audio files will be destroyed once they are transcribed. The written transcripts of the interviews from this study will be kept in a locked filing cabinet at the Civil Engineering Office of Dalhousie University for at least five years before being destroyed as required by the Dalhousie University Policy on Research Integrity.

Questions

If you have any questions regarding your participation in the study or the study itself, please contact Graham Gagnon at (902) 494-3268.

Problems or concerns

If you have any difficulties with, or wish to voice concern about, any aspect of your participation in this study, you may contact Patricia Lindley, Director of Dalhousie University's Office of Human Research Ethics Administration, for assistance at (902) 494-1462, or patricia.lindley@dal.ca.

We would like to thank you for your time and we look forward to working with you in the near future.

Sincerely,

Dr. Graham Gagnon

Appendix C Individual Consent Agreement

Individual Verbal Script: Success Factors for Sustainable Small Drinking Water Systems

Before we begin with the interview I'd first like to provide some important information. Your participation in this survey is completely voluntary. You have several rights as a participant, including to: (1) refuse to answer any question at any time; (2) withdraw from the interview at any time; (3) withdraw from the study later - by e-mailing or phoning me using the contact details on the information sheet you have just read, and in doing so remove your responses from the study; and (4) gain access to the findings by requesting a copy of the final report.

Your participation in this study in completely confidential. I will not attribute your name to any of the findings in the final report or in presentations.

Do you have any questions about your rights as a participant?

Do you consent to participating in this interview?

Do you consent to have this interview digitally recorded?

Do you consent to have direct quotations from this interview in writing and presenting study results?

Verbal consent secured: ☐

Appendix D Interview Guide for Operators

Audience – Questions for Operators/Town Engineer/Municipal Staff/EHO

I. Interviewee Characteristics/Demographics

1. How long have you been employed as…?
    a) How did you come to be in your current position?
    b) What are your other responsibilities, aside from drinking water treatment and operations?
2. How long have you been in the community? Do you live in the community?
3. For the operator(s): What level of training have you received? What type of training (i.e. formal/on the job)
4. What do you know about the water system:
    a) Age of water system
    b) Management structure
    c) Last boil water/drinking water advisory
    d) Description of the water system (see below)

II. Description of the Water System

1. Please provide a general description of the water system including the specific components listed below. Please provide before and after answers.
    a) Water source
    b) Intake and pumping facilities
    c) Treatment in place
    d) Storage/reservoir facilities
    e) Distribution approach
    f) Capacity of system
    g) Governance/management framework: who is responsible for decision making?
    h) Financial capacity i.e. is system operated on a cost recovery basis? What are the water rates in the community? How are they set?
    i) Number of operators and status: full time/part time and level of training

III. Overview of the Improvement

1. Provide a general description of the improvement that was put in place.
    a) What brought on the decision to make the improvement? Who was involved?
    b) What was your involvement, if any?
2. What is the current status (in progress/complete)?
3. How long did it take to plan and then implement?
4. What led to the need for improvement?

IV. Process – Alternatives

1. What alternatives were considered to the improvement that was ultimately chosen?
    a) What information did you/others use to develop and identify and assess the alternatives? What were the sources of information?
2. How were alternatives compared (i.e. technical analysis, cost-benefit analysis or other quantitative measures/qualitative measures)?

V. Process – Operator Involvement

1. How was the operator involved in planning and implementing the improvement?
    a) Did this require a significant amount of time investment, over and above regular operations?
    b) Were regular operations affected? If so, how was this managed?

VI. Process – Governance/Management Involvement

1. How were community decision-makers (i.e. mayor, council) involved in the improvement?
    a) Did they have a decision-making role?
    b) Were some/all of them quite involved/interested in the process?
2. Who managed the process (both planning and implementation)?
3. Who made the final decision on which improvement project to implement?
4. What role did other municipal staff have in the process?
    a) Did they have a decision-making role?
    b) Were some/all of them quite involved/interested in the process?

V. Process – Community Involvement

1. How was the community involved in the improvement?
    a. Were there community meetings? What was attendance like?
    b. Were community members involved/interested in the project? Were questions asked and what kind?
    c. What sort of feedback was received from the community?
    e. How were these addressed, responded to or incorporated into the final project?
2. What kind of information was made available to the community about:
    a) The need for improvement?
    b) Alternatives?
    c) Implications of the improvement?
    d) Progress on implementation
3. Was there a formal community involvement plan?
    a) If yes, who developed it, when was it implemented, was it evaluated/considered a success?
    b) What was the level of community awareness of the problem and/or the improvement initiative? How was this formally assessed?
4. What is the community's perspective on their water supply and treatment operations?
    a) Has this changed from before and after the improvements?
    b) Were community members supportive, unsupportive or neutral to the project?
    c) Did the community see the need for improvement?

VI. Process – Funding

1. What was the source of funds for the improvement – was it part of regularly budgeted funds or over and above?
2. Was external funding received to fund the improvement?
    a) If yes, from what source?
    b) What was the process to obtain the funds?

c) Was a business case provided, how was it gathered, who was responsible?
d) Was a cost benefit analysis conducted?

3. Did the cost of the general operations increase or decrease after the improvement?

VII. Process – Costs

1. What were the capital costs of the improvement?
    a) Maintenance costs (annual, increased water rates/taxes for the community, increased wages for operators.
2. Have other costs increased or decreased after the improvement?

VIII. Process – Other Contributions

1. Were there any other contributions (in-kind)?

IX. Sustainability after the Improvement

1. Can operations be sustained, both financially and with respect to level of training/knowledge required?
2. Do people drink the water/accept the changes?
    a) Are people commenting that improvements are being noticed?
    b) Have any follow-up community meetings/surveys/interviews been held?
3. Were additional training skills/staff required to operate the improved system?
    a) Were these identified up front as part of the alternatives assessment?
4. How were any new requirements gained/addressed?
5. Do operators receive regular refresher training?
6. Does the new system involve more or less work for operators?
7. Are more staff required now?
    a) If yes, have they been recruited?

X. Benefits of the Improvement

1. What benefits have resulted from the improvement? (i.e. improved water quality, reduced illness, etc.)

XII. Challenges

1. What key challenges were encountered in planning and implementing the improvement?
    a) Was it a challenge getting management support or funding from the municipality?
    b) Was it a challenge to get community support?
    c) What specifically were the challenges (communicating information, overcoming preconceived notions/believe that there weren't any problems with the water, etc.)

XII. Concerns

1. Are there any lingering concerns (e.g., water quantity/quality/cost) after the project was implemented?
    a) If so, are these widespread.

b) Please respond from your perspective, and from the perspective of others if possible

Appendix E Interview Guide for Customers

Audience – Questions for Members of the Public and Private Sector

I. Interviewee Characteristics/Demographics
1. How long have you lived in the community?
    a) If a business owner: what is the nature of your business? What role does drinking water play?
2. Do you know: Age of water system, Last boil water advisory, Drinking water source, Type of treatment used
    a) Where did you come across this knowledge?

II. Description of water system questionnaire

Section A. What is your perspective on the town's drinking water supply – quantity/quality, including aesthetics (colour, odour), both **before** and **after** the changes?

How satisfied are you with each of the following aspects of your community's tap water **before/after** the improvement?
The first one is *clarity*
- ☐ Very satisfied
- ☐ Somewhat satisfied
- ☐ Neutral
- ☐ Not very satisfied
- ☐ Not at all satisfied

The next one is *smell*
- ☐ Very satisfied
- ☐ Somewhat satisfied
- ☐ Neutral
- ☐ Not very satisfied
- ☐ Not at all satisfied

The next one is *taste*
- ☐ Very satisfied
- ☐ Somewhat satisfied
- ☐ Neutral
- ☐ Not very satisfied
- ☐ Not at all satisfied

The final one is *safety*
- ☐ Very satisfied
- ☐ Somewhat satisfied
- ☐ Neutral
- ☐ Not very satisfied
- ☐ Not at all satisfied

How worried are you about the availability of drinking water in this community **before/after** the improvement?

- ☐ Very worried
- ☐ Somewhat worried
- ☐ Neither worried or not worried
- ☐ Not very worried
- ☐ Definitely not worried

Section B. If you had concerns **before** did you express them publicly or through any "formal" process? What was the source of knowledge for your concerns – personal experience, TV or radio, newspaper, information provided by officials, etc.

To what extent do you think having access to safe, good quality drinking water has an impact on your health?

- ☐ Great impact
- ☐ Some impact
- ☐ Neither an impact or no impact
- ☐ Little impact
- ☐ No impact

How worried are you that the current state of access to safe, good quality drinking water in your community is having a negative impact on your health?

- ☐ Very worried
- ☐ Somewhat worried
- ☐ Neither worried or not worried
- ☐ Not very worried
- ☐ Definitely not worried

Have you ever experienced health problems due to drinking your local tap water?

☐ No
☐ Yes

Was the health problem self-diagnosed and monitored

☐ yes
☐ no

Was the health problem diagnosed by a doctor or other health care provider

☐ yes
☐ no

Did the health problem exacerbate an existing condition

☐ yes
☐ no

Have you ever spoken with your doctor or another health service provider about issues of drinking water quality or availability in the community and their potential impacts on your health?

☐ Yes
☐ No

Have you ever contacted an elected representative of government about issues of drinking water quality or availability in the community?
☐ Yes
☐ No

Have you ever contacted the media about issues of drinking water quality or availability in the community?
☐ Yes
☐ No

Which of the following sources would you turn to for information about drinking water quality or availability: (can select more than one)

- ☐ Non-profit science, environmental, or health organizations
- ☐ Local government
- ☐ Provincial government
- ☐ Federal government
- ☐ Media
- ☐ Businesses
- ☐ Regional health authority
- ☐ Your doctor
- ☐ Other: _____

Section C: How do you use your water supply in your homes / businesses (i.e. do you drink the tap water or use bottled water?) Has this changed? (**before & after)**

What type of drinking water do you *primarily* consume at home?

- ☐☐ Private well
- ☐☐ Local tap water
- ☐☐ Filtered local tap water
- ☐☐ Boiled local tap water
- ☐☐ Bottled

If using filtered or boiled local tap water: Why?

What is the main reason why you usually drink [*WATER SOURCE X*]? (pick one)

- ☐☐ Cost
- ☐☐ Taste
- ☐☐ Convenience
- ☐☐ Environmental reasons
- ☐☐ Availability at your place of work
- ☐☐ Like to have cold water
- ☐☐ Tap/bottled water is not available
- ☐☐ Have it while traveling
- ☐☐ It is safe
- ☐☐ Health reasons
- ☐☐ Other: specify _____

Please tell me the extent to which you *agree* or *disagree* with the following statements about tap water: (Note: we use the phrase 'tap water' and by this we are referring to non-bottled, so this may include well water).

Tap water is cleaner and safer than bottled water

- ☐ Strongly agree
- ☐ Somewhat agree
- ☐ neither agree nor disagree
- ☐ Somewhat disagree
- ☐ Strongly disagree

Tap water meets stricter safety regulations than bottled water

- ☐ Strongly agree
- ☐ Somewhat agree
- ☐ neither agree nor disagree
- ☐ Somewhat disagree
- ☐ Strongly disagree

I like the taste of bottled water better than tap water

- ☐ Strongly agree
- ☐ Somewhat agree
- ☐ neither agree nor disagree
- ☐ Somewhat disagree
- ☐ Strongly disagree

It is expensive to drink bottled water when compared to tap water

- ☐ Strongly agree
- ☐ Somewhat agree
- ☐ neither agree nor disagree
- ☐ Somewhat disagree
- ☐ Strongly disagree

Bottled water has a greater negative impact on the environment than tap water

- ☐ Strongly agree
- ☐ Somewhat agree
- ☐ neither agree nor disagree
- ☐ Somewhat disagree
- ☐ Strongly disagree

Tap water is fine for adults, but it is better to give children bottled water

- ☐ Strongly agree
- ☐ Somewhat agree
- ☐ neither agree nor disagree
- ☐ Somewhat disagree
- ☐ Strongly disagree

Tap water is better for my health than bottled water

- ☐ Strongly agree
- ☐ Somewhat agree
- ☐ neither agree nor disagree
- ☐ Somewhat disagree
- ☐ Strongly disagree

Section E: Role of the operator:

Who is the person(s) who handles the treatment of water in your community i.e. the operator?

Are you aware of your water source, any measures in place to protect it, i.e. treatment system?

Are you aware of the operator's other responsibilities? [e.g.: road maintenance, garbage pick-up, snow removal, etc.]. If yes then ask question 4:

Given that the operator has these other responsibilities, which do you feel should be the top three priorities?

III. Overview of the improvement

1. Are you aware of the changes that have been made to your town's water system?
2. When and how did you become aware of them?
3. Are you aware of why the changes were implemented? If no, why not?
4. What is your perspective on the changes made, were they worth the effort?
5. Did the changes impact your usage after they were implemented?
6. Do you have any lingering concerns despite the changes being in place?

For business owners:

7. Did you take additional precautions before the improvements were made? If yes, please explain.

IV. Process – Community Involvement

1. How was the community involved in the changes?
   a) Was information made available about the need for changes on:
   b) The alternatives being considered
   c) The alternative that was chosen
   d) Implication of the changes
   c) Progress of implementation
2. Did you personally participate in meetings or other forms of consultation?
   a) Why/why not?
   b) How often did these occur?
   c) Was consultation adequate (content, frequency, timing)? Why/why not?
3. Were community members (i.e. neighbours or fellow business owners) involved/interested in the project?
   a) Did the community see a need for change?

b) What sort of feedback was received from the community? If yes then:

c) How were these addressed, responded to or incorporated into the final project?

If a business owner:

d) Were private sector issues raised and what was the nature of the concern?

4. What is the community's perspective on their water supply and treatment operations?

a) has this changed before/after the changes?

b) were community members supportive, unsupportive, neutral of the project?

V. Process – Alternatives

1. Were alternatives presented to the community?

a) Did the community participate in identifying alternatives? Analysing their pros and cons?

b) What kind of evaluation was presented?

VI. Costs

1. Did you experience any changes in expenses with respect to water use after the changes?

a) Have your water rates increased?

b) Were you buying bottled water before? Have you decreased use of bottled water after? Why/why not?

c) Were you using your own water treatment devices in your home or business before? What about after? Why/why not?

2. Were there any non-monetary costs/problems that you experienced during or after the change? (i.e. inconvenience because of construction, water quality problems during the changes, etc).

VII. Benefits of the Improvement

1. What benefits have resulted from the improvement?
2. Have there been particular benefits for the private sector/businesses?
3. Are you satisfied with the quality and supply of the water?

VIII. Success Factors

1. What are the key factors that made the project a success?

a) funding, support of management, support of regulatory authority, community involvement, specifics n an y particular successful forms of communicating with the public/gaining public input

IX. Challenges

1. From your perspective, were there any key challenges in planning and implementing the improvement?

a) Community support – a challenge?

b) Timelines in completion of the project (or stages of the project) – a challenge?

c) Problems in getting information to the community in an appropriate way – a challenge?

2. How were these challenges over come?

X. Concerns

1. Are there any lingering concerns (i.e. water quantity/cost/quality) after the project was implemented?

    a) Are these widespread in the community?

    b) Are these being addressed by regulators?

Appendix F Interview Guide for Decision-Makers

I. Interviewee Characteristics/Demographics

1. How long have you been in your current role?
    a) How long have you been involved in the council?
    b) When did you enter into community politics?
2. How long have you lived in the community?
3. Do you have a profession/job within the community?
4. Can you describe the drinking water system:
    a) Age of the water system?
    b) Last boil water advisory
    c) Drinking water source
    d) Type of treatment used

II. Description of the water system

1. What is your perspective on the town's drinking water supply, both before and after the improvement?
2. Questions about the operator:
    a) Are there enough staff involved in treatment?
    b) Are they trained to the correct level?
    c) How long has the operator been employed in his/her current position?
    d) Is the operator/operational staff full time, paid position(s)?
    e) What process was used to hire the current operator/operational staff?
    f) Are succession plans in place?
    g) Is recruitment and retention a problem?
    h) What other responsibilities does the operator have?
    i) From your perspective, what should be the operator's top three priorities?

i) what portion of the operator's work should be attributed to drinking water treatment and operations?

III. Overview of the Improvement

1. How would you describe the improvement that was put in place?
2. What were your concerns with the water supply before the improvement?
    i.e. water quality issues, regulatory pressures, community complaints, supply…
3. What were the community's concerns before the improvement?

a) How were the concerns identified/verified?

IV. Process – Alternatives

1. What alternatives were considered to the improvement that was ultimately chosen?
2. How were alternatives compared (i.e. cost-benefit analysis or other quantitative measures/qualitative measures)?
3. Who was responsible for/led the analysis, and who else was involved?

a) What was your or council's involvement in the evaluation of alternatives? What was the operator(s) involvement?

b) Were community members or other stakeholders involved in this stage?

c) Why was the improvement chosen over other options?

IV. Process – Governance/Management Involvement

1. How were community decision-makers (mayor, council) involved in the improvement? What was your role?
    a) Compared with other issues in the community, how was this item considered?
2. Who managed the process (both planning and implementation)?
3. Who made the final decision on which improvement project to implement?
4. What role did other municipal staff have in the process? What was the role of other stakeholders?

a) Was there interest on the part of the public and media on the issues and the final decision?

V. Process – Community Involvement

1. How was the community involved in the improvement?
    a) Were there community meetings? How many attended?
    b) Were community members involved/interested in the project?
    c) What sort of feedback was received form the community?

d) How was feedback addressed, responded to, or incorporated into the final project?

e) Was there a formal community involvement plan? Who developed this, and at what stage was it implemented? Was it evaluated/considered a success?

f) What was the level of community awareness of the problem and / or the improvement initiative? How was this assessed?

2. What information was available to the community regarding:
    a) The need for an improvement, alternatives, implications, progress
    b) How was this communicated?
    c) How engaged was the community throughout the process?
3. What is the community's perspective regarding their water supply and treatment operations?
    a) Has this changed from before and after the improvements?

b) Were community members supportive, unsupportive or neutral to the project?
    c) Did the community see the need for the improvement?

VI. Process – Operator Involvement

1. How was the operator involved in planning an implementing the improvement?
    a) Did this require a significant time investment, over and above regular operations?
    b) Were regular operations affected? How so, and how was this managed?

VII. Process – Funding

1. What was the source of the funds for the improvement – was it part of regularly budgeted funds or over and above?
2. Was some external funding received to fund the improvement?
    a) From what source?
    b) What was the process to obtain funds?
3. Was a business case/cost benefit analysis completed?
    a) What information was provided, how was it gathered, who was responsible?

4. Did cost of general operations increase or decrease after the improvement?
5. Were there any contributions (i.e. in kind)?

VII. Costs
1. What were the capital costs of the improvement?
2. Have other costs increased or decreased after the improvement? i.e. maintenance costs (annual), increased water rates/taxes for the community, increased wages for operators.

VIII. Sustainability after the Improvement
1. Can operations be sustained, both financially and operationally?
2. Is there ongoing community (or other) financing to ensure the improvements are maintained?
3. Were additional training/skills/staff required to operate the improved system?
a) Were these identified up front as part of the alternatives assessment?
b) Does the new system involve more or less work for operators?
c) Do operators receive regular refresher training?
d) Are more staff required now? If yes, have they been recruited?
4. Is the council/community satisfied with the improvement?
a) Based on which measures?
b) How was the improvement evaluated?
5. Do people drink the water/accept the changes?
6. Does the community operate on a cost-recovery basis for its water supply?

IX. Benefits of the Improvement
1. What benefits have resulted from the improvement? (i.e. improved water quality, reduced illness, peace of mind, fewer advisories, improved awareness, tourism, etc)
2. Has the community received external recognition (i.e. regulators, municipal associations, other municipalities) for the improvement?

X. Success Factors
1. What are the key factors that made this project a success?
2. How do you define/assess success for the project?

XI. Challenges
1. What key challenges were encountered in planning and implementing the improvement?
2. What were the anticipated challenges vs. surprise ones that arose during the process?
a) Was it a challenge getting funding or other support from other levels of government?
b) Was it a challenge to get community support? What specifically were the challenges?
c) How were these challenges overcome?

XII. Concerns
1. Are there any lingering concerns (i.e. water quantity/quality/cost) after the project was implemented?
a) Are these widespread?

2. Can you describe concerns from both a personal perspective and a general community/regulatory perspective.

Appendix G Definitions of Readiness Dimensions

Definitions of Readiness Dimensions

The Community Readiness Model identifies six dimensions of readiness. Each of these dimensions represents a key factor that can influence a community's preparedness to take action, implement and maintain a particular issue. These factors are explored through interviews with key individuals in a participating community.

Please consider each readiness dimension as described below and then refer to the Excel document (**Readiness Dimensions Survey Round 1**). Here, 'the issue' refers to the supply (source, treatment, distribution) of potable tap water in a community. Based on your professional experiences and your understanding of small community water supplies please use the attached Excel file to (**1**) evaluate the level of importance of each dimension and, (**2**) to provide a subjective weight value for each readiness dimension. The dimensions are described below.

Definition of Each Readiness Dimension

A) Community Efforts describes the efforts, programs, and policies (local or otherwise) in place in a community related to the safety and availability of tap water supplies.

> *For example, does the community meet or exceed drinking water quality regulations? Are community members conserving water with (or without) programs/policies in place? Are there source water protection or clean-up efforts in place? Can you fish from the water source (if a lake or river)? Is information about the water supply or service available publically?*

B) Community Knowledge of the Efforts describes the extent to which community members know of and participate in local efforts related to tap water, and the effectiveness of their participation in these efforts.

> *For example, is the effort enough to be effective considering the problem at hand? For example, are source water clean-up efforts making a difference or is dumping/pollution still a problem? If conservation is the goal, have all residents switched to low-flow showerheads, limited lawn watering, etc.?*

C) Leadership describes the extent to which appointed leaders and influential community members support the need to improve current measures related to tap water.

> *For example, are local decision-makers expanding efforts related to water conservation or source protection (i.e. through new policies or by-laws)? Are water rates high enough to cover costs incurred through operating the system?*

D) Community Climate describes the prevailing attitude of the community toward their tap water, ranging from helplessness ('it is what it is') to one of responsibility, ownership and empowerment ('we can and must work to protect this resource').

For example, are individuals or groups involved in source water protection planning? Are schools providing water-related education? How many events in the community are bottle-water free? Do community members drink predominantly tap water, bottled water or a combination of both?

E) Community Knowledge about the Issue describes the awareness among community members of challenges facing their tap water supplies, the consequences of these challenges (i.e. to health, industry, etc.), and how these could impact the community?

For example, do community members see water services as playing an important role in the local economy? Do they know about operator retention or training issues? Are they aware of the community's intent to make a significant change (i.e. regionalize the water supply or change source water), and the impact this could have on individuals in the community?

F) Resources Related to the Issue describes local resources – people, time, money, space, etc. – that are available to support efforts.

For example, is there adequate funding for operation and maintenance of the system? Who in the community is involved in tap water issues other than the operator? Do local businesses or government offices serve tap water or do they import bottled water?

Appendix H Readiness Assessment

Community Readiness Assessment: Survey

Assessing Community Readiness for Change Regarding Tap Water Quality and/or Quantity
Implications for a Drinking Water Safety Plan Approach
Community Expert Survey

A. Community Efforts (Programs, activities, policies, etc.)

B. Community knowledge of efforts

2. Using a scale from 1 – 10, how much of a concern is tap water in your community (with 1 being "not at all" and 10 being "a very great concern"? Please explain. ***Note: This figure does not factor into overall scoring in any way, it is only to provide a reference point.*

Note response: _____
_____
_____
_____

3. Do people talk formally (or informally) about tap water quality and/or quantity issues within the community?

Prompt: Taste, odour or colour concerns, health concerns, bottle water, fish in the source water late or river, garbage or human activity (ie. housing or recreation) in the watershed, lawn-watering restrictions, operator's qualifications, etc.?

Note response: _____
_____
_____
_____

4. In your opinion, do people drink the tap water? Why or why not?
Note response: _____
_____
_____
_____

5. Please describe the efforts in your community related to tap water quality and/or quantity issues.

Prompt: Regulations, local policies and by-laws, operator training, seasonal restrictions, etc.

Note response: _____
_____
_____
_____

6. Using a scale from 1 – 10, how aware are other people in your community of these efforts (1 being no awareness and 10 being very aware)? Please explain. ***Note: This figure does not factor into overall scoring in any way, it is only to provide a reference point.*

Note response: _____
_____
_____
_____

7. How are people informed of efforts related to maintaining or improving tap water quality and/or quantity?

Prompt: Announcements in the local newspaper, radio, or at a meeting, a bulletin in the post office, laundromat, or library, or by word of mouth.

Note response: _____
_____
_____
_____

8. Do people participate in efforts related to tap water quality and/or quantity? Why, or why not?

Prompt: How is turnout at community meetings? Do people come to watershed clean-up events?

Note response: _____
_____
_____
_____

9. What are the strengths of efforts related to tap water quality and/or quantity?

Note response: _____
_____
_____
_____

10. What are the weaknesses of these efforts?

Prompt: Is this an in-school program that only benefits children and parents of those children? Is it is volunteer-based, with few willing to maintain the program, etc.?

Note response: _____
_____
_____
_____

11. Would there be any segments of the community for which these efforts may appear inaccessible?

Prompt: Are watershed activities geared towards 'outdoorsy' people only? Are water issues considered too technical for the general public to understand?

Note response: _____
_____
_____
_____

12. Is there a need to expand existing efforts? Why or why not?

Prompt: If there are no issues with the current supply no additional efforts are required.

Note response: _____
_____
_____
_____

13. Are there plans for additional efforts going on in your community related to tap water quality and/or quantity? If yes, explain.

Note response: _____
_____
_____
_____

14. What formal or informal policies, practices and laws related to tap water quality and/or quantity are in place in your community, and for how long have these been in place?

Prompt: Policies could include a by-law related to illegal dumping in watershed areas or water use during dry months. Practices could include neighbours watching other neighbours to make sure they are not watering on 'off' days. Laws include regulations, including Drinking Water Safety Plans.

Note response: _____
_____
_____
_____

15. Are there segments of the community for which these policies, practices and laws may not apply?

Prompt: The people living in the watershed are on wells not the community water supply.

Note response: _____
_____
_____
_____

16. Is there a need to expand these policies, practices and laws? If yes, are there plans to expand? Please explain.

Note response: _____
_____
_____
_____

17. How does the community view these policies, practices and laws? Are they effective in ensuring tap water quality and/or quantity?

Note response: _____
_____
_____
_____

C. Leadership

18. Who are the leaders in the community responsible for ensuring tap water quality and/or quantity?

Prompt: Operator, mayor, council, foreman, etc.

Note response: _____
_____
_____
_____

19. Using a scale from 1 – 10, how much of a concern is tap water quality and/or quantity to the leadership in your community (1 being not at all and 10 being a very large concern)? Please explain. ***Note: This figure does not factor into overall scoring in any way, it is only to provide a reference point.*

Note response: _____
_____
_____
_____

20. How are these leaders involved in efforts regarding tap water quality and/or quantity? Please explain.

Prompt: What are their roles with regards to different aspects of ensuring the quality or quantity of tap water in the community?

Note response: _____
_____
_____
_____

21. Would the leadership agree to devote additional resources and efforts to improving tap water quality and/or quantity? Please explain.

Prompt: Under what circumstances could you envision more resources being devoted to drinking water? Are there issues thought to be more pressing at this time that are more deserving of these resources?

Note response: _____
_____
_____
_____

D. Community climate

22. Describe your community.

Prompt: Economic history, key events, etc.

Note response: _____
_____
_____
_____

23. How does the community support current efforts related to ensuring tap water quality and/or quantity is maintained today, and into the future?

Prompt: The community takes an interest in source water protection.

Note response: _____
_____
_____
_____

24. What are the primary obstacles to efforts addressing tap water quality and/or quantity issues in your community?

Prompt: Do people think water should be free? Do people not like the taste of chlorine and therefore do not drink/support anything to do with tap water? Is there not enough information about tap water available to the community?

Note response: _____
_____
_____
_____

25. Based on the answers you have supplied thus far, what do you think is the overall feeling among community members regarding tap water quality and/or quantity?

Note response: _____
_____
_____
_____

E. Knowledge about the issue

26. How knowledgeable are community members regarding tap water quality and/or quantity? Please explain.

Prompt: Do they know that water quality is regulated by the province? Do they know about boil water advisories and what they mean? Do people understand why water is chlorinated? Do they know where their tap water comes from (i.e. source water)?

Note response: _____
_____
_____
_____

27. What type of information is available in your community regarding tap water?

Prompt: Pamphlets, watershed tours, newspaper, radio or community meetings.

Note response: _____
_____
_____
_____

28. What local data on tap water quality and/or quantity are available in your community?

Prompt: Are the results from water quality tests (daily/weekly/monthly) available online or posted at the municipal office?

Note response: _____
_____
_____
_____

29. How do people obtain information regarding the tap water in your community?

Prompt: Do people know who the responsible parties are (i.e. the operator, decision-maker), and would they approach them if they have a question? If the information is available online, do all individuals have access to a computer? Is the information presented in a way that is understandable?

Note response: _____
_____
_____
_____

F. Resources for change efforts

30. Who would an individual concerned about tap water quality and/or quantity in the community first contact? Why?

Prompt: Would they contact the operator? A decision-maker? Is there a special access number?

Note response: _____
_____
_____
_____

31. On a scale from 1 – 10, what is the level of expertise and training among those working to ensure tap water quality and/or quantity? Please explain. ***Note: This figure does not factor into overall scoring in any way, it is only to provide a reference point.*

Prompt: Do you now what level of training the operator has and how many years they have been doing their job? Does anyone on the council have experience working directly with drinking water treatment or related issues?

Note response: _____
_____
_____
_____

32. Do efforts to address tap water quality and/or quantity issues in your community have a broad base of volunteers?

Prompt: Watershed groups, education groups, neighbourhood watch (i.e. for during water restrictions).

Note response: _____
_____
_____
_____

33. What is the community's and/or local businesses' attitude towards supporting efforts related to supporting, promoting or improving tap water quality and/or quantity?

Prompt: Would they support a bottled water-free event? Would they donate funds to be used towards purchasing source water lands? Would they donate time or space to work on water-related events (i.e. a 'Water Days' festival)?

Note response: _____
_____
_____
_____

34. How are current efforts related to tap water quality and/or quantity currently funded? Please explain.

Prompt: Are there funds other than government grants, loans and property tax devoted to drinking water infrastructure and supplies? Is there a community fund (i.e. financed through user fees)? Are there non-monetary resources involved?

Note response: _____
_____
_____
_____

35. Are you aware of any proposals or action plans that have been submitted for funding that address the improvement of tap water quality and/or quantity within your community? If yes, please explain.

Note response: _____
_____
_____
_____

36. Do you know if there are currently any evaluation efforts related to tap water quality and/or quantity? If yes, on a scale of 1 to 10, how sophisticated is the evaluation effort (with 1 being 'not at all' and 10 being 'very sophisticated')? ***Note: This figure does not factor into overall scoring in any way, it is only to provide a reference point.*

Prompt: Aside from meeting regulations, are there other goals within the community related to drinking water? How and how often are these measured?

Note response: _____
_____
_____
_____

37. Are the evaluation results being used to make changes in programs, activities, or policies, or to start new ones related to tap water quality and/or quantity?

Note response: _____
_____
_____
_____

Conclusion

38. The purpose of the Drinking Water Safety Plan is to better address tap water issues using a holistic, 'source to tap' approach. This will require the input of many individuals in your community. What, if any, are the key barriers to such an approach, and what must be done to make DWSPs a success over the long term?

Note response: _____
_____
_____
_____

Appendix I Delphi Recruitment Email

Dear [Name],

You are receiving this email as you have been purposely selected to participate in a survey on community readiness to address drinking water challenges. This survey was developed as part of my PhD research on small community drinking water supply systems in Canada, and has undergone review and received approval from the Dalhousie Research Social Sciences & Humanities Research Ethics Board (REB #2013-2924). As an expert in this field, I would greatly appreciate your input and feedback! In addition, if you can think of other individuals who should be included in this study, please pass on the materials, or forward their information to me.

The Project

In a project funded by the *Canadian Water Network*, our research team is seeking your input as part of an expert panel. This panel, comprised of stakeholders from various backgrounds, will be asked to contribute to a study on community readiness for change in the drinking water context. This panel will exist entirely online, and comprises two rounds of survey questioning. Panel members and their responses will held in confidentiality by the research team. All results from this study will be presented as an aggregate.

The purpose of this research is to gain expert consensus on a set of readiness dimensions. These dimensions have been tailored to reflect the types of challenges faced by small communities (those serving fewer than 5,000 people). The concept of community readiness for change has been used extensively to examine and address implementation challenges for programming related to health and social wellbeing. Readiness is a useful tool for assessing and understanding a community's position relative to an innovation, strategy or goal. This research is interested in developing a tool for small communities seeking to achieve complex goals related to improving drinking water quality and quantity, many of which require considerable community support and readiness.

To conduct this study a two-round Delphi technique is used. A Delphi technique is used to bring highlight and find consensus among experts from a range of backgrounds using a consensus-based process. Participants will remain anonymous to each other throughout this study.

The Survey

Round 1 (To be completed by **April 17, 2013**): Read the **Information Letter** appended to this email, then open the PDF document "**Definitions**". Herein you will find a description of the community readiness dimensions being used in this research. Once you have read the definitions open the Excel file "**Rate and Value Readiness Dimensions**". The Excel file will prompt you to rank the importance of each readiness dimension, and then to determine a relative value for each readiness dimension. Once you have completed the form please save the file and return it to me via email.

Round 2 (To be completed by **May 15, 2013**): You will be provided with your original scores on each of the dimensions, as well as an overview results from all respondents, and an explanation of what these results indicate. At this time you will have the option to make any changes to your original scores, or to leave your scores as indicated in Round 1. Once you have completed the Excel file please save it and return it to me via email.

The survey is email-based. If you consent to participate in this study, please complete and return the Excel file via email. To ensure confidentiality, your name will not be associated with any of your responses. Please see the attached Letter of Information for further details on this. Completion time of the survey rounds will vary depending on the depth of your contribution. We ask that you complete each round by the date specified in the instructions. You will also receive reminders to ensure consistency in participation across each round.

All participants who submit surveys for Round 1 and 2 will be entered into a draw for a cash prize of $150.

We look forward to receiving your input. To begin, simply open the files appended to this document in their numbered order. Read each document before moving on to the next one. Should you encounter difficulties accessing the appended documentation, or for a printed version of the survey, please contact myself, Megan Kot (megan.kot@dal.ca).

Sincerely,

Megan Kot (Principal Investigator)
Interdisciplinary PhD Program
Dalhousie University
Halifax, Nova Scotia
megan.kot@dal.ca
Website: www.waterstudies.ca

Appended:
1. Information Letter (PDF)
2. Definitions of Readiness Dimensions (PDF)
3. Readiness Dimensions Survey Round 1 (Excel file)

Appendix J Delphi Letter of Information

Research Project: Refining a Community Readiness Model for Use in Small Community Drinking Water Systems

PURPOSE: In a project funded by the *Canadian Water Network*, we (Water Studies) are seeking your involvement in a Delphi Survey Panel, the purpose of which is to synthesize expert opinions on aspects of community readiness for change in relation to public drinking water systems. The concept of community readiness for change has been used extensively to examine and address implementation challenges related to programing in the areas of health and social wellbeing (i.e. smoking cessation, drug and alcohol abuse, and others). Readiness is a useful tool for assessing and understanding a community's position relative to an innovation, strategy or goal. The Community Readiness Model (CRM) is an existing model used to understand and advance community readiness for achieving a particular goal or desired outcome.

The goal for this research is to modify the CRM for use within the small community drinking water system context ('small systems' - those serving a population of fewer than 5,000 persons). The original six dimensions of readiness outlined in the original CRM will be reviewed and adjusted to better suit the small systems context. In addition, values for each dimension are not included in the current model, thus each dimension is considered equally important. The purpose of this study will be to help determine if this is a valid consideration in light of project goals. To do so, study participants are being asked to assign a level of importance and relative value (weight) to each dimension using an electronic (email) Delphi study. A Delphi study is an anonymous, multi-round, consensus-building survey technique.

YOUR PARTICIPATION: Your voluntary participation in this study comprises <u>two</u> 'rounds'. Each will be delivered and returned by email. Each round of the study will ask that you consider specific dimensions related to community readiness in light of your experience working with and within small community drinking water systems. You will then be asked to assign a value between 1 (indicating little importance) and 10 (indicating critical importance). This should take no more than 15 – 30 minutes of your time. In Round #2, a summary of the aggregate responses from the group will be provided to you, and you will have the opportunity to refine your response. The purpose the two-round Delphi study is to gain consensus on the importance of each dimension to community readiness in the small systems drinking water context. You will have two weeks to complete each round. Round #1 of the study will take place from April 4th, 2013 – April 18th 2013, and Round #2 from May 2nd 2013 – May 16th 2013. If you would like to receive a copy of the results once they have been published, please contact megan.kot@dal.ca to request a copy.

HOW THIS RESEARCH WILL BE USED: The outcome of the weight values will be used to modify an existing model for assessing and improving community readiness for change. Any use of the research findings, oral or written presentations will not include your name or affiliation(s).

BENEFITS OF THIS STUDY: The information obtained from this study is intended to support the use of community readiness evaluations in the small systems setting. The intended outcome of such evaluations will be to support and elevate change efforts for the improvement of drinking water supplies.

RISKS: There is minimal to no risk in participating in this study. If you become uncomfortable during your participation please discontinue the survey. If necessary I will offer to reschedule and/or remind you of your right to strike comments from the record and/or withdraw at any time with no penalty.

WITHDRAWAL FROM THE STUDY: You may refuse to participate or to later withdraw from the study at any time, including before, during and after you have completed the survey. Please be advised that after the first round of the study your input will be integrated with the overall survey results, and therefore cannot be retrieved. However, your input will remain confidential at all times to other members of the panel (see below).

CONFIDENTIALITY: A Delphi study was selected to ensure anonymity of panel members from one another. Only the principal investigator will have access to your name and survey results. Your name will not be stored with your survey responses, which will be assigned a numeric ID for the purposes of analysis. No individual responses will be presented and no individual participants will be identified in any way in the dissemination of the research. All findings from Round #1 of this research will be collated prior to their redistribution in Round #2. All data will remain with the principal investigator in a secure location on campus (password-protected computer) and will be destroyed within five years of the study's completion.

CONSENT: By completing the survey (attached) and returning it to the principal investigator you provide your consent to participate in this study.

If you have any complaints or concerns about this research that you feel you cannot discuss with Megan Kot, Dr. Castleden or Dr. Gagnon, you can contact Dr. Catherine Connors, Director of Dalhousie University's Human Research Ethics Office at (1) Phone: (902) 494-3423; or (2) Email: ethics@dal.ca. This study has been reviewed by the Dalhousie University Social Science and Humanities Research Ethics Board (REB #2013-2924)

Now, please see PDF document
"Definitions of Readiness Dimensions"

Appendix K Delphi Survey

Readiness Dimensions Survey Round 1

Part 1: Rank the importance of each readiness dimensions **in order** from 1 - 6.
Note: 1 denotes the least important, 6 denotes the most important dimension.

Readiness Dimension	Rank (select from drop down)
Community Efforts	
Community Knowledge of the Efforts	
Leadership	
Community Climate	
Community Knowledge about the Issue	
Resources Related to the Issue	

Part 2: Determine a relative value for each readiness dimension. Use decimals if required (see Note 1). Then indicate the confidence of your response (see Note 2).
Note 1: Weight value can be any number between 1 and 10. Guide: 1 = limited important, 5 = important, 10 = critically important
Note 2: Confidence of response can be any number between 1 and 5. Guide 1 = not confident, 5 = very confident.

Readiness Dimensions	Weight Value	Confidence of Response
Community Efforts		
Community Knowledge of the Efforts		
Leadership		
Community Climate		
Community Knowledge about the Issue		
Resources Related to the Issue		

Please save your responses and return file by email to megan.kot@dal.ca.

Thank You!

Appendix L Delphi Summary of Findings from R1

Summary of Findings from Round 1 – Refining a Community Readiness Model for Use in Small Community Drinking Water Systems

The following summarizes findings from **Round 1** of the Readiness Dimensions Survey. Results from the three components of the survey: Rank Order of Readiness Dimensions, Weight Value of Readiness Dimensions, and Confidence of the Response are shown below.

The intent of providing this overview is to facilitate consensus between the responses of panel members. Please view the results of the findings as summarized in the figures below. Next, open Round 2 of the survey (Excel document: 'Delphi Readiness Survey Round 2'). Your responses from Round 1 are shown here. You are asked to consider your responses in light of the findings below. Then, complete your survey either by providing either the same responses, or you can adjust your responses as you see fit. Once you have completed this please save and return the Excel file to megan.kot@dal.ca

Findings from Round 1: Panel Results

A) Rank of the Community Readiness Dimensions
Respondents were asked to rank the importance of each readiness dimension **in order** from 1 – 6. Here, 1 denotes the least important dimension, and 6 denotes the most important dimension. *Note: Due to an made error in some of the responses, only data from 9 panel members could be used.*

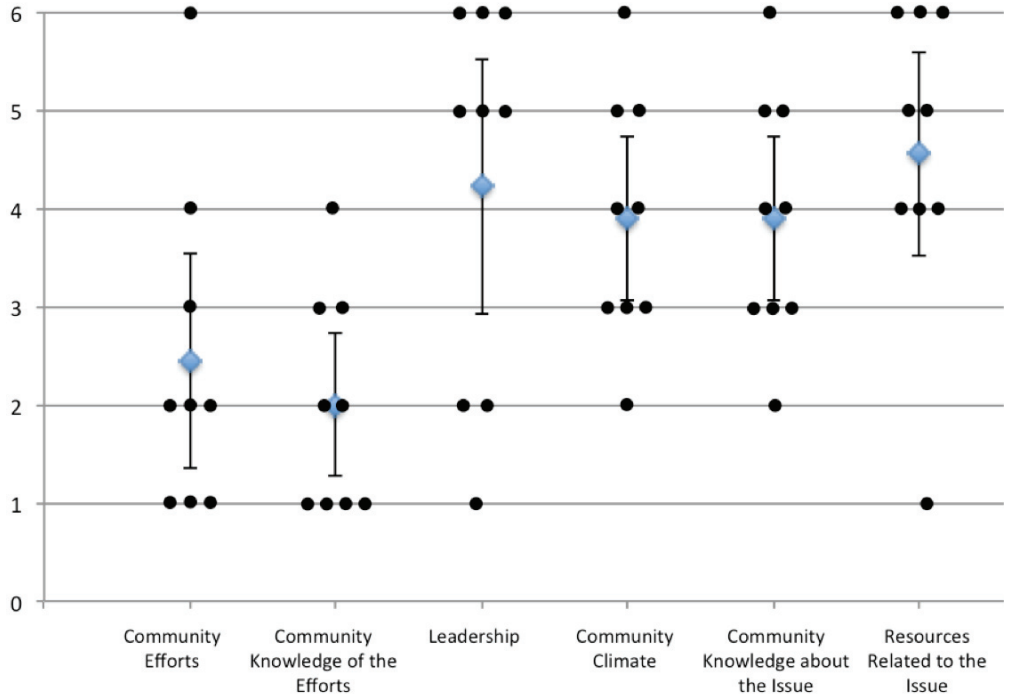

Figure 1: Rank of the Community Readiness Dimensions. The data shown reflects the mean (blue triangle) and the confidence intervals (black lines). Individual responses are shown in black dots.

B) Determine a Relative Value

Respondents were asked to rank the importance of each readiness dimension in order from 1 – 10. Here, 1 denotes the least important dimension, and 10 denotes the most important dimension.

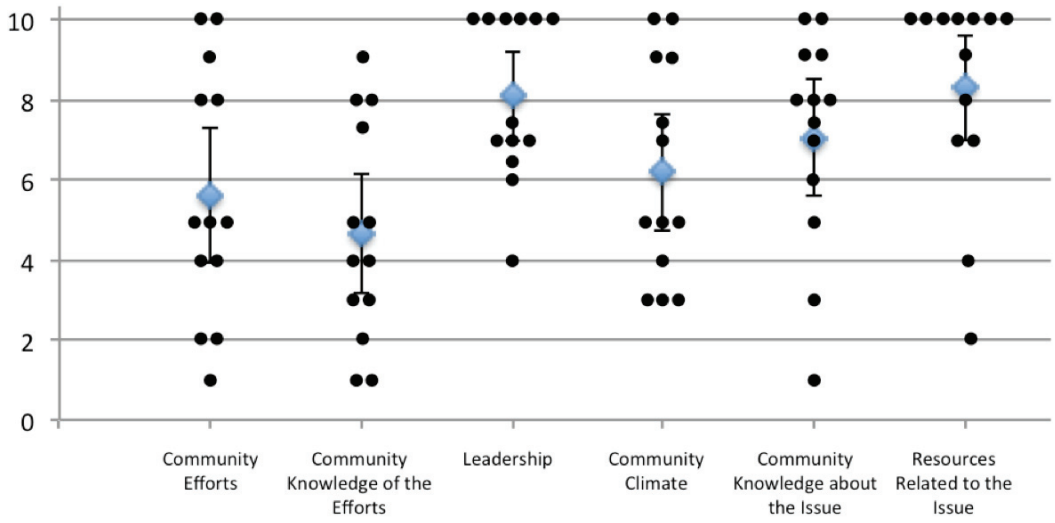

Figure 2: Relative Value of Readiness Dimensions. The data shown reflects the mean (blue triangle) and the confidence intervals (black lines). Individual responses are shown in black dots.

C) Confidence of response

Respondents were asked to indicate the confidence of their response to the question above using a score of 1 - 5. Here, 1 denotes the least low confidence, and 5 denotes high confidence.

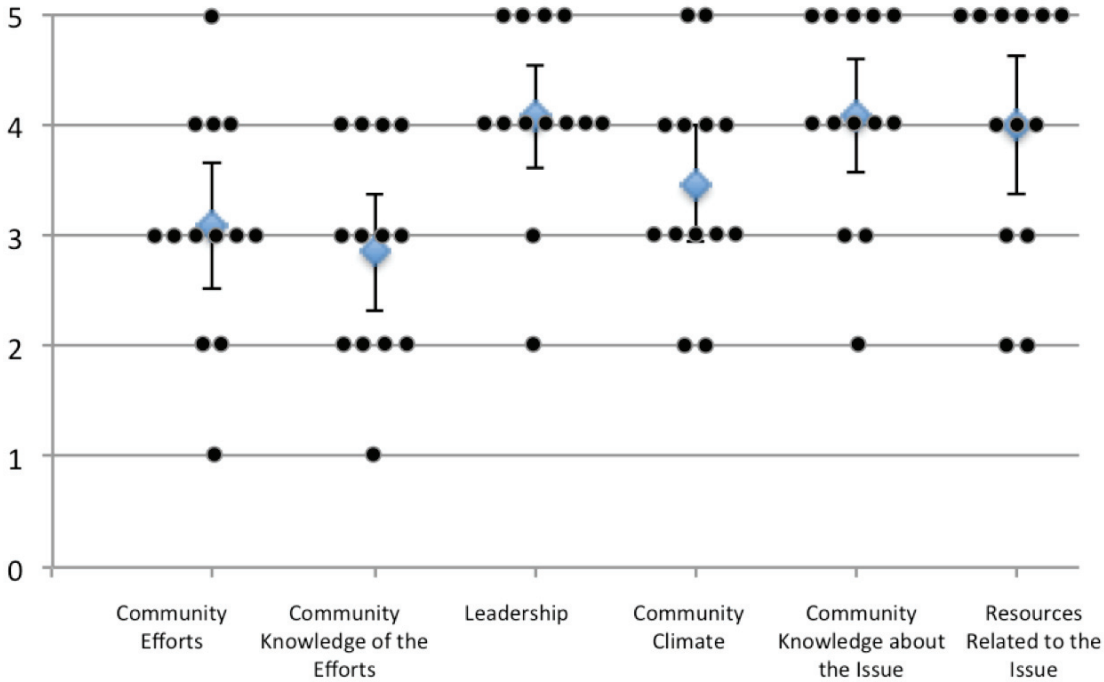

Figure 3: Confidence of the Response. The data shown reflects the mean (blue triangle) and the confidence intervals (black lines). Individual responses are shown in black dots.

Now, please proceed to the Excel Attachment "Delphi Readiness Survey Round 2", complete the survey, and return to megan.kot@dal.ca by **May 16th 2013.**

Thank you!

Appendix M Readiness Assessment –Script

Telephone Script (Individual Participation in Study)

Hello _____;

My name is Megan Kot and I am a graduate student at Dalhousie University in Halifax Nova Scotia. I am working on a study that looks at community preparedness to take on Drinking Water Safety Plans. The goal of the study is to help communities better understand their existing capacities to implement new programs, such as drinking water safety plans.

I am interested in speaking with a few individuals in your community who may be involved or have a good understanding of drinking water issues. I received your contact information via (person, online, other) and I understand you are (involved in local water issues, responsible for community water supplies, interested in local water supplies, other). Would you be interested in speaking with me as part of this project? It would involve a telephone-administered survey that will take 30 – 60 minutes of your time to answer. I should let you know, that any information you provide would be completely confidential.

If No:

Ok. Thank you for your time.

If Yes:

Thank you. I have an information letter that I would like to send to you. The letter describes the project in detail. We can talk about the details of the letter at a time that is most convenient for you, and I can answer any questions you may have. Would you have an email address that I can send this letter to?

(If no email address then prompt for another way i.e. fax for pick up).

Great. I will forward the information letter on to you. If you would like, we can arrange a time to speak now, or in the future. We can arrange this by email. Again, the interview will take between 30 and 60 minutes of your time.

Thank you. Again, my name is Megan Kot, and I am a graduate student at Dalhousie University. The title of the project is "*A 'community readiness' approach for facilitating Drinking Water Safety Plan implementation in Alberta's small communities*". Please don't hesitate to contact me with any question you may have, and I look forward to speaking with you once we arrange a time.
End.

Appendix N Readiness Assessment – Letter of Information

waterstudies

Dalhousie University,
1360 Barrington St., D514,
Halifax, NS B3H 4R2

t: 902.494.6070
f: 902.494.3105
www.waterstudies.ca

October 23, 2013

Dear [name],

Research Project: A 'community readiness' approach for facilitating Drinking Water Safety Plan implementation in Alberta's small communities

You are invited to participate in a study examining community readiness for Drinking Water Safety Plan (DWSP) implementation. This project seeks the participation small communities in Alberta. This project is funded through a research grant from the Canadian Water Network.

PURPOSE: The purpose of this study is to understand community readiness for the development and implementation of DWSPs. To accomplish this, a community readiness survey is being conducted via telephone with 10 small communities from across Alberta.
YOUR PARTICIPATION: Your voluntary participation involves a phone interview taking place at a time of mutual convenience, and lasting approximately 15-30 minutes. During this interview there are no right or wrong answers, as the research team is interested in your perspective and experiences. This interview has five key themes: (I) Knowledge in your community regarding DWSPs; (II) Leadership efforts; (III) Community attitudes; (IV) Knowledge in your community regarding drinking water safety; and (V) Available resources. Careful measures will be taken to keep your information confidential and your identity will not be revealed.

HOW THIS RESEARCH WILL BE USED: Responses to the survey questions will be used to determine your community's readiness in relation to DWSP implementation. Your name will not be included in any reports or presentations made as a result of these research findings. You will receive a copy of the findings from your community.

BENEFITS OF THIS STUDY: At the conclusion of this study you will receive information on strategies for improving your community's readiness for change. These recommendations will be tailored to your community and the implementation of DWSPs. As a community leader, this information may prove useful as an additional tool for supporting and implementing drinking water quality initiatives both immediately and in the future.

RISKS: There is minimal risk involved in participating in this study. If there is anything you wish to withdraw from the interview once we have finished, please tell me, and I will remove that section from the material that I will use for my analysis.

WITHDRAWAL FROM THE STUDY: You may refuse to participate or to later withdraw from the study at any time, including before, during, and after the interview, without penalty by simply telling me, Megan Kot. You also have the right to leave any questions you prefer not to answer. Should you wish to withdraw after you have completed your interview, you will have the option to also withdraw your interview contribution up until one month after the interview.

CONFIDENTIALITY: Because this research is being conducted with a targeted group of individuals in your community it may not be possible to keep your participation in this project completely anonymous. However, your name will not be used and your individual responses to specific questions will not be shared. An identifying number will also be assigned to ensure confidentiality of your responses in the analysis stage of the research. All individual responses will remain with myself, Megan Kot, in a secure location on campus (password-protected computer and locked files in a locked office), and will be destroyed within five years of the study's completion. This data will only be available to myself and the research team.

CONSENT: Attached to this information sheet is a Consent Form. I will go through this information sheet and the consent form with you, answer any questions you might have about the research and your involvement in it, and give you the opportunity to read over the consent form and ask any questions that you may have prior to providing your consent. When you are ready, and you have provided your consent, we may then begin the interview.

If you have any complaints or concerns about this research that you feel you cannot discuss with Megan Kot or her Supervisor (Dr. Graham Gagnon at graham.gagnon@dal.ca), you can contact Catherine Connors, Director, Research Ethics, at (1) Phone: (902) 494-3423; or (2) Email: ethics@dal.ca. This study has been reviewed by the Dalhousie University Research Ethics Board.

We would like to thank you for your time and for participation in this exciting project.

Thank you,

Megan Kot
PhD Candidate
Interdisciplinary PhD Program
Dalhousie University
Halifax, Nova Scotia
c. 902-402-8384

Appendix O Readiness Assessment – Individual Consent

Individual Consent Verbal Script: A 'community readiness' approach for facilitating Drinking Water Safety Plan implementation in Alberta's small communities

Before we begin with the interview I'd first like to provide some important information. Your participation in this survey is completely voluntary. You have several rights as a participant, including to: (1) refuse to answer any question at any time; (2) withdraw from the survey at any time; (3) withdraw from the survey later - by e-mailing or phoning me using the contact details on the information sheet you have just read, and in doing so remove your responses from the study; and (4) gain access to the findings by requesting a copy of the final report.

As a reminder, your participation in this study in completely confidential. I will not attribute your name or the name of your community to any of the findings in the final report or in presentations.

Do you have any questions about your rights as a participant?

Do you consent to participating in this interview?

Do you consent to have direct quotations from this interview in writing and presenting study results?

Verbal consent secured: ☐

Appendix P 'Environmental Reviews' Copyright Release Form

Reprints and permissions - Copyright Release Request

Eileen M Evans-Nantais <eileen.evans-nantais@nrcresearchpress.com> Thu, Sep 11, 2014 at 10:59 AM

To: "megan.kot@dal.ca" <megan.kot@dal.ca>

Hello Megan,

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Appendix Q 'Water Policy' Copyright Release Form

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Megan Kot
School for Resource and Environmental Studies
Dalhousie University
6100 University Avenue
Suite 5010
Halifax
Canada
B3H 4R2

24 April 2015

Dear Megan

Permissions request relating to material published in *Water Policy:*

In response to your request for copyright clearance to include the following publication as part of your thesis:

> Water compliance challenges: How do Canadian small water systems respond? Kot, M., Gagnon, G., & Castleden, H. Water Policy, In press doi:10.2166/wp.2014.172

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Yours sincerely

Michelle Herbert
Journals Editorial Co-ordinator