

EXPLORING A REGIONAL APPROACH TO DRINKING WATER MANAGEMENT IN THE STRAIT OF BELLE ISLE, NEWFOUNDLAND AND LABRADOR

Dr. Kelly Vodden, Mr. Vincent Kuuteryiri Chireh
April 2020

**EXPLORING A REGIONAL APPROACH TO DRINKING WATER MANAGEMENT
IN THE STRAIT OF BELLE ISLE, NEWFOUNDLAND AND LABRADOR**

FINAL PROJECT REPORT

Prepared by
Vincent Kuuteryiri Chireh and Dr. Kelly Vodden, Memorial University
Grenfell Campus, Memorial University
20 University Drive
Corner Brook, NL, A2H, 5G4, Canada
Phone: 709-637-2181
vkchireh@grenfell.mun.ca

December 2018
(revised/finalized March 2020)

Executive Summary

This report contains the results of a study conducted in collaboration with communities of the Straits of Belle Isle region (“the Straits”) on the challenges facing their water systems and the potential for multiple community collaboration as a possible approach for addressing these challenges. Using a case study methodology we drew lessons from other examples in and outside of Newfoundland and Labrador (NL). The Straits region faces several water challenges including long-term boil water advisories, high levels of disinfectant by-products, failing infrastructure, and inadequate financial and human resource capacity. These issues are likely to continue to disrupt the sustainable supply of potable drinking water to community residents into the future without changes to current approaches.

This study explored the potential for a regional approach to addressing these shared challenges in the Straits region. By providing an inventory of water systems, common water challenges, and the potential for regional approaches this research expands the literature on drinking water issues in rural NL. It also helps to address a lack of recent literature on regional approaches to drinking water systems or the feasibility of such approaches in rural settings. There have been previous examples of shared services such as fire protection, waste management, and youth services among communities on the Great Northern Peninsula (GNP), and in the Straits specifically. Drawing from secondary source and interviews with municipal mayors, town managers, water operators, and community volunteers, this study explored how these examples might be built upon to support the feasibility of further regionalizing water supply systems to secure a safe and reliable water supply. The project also sought to adapt lessons from experiences elsewhere to the Straits context.

The results of the study suggest that a regional approach could help to resolve water challenges for communities in the Straits region. Factors supporting a regional approach include the identification of clusters of communities within close proximity; the availability of sufficient and shared source water supplies; volunteer commitment, willingness to support one another, and relationships among communities resulting from existing joint services and regular interactions; the similarity of water challenges and related experiences, creating common concerns in the region; and a belief that a regional approach could address the concerns raised. Conversely, there are also potential challenges centered around distance and climatic conditions, socio-economic imbalances between communities, and political/administrative differences that will need to be addressed in order for regional approaches to be successful.

Recognizing both these strengths and weaknesses of a regional approach to drinking water management, this report draws the following key recommendations from the results:

- 1) Identify and secure agreement on roles of primary and secondary stakeholders within regional water supply and/or management in the Straits region.
- 2) That the provincial government play an active role in facilitating and providing financial support for a regional drinking water initiative in the Straits.
- 3) Further assess existing clusters of communities to establish their specific potentials for water service-sharing informed by community characteristics.
- 4) Establish a pilot project as a testing ground for expanded regional water service delivery and management in the Straits.
- 5) Explore other options such as regional governance structures that go beyond water service-sharing to encompass and address other challenges faced by the region.

Acknowledgments

First, we gratefully acknowledge the support of The Leslie Harris Centre of Regional Policy and Development, Memorial University through the RBC Water Research and Outreach Fund, which funded this research. We are also grateful to the Towns of Flower's Cove and Anchor Point, Municipalities Newfoundland and Labrador (NL) and Grenfell Office of Engagement for collaborating in the study. We thank Shem Evans for his field assistance and Drs. Sarah-Patricia Breen, Dr. Sarah Minnes, Brennan Lowery and Brady Reid for their insights and editorial support in completing this study. Finally, the contributions of all participants in the Strait of Belle Isle region and government officials are greatly valued and appreciated.

Table of Contents

Executive Summary	ii
Acknowledgments	iii
Table of Contents	iv
List of Tables	vi
List of Figures.....	vii
List of Acronyms	viii
List of Appendices.....	ix
PART 1: INTRODUCTION.....	1
1.1: Background of the Study	1
1.2: Justification	1
1.3: Research Objectives	2
1.4: Methods	3
1.4.1: Research Design and Justification	3
1.4.2: Description of the Study Area	3
1.4.3: Ethics Clearance	5
1.4.4: Research Limitations	5
1.5: Conceptual Approach.....	5
1.6. Lessons from the Literature.....	6
PART 2: PROJECT RESULTS	9
2.1: Characteristics of Water Supply Systems in the Straits	9
2.2: Who and How Water Systems are Managed in the Straits	12
2.4: Challenges and Responses in Water Management in the Straits	15
2.4.1: Challenges of Water Supply Systems	15
2.4.2: Responses to Drinking Water Challenges	17
2.5: Examples of Service-Sharing in the Straits.....	19
2.6: Experiences to Date with Regional Approaches	21
PART 3: DISCUSSION.....	25

3.1: Prospects of Regional Water Management in the Straits	25
3.1.1: Geographical Conditions	26
3.1.2: Socio-Economic Conditions	27
3.1.3: Political/Administrative Conditions	28
3.2: Potential Challenges of a Regional Approach.....	29
3.2.1: Geographic Challenges	29
3.2.2: Socio-Economic Challenges	29
3.2.3: Political/Administrative Challenges	30
PART 4: RECOMMENDATIONS AND CONCLUSION	32
4.1: General Conclusions from the Research	32
4.2: Recommendations for Regional Water Management in the Straits	33
4.3: Contribution of the Project to Policy, Practice, and Literature.....	36
4.4: Areas for Future Research.....	37
Reference List	38
Appendices.....	46

List of Tables

Table 1.1: The Five Themes of New Regionalism	6
Table 2.1: Characteristics of Water Systems in the Straits	9
Table 2.2: Common Features of Water Systems in the Straits	12
Table 2.3: Summary of Key Points on Water Leadership and Personnel.....	15
Table 2.4: Summary of Key Points on Water Management Challenges and Responses.....	19
Table 2.5: Existing Regional Service-sharing in the Straits	20
Table 2.6: Summary of Key Points on Regional Approaches	22

List of Figures

Figure 1.1: Map of the Great Northern Peninsula.....	4
--	---

List of Acronyms

BWA	- Boil Water Advisory
CCME	- Canadian Council of Ministers of the Environment
CISL	- Capacity Infrastructure Services Limited
CBCL	- Canada's Best Management Companies
DBPs	- Disinfectant by-products
DMAE	- Department of Municipal Affairs and Environment
DOEC	- Department of Environment and Conservation
GCDWQ	- Guidelines for Canadian Drinking Water Quality
GNL	- Government of Newfoundland and Labrador
GNP	- Great Northern Peninsula
HAA	- Haloacetic acid
HCS	- Health and Community Services
LED	- Local Economic Development
LSD	- Local Service District
MBSAP	- Multi-Barrier Strategic Action Plan
MCW	- Municipal Capital Works
NL	- Newfoundland and Labrador
THM	- Trihalomethane
WCS	- Wellington Community Services
WSL	- Water Services Limited
WO	- Water Operator

List of Appendices

Appendix 1: Project Information	46
Appendix 2: Consent Form- Water Managers/Community Leaders/Key Informants	47
Appendix 3: Interview Guide for Community Leader/Person Managing Water Systems.	49
Appendix 4: Interview Guide for Key Informants: Resource Persons in the Water Sector	51

PART 1: INTRODUCTION

1.1: Background of the Study

Canada is gifted with one of the world's largest supplies of renewable fresh water, yet some rural populations do not have access to safe and clean drinking water and face multiple water management challenges (Adeel, 2017; Peterson & Torchia, 2008; Eggertson, 2008). These challenges include high cost of building and operating treatment plants, aging and failing water infrastructure, high costs of maintaining distribution lines, inadequate source water protection, and limited human and financial capacities (Minnes & Vodden, 2014; Kot, Castleden, & Gagnon, 2011). These issues could affect the sustainable supply of good quality drinking water in rural communities in Newfoundland and Labrador (NL) now and into the future.

A public water supply system is one built, managed, and maintained by the local government (including community members), while private water systems are established and operated by private individuals or groups of individuals (Butt, 2009; Government of Newfoundland and Labrador, 2007). By the end of 2007, there were about 535 public water supply systems that served 376 communities and 223 communities had no public water supply system in Newfoundland and Labrador (NL) (Government of NL, 2008). Some of these public water systems and many other privately-managed water systems are poorly managed, mainly due to inadequate expertise and a lack of financial support (Dore, 2015). This has resulted in drinking water quality issues such as boil water advisories (BWA), some of which have lasted for 15-20 years, as well as high levels of disinfectant by-products and giardia outbreaks (Department of Municipal Affairs and Environment (DMAE), 2017). In the Strait of Belle Isle region (referred locally and hereafter as "the Straits") of NL, there are various challenges to both the public and private drinking water systems which are further discussed in this report (DMAE, 2014).

According to the Committee on Small Water Supply Systems in the United States of America, if communities lack or are unable to develop the required capacity (e. g. qualified personnel, funds, technology, etc.) to manage their water systems to expected standards, then the management needs restructuring (National Research Council, 1997). One proposed restructuring strategy has been for communities to collaborate at a regional scale to manage water supply systems (Breen & Markey, 2015; Hruday, 2011). Through a regional approach several communities can share water supply systems (or components of them) based on need and/or geographical convenience by consolidating individual community efforts and limited resources available to resolve water challenges. Trained and qualified staff and water equipment can, for example, be shared in such regional water management arrangements. Such an approach can restructure smaller and dysfunctional systems into larger, more viable ones to provide safe and clean drinking water, in some cases at a lower cost (Hruday, 2011). Using a case study, new regionalist approach, this project explored the potential of regional water management to mitigate current water challenges in the Straits, and potentially other areas of rural NL as well where lessons from the Straits might have some applicability.

1.2: Justification

Drinking water systems are an essential link between the environment, economic development, and socio-cultural elements of community development (Economics, 2012). Although challenges exist in managing water supply systems, there are opportunities for partnerships and collaborations among lower-level governments to ensure water safety. This

research will identify aspects of water systems where partnerships and collaborations could result in more vibrant and effective water supply systems to minimize or resolve current water challenges and contribute to community and regional development and greater rural resilience.

This study adds to the NL specific scholarly works in regard to rural resilience and sustainability and the contributions of regional approaches to these aims. It further builds on previous water research conducted in NL (Breen, Minnes & Vodden, 2015; Hanrahan, Dosu, & Minnes, 2016; Minnes & Vodden, 2014), none of which is specific to the Straits region. There have been recommendations in recent literature for further research related to drinking water systems in NL, particularly on water management and governance (Butt, 2009). Specifically, Minnes and Vodden (2014 p.75) recommend further research on the “feasibility of a regional water operator and other regional approaches” in rural areas. Hence, this study aimed to address this gap by exploring the potential of a regional approach in water management to resolve water challenges in the specific context of the Straits region as a case example. As the first academic study examining the potential for a regional approach to water management in the Straits, it sets the agenda for further discussions and prompts questions for future research both specific to the Straits region and in other rural areas with regard to water management and the role and application of multi-community (regional) approaches. It also provides a case study for comparison with existing literature where regional approaches have been examined in other locales (see Chapter 2 for examples), broadly adding to existing literature on water management and governance in Canada.

Beyond these contributions to the literature, this research provides community partners and policymakers with insights into options for multiple-community (regional) collaborations on drinking water management, as well as lessons that may be applicable to other types of regional efforts. Specific to water, regional scale cooperation aims to contribute to efforts to improve the quality and reliability of drinking water supplies serving rural community residents. Research findings that support and inform these aims could support local government staff, volunteers, and residents who often contend with drinking water challenges. This study provides evidence of water supply sharing while noting the role of factors such as geography, resource capacities, common needs, population disparities, and place specificities among communities in managing water supply systems and in the potentially viability of regional approaches. This research further contributes to the broader discussions about municipal service-sharing and a proposed “regional government system” in NL. It is our hope that this research will enhance efforts made by the provincial government, Municipalities NL, and other stakeholders to advance these ongoing discussions.

1.3: Research Objectives

The goal of the study was to suggest solutions to water challenges, particularly in rural areas, by searching to identify the potential for communities to jointly manage water supply systems. Specific objectives were:

- To identify current water management challenges in the Straits;
- To identify aspects of the drinking water system that can be delivered on a regional-scale;
- To explore the suitability and feasibility of a regional approach to water management, with particular attention to technical, geographic, socio-economic, and political/ legal conditions; and

- To identify the people and processes required to pursue further analysis and implementation of regional drinking water initiatives.

1.4: Methods

1.4.1: Research Design and Justification

A qualitative case study approach was employed in this research. The Strait of Belle Isle (The Straits) was selected as the case study area for several reasons. First, the team had prior knowledge and familiarity with the region from previous research conducted that could be built upon (e.g. Butters et al., 2017, Carter and Vodden, 2017; Thomas and Vodden, 2014; Vodden, 2005). Second, the literature reviewed on drinking water systems in NL revealed instances of multiple water quality issues and management challenges in the region that were deemed worthy of further investigation (Minnes & Vodden, 2014; Gibson, 2013). Third, the Towns of Flower's Cove and Anchor Point offered their support and willingness to collaborate in the research.

The team used primary data, which was supported by secondary data from academic articles and grey literature. For the primary data, 11 people in leadership positions in the Straits region were interviewed. These people included municipal mayors, town managers, water operators, and community volunteers. Four provincial officials from the Water Resource Management Division, a representative of the NorPen Waste Management Authority, and a regional water/wastewater operator were also interviewed. Two semi-structured interview guides were used to interview respondents (see appendices 3 and 4). All interview sessions were audio-recorded, aside from four interviews where respondents chose not to be recorded. In these cases, careful notes were taken. The respondents chose venues convenient to them for the interviews. The interviews were transcribed and transcripts organized for further analysis using computer software: Express Script Version 5 and NVivo respectively.

Secondary data were used to supplement the interviews, drawn from the Annual Reports on Drinking Water Safety in NL, the Water Resource Portal, Municipalities Newfoundland and Labrador's (MNL) report on the regional government system, the joint Integrated Community Sustainability Plan (ICSP) of Anchor Point, Bird Cove and Flower's Cove (2010), and a study to examine local government in the region (Blackmore, 2003). Other secondary data came from notes and minutes from regional government consultation sessions at Rocky Harbor and St. Anthony held in fall 2017 as part of provincial consultations being held across NL.

1.4.2: Description of the Study Area

This research was conducted in the Strait of Belle Isle, located on the Great Northern Peninsula in NL (see Figure 1.1 below). The Straits region has a population of about 3,292 people according to the 2016 census, a 7.7% decline from 2011 (pop. 3,545)¹. The region is comprised of 22 small communities stretching from Castor River South in the south to Eddies Cove East in the north, with population sizes ranging from 37 (Deadman's Cove) to 314 (Anchor Point). These communities have a mix of local government structures, each with varying roles and capacities. The region includes three incorporated municipalities: Bird Cove, Flower's Cove,

¹ See http://stats.gov.nl.ca/Statistics/Census2016/PDF/CCS_Community_2016.pdf

and Anchor Point. All other communities are Unincorporated Areas (UIAs)² and Local Service Districts³ (LSDs) (Government of NL, 2014).

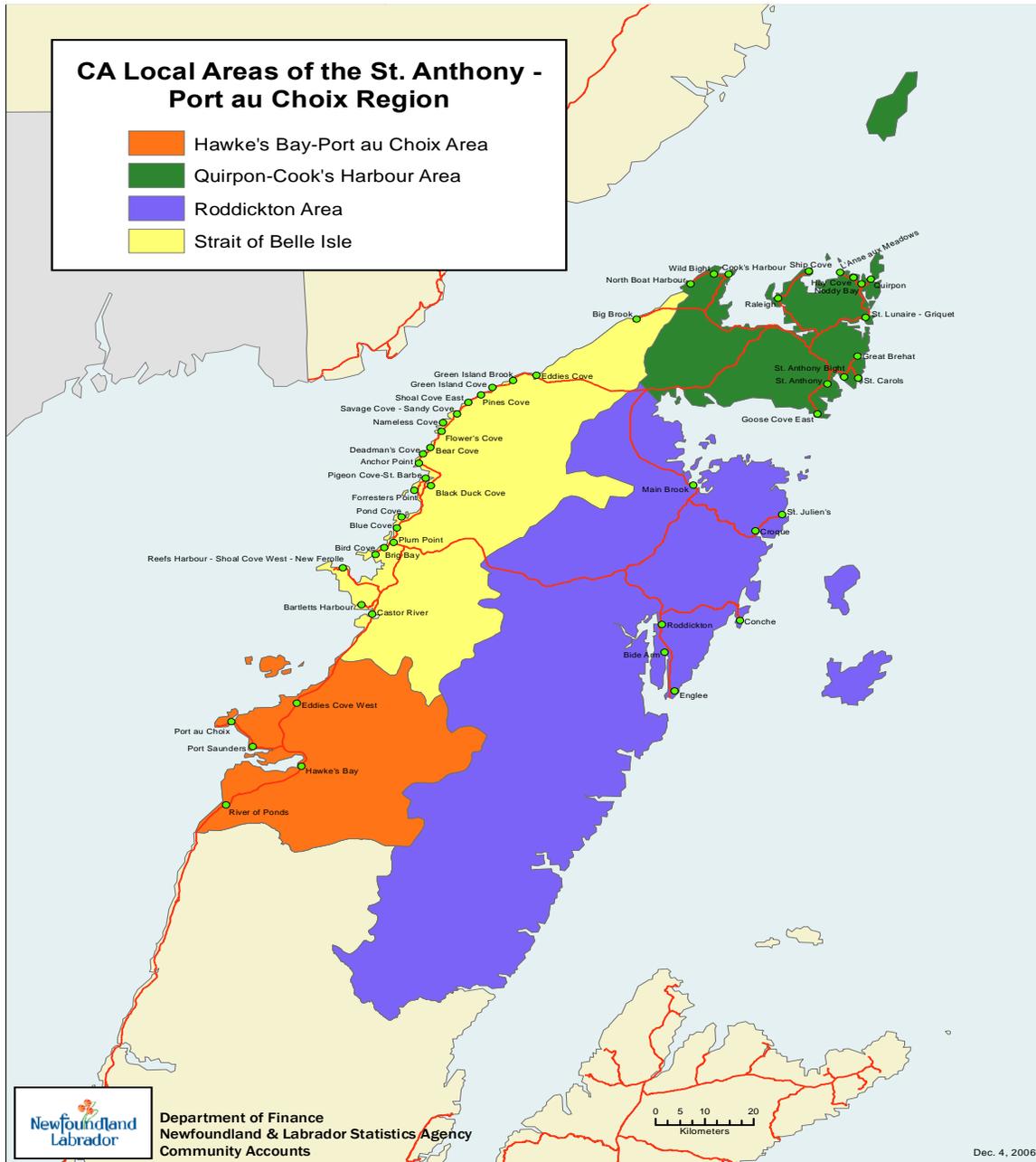


Figure 1.1: Map of the Great Northern Peninsula

Source: NL Statistical Service, 2006

² Unincorporated Areas are small localities not covered by the Municipality Act, with no management in place hence, the provincial government provides for their basic service (Gibson, 2013).

³ Local service districts (LSDs) are defined areas within an established location permitted under the Municipal Act to provide basic services such as water supply, sewer systems, fire services, waste management, street lighting, animal control, and snow clearing under the leadership of community volunteers. See http://www.mae.gov.nl.ca/faq/faq_lsd.html#q5

1.4.3: Ethics Clearance

The research project involved human subjects, therefore, the team was careful to ensure to the best of their abilities that community members who participated were not negatively affected and that the project entailed mutual benefits. In this regard, we collaborated with two of the communities involved and our proposal was examined and approved (Certificate no. ref: 200180751) by the Grenfell Campus Research Ethics Board (GC-REB) before we commenced fieldwork. We provided oral and written information about the project to all respondents, explaining the benefits and the potential risks of partaking in the research. All respondents gave their informed consent before they were interviewed. Participants were also informed of their option not to answer certain questions or completely withdraw from the interviews at any point without consequences. All the field data, which included recorded, interview transcripts, and filed notes, were coded in the analysis process to conceal the identities of the respondents. The project documents have been securely stored in a locked office and in password protected folders.

1.4.4: Research Limitations

The team faced several challenges during the data collection period. The data collection for this study occurred during the same period that the NL government held its regional government consultation workshops at Rocky Harbour and St. Anthony (fall 2017), which are close to the case study region. Some respondents misread our research as part of a provincial government proposal to bring communities under a regional government system. This is likely to have caused some suspicion and affected participation. However, the team continually clarified to participants that this study was different from the provincial government consultations. Our goal was to identify the potentials for water service-sharing that could be decided and acted upon by the communities.

Accessibility and distance were additional challenges. The research team was able to make two trips to the case study region to interview participants and to observe their water systems, rather than the four originally planned trips. This was because the case region could not be accessed by public transport, but rather only by private vehicle. This left lead author and principal researcher Vincent Chireh reliant upon other team members for transportation. In some cases, community representatives were unavailable during the times visited their communities. This affected the number of interviews conducted and the number of communities covered. However, these shortcomings were mitigated by the presence of other experienced team members and previous research in the region that could be built upon, and, related to this, the use of secondary data including meeting notes, minutes and reports from the regional government consultation sessions, to complement the interview data.

1.5: Conceptual Approach

This research study is grounded in the conceptual framework of new regionalism. New regionalism has emerged as a form of overarching regional development strategy. Various defined by different scholars, new regionalism has been described as a multi-dimensional system involving state and non-state actors working together for the common interest of regional development (Luo & Shen, 2012). Vodden, Gibson and Daniels (2014, p 21) define new regionalism as an emerging concept which seeks to understand the political, economic and social restructuring of the global system while considering the region as the central point for planning

development through networks that extend within and beyond the regional scale. The five themes of the new regionalism approach are elaborated upon in Table 1.2 (see also Vodden et al., 2019).

Table 1.1: The Five Themes of New Regionalism

Theme	Explanation
Place-Based Development	Development that seeks to recognize and build on the endowments of a specific area; strives to recognize place uniqueness in planning processes to foster development while building social capital.
Rural-Urban Interdependencies	Larger and smaller communities (e.g. municipalities, LSDs and UIAs) are interdependent with regards to business activities, shared environments, and governance. This inter-reliance supports a regional approach to service (including water supply) delivery.
Knowledge, Innovation, and Learning	Co-production of knowledge and innovation to tackle new challenges is crucial. Knowledge sharing and learning are necessary to approaching new and changing development issues at the local and regional levels for sustainable development and rural resilience.
Multi-level Collaborative Governance	An inclusive governance system that incorporates diversity and collaboration among various levels and scales of stakeholders to foster co-construction and collaborative decision-making.
Integration	Embraces inclusivity in development policy and planning and makes use of varied and holistic strategies to address complex development issues.

Source: Adapted from Chireh (2018, p. 27)

New regionalism suggests an integrated and multi-disciplinary approach to resource (including water) management that includes public buy-in, place-based knowledge, knowledge-sharing, and collaborative decision-making which involves multiple actors (Zirul, Halseth, Markey & Ryser, 2015; Markey, 2011). A new regionalism approach is grounded in attributes such as place-based development, multi-level and collaborative governance, integration, innovation and knowledge co-production, and knowledge sharing (Breen, 2018). The use of new regionalism as a framework highlights the significance of local collaboration in shared-services as necessitated by, and which must consider, capacity/resource disparities and demographic challenges, particularly among rural communities (e.g. the Straits). Further, its integrated perspective calls for an acknowledgement of the important linkage between safe and sustainable water supply and the overall regional development agenda and context.

1.6. Lessons from the Literature

There have been increased efforts by water management authorities across Canada to safeguard water quality, particularly after the Walkerton and North Battleford waterborne disease outbreaks in 2000 and 2001 respectively (Charron et al., 2004; O’Connor, 2002). Improvements are needed in water management to avoid a similar case in NL (Minnes and Vodden, 2014). Arguably, municipalities and other community entities have assumed greater responsibility in providing safe drinking water to residents than upper level governments. Generally, federal and provincial governments have varying degrees of responsibility when it comes to provision of water supply in Canada. For instance, the federal government manages national/public water

resources including marine resources, trans-border waterbodies, water for Indigenous people, and water on federal lands. Provincial and territorial governments are expected to perform roles such as water quality monitoring and water infrastructure funding and management (DMAE, 2016; Hill, Furlong, Bakker, & Cohen, 2008).

Upper-level governments can play a role in enhancing water policy and planning, providing financial and technical support, and improving water governance to tackle some of the noted challenges. In NL, for example, the Department of Municipal Affairs and Environment, Health and Community Services and Services NL work with other stakeholders to implement the Multi-Barrier Strategic Action Plan (MBSAP). This plan was adopted to safeguard public health in regard to drinking water quality through the prevention or reduction of water contamination from source to tap (Government of NL, 2016). The Public Water Dispensing Unit (PWDU)⁴ program was initiated to strengthen and improve rural water supply by installing a stationary mobile water facility that treats and supplies clean and safe drinking water in rural communities with less than 500 population experiencing water quality issues (Picco & Chaulk, 2010; Dawe, 2010). While still maintaining these and other roles further discussed below, upper-level governments have downloaded much of the responsibility for safe drinking water provision to lower-level governments, often without corresponding support to provide the ability to fulfill this mandate (Adeel, 2017). Local governments are charged with the day-to-day operations of water systems, including the protection of source water, provision of water infrastructure and the compliance with water standards and regulations.

Researchers have categorized the components of water supply systems differently over time. Common components of water supply systems that have been identified include source water, water infrastructure (e.g., for storage, distribution, treatment), human and financial resources used in the delivery of drinking water services, and policy, planning and governance related to drinking water (Minnes & Vodden, 2017; Hruday, 2011; Davison et al., 2005). Detailed descriptions of these components of the water supply system are provided in Chireh (2018). Some of the common water challenges in rural water systems include ageing and failing infrastructure, limitations in financial, technical and human resource capacity, a lack of asset management, multi-use watersheds with demands that compete with drinking water quality objectives, and unenforced water regulations (Minnes and Vodden, 2017; Vodden, Sarkar, Holisko, & Speed, 2014). Across Canada, water managers and practitioners have devised strategies to resolve the many challenges of supplying clean water to residents. One of these strategies is the restructuring of water management (Hanrahan, Dosu, & Minnes, 2016; Capacity Infrastructure Services Limited, 2012; National Research Council, 1997). In some jurisdictions, for example, communities lease out the ownership, control, and management of their water system to a third party (Bakker & Munk Centre Program on Water Issues, 2003; National Research Council, 1997). The restructuring process could involve either public (regional or municipal authorities), private (for-profit companies), or public-private partnership (Watercare Services Limited, 2017). Examples of these arrangements are common in New Zealand and other bigger cities including the Greater Toronto Area and Vancouver in Canada (see Chireh, 2018).

Moving toward a regional water management approach is one form of restructuring in drinking water governance. While various scholars have defined a regional water management approach differently, for the purpose of this report, it is a water management strategy where

⁴ A PWDU is a stationary mobile water facility that treats and supplies clean and safe drinking water to rural communities (<500 population) experiencing water quality issues in rural areas (Picco & Chaulk, 2010; Dawe, 2010).

neighbouring communities with common challenges or needs within a defined geographical location collaborate to consolidate limited individual community resources to collectively manage and provide sustainable water supply to their residents. The widespread regional management of resources by communities in both the developed and developing world in recent years offers motivation for examining applying such an approach in water management within rural NL (World Economic Forum, 2017). Some of the reasons why communities consider sharing water supply systems include: 1) the failures of current individual community water management; 2) the complexity of water challenges that require multiple-community and - stakeholder collaboration; and 3) the worry that future, even more serious water challenges are likely occur if these failures and challenges are not addressed.

In many existing examples of regional water management in NL and Canada as a whole, partnering towns have benefited in terms of enhanced capacities, cost savings for water infrastructure and supplies through economies of scale, improved quality of services, improvement in public health, and even amendments to water standards and regulations from upper-level governments that take into account place-specific challenges based on pressure from unified communities working collaboratively on a regional-scale (Hanrahan, Dosu, & Minnes, 2016; Furlong & Bakker, 2011; Haque, Csapo & Round, 1999). One Canadian example is the 21 municipal governments within Metro Vancouver (formerly Greater Vancouver Regional District, or GVRD), which jointly owns, manages and shares water and wastewater supply systems across the member municipalities (Bakker & Munk Center of Program in Water Issues, 2003). The system is administered by a management board made of representatives from member municipalities (Forest, 2010a), which also provides water to Tsawwassen First Nation as a member and to Point Roberts, Washington. Member municipalities purchase water from the regional supply but are responsible for the installation, operation and maintenance of water distribution systems within their municipal boundaries. In the City of Vancouver alone this includes nearly 1,500 km of water mains, over 100,000 connections and 20,000 meters, 25,000 valves etc. (City of Vancouver, 2018).

The Metro Vancouver case is one of several cross-border water sharing examples provided by Forest (2010a). Another is two communities in Quebec, Stanstead and Rock Island, and Derby Line in Vermont, USA, which began sharing drinking water and wastewater management as well as a trans-border library in 1906 (Forest, 2006; Forest 2010a, b). Initially a private company was established, the International Water Company (IWC), to supply treated water to the three municipalities from Holland Pond (USA). As the population and water demand increased, the municipalities acquired facilities from the company in 1996 (Forest, 2006; Forest, 2010a). Watershed management organizations across the country provide further examples of shared approaches to source water protection and water conservation (Columbia Basin Trust, 2016; Vodden, 2015; Breen & Minnes, 2013). Additional NL examples are provided in section 2.6 below.

PART 2: PROJECT RESULTS

This section of the report provides the results and findings of the interviews conducted between November 2017 and May 2018 in selected communities in the Straits and with provincial officials. As stated above, additional data was accessed from secondary sources to supplement the interviews. We describe here: general characteristics of the water facilities in the Straits; the nature of current water management structures and related challenges; some examples of regional service-sharing and related experience; and the viewpoints of respondents related to regional approaches to water management.

2.1: Characteristics of Water Supply Systems in the Straits

Most communities in the Straits have small systems where raw water is supplied from surface water sources and then treated. The use of chlorine to disinfect and treat water is a common treatment method in the Straits as in many parts of rural NL. Most water systems have water disinfection facilities as well as pump houses, storage reservoirs/tanks, main water lines, and distribution lines that supply water to residential and commercial establishments. Table 2.1 presents an overview of water supply systems in the Straits. The research team was unable to obtain information about the water systems (if they exist) of other communities. Features of the water supply systems outlined in the table include the type of water source, treatment, population served, BWA status, and the recordings of Trihalomethanes (THMs) and Haloacetic acids (HAAs) as of September 2017.

Table 2.1: Characteristics of Water Systems in the Straits

No.	Supply Area/ Community	Supply and Source Type	Supply protection/ Filtration/ Chlorination System	Pop'n (2016)	BWA	THMs µg/L (2017)	HAAs µg/L (2017)
1.	Flower's Cove (municipal)	Surface water French Island Pond	Protected Filtration Gas (chlorine)	270		147.75	107.47
2.	Nameless Cove (LSD)	Surface water French Island Pond <i>Provided by Flower's Cove</i>	Protected Filtration Gas (chlorine)	69		160.00	112.95
3.	Bear Cove (LSD)	Ground water Lower Bear Cove	Unprotected/Drilled Liquid (chlorine)	91	Jun 21, 2000		
4.	Forrester's Point (LSD)	Surface water Rudges Pond	Protected Liquid	208		116.65	45.43
5.	Plum Point (LSD)	Surface water Grand Pond	Protected Liquid	112	Dec 17, 1997	237.40	100.33
6.	Bird Cove (municipal)	Surface water Inner Gilmour Pond	Protected Infiltration Gallery Liquid	179+117	Aug 02, 2011		
7.	Brig Cove (LSD)	Surface water Inner Gilmour Pond <i>Provided by Bird Cove</i>	Protected Infiltration Gallery Liquid	117	Aug 02, 2011	124.00	71.50

No.	Supply Area/ Community	Supply and Source Type	Supply protection/ Filtration/ Chlorination System	Pop'n (2016)	BWA	THMs µg/L (2017)	HAAs µg/L (2017)
8.	Green Island Brook (LSD)	Surface water Green Island Brook	Unprotected Liquid	202		109.33	53.33
9.	Black Duck Cove (LSD)	Surface water Long Pond - Black Duck Cove Intake	Unprotected Liquid	155	Dec 17, 1997		
10.	Castor River North (LSD)	Surface water Long Pond (same as Bartlett's Harbour)	Protected Liquid	141	Jan 01, 1991		
11.	Castor River South (LSD)	Surface water Brook	Unprotected No disinfection	136	Jan 01, 1991		
12.	Pidgeon Cove-St. Barbe (LSD)	Surface water Long Pond/Intake #2	Protected Liquid	135	Mar 29, 2018		
13.	Anchor Point (municipal)	Surface water Well Cove Brook	Protected Infiltration gallery Gas	314		131.25	102.82
14.	Deadman's Cove	Surface water	Protected Liquid	37			
15.	Savage Cove	Surface water Wild Cove Pond	Protected Filtration/Liquid	120			
16.	Sandy Cove	Groundwater	Protected/Liquid	131			
17.	Eddies Cove West (LSD)	Surface water Brook	Unprotected No treatment	70	Apr 10, 2003		
18.	Bartlett's Harbour (LSD)	Surface water Long Pond (same as Castors River North)	Protected Liquid	129	Apr 29, 1998	0.35	

Source: Adopted from Chireh, 2018: page 34

Of the 18 community drinking water systems in the Straits described above, 16 have surface water sources and two ground water supplies. The open nature of surface water sources makes them more vulnerable to contamination and pollution through human, industrial, or animal activities. Several of these surface water sources are shared. French Island Pond, for example, provides a drinking water supply to both Flower's Cove and Nameless Cove, Inner Gilmour Pond to Bird Cove and Brig Cove, and Long Pond to Black Duck Cove, Bartlett's Harbour, Pigeon Cove-St. Barbe and Castor River North.

The nature and condition of drinking water systems varies among communities as it depends on factors such as the physical conditions of the area, age of infrastructure, and the human and financial resource capacity of each community. Whilst the municipalities of Flower's Cove and Anchor Point have relatively robust water systems, for example, the disinfection components in particular are not effective (or even non-existent) in some LSDs due to inadequate funds and expertise. This is illustrated by an LSD volunteer, who operates the water system:

Our water comes from the pond across the road. It has a pump house and a reservoir... It was established in 1982. Water is not treated but there is a system... There are artisan wells for 10 houses, but all other houses couldn't drill wells

because of salt water intrusion... We don't have the money to hire an engineer and we don't want a big system to get us off boil water...

Another explains:

This line was put in place in 1982. The side systems off that are older, hence failing all of the time. The pump house too is about 15-16 years old. Other problems include findings leaks in the line and abandoned valves as well, the long distribution lines in the community. The technology is not there to always check for leakages when they occur ... We drink the water at our own risk.

On the other hand, a mayor explains that some municipalities have water systems in place that treat water for their residents effectively:

We have got a 15-horse power pump, we chlorinate, we put a filtration gallery in, and our water is actually damn good... we are getting a new flow meter. We supply somewhere between 320-330 people and about 101-102 households. Anchor Point has been very stable for the last 34 years. Our town clerk, town manager does check the residuals regularly... Science and Environment, they come around once a month or so and they check in two or three different places. They come from St. Anthony and someone too comes from Corner Brook.

In 2016 Anchor Point undertook water system improvements that included “the removal, cleaning and re-installation of all media in the infiltration gallery, the installation of new washed stone, new geotextile filter with anchors, new screens in the intake chamber, dam repairs and related works and appurtenances” (Government of NL, 2016). Similarly, representatives of the Town of Flower's Cove suggest:

There are no problems with water supply. Not many boil waters. Aging pipelines have been taken-up and replaced. As a new hospital and school were hooked to the system, capacity was affected but adaptors were installed to deal with the extra demands... Not lots of breaks in the line, about 2-3 times in a year. We normally dig it up (patch or fix). The water infrastructure is about 40 years old. Chlorine levels have always been tested every month and it comes out good.

This is not to say, however, that municipal systems do not face challenges as well (discussed further below).

Another common characteristic that was discovered about the water systems in the Straits through interviews and the secondary sources is widespread BWAs⁵ and levels of disinfectant by-products (DBPs) above those recommended by Health Canada guidelines (80 µg/L for HAAs and 100 µg/L for THMs) (see details in Table 2.1). Of the 18 water systems in the Straits described in table 2.1., ten have long term BWAs in place. Five of these have been in place for over two decades.

Table 2.2 summarizes key points raised by interview respondents on the common features of the water systems in the Straits region. The table captures views expressed by the two

⁵ BWAs are notices placed by communities or the provincial government when there are known risks, perceived contamination, or pollution in the water system advising residents to boil the water before use (DMAE, 2016).

categories of respondents: community water management leadership and provincial officials/resource persons.

Table 2.2: Common Features of Water Systems in the Straits

Category of Respondent	Key Points
Community Leaders	<ul style="list-style-type: none"> • Municipalities serve 200-350 people; LSD and UIAs serve 50-100 people. • Surface water is the most common water source. • Many water systems were constructed 40-50+ years ago with little or no upgrades in recent years. • Municipal water systems have treatment systems, including filtration and chlorination. • Some LSDs and UIAs pump untreated water for domestic use with little or no chlorination.
Provincial Officials	<ul style="list-style-type: none"> • Most communities have chlorination systems but some do not want to use chlorine. • There are private wells in many LSDs and UIAs.

Source: Adapted from Chireh, 2018: page 51

2.2: Who and How Water Systems are Managed in the Straits

In most Straits communities, the water systems are operated by uncertified and/or part-time personnel or volunteer community members. It was discovered that the people who administer the communities are often the same people managing the water systems, whether town staff with a range of other responsibilities or community volunteers with little or no water management training. One provincial official explained:

They are volunteers ... so whenever they get free time they will take in training but most of the time they're busy doing other things. Like I just got a call from a community further south that, I trained six people out there last summer. They are all fishing right now and not watching the water, and they are on a boil water advisory... The lack of a permanent, paid operator is the true issue there.

LSD volunteers and community leaders tell a similar story:

Everything for the repairs would be pretty much volunteer, so we can't send a job out to tender or contract to fix it (especially when we know how to fix it ourselves) because we don't have that kind of money.

The chairperson of the LSD board pays bills and whatever needs to be done to keep the system running. I've been on the LSD board since 1989, chairperson 5-6 yrs. No formal training. I maintain system lines, pumps, chlorine machine 20 litres every 4 days or more... Why? Because no one else will take it up.

I've been President of the LSD since 1994. We are the next in line. No one else wanted to do it. We are the last generation that is able to do it... I am just a member of the community who looks after the pumping system, infrastructure. It is a volunteer position. No formal training. My father was in it and I just had to take over from him.

In other cases, in particular in the municipalities, communities have paid staff assisting with operating and maintaining the system but they “... *don't employ a “water operator” they employ a “maintenance man.” The maintenance man is responsible for the water system as well as roads and other services...* (provincial official RP02). In other municipalities the town clerk/manager takes on all or some of the water-related responsibilities:

The town manager/clerk tests for residuals... We have got three main people... they are not full-time employees. They take turns... they basically control the chlorination. They maintain the pumps and make sure if they have to be lubricated...

... town manager does the technical work (testing and maintenance) within the system; no training.

We do have a part-time water operator... takes care of chlorination, and readings...making sure the chlorination levels are at the proper level and the readings are collected and sent to the department. That is basically what they do. We pay for 10 -15 hours per week to do that... Training? No...they have been training from the previous operator... I have even found myself at the pump house sometimes to do readings, which actually I don't have the time to do. I am not even paid to be a mayor let alone to be doing that as well but, so you know, you do what you do in small communities, you volunteer to.

This is, however, a common characteristic of rural water systems across the province (Minnes & Vodden, 2014; Dore, 2015). Many of these long serving community leaders and volunteers who also serve as water operators remarked that they have limited options for handing over the leadership mantle to others but instead continue with their commitment to ensure potable water for their residents. While uncertified they tend to have received some form of basic training to help them perform essential functions such as chlorine injection, testing, and basic line maintenance, through provincial sources and from others who have performed these duties in their communities in the past or in neighbouring communities. Nevertheless, a lack of formal training is seen as a concern for some. One municipal representative remarked, for example:

One of the biggest challenges is not having certified, fully qualified staff in place to manage the system... that is why we are running into issues and doing bandaged solutions because a lot of things are just operating at their minimum. When we have a full system in place, we have a pump house you know that has the full system there, then that is far beyond what our part-time operators are used to and quite frankly probably capable of operating.

Over the years, communities in the Straits have benefited from provincial government assistance through funding to construct and upgrade water facilities, as well as technical assistance in source water protection, water sampling and testing, and the training and certification of water operators. The most widely mentioned provincial agency was Service NL. As one town manager who acts as a water operator described, “...*we have the Service NL doing all those readings monthly.*” According to a provincial official, an environmental hydrologist has been designated to collect and test water samples in the GNP and Labrador and to grant permits for source water protection. Municipal Affairs & Environment was also noted, in particular funding through the department and the support of Environmental Scientist Gerry Lahey and the operator training program.

Funding-wise, we have applied for an emergency funding and other funds from time to time, and even recently to fix our pump house, to replace a brand new pump a couple of years ago and other things that come up...We've been trying to avail of funding where we can. ... So, government is there to provide help when possible.

Community representatives also noted the limitations of provincial assistance, both in terms of available human resources and funding:

We've tried to with the guy in Deer Lake, from government to come in and do some leak detection. He has done it a couple of times, but with government and with wells, they don't have a lot of time for the rural communities that they cover.

Municipal Affairs. We applied for \$644.00 - \$6400.00 to match and the government turned us down.

Aside from the provincial support, communities often seek the services of neighbouring communities, local contractors or private companies from Corner Brook or St. John's in managing and upgrading their water supply systems. Particularly, Flowers Cove, Bird Cove, and Anchor Point have engaged the services of companies to supply water equipment or to fix their broken-down water systems. This comes at a cost:

Any emergency work that arises we have to hire local contractors, depending on the issue whether that is going to be a carpenter, or electrician or an engineer, when it is really costly ... You know, in some cases for some special things we have to get companies from Corner Brook to come down and it is just quite costly to do so. And so, that is one of our biggest issues. We don't have properly trained staff on site or within the region to draw upon. So coming in from Corner Brook, the travelling alone, you know, it doubles up the cost for any companies to come here.

... the chlorination system gave up on us... and we didn't just have the expertise and I don't like people working on chlorination system, our chlorination system when they are not sure what they are doing. So, we contacted the supplier... we are more likely to do that now, every second year or so we bring somebody in. We can't do it every year because the cost.... the time you get finished, we got somebody come in from St. Johns, \$3,000 or \$4,000 or \$5,000 you know.

For LSDs without a municipal tax base, acquiring such outside assistance may not even be an option as one representative explained: "Everything for the repairs would be pretty much volunteer, so we can't send a job out to tender or contract to fix it (especially when we know how to fix it ourselves) because we don't have that kind of money."

In summary, some notable points from the interviews related to the water management leadership and personnel in the Straits are shown in table 2.3:

Table 2.3: Summary of Key Points on Water Leadership and Personnel

Category of Respondent	Key Point
Community Leaders	<ul style="list-style-type: none"> • Most leaders have held their positions between 10-20 years. • While the mayors and councils provide oversight and policy direction, town managers, maintenance staff and/or community volunteers maintain the water systems. • Some take up water-related positions because there are no options (no one else willing or able to assume the role). • The federal and provincial government, private companies, and neighboring communities have helped to resolve water problems.
Provincial Officials	<ul style="list-style-type: none"> • Departments that assist communities to manage their water systems include: Water Resource Management Division, Department of Municipal Affairs and Environment and Service NL. • Roles include: operator education, training and certification, sampling and testing, funding support. • Most have held positions for 2-5 years; one has over 20 years of experience. • Most people operating the water system are uncertified volunteers; can be high turnover of volunteer operators and/or seasonal presence.

Source: Adopted from Chireh, 2018: page 54

2.4: Challenges and Responses in Water Management in the Straits

This section outlines some additional characteristics of water management in the region as captured in the interviews (see Table 2.4). Specifically, the challenges that confront the management of the water systems, the effects, and the strategies employed to provide drinking water despite these challenges are discussed.

2.4.1: Challenges of Water Supply Systems

Water challenges are complex and each one facilitates the next! – Participant RP02

The quote above reveals an important finding this study: water challenges are multi-faceted, with one leading to and/or connected to another and, given the importance of drinking water for human health, this has consequences that threaten livelihoods and public health. Most of the communities in the Straits experience multiple water challenges, including: aged and failing water infrastructure; inadequate funds for infrastructure maintenance and/or improvements; and a lack of qualified personnel to properly manage water supply systems.

With respect to human resource capacity for providing clean, safe drinking water to citizens, many respondents noted that their communities are unable to hire qualified personnel to manage the water systems due to the absence of available expert staff as well as the lack of funds. The outcomes under such management can result in serious water quality issues. Speaking of towns without a paid, certified water operator, one official explained, *“You end up with communities on boil water advisories. These are the ones you have trouble with ...”* This is further illustrated in the statement by an LSD volunteer:

We have been on boil water advisories for some years now. I put the chlorine inside, but they come and test and say, it’s not enough. So, we know that we use the water at

our own risk. Most people in the community drink bottled water from the grocery shops.

Contamination and siltation of water sources was noted as another challenge related to water treatment and inadequate source water protection. As described above in Table 2.1, many communities in the case study region use surface water as their water source. According to a provincial official, inadequate planning for source water protection could compromise the quality of water sources. In such instances, water treatment becomes more complicated and expensive for communities. For example, according to an LSD volunteer, some ponds, brooks, and lakes that serve as water sources experience “collapse” (e.g. landslides or erosion of shorelines) during weather events, depositing organic matter such as silt and mud in the basins. The resulting presence of impurities in the water system can increase the difficulty and cost of water treatment and the potential for waterborne illnesses if communities and/or residents are unable to treat but still drink the potentially contaminated water. In the U.S., for example, 50% of waterborne illness outbreaks over the past fifty years happened after a heavy rainfall, leading to contamination of water sources and overloading disinfection systems (Vodden et al., 2013).

Many communities have small water systems with insufficient filtration and/or disinfection technology and/or supplies. Reasons cited for BWAs in the communities include an absence of chlorine residual detected in the system (a reason cited in five communities), lack of a treatment system (Castor River South) or, in the case of Black Duck Cove and Eddie’s Cove West “Chlorination system is turned off by operator, due to lack of funds to operate” (NL, 2020). Further, given the reliance on surface water sources and resulting high levels of natural organic matter in water supplies that can lead to DBPs as a by-product when interacting with chlorine, seven Straits communities experienced DBPs in their drinking water above Health Canada guideline levels in 2017. Yet these communities typically do not have the financial resources to invest in filtration systems to remove the organics prior to chlorination (Daniels and Vodden, 2015). Some municipalities have been able to invest in basic filtration systems, for silt screening for example, but leaders in smaller communities, particularly LSDs, do not see investments in new systems as a feasible option. One LSD representative exclaimed: “*Why would you want a multimillion-dollar treatment plant for this small community and who is gonna pay for it?*” Another added: “*We don’t have the money to hire an engineer and we don’t want a big system to get us off boil water*”.

Another notable, related challenge is the aging and failing water infrastructure. As noted above, most of these facilities were constructed over 40-50 years ago and have since received limited or no upgrades. These old facilities are susceptible to breakages and leakages, which affects capacity to support current demand. As participants suggested, this can be an even greater challenge with increasingly common extreme weather events, with instances of flooding and freeze thaw cycles more likely to cause damage to water distribution systems as piping ages. The failing water distribution lines in the Straits experience regular breakages, which affects the supply of good quality water in most communities. Chlorination-based disinfection was found to be the standard and common water treatment method in the Straits. In such systems, chlorine is lost during water spills, reducing the effectiveness of the chlorination and chlorine levels, sometimes leading to a BWA. Further, even when a portion of the drinking water distribution system is replaced, if problems remain in other parts of the system then leakages and contamination can still occur. This is reflected in the remarks by a town manager, participant SB02: “*And the lines are old and when you dig up and fix the lines and you don’t have all new*

ones running through, you're going to have a set of problems, right?" Another municipal representative adds that despite a new main line:

It was connected to a lot of existing older water lines in the LSD... one of the issues are facing, that raises issues now, we are on boil water most of the time, is because we feel we are not getting the correct readings ... if you think about, if you are getting to read at the end of the line, which is the home farthest away ... an old water line you are going to do that reading into that last home, so it would not necessarily be the same reading would be in last home in the new water line. Because I would assume that there will be more leakages on the older line and they would be losing more water and the chlorine levels would reduce.

Once again, fiscal realities present a further challenge when community leaders attempt to address these infrastructure gaps. As one mayor explains, “coming out with 10% of our funding project of \$0.5 million dollars is a huge task for us. So, we have a small tax base and we have a LSD that doesn't have any tax base ...”

The dislike for the chlorination-based disinfection method of water treatment by residents in some communities is yet another challenge affecting water supply. One LSD representative reported that a resident allergy to chlorine led to the community ceasing chlorination. According to some provincial respondents, there is also a long-held claim, especially in LSDs and UIAs, that chlorine residuals in drinking water can cause cancer when the water is consumed for extended periods. This in turn is a deterrent to chlorination in drinking water systems. While the use of chlorine minimizes the microbial impact in water, it can have side effects on human health when the disinfectant by-products (BDPs) are in excess (Drogui & Daghrir, 2015). Although public health studies have observed a link between the long-term consumption of water with high levels of BDPs and cancer risk, other suggests there has not been any clear evidence to that effect (Li & Mitch, 2018). For more on DBP-related issues in rural NL water systems see Daniels & Vodden (2015).

One final challenge raised was that the absence of business entities or commercial activities such as motels, restaurants, and tourist destinations that require good quality water to operate in many of the communities. Participants suggested that this could be contributing to the lukewarm attitude towards improving the community's water supply.

2.4.2: Responses to Drinking Water Challenges

Faced with such challenges, water managers in the Straits have explored options to resolve the most urgent problems associated with drinking water supplies. This has included seeking assistance from volunteer community members, the provincial government, neighbouring communities, and private companies to address these issues. Community members in the Straits lead and provide vital services to their communities, including the operation and maintenance of water systems. Particularly in LSDs and UIAs without paid staff, these roles are performed by community volunteers. During inclement weather conditions when source waters are disrupted or line breaks occur, volunteer community members often mobilize to solve the problem. One of the interviewees, participant SB06 remarked: ... *We fix it ourselves. This has occurred a couple times in a year as you guys have come to see us yesterday. Volunteers come in to assist sometimes – yesterday was the first time in a while we had an excavator.* An LSD representative added, “*we are pooling money to get the line fixed (for the cost of digging it up and insulating the line). Sometimes we will use the other people's water from the artisan wells if*

the main line is frozen or leaking.” In some circumstances where the water problem is beyond the technical capacity of community members to resolve, they call on neighbouring communities for assistance. An example provided by a municipal mayor: ... *We will, from time to time call on somebody else from other local communities if they have a similar issue and learn lessons from what they have done...* Another town manager and water operator noted that they share some water-related supplies and equipment with the Town of Rocky Harbour more than 200 km to the south.

Where possible, and with assistance from provincial and federal governments, communities in the Straits have also made investments to upgrade and renew their water systems. The example of the Town of Anchor Point provided above included, investments in new pumps, chlorination and screens/filtration screens. Representatives explained the flow meters were also to be installed soon to determine the amount of chlorine that is going into the system and self-regulate chlorination. In Flowers Cove “aging pipelines have been taken-up and replaced”, and in Bird Cove/Brig Bay, after waterborne disease outbreak led to eight confirmed and 242 suspect cases of illness from Giardia in August 1993, the majority of the water system was replaced. The original system had been installed in 1963 (Dawe, 2013). However, some portions of the distribution lines were not renewed, leading to ongoing leakages and BWAs. Another adds that, *“fixing one section puts some pressure on the other bits which causes more leaks.”*

The provincial government has come to the aid of rural communities through programs such as the Municipal Capital Works (MCW) and federal cost-shared infrastructure funding programs, a regional water operators pilot program (2015-21), and the Drinking Water Safety Initiative (DWSI), focused on communities with populations of less than 500 people and demonstrated multiple high risk drinking water quality such as long term BWAs, high levels of DBPs or exceedances of other health related parameters (NL, 2020). In 2017, the Province began to provide a 90/10 funding ratio for municipal drinking water infrastructure investments, with the provincial government providing the 90% share (MNL, 2017a). Towns like Anchor Point, Bird Cove, and Flower’s Cove, and LSDs such as Black Duck Cove and Plum Point have benefited from these funding programs to build or upgrade their water infrastructure. A municipal representative explains that they *“have an application to capital works to complete the other homes with new water lines, so if we have the funding, hopefully the next spring, our entire community will be on the new water line system.”* These and other provincial contributions in area such as training and water testing illustrate the relevance of the multi-level collaborative governance theme of new regionalism (see Section 1.6), with the provision of clean, safe drinking water to the province’s residents being a shared responsibility requiring commitments and collaboration from multiple levels of government and other stakeholders in drinking water service delivery and governance.

Key points related to challenges in Straits drinking water systems and solutions that have been employed to date are summarized in Table 2.4 below:

Table 2.4: Summary of Key Points on Water Management Challenges and Responses

Category of Respondent/ Key Point	Water Challenges	Responses
Community Leaders	<ul style="list-style-type: none"> • Aged water lines cause breaks and leakages and unstable chlorine levels, leading to BWAs. • Difficult to locate leaks especially during the winter and to dig frozen ground to fix. • Difficult to raise 10% to earn 90% provincial funding. • Low population reduces human and financial capacities of communities. 	<ul style="list-style-type: none"> • Some communities have received provincial funding for system upgrades. • Often repair damaged systems themselves or hire services of private companies if possible and/or look to neighbouring communities for advice. • Only one municipality has a leak detection device; others use spills on the ground or chlorine levels to find leaks. • In some cases, boiled and/or purchased bottled water is relied upon as an alternative due to severe water challenges.
Provincial Officials	<ul style="list-style-type: none"> • Poor quality of source water, particularly during winter months in some communities. • Unauthorized activities around water sources. • Some communities do not accept chlorination-based water treatment. • Small populations with low taxes and revenues. • Aged infrastructure is failing, which increases maintenance costs. 	<ul style="list-style-type: none"> • Community education is needed on water quality and standards. • Engineering solutions are also required in most communities to restore water systems.

Source: Adopted from Chireh, 2018: page 55

These discussions have highlighted some proposed solutions to drinking water management in the Straits, including the potential for regional approaches to managing water (such as sharing of knowledge and expertise) that build on previous experiences with collaboration.

2.5: Examples of Service-Sharing in the Straits

There are a number of examples of joint services among communities in the Straits practiced based on their closeness or common need/interest in areas including water supply, waste management, fire and youth services. Table 2.5 below shows examples that were mentioned in the interviews. Shared services that are noted as formal initiatives refer to those entered into through a signed agreement among communities that may be supervised by community representatives and/or by upper-level governments. Informal initiatives include service-sharing among communities without any signed agreement, relying instead on verbal negotiations and understanding.

Table 2.5: Existing Regional Service-sharing in the Straits

Service	Communities	Brief Description
<u>Water Related</u>		
Water Supply	Flower's Cove (municipality) and Nameless Cove (LSD)	<ul style="list-style-type: none"> • An informal agreement; Flower's Cove sells treated water to Nameless Cove for a fee (pay for use). • Each community manages own distribution lines and testing. • Respondents consider it a successful initiative.
Water Supply	Bird Cove (municipality) and Brig Bay (LSD)	<ul style="list-style-type: none"> • Volunteers in Brig Bay manage their part of the system (testing chlorine levels, upgrades for distribution lines, and collection of water service fees to cover the bill owed to Bird Cove). • Inadequate funding and the loss of water from breakages in older lines were reported as major challenges.
Water Supply	Bartlett's Harbour and Castor River North (both LSDs)	<ul style="list-style-type: none"> • Bartlett's Harbour supplies treated water to Castor River North; charge a fee based on consumption. • Aside from high DBP recordings, the collaboration has been successful, according to respondents.
Sharing equipment and knowledge	The Straits	<ul style="list-style-type: none"> • Informal consultations among neighbouring communities to help fix broken water systems or lend/borrow water-related equipment.
<u>Other Service Types</u>		
The Straits Volunteer Fire Department	13 communities (Eddies Cove East to Anchor Point)	<ul style="list-style-type: none"> • A formal arrangement administered by the Northern Peninsula Services Board. • Volunteers are from member communities. • Community representative suggest has worked well.
Fire Department	St. Barbes, Foresters Point, Black Duck Brook and Pigeon Cove	<ul style="list-style-type: none"> • Three communities have a fire department made up of volunteer community members. • Management administers the finance and services of the department.
The NorPen Waste Management Authority	22 communities	<ul style="list-style-type: none"> • Formed based on recommendations of engineering feasibility study and to implement Provincial Waste Management Strategy. • Three subregions: Subregion 1 (St. Anthony – L'Anse Aux Meadows); Subregion 2 (Main Brook - Englee); and Subregion 3 (the Straits) (Eddies Cove East - Castors River South). • Administered by a seven-member board representing each subregion; hired coordinator oversees day-to-day supervision. • Resident fees for collection and administrative expenses.
Regional Community Youth Network (CYN) and Centres: Flower's Cove and Plum Point	Flower's Cove: 11 communities (Anchor Point to Eddies Cove); St. Barbe/Plum Point: 14 communities (Castor River South to St Barbe)	<ul style="list-style-type: none"> • Administered by elected youth executives from participating communities (target ages 12-18). • Focus on services and support of learning, employment, community building (one-on-one and groups). • Youth activities in leadership and civic engagement, work experience/volunteering, career and entrepreneurship skills. • Funded by NL government (through National Child Benefit Reinvestment Fund).

Source: Adopted from Chireh, 2018: page 63; Blackmore (2003); Towns of Bird Cove, Anchor Point & Flower's Cove (2003), Government of NL (2000c)

Additional regional services for youth include the school (Viking Academy), serving Pond Cove, Bird Cove, Brig Bay, Blue Cove, Plum Point, St. Barbe and Castor River and a Family Resource Centre located in Flower's Cove, which provides support for pre-school children and their parents. The Junior Canadian Rangers Program is led by the Department of National Defence (DND), the program focused on integrating practical skills and cultural practices (ranger skills, traditional skills and life skills) and is available in remote communities across Canada. According to published program information, the Port Saunders patrol includes 23 communities from Castor River in the South to Eddies Cove in the north (approx. 80 km), with Flowers Cove and Plum Point as focal points for the patrol and its 99 members, 20 member Adult Committee and 20 more volunteers (Canada, 2000).

Participants explained that St. Barbe and surrounding communities also share an arena. The Straits Arena is run by a volunteer association of over 60 members, with self-generated revenues raised through sources such as canteen sales, hockey registration and rentals, as well as other community fundraising efforts such as door-to-door donation collections (Bartlett, 2017). Other examples of collaboration among communities referred to in secondary documents include the Bird Cove/Pond Cove Fire Department (one municipality and four LSDs and unincorporated areas), and the GNP Joint Council (16 towns represented by their mayors) (Towns of Bird Cove, Anchor Point, & Flower's Cove, 2010; Blackmore, 2003), and the Integrated Community Sustainability Plan (ICSP) developed by the Towns of Bird Cove, Anchor Point, and Flower's Cove.

2.6: Experiences to Date with Regional Approaches

Experiences from existing service-sharing arrangements in the Straits have the potential to influence respondents' views on regional approaches in managing drinking water systems. Respondents shared their views on potential areas of regional collaboration, as well as some benefits from, and potential challenges to regional water management. These are summarized in table 2.5 below. A key lesson from these examples is that respondents are inspired by and have gained experience from past experiences. This increases confidence in the potential for regional water management. This is evident in the statement by a municipal mayor: *... we have proved it with the Youth Center, we have proved it with the fire service, and the waste disposal was beginning to screw up, but it can be another benefit if it was done the right way. Shared services can work.*"

The success of joint services was assessed by participants in relation to the current level and quality of services they receive as a result, and the costs involved. The respondents evaluated many existing joint services as successful while others, particularly the regional waste management system, have been confronted with challenges. Serving a region from River of Pond northward, one representative suggested that the region was too large. The most repeated concerns, however, included inconsistency with rules and regulations and poor communication related to changes that are put in place. Municipal representatives provided the following examples:

I have been away for a while and my garbage is being picked up, but all of a sudden they were not picking up my garbage! So, I contacted the minister: Well your garbage should be within 10 ft. from the road. Ok. So, I went up and measured mine. And mine was 2.5 ft. from the road, and they were not picking up... There is inconsistency in applying

regulations they have put in place. And they don't communicate the regulations very well. So, yeah, there are challenges.

The original plan was that we were going to have three or four transfer sites here and there was supposed to be a super site going somewhere in the west coast, somewhere in Corner Brook or Deer Lake area. We are now, it has now been advised that the super site is now going to be at Northern Arm. If we have to transfer garbage from here to Northern Arm, I can see our rates are going to be sky-rocketing. So, we have been fighting that.

Table 2.6: Summary of Key Points on Regional Approaches

Community Leaders	Provincial Officials
<p>Regional Approach</p> <ul style="list-style-type: none"> • Aspects of water system that can be shared; water supply, distribution lines, water operator, source water protection, water quality monitoring, logistics within reasonable distances. <p>Benefits</p> <ul style="list-style-type: none"> • Can deliver quality water supply at a lesser cost. <p>Challenges</p> <ul style="list-style-type: none"> • Declining and aging population will affect the human and financial resources of the region. • Alleged little or no interest and support from the provincial government. • Unfavorable geography (e.g. long distances between communities, and hard underlying rock). • Perception of loss of identity, sovereignty, and independence by small communities to bigger ones in a shared water system. • Differing community governance structures (municipal, LSDs, UIAs) and capacities. • Challenges to reach a consensus on various communities' needs/interest. <p>Potentials</p> <ul style="list-style-type: none"> • Several clusters of communities. • Available headwaters to support peak demand in a shared water system. • Evidence of other successful shared services. • Willingness of communities to collaborate and the provincial government to support. <p>Recommendations</p> <ul style="list-style-type: none"> • Small clusters of communities should be considered. • Provincial government should lead the process through consultations, policy reforms, financial and logistical support, and human resources. • Begin with a pilot sharing of one component of the water system. 	<p>Regional Approach</p> <ul style="list-style-type: none"> • Would depend on distances, quantity of potable water, condition of infrastructure, and tax base. <p>Benefits</p> <ul style="list-style-type: none"> • Ability to have someone continuously monitoring and checking on the water system. • Can reduce the cost of supplying quality drinking water and reduce BWAs. <p>Challenges</p> <ul style="list-style-type: none"> • How and where to get the skilled people to manage the water system. • Some people don't want chemical treatment or additional cost. • Disagreements among communities on sharing of cost and responsibilities. <p>Recommendations</p> <ul style="list-style-type: none"> • Education and sensitization of communities on water safety. • Learn from other service-sharing initiatives in the Straits and elsewhere. • Upper-level governments should intervene through financial and technical support.

Source: Adopted from Chireh, 2018: page 63

Community respondents were positive overall regarding experiences to date with sharing water-related services and expertise. There have been some challenges when one community has older infrastructure than the other (e.g. Bird Cove and Brig Bay). In this case the communities are working together to pursue eventual upgrades of the entire distribution system and, while the operation of the intake and treatment is led by the municipality, each community takes responsibility for testing and applying for funding necessary infrastructure upgrades. In both the Bird Cove/Brig Bay and Flower's Cove/Nameless Cove cases municipalities provide treated drinking water to their neighbouring LSD for a fee. There were no concerns expressed about this arrangement, although one municipal representative suggested, "*we run issues from time to time over the years in collecting fees and getting them to understand the operations of it.*" Similarly, the LSD of Bartlett's Harbour supplies treated water to Castor River North. Again, respondents report that the collaboration between these neighbouring communities has worked well overall. Provincial perspectives on regional approaches to water management are also informed by previous experiences, including: the Regional Water and Wastewater Pilot Program; examples of communities in western and central NL that came together to share a water operator (Minnes & Vodden, 2014; Rolling, Chant & Gazley, 2017); and shared water supply systems such as the Exploits Regional Water Supply at Grand Falls-Windsor (Government of NL, 2014; Exploits Regional Service Board, 2008). The regional water/wastewater operator pilot program in selected communities in central, western and eastern NL has resulted in several communities being taken off BWAs, some that had been in place for 15-20 years, while others improved their maintenance practices by creating and implementing [Maintenance Assurance Manuals](#). Funding has been acquired for new infrastructure, system monitoring and chlorine adjustments improved, community awareness and education activities undertaken, and new shared water supplies/multi-community water systems established. It is worth noting, however, that in the western region some communities, particularly LSDs, did not have the capacity to participate in the program due to lack of financing and weak governance structures, and also a lack of interest in some cases in chlorination. Five new communities did later join the program (Rolling, Chant & Gazley, 2017).

In Central NL, six neighbouring communities across a distance of 88 km from Centreville-Wareham-Trinity in the south to Musgrave Harbour in the north, shared a single water operator, facilitated by the Bonavista North Joint Council. Despite their varied water systems (e.g., hypochlorite vs. gas chlorination treatment) the group saw successes such as improved water record keeping, quick identification of system problems, increased training activities, and improved regional asset maintenance programs and plans (Breen & Minnes, 2015; Daniels, 2014). Another successful example is the hiring of a single certified water operator by the communities of St. Paul's, Cow Head, Parson's Pond, and Daniels Harbor to the south of the Straits on the Great Northern Peninsula, again leading to lifting of BWAs in three of these communities. In each of these cases, the towns save on the human and financial costs that would be incurred if each community were to hire their own trained water operator (Rolling, Chant & Gazley, 2017; Vodden & Minnes, 2014).

Yet another example related to shared water infrastructure is the supply of water by the Town of Grand Falls-Windsor under the regional service provisions in the Municipalities Act to neighbouring communities. The system was initiated in 1972 and built with federal support in 1976, with the Town of Grand Falls-Windsor charged with operations, planning and budgeting of the system, including operations of a water treatment plant and other infrastructure. Initially a 13-km water main line connected Grand Falls-Windsor and Bishop's Falls. In 2005, an 18-km line was constructed to connect Botwood and Peterview. Flow meters measure the water

supplied to each community, with bills calculated accordingly. The costs of water treatment, distribution as well as other operational costs are shared based on community population and paid monthly bill to the Town of Grand Falls-Windsor. In most communities, households are then charged a flat-water tax or rate to offset the costs of the system (Chireh, 2018; Exploits Regional Service Board, 2008). St. John's metropolitan area and Corner Brook offer further examples of larger centres in the province sharing water supply and infrastructure with neighbouring communities.

PART 3: DISCUSSION

3.1: Prospects of Regional Water Management in the Straits

The lessons from the literature and the experiences from existing service-sharing initiatives in the region and elsewhere in the province can provide the basis for further collaboration among communities to jointly manage and improve water supply systems. The regional approach proposed in this project can be seen as any form of collaboration among communities to jointly manage water supply systems to provide good quality drinking water for the populace within a specified location. This shared water management can be through formal documented agreements, or more informal, casual agreement among communities. However, as investments in human resources and infrastructure increase so does the need for greater clarity and formal documentation of agreed upon arrangements for service delivery, financing etc. While leaders of individual communities continue to work to provide potable drinking water to their residents, there are significant barriers to achieving this goal in the Straits, and in other small, rural communities. This is evident in the many BWAs and continuous recordings of high levels of DBPs in many communities in the Straits, for example. Service-sharing, including the sharing of water supply (piped infrastructure, treated water and related equipment, etc.), has been successful in the Straits and other places, demonstrating benefits for communities to come together on a regional-scale to manage parts or the whole water supply system. For instance, multiple communities could pool limited resources together to finance the training, hiring, and retention of qualified and certified personnel such as water operators, engineers, and planners to develop proper asset management plans for the Straits. Community representatives mentioned the following aspects of water systems that they felt could be shared: treatment and distribution infrastructure (perhaps allowing for new treatment options such as UV), access to equipment/replacement parts, bulk ordering of supplies, water quality monitoring and a trained/certified water operator.

I think if you get a properly trained regional water operator, they can certainly take care of say 3 pump houses and three water systems in 3 small communities. I think in a round of a week... And as long as I think municipalities and some LSDs can have oversight and make use of their individual community water systems, they might be OK with the sharing of regional water operator if properly trained. As long as they get a day or they get equal time to be able to deliver what they need. Like I said, in most cases we've got a regional water operator who is working only 10 hrs a week anyway, so we combine all those 10 hrs together and maybe give it to one that we share full time... If we join together they could be fully trained regional water operator on a full-time basis not somebody who is a part-time water operator and part-time fisherman and a part-time everything else... regularly and truly maintaining and monitoring all the systems, which is what we need.

Experience has shown that this kind of collaboration can provide enhanced capacities through economies of scale and cost savings, improved quality of services, and improvements in public health (Furlong & Bakker, 2011; Haque, Csapo, & Round, 1999). Many respondents in this project recognized that regional approach to managing water supply systems that involves place-based planning and an established relationship with other levels of government could help resolve water challenges and build regional resilience. Benefits envisioned included the potential for cost savings and a better, higher quality service. Several municipal representatives also

suggested that regional water systems and/or management could be one function of a regional government should such a system be put in place, or part of a regional government pilot project.

Based on these project results, the following section discusses the potentials and opportunities of the Straits to adopt a regional approach to drinking water supply going into the future. These discussions consider the themes of new regionalism: multi-level collaborative governance (involving state and non-state actors working together for the common interest of regional development), place-based development, integration, innovation and knowledge sharing, and rural-urban interdependence⁶ (Gibson et al., 2015; Vodden et al., 2014; Luo & Shen, 2012). New regionalism's place-based approach requires that regional governance, in this case drinking water governance, be based on geographical, social, economic and/or political/administrative realities of the region in question, with particular emphasis on regional strengths (or assets) that can be built upon. The following discussion of the study findings is, therefore organized by considering three key sets of factors highlighted in this research that could facilitate or impede regional water management in the Straits: physical geography, the social and economic conditions, and political and administrative structures. We first discuss strengths of the region within each of these realms, followed by a discussion of related challenges (3.2).

3.1.1: Geographical Conditions

In terms of place-based strengths, there are two major place specific advantages related to the geography of the Straits region that can support a regional water system. These include the existence of clusters of communities within close proximity and the availability of sufficient and shared source water supplies. While the Straits stretches over 80 kilometres, there are several smaller groups of communities within shorter distances. These groups of communities could share source water bodies (and indeed some already do) within a regional water system. For instance, from Pigeon Cove-St. Barbes to Forrester's Point and from Pond Cove to Brig Bay are smaller clusters within a five-kilometre range that could potentially share a water supply. In each of the cases, the distances between these communities appear to be convenient for sharing water, comparable to the 18-km water distribution line that serves five communities in the Exploits Regional Water Supply example (see further examples in Chireh, 2018).

Multi-community collaborations in sharing water supplies are more feasible where source water is sufficient to meet the higher water demand that results when several communities come under a single water system (Dore, 2015). As noted, the Straits has vast source waters (in brooks, lakes, and springs) that are strategically located near these clusters of communities. This offers some advantages for constructing a shared water system within these shorter distances. This is reflected in the following comment by a municipal mayor:

Water sharing depends on where the headwater is coming from, tying into us it is related to geography, the cheapest and closest options... If you look at the headwaters here within certain communities, we have tons and tons of headwater. You can have two or more communities to share headwater. Now, with the regional water supply, again, it depends on the amount of headwater. And it is much easier to get source water from Eddies Cove and supply to Eddies Cove and the surrounding

⁶ Recognizing that urban-rural relationships within the study region are relationships between larger and smaller communities given that all communities involved have less than 500 people, although relationships with decision makers in urban centres of Corner Brook and St. John's are also relevant.

communities than get source water from cross-country and draw a line to Eddies Cove.

Shorter distances can help to mitigate the challenge of freezing and leak detection, particularly during cold winter seasons, that are likely to occur in longer distribution lines. Similarly, water managers and operational staff (and/or volunteers) could easily travel for meetings or to service the shared water system within a close distance. The close proximity of these clusters of communities could significantly reduce the financial cost to traverse water distribution lines across longer distances as well as the human resource demands to serve neighbouring communities.

3.1.2: Socio-Economic Conditions

Multi-community arrangements that involves multiple stakeholders engaged in system design, funding and implementation as well as governance interactions are influenced by various socio-economic factors. For example, there can be difficulties when communities with independent identities interact in an attempt to collaborate in the pursuit of a single goal (Daniels et al., 2014). This is particularly challenging when identities are distinct, without shared characteristics, and/or where there is limited history of social interaction. In the Straits, however, there are several socio-economic factors that could support regional water management. These include: 1) volunteer commitment and willingness to support one another; 2) relationships among communities resulting from existing joint services and regular interactions; 3) the similarity of water challenges in the Straits and related experiences (including economic/financial constraints), which provide common concerns; and 4) a common belief among many community participants that a regional approach could help to resolve water challenges. These conditions create some common ground and foster social capital, which can be considered as a resource (or place-based asset) to support a joint management approach.

This study has revealed that there is significant potential in these rural communities in the form of a communal and volunteerism spirit among residents, particularly in times of challenges. This is combined with a common identity and apparently cordial relationships among neighbouring communities. The communities have identified themselves as part the Straits region. Additionally, communities have often depended on their neighbours to resolve development challenges, showing and building strong social linkages. In the various communities, individual members have shown that they are prepared to volunteer money, time, and labor during times of critical water challenges (e. g., broken pipelines, collapsed brooks). There has also been support offered by neighbouring communities in terms of equipment or consultancy services. This illustrates the social capital in the region, which is a key ingredient in multi-stakeholder collaborations and partnerships that could be drawn upon in the implementation of a regional water management approach. Building strong social ties means "to go beyond the adversarial politics of competing interest" (Lasker & Weiss, 2003 p. 24). These relationships and bonds can facilitate knowledge flows and dialogue that will aid in developing compromises and consensus in the collective interest of the region to tackle water challenges.

Experiences from existing joint services could serve as a starting point and motivation for expanded collaborations related to water supply and management. The experiences of the many existing joint services among some clusters of communities in the Straits (as outlined above in section 2.5) provides lessons and common ground to build upon. Building on the existing trust and interdependence among communities enhances the likelihood of voluntary participation in

regional water management. Current joint service delivery was often as a result of common challenges in the past, which led affected communities to collaborate. These previous experiences, largely considered to have been successful, offer optimism for many community representatives experiencing water challenges that a viable option may be to combine individual community strengths and resources as witnessed in these previous experiences. A municipal representative provided an example: “*we currently share fire service for example between the 5 communities in this small catchment area, so 1 municipality and 4 LSDs and unincorporated areas... We do that quite well again now, so, there could be an opportunity to share even with those LSDs with a regional water operator*”. The success of current joint services also shows the potential to build on and strengthen interdependence between larger and smaller communities. These interactions, and others that occur in day-to-day interactions and through friendship and kinship ties, have created social relationships that may allow the issue of drinking water systems and provision of clean, safe drinking water to become a broader regional concern.

There is growing agreement in the Straits region on the potential for regional approaches to water management. Most respondents admitted that a regional approach could help to mitigate common water challenges and other development marginalities that confront the Straits. This is reflected in the remarks by a mayor, who expressed: *I strongly agree. I do not know how we are going to get there, but I strongly agree where we are, we seem to be moving to a point that we are not going to have a choice*. This was echoed by other interviewees. Leaders in the region’s municipalities, in some of the LSDs and UIAs, and provincial officials appreciate that with the present context (e.g., small tax bases, low revenues, aged/retiree population), it will be difficult for communities to individually address their water challenges. When asked if they think water supply systems can be managed on a regional-scale (by several communities) representatives of all three participating municipalities agreed that this was possible. LSD representatives were mixed. Some feel regional approaches could work, others are divided even within their organizations, and others do not feel this is a viable option. When further asked if they agree or disagree that we should be moving towards more regional approaches, again, all municipal representatives either strongly or somewhat agreed, while LSD representatives had mixed views, with an equal number stating that they strongly disagreeing as those who somewhat agree. While not universally agreed upon, this common interest paves the way to further explore the potential and possible next steps to adopt a regional water management approach.

3.1.3: Political/Administrative Conditions

A regional water management approach would require a conducive political and administrative environment to thrive. Gibson (2015) argues, for example, that upper-level government support is a major component to the success of lower-level government collaborations. An increase in provincial support to rural communities could facilitate the adoption of regional approaches at the local level. This study found that the provincial government has been supporting and collaborating with rural communities for many years, particularly towards capacity building for communities to solve their water challenges. Provincial officials are aware of the multiple water challenges and other development deficiencies in rural NL, including the Straits region. The provincial government has also acknowledged the inability of individual communities to address these challenges. Therefore, various supports have been offered, particularly for regional initiatives (DMAE, 2016). For instance, the provincial government provided the first-year remuneration for the water operator in the shared water operator case example in western NL and supported the regional water/waste

water pilot program (DMAE, 2016). The Province also provides technical and logistical support to communities such as water sampling and testing, and the education, training and certification of water operators for public water systems that could enhance a regional water system. Finally, the NL government has held regional government consultations, examining the potential to bring communities under a regional government system.

These current roles played by the government could be helpful in establishing an expanded multi-level collaborative governance model that taps into local and provincial government commitments to solve the current challenges in the system with a focus on the regional scale. Although there are potentials and opportunities in the Straits that can facilitate a regional water management strategy, there are also challenges to its implementation. The next section expands on some of the existing challenges that (may) hinder a successful regional water management system in the region.

3.2: Potential Challenges of a Regional Approach

While there are potentials in the Straits to embrace a regional water system, it can be difficult to bring together independent individuals or communities to work together and share goods/services. It has been shown in other related research (e.g. Robinson, Rosenberg, Teel & Steinback-Tracy, 2003; Mandel, 1999) and in this project that some challenges should be expected; therefore, these should be identified where possible and potential solutions offered upfront. Many of the challenges of current water supply systems are liable to affect regional water management. Additional challenges that could affect the adoption of a regional approach can again be categorized as geographic, socio-economic, and political/administrative considerations and are discussed further below.

3.2.1: Geographic Challenges

One major expected challenge to the regional approach described in this study was the unfavourable geographic characteristics of the region such as long distances between some communities, and difficulties associated with a rocky, uneven landscape and winter freezing. For instance, if the 80km stretch of the Straits is considered for a shared piped infrastructure, there could be maintenance challenges. Particularly during the winter seasons, water distribution lines laid for longer distances are likely to freeze and line breaks could be difficult to locate and fix due to heavy snowpack, particularly if lines are unmapped (without enhanced asset management). Although water distribution lines have traversed for longer distances to serve municipalities, such as in the Metro Vancouver case example provided above, differences in geography, human and financial capacities all play a part in their success. It might be difficult for small communities with limited resources, as in the case of the Straits, to adopt such a model. The cold climates in NL are described as very hard on piped infrastructure. This combined with the rocky terrain would affect a shared water approach comprising communities within a larger area. Further investigation of large water systems within similar environments may be helpful in this context.

3.2.2: Socio-Economic Challenges

Other possible limitations to a regional water management system are the demographic trends and related fiscal challenges facing the communities of the Straits. According to Statistics Canada (2017), the population of the Straits is aging and rapidly declining, which will affect the

region's economic and human resource capacity to jointly manage a water supply system (and continue to challenge their ability to manage their current individual systems). As noted above, many communities are home to retirees and seniors with limited economic activity. Several participants noted a link between demographics policy surrounding Crown lands access. They reported that difficulties involved in acquiring crown lands in the various communities within the Straits affects the establishment of businesses as well as residential construction, therefore exacerbating the demographic decline.

These demographic characteristics and trends limit both revenue generation potential for communities (to support human and capital resource investment) and the available workforce to support regional water management. A regional water management approach would require trained technical personnel and strong local leadership to oversee implementation. Given the demographics and the characteristics of current water managers in most communities, there is a concern about the future availability of necessary human resources to sustain water supply systems, whether under management by individual communities or regional water authorities.

A small tax base and aging population with little ability to absorb significant increases in taxation or fees also limits the ability of communities to contribute to infrastructure investments, even when upper level governments are willing to cover the majority of related costs. As one LSD representative observed, "*there is a big cost for proper treatment of water,*" and as one mayor added, "*People are not here to pay the money*". Communities representatives remarked that they struggle (and would struggle if an expensive new system were put in place under a regional approach) to raise the 10% of the project cost required for their contribution under the Municipal Capital Works program for provincial support for new water infrastructure. Ultimately, given their demographic situation, some representatives felt that large infrastructure investments in particular but also "*the costs of sharing*" generally would not make sense in their communities:

Water and sewage involves multiple million dollars. We might need about \$6.8 million to bring it up to the snuff. How long does it take to pay that back? Will people be alive or left around to use the service. To take on a big cost – but everyone is aging. A lot of people buy their drinking water from the shops and that's just a cost of living around the bay.

3.2.3: Political/Administrative Challenges

While existing political and administrative structures offer potential opportunities that can be tapped into to facilitate a regional water management approach, there are also several related challenges. The current administrative structures in the communities of the Straits present disparities in capacity, authority and responsibilities. The incorporated municipalities, LSDs, and UIAs, have varying degrees of power, responsibility, and capacities (Gibson, 2013). While municipalities operate within the Municipality Act to legally charge taxes and provide essential services, the LSDs and UIAs have no formal government structures and limited or no jurisdiction to charge taxes (only fees in exchange for a service). As a result, they often rely on volunteers to provide essential services to their residents. Differences in community administration, human resources, and taxation ability are likely to impede the smooth implementation of a regional water management system.

Specifically, the differences in financial capacities and history and powers of taxation between municipalities and LSDs (and UIAs) could discourage some communities to join a

shared water system that involves cost-sharing. As noted above, this was seen in the provincial regional water operator pilot program as well within the western region. In LSDs and UIAs that currently do not pay taxes or fees (or pay limited fees for waste collection, for example) it may be difficult to collect service fees and charges. “*Why would they want to pay taxes?*” asks one Straits municipal leader. Another explains:

The biggest challenge, I guess for us between is the political framework of LSD and municipalities.... A lot of all these other communities while they have LSD on paper..... they are not functioning as LSD really... we have raised the issue to government and to whoever would listen from time to time and time to time again.... they don't have.... on a large scale have the capacity to operate the systems that we have in place as small municipalities... we have the municipality act.... just don't feel... we have got necessarily a free playing field that is going to come between LSDs and municipalities. ...they are often scared of having to pay property taxes or extra fees or whatever...”.

Many of the region's LSDs and UIAs appear to be unlikely to voluntarily accept new charges based on interview results and previous discussions: “we talked with smaller communities but the older ones (ones with an older population) said no. If it was going to cost more money to the individual then, they would not participate in such a collaboration”. Several LSD representatives explained that they are willing to accept the consequences of not having to invest in a treated, certified water system, expressing comments such as: “*no one gets sick and we don't mind having to boil it*” and “*People have been drinking this water for over 60 years and had no problems...People still get water from the store*”.

Mistrust is also a factor. Some smaller communities presume that they would only incur extra taxes or cost if they were to join a regional water management system, sharing high municipal operational costs through the payment of taxes and/or fees without commensurate benefits through improvements in their water situation. An LSD volunteer suggests: “*You know what, it's not going to happen. You go and partner with other big community, they will get the benefit, we get none. And that is what is going to happen.*”

Municipalities, on the other hand, are willing to commit and pay tax (increases) or service fees to finance regional water management activities in order to provide quality water. Concerns exist within these communities as well, however, about sharing human resources and/or infrastructure without benefit despite additional costs to their towns. Given that some smaller communities will require investments to bring them up to the level of current municipal water systems and, ideally, to enhance services for all, municipal representatives suggest that provincial funding will be required: “*It is not about doing it. The question is cost. Who pays the cost? ... Water services can be shared regionally if the provincial government comes on line and puts some money into it...*”

These differing views and political and financial considerations will make building consensus, trust, and commitment, all crucial ingredients for collaborative approaches in regional drinking water management, challenging to achieve. Reaching agreement on financial and service arrangements that are considered equitable with regard to who gets what services (e.g. quantity and quality of water supply), when (e.g. scheduling of a shared drinking water operator), how, and, perhaps most importantly, who pays will be key. This will require the ability to engage in dialogue and overcome differences to come up with an agreement that is considered fair by all parties. Experiences from other shared services within the region and models of shared water services elsewhere can be helpful in this process.

PART 4: CONCLUSIONS AND RECOMMENDATIONS

4.1: General Conclusions from the Research

The first objective of this study was to identify current water management challenges in the Straits. These include the presence of long-term boil water advisories and high levels of disinfectant by-products, failing infrastructure, and inadequate financial and human resource capacity (as discussed in sections 2.1-2.4 of this report). A second, key objective was to identify aspects of the drinking water system that can be delivered on a regional-scale. Community representatives suggested that opportunities for expanding current collaborations related to drinking water service provision could include: expanded sharing of treatment and distribution infrastructure, shared access to equipment/replacement parts, bulk ordering of supplies, and enhanced chlorine management and water quality monitoring with the help of a shared trained/certified water operator. Several municipal representatives also suggested that regional water systems and/or management could be one function of a regional government should such a system be put in place, or part of a regional government pilot project.

Moving towards a more regional approach to drinking water systems in the region will come with a number of challenges. Some smaller communities with little or no tax revenues tend to view regional water management as mere increases in expenditure without expected commensurate benefits in quality water service delivery. Additionally, the differences in capacity and responsibility among larger and small communities, particularly in terms of taxation and the ability to generate revenues to pay for water services, were raised as a concern. The unequal levels of human and financial resources among the region's communities may impede a water-sharing agenda and necessary sharing of costs and responsibilities, although this can be overcome with negotiated agreements and has been overcome with shared services in the past. It is also important to point out that, in this context all of the communities in the region have less than 500 residents and most have a similar demographic profile. The most relevant and challenging differences are in the differing legal and administrative structures of municipalities and LSDs (or UIAs).

Despite these challenges, the findings of this study suggest that greater collaboration among communities to jointly operate and manage water systems is one solution to drinking water challenges in the Straits. The study shows that small, rural communities that share water supply and/or related services (such as a regional water operator) tend to maintain better access to clean drinking water than before entering into these arrangements, at a reduced cost to the provision of equivalent services in each individual community. For example, benefits from the provincial regional water/wastewater operator pilot program have included cost savings, enhanced capacities, and improved water quality in participating communities. For instance, boil water advisories have been lifted, new infrastructure developed, asset management and maintenance plans created and implemented.

Three major factors suggest that the capabilities of the communities in the Straits region outweigh the challenges to adopting a regional water approach, and position this research as a timely contribution to advocacy for regional water management in the Straits region: 1) the inability to date of individual communities to resolve their water challenges (e.g. long term BWAs), 2) the region's declining and aging population and related fiscal challenges, and 3) the willingness of the provincial government to support multi-community collaborations in providing essential services. Strong social networks and previous collaborations, a common need

for a quality water supply in the face of shared drinking water challenges, abundant and adjacent water supplies, and groups of communities within close proximity offer a foundation for the success of a regional approach to managing water supply systems. Additionally, the support of the provincial government for enhanced drinking water services can help the region's communities in overcoming the geographic, socio-economic, and political challenges identified.

Although there are challenges to implementing regional water management, communities of the Straits could overcome these challenges if they are willing and committed to a regional vision that extends beyond single-community interests. There is potential for significant breakthroughs in addressing community capacity challenges if communities reconcile their differing interests and come together at a regional-scale, pooling limited resources and efforts and both lobbying and collaborating with upper-level governments collectively. Fortunately, Straits communities have demonstrated their ability to rise up to this challenge and opportunity in the past, with several already existing examples of service sharing in water and other kinds of services. Therefore, the Straits region is relatively well positioned to share water components such as water supply, expertise, and watershed management responsibilities within certain jurisdictions as geography, resources and political will permit.

4.2: Recommendations for Regional Water Management in the Straits

Most respondents in this study acknowledged the potential for community collaboration in managing water supply systems due to both the impacts of current water challenges and the present and future capacity vulnerabilities of individual communities. Despite this potential the specific nature of that collaboration (or collaborations), as well the process and procedures needed to put new aspects of regional water supply and management in place remain undetermined. The issue at hand then is *what to do next?* The following section attempts to answer this question by discussing recommendations of community leaders and NL officials, combined with insights gained by the authors from experiences from other locales, for next steps towards an (expanded) regional approach to managing drinking water supply systems in the Straits region.

4.2.1. Recommendation 1: Identify and secure agreement on roles of primary and secondary stakeholders within regional water supply and/or management in the Straits region.

A fourth and final objective of this study was to identify the people and processes required to pursue further analysis and implementation of regional drinking water initiatives. A regional water management approach would need the support of various stakeholders to succeed. An important step in moving forward will be to establish different stakeholders' prospective roles and capacities in the regional water management system. Franch, Martini, and Buffa (2010) have grouped stakeholders under primary and secondary based on their relative importance, influence, and legitimacy. Although both groups of stakeholders are involved in achieving the goals and objectives of an organization or program, primary stakeholders are those directly involved and affected by the program outcomes (Todd, Leask, & Ensor, 2017; Komppula, 2016). Secondary stakeholders participate less directly, often supporting the actions of primary stakeholders. In this study primary stakeholders have been identified as community leaders, water operators, and residents in the Straits region as they would actively participate in and be directly impacted by the outcomes. A level of commitment, time, leadership, and funds would be

required from these actors to implement the regional water system. Residents and local governments have already been supporting water management in their communities by contributing funds, providing knowledge, skills and labour, and sharing equipment, and many of the participants in this study were willing to play a part in implementing a more regional approach. The specifics of what the role of these various stakeholders can and should be will need to be considered concurrently with decisions about what aspects of the drinking water system are to be shared, at what scale(s), and how these arrangements will be implemented (including who benefits and who pays).

Secondary stakeholders for this project have been identified as the federal and provincial governments, private companies, and neighboring communities, along with organizations such as Municipalities NL and Memorial University. All have important roles to play as well in supporting community efforts. Interviewees noted that for a regional approach to be successful in the Straits, the nature, scope, and operations of water management should ideally emerge from the communities and then receive support from secondary stakeholders. At the same time, many felt that senior government may need to play a more proactive role, at least in encouraging these discussions to occur through the provision of incentives and disincentives. The findings of this study suggest that the support of senior governments is urgently needed to facilitate processes of regional water management, and given the jurisdictional responsibility and funding expectation of the provincial government they might even be considered a primary stakeholder.

4.2.2. Recommendation 2: That the provincial government play an active role in facilitating and providing financial support for a regional drinking water initiative in the Straits.

Community respondents noted their appreciation for the support they have received to date from the provincial government in resolving water challenges, but they urged the Province to take an even more proactive approach in offering financial and other supports for regional water supply and management efforts. One municipal leader exclaimed, for example: *“We’re not going to be on board unless there is funding and start-up... If they don’t step up to the plate, it’s not going to happen...”* The recommendation that the provincial government play an active role in facilitating and providing financial support for a regional drinking water initiative in the Straits is supported by other research that illustrates multi-community or regional programs and projects initiated by lower-level governments often need the support of upper-level governments and authorities to succeed (Hanrahan, Minnes & Dosu, 2016). This provincial support could take many forms. Funding is critical and emphasized by community leaders, but other important forms of support include funding, technical assistance (training, information and advice), and encouraging participation by the region’s LSDs, possibly through policy and legislative reforms. Municipal respondents called for policy reforms to increase the capacity and responsibility of LSDs and UIAs as local governments and to enable these communities to contribute proportionately to regional-scale water management alongside incorporated municipalities. Some respondents suggested that further incentives to participate in a regional-scale initiative (or disincentives to continue current practices) would be needed to attract communities into more regional approaches to service delivery.

4.2.3. Recommendation 3: Further assess existing clusters of communities to establish their specific potentials for water service-sharing informed by community characteristics.

While the support of upper-level governments is needed in the processes of regional water management, it is important to acknowledge place-specific needs and community characteristics in the design of local services and governance arrangements. A third recommendation for moving forward is further assessment of the existing clusters of communities within the Straits to establish specific potentials for water service-sharing arrangements of different types at appropriate scales. In the assessment process, the factors that should be considered include available human and financial resource capacities, the histories and geography of the region, the distance between communities and from community to their water sources. Particularly when it comes to shared water supply, clusters of neighbouring communities working together addresses the challenge of long-distance raised in opposition to a regional approach. Also, water supply sharing among communities in close proximity involves fewer communities, aiding in consensus building and helping to mitigate conflict between diverse interest/needs. Shared water supply has already been successful in several pairings of Straits communities.

Specific groupings of communities suggested by participants as potentially appropriate for sharing water services included the 13 communities from Eddies Cove East to Anchor Point. Other services have already been shared by these communities, creating a foundation of relationships and shared service arrangements to build upon. This larger area may be well suited for sharing mobile equipment or supplies, or a trained regional water operator and asset management planning. Another LSD representative suggested, to the south of this cluster, that the three LSDs from St. Barbe to Forrester's Point could be assessed for potential sharing of infrastructure, testing and treatment. Another municipal leader suggested that a grouping of the three municipalities plus this cluster of LSDs could be appropriate for a shared water operator (extending from Flower's Cove and Nameless Cove in the north to Bird Cove and Brig Bay in the south), recognizing that not all communities may participate initially: *"if you look at the politics in it, it might just be only the municipalities.... we can do that way between three municipalities within the 40 kms that we cover"*. These suggestions provide a starting point for recommended further detailed assessment of specific geographies and alliances between local governments that are willing and suitable to engage in specific kinds of water service sharing arrangements.

4.2.4. Establish a pilot project as a testing ground for expanded regional water service delivery and management in the Straits.

In the interest of building on the experiences of existing water service-sharing among communities, some respondents suggested a pilot project as a testing ground for expanded regional water management in the Straits. Although experiences from current service-sharing initiatives shed light on the effectiveness of community collaborations, expanding the number of communities involved in such arrangements or types of services being offered could benefit from an experimental design period to determine (and demonstrate and/or improve) its viability before being rolled out across a larger region or a wider range of water system aspects. This pilot could start with just one aspect (or a limited number of aspects) of the water supply system involving a greater number of communities than are currently collaborating, such as a regional water operator and/or shared supplies (which could address chlorine shortages reported in some

communities, for example). This could be part of an expansion of the provincial regional water operator pilot program. The experiences of current service sharing initiatives in the Straits, as well as other relevant examples from elsewhere, should guide the design process of the proposed pilot program.

4.2.5. Explore other options, including regional governance structures, that go beyond water service-sharing to encompass and address other challenges faced by the region.

While beyond the need for support of regional water service-sharing and therefore the scope of this report, provincial officials and municipal respondents also recommended a regional government in the Straits within a reasonably defined location that could be administered by community representatives and could oversee shared water supply and management in the region. The following quote in the Local Government Feasibility Research Findings illustrates the long-standing interest in a regional approach to municipal services and governance in the area: *The majority of the people in leadership positions as well as the general public feel that a single municipal organization encompassing the whole area from Anchor Point to Eddies Cove East is essential for the present and future development of the Straits* (Blackmore, 2003. p. 31). Municipal participants argued that a regional government would improve the prospects for resolving the many development challenges facing the region, including those associated with drinking water provision but again called for leadership from the Province to implement regional government in the Province, stating that *“they have to have the political will to do it.”* As with regional approaches to drinking water supply, there was mixed support for the idea of regional government, but general agreement that should regional government proceed it will be important that the region be scaled appropriately. One municipal leader pointed to the region proposed in the 2017 consultations, for example: *“Rivers of Pond northward, with 15-16 communities and 30 LDSs. It’s too big, was too large to work effectively”*.

Finally, community respondents urged the Province to decentralize the leasing and release of crown lands so that it falls within community, and perhaps regional jurisdiction. Participating community leaders suggested that easier access to crown land in the various communities would facilitate the use of available land for both commercial and residential development. This would have the potential to enhance the local economy, increase municipal revenues, and the ability of residents to pay water fees.

4.3: Contribution of the Project to Policy, Practice, and Literature

This project aimed to provide information that could inform drinking water policy and programs and improve water management and ultimately water quality and access, particularly in the Straits region. In summary, the recommended regional approach for the Straits requires a bottom-up design but with involvement and leadership from the Province and others as well as key supports. The above recommendations should provide a platform for further dialogue among various levels of government and within the region to build consensus for pursuing a more regional approach to the development and operation of drinking water systems.

The research also aimed to contribute to existing research conducted in the water sector in NL and rural Canada. The above results are consistent with a number of observations made by previous studies about rural water systems and the potential for regional approaches, while outlining the unique challenge and potentials of the Straits region. The study suggests the importance of bottom-up or community-driven (and supported) approaches to regional planning

and development, for example, that incorporate local knowledge and consider place-specificities, while at the same time emphasizing the need for collaborative approaches to drinking water governance and an active role for senior levels of government, particularly in helping to support a viable strategy to initiate a regional governance model. This study provides alternatives to conventional top-down approaches to implementing water management and governance policies by encouraging the incorporation of practices such as collaboration and partnership among various levels of government but also with residents, researchers, industry, and others in addressing water challenges.

This study has advanced knowledge in how rural people can and do manage their water challenges to access good quality water supply, highlighting the potential of rural communities to share aspects of water supply systems to minimize water challenges. By outlining the existing context of primarily informal service-sharing activities in the Straits, the research highlights the role that social capital plays in these collaborations, and in rural development and resilience more generally. The study also brings out the similarities in water challenges in the communities of the Straits, drawing attention to the issues associated with single-community efforts that serve as a basis for collaboration. An inventory of water systems, common water challenges, and possible solutions, including regional approaches, as revealed by this research, further expands the literature on drinking water issues in rural NL. Finally, the issues raised in this study suggest areas in which further research could be undertaken to advance both knowledge and practice towards a regional water management agenda.

4.4: Areas for Future Research

While the research has met its specific aims and objectives, it also raises questions that warrant further investigation and could stimulate future applied research regarding drinking water management in the region. Some identified needs for further research that could assist in advancing regional approaches to drinking water supply and management, in the Straits and beyond include:

1. Conduct a cost/benefit analysis for each community for participation in regional water management. The LSDs/UIAs have a common perception that they would be the losers relative to incorporated municipalities; a CBA would demonstrate exactly what these and other communities would stand to gain (and would need to contribute) if approached through a full-cost accounting perspective.
2. Further investigate the suggestion that communities do not like chlorination-based water disinfection methods, the reasons for this reported aversion to chlorine, and the potential for solutions such as a related public awareness campaign and improved chlorine management.
3. Drawing from the results of this research and other examples presented in this report, develop a roadmap for the implementation of the discussed regional approach to water supply and management, in partnership with the Straits communities. This could include the identification of one or more specific pilot project options and a plan for monitoring pilot project results, which could then be built upon in future efforts to enhance drinking water quality and availability in the Straits region and/or to further pursue other forms of regional governance.

Reference List

- Adeel, Z. (2017). Placing Canada's water policies in an international context. In S. Renzetti and D. Dupont (Eds.), *Water Policy and Governance in Canada* (pp. 99-120). Springer International Publishing.
- Bakker, K. (2003). *Good governance in restructuring water supply: a handbook* [eBook edition]. Federation of Canadian Municipalities & Program on Water Issues.
https://www.iatp.org/sites/default/files/Good_Governance_in_Restructuring_Water_Supply_.pdf
- Bakker, K. (Ed.). (2007). *Eau Canada*. UBC Press.
- Bartlett, G. (2017, December 17). *Penny wise and selling fries: How the Straits Arena stays open without municipal backing*. CBC Newfoundland and Labrador.
<https://www.cbc.ca/news/canada/newfoundland-labrador/straits-arena-northern-peninsula-1.4448197>
- Bereskie, T., Rodriguez, M. J., & Sadiq, R. (2017). Drinking water management and governance in Canada: An innovative plan-do-check-act (PDCA) framework for a safe drinking water supply. *Environmental Management*, 60(2), 243-262. <https://doi.org/10.1007/s00267-017-0873-9>
- Blackmore, F. E. W. (2003). *Research findings: Local government in the Straits*. Grand Falls-Windsor, Newfoundland.
- Breen, S. (2018). Exploring a new regionalism-based approach to managing drinking water systems in rural regions, *Society & Natural Resources*, 31(6), 698-716.
<https://doi.org/10.1080/08941920.2017.1423432>
- Breen, S. (2017). *From Staples Theory to New Regionalism: Managing Drinking Water for Regional Resilience in Rural British Columbia* [Doctoral dissertation, Simon Fraser University]. SFU Summit Institutional Repository.
- Breen, S. & Markey, S. (2015). Unintentional influence: Exploring the relationship between rural regional development and drinking water systems in rural British Columbia, Canada. *The Journal of Rural and Community Development*, 10(3), 52-78.
- Breen, S., & Minnes, S. (2013). *Water and watershed management: A regional development perspective (No. CRD-7)*. Corner Brook. Retrieved April 20, 2018, from http://cdnregdev.ruralresilience.ca/wp-content/uploads/2014/12/Water_Watershed_Management-WP-CRD7.pdf
- Breen, S., & Minnes, S. (2015). *A Regional Approach to Drinking Water Management: NL_BC Comparative Water Systems Study*. Harris Centre Memorial University of Newfoundland. https://www.mun.ca/harriscentre/reports/Breen_Water_13_14_Final.pdf
- Butt, K. (2009). *Drinking water quality research summary and suggested priorities report*. Harris Centre Memorial University of Newfoundland.
<https://www.mun.ca/harriscentre/funding/water/WaterResearchInventory.pdf>
- Butters, L., Eledi, S., Okusepi, O., Vodden, K. (2017). Engaging the Past to Create a New Future: A comparative study of heritage-driven community development initiatives in the Great Northern Peninsula. *Journal of Rural and Community Development*, 12(2/3), 186-209.
- Canadian Infrastructure Report Card 2016. (2016). *Informing the Future*. Retrieved June 20, 2017, from <https://fcm.ca/en/resources/canadian-infrastructure-report-card-2016>

- Capacity Infrastructure Services Limited. (2012). *Delivering water services in the Wellington region; A new model for delivering water services in the Wellington region*. Retrieved on May 26, 2018, from <http://iportal.huttcity.govt.nz/Record/ReadOnly?Uri=2875623>
- Carter, K., & Vodden, K. (2018). Applicability of Territorial Innovation Models to peripheral regions: Lessons from the Northern Peninsula of Newfoundland. *Journal of Rural and Community Development*, 12(2), 1-19.
- Charron, D. F., Thomas, M. K., Waltner-Toews, D., Aramini, J. J., Edge, T., Kent, R. A., Abdel R. & Wilson, J. (2004). Vulnerability of waterborne diseases to climate change in Canada: a review. *Journal of Toxicology and Environmental Health, Part A*, 67(20/22), 1667-1677. <https://doi.org/10.1080/15287390490492313>
- Chireh, V. K. (2017). *Examining regional approaches to drinking water management in rural Canada; Newfoundland: A literature review*. Rural Policy Learning Commons. http://rplc-capr.ca/wp-content/uploads/2015/04/DrinkingWaterManagement_LiteratureReview_VincentChireh.pdf
- Chireh, V. K. (2018). *Exploring regional approaches in drinking water management in the Straits of Belle Isle, NL* [Master's Thesis, Memorial University of Newfoundland]. Memorial University Research Repository.
- Chireh, V. K. (in-progress). *Service-sharing in drinking water supply: The case of the Exploits Regional Water Supply, Grand Falls-Windsor*. Municipalities Newfoundland and Labrador, St. John's, Newfoundland and Labrador.
- City of Vancouver. (2018). *Waterworks Utility Annual Report 2018*. <https://vancouver.ca/files/cov/water-quality-utility-report-2018.pdf>
- Columbia Basin Trust. (2016). *Innovative Water Conservation Model Proved Successful*. Retrieved August 22, 2017, from <https://ourtrust.org/innovative-water-conservation-model-proved-successful/>
- Daniels, J. (2014). *TownSuite Mapping LITE (+Scanning) and Managing Municipal Water Systems: Spotlight on the Town of Centreville--Wareham--Trinity*. Retrieved February 12, 2018, from http://nlwater.ruralresilience.ca/wp-content/uploads/2013/04/Case-Study_TownSuite-Mapping-LITE_FINAL.pdf
- Daniels, J., & Vodden, K. (2015). *Sunnyside drinking water project: Examining chlorinated disinfectant by-products, resident perceptions and practices, and municipal responses in securing safe drinking water in the Town of Sunnyside, Newfoundland and Labrador*. Harris Centre Memorial University of Newfoundland. https://www.mun.ca/harriscentre/reports/Vodden_14-15_Water_Final_Report.pdf
- Daniels, J., Vodden, K., Minnes, S., & Breen, S. (2014). *Canadian Regional Development: A critical review of theory, practice, and potentials: A case study of the Kittiwake economic zone, Newfoundland and Labrador*. Harris Centre Memorial University of Newfoundland. <https://www.mun.ca/harriscentre/reports/arf/2011/11-12-ARF-Final-Vodden.pdf>
- Davison, A., Howard, G., Stevens, M., Callan, P., Fewtrell, L., Deere, D., Bartram, J., & World Health Organization. (2005). *Water Safety Plans: Managing Drinking-Water Quality from Catchment to Consumer*. WHO Report. Retrieved May 20, 2017, from http://www.who.int/water_sanitation_health/dwq/wsp170805.pdf.
- Dawe P., (2010). *Portable Water Dispensing Units; Experience in NL*. Dept. of Environment and Conservation, Water Resource Division. Municipal Affairs and Environment.

- http://www.mae.gov.nl.ca/waterres/training/adww/smalltown/13_paula_dawe__gander_2008_potable_water_dispensing_units.pdf
- Dawe, P. (2013). Using Quantitative Microbial Risk Assessment to Determine if Health Risk Warrants Boil Water Advisories in Newfoundland and Labrador: Time for a New Approach [Master's Thesis, Royal Roads University.]
https://viurrspace.ca/bitstream/handle/10170/652/dawe_paula.pdf?sequence=1&isAllowed=y
- De Loë, R. (2008). *Toward a Canadian national water strategy*. Rob de Loë Consulting Services. <http://deslibris.ca/ID/213747>
- De Loë, R., & Kreutzwiser, R. (2007). Challenging the status quo: The evolution of water governance in Canada. In K. Bakker (Ed.), *Eau Canada: The Future of Canada's Water* (pp. 82–103). UBC Press.
- De Loë, R., Murray, D., Michaels, S., & Plummer, R. (2016). Policy transfer among regional-level organizations: Insights from source water protection in Ontario. *Environmental management*, 58(1), 31-47. <https://doi.org/10.1007/s00267-016-0699-x>
- Department of Environment and Climate Change, Government of NL. (2017). *Boil Water Advisories*. <http://www.ecc.gov.nl.ca/waterres/quality/drinkingwater/advisories.html>
- Department of Environment and Conservation. (2010). *Evaluation of Existing Potable Water Dispensing Units and Recommendations for Design and Operational Guidelines*. <https://www.mun.ca/harriscentre/reports/arf/2011/11-12-ARF-Final-Vodden.pdf>
http://www.mae.gov.nl.ca/waterres/reports/drinking_water/093017_00_PWDU_Study_FINAL_REPORT.pdf
- Department of Municipal Affairs and Environment. (2001). *Source to tap - water supplies in Newfoundland and Labrador*. https://www.mae.gov.nl.ca/waterres/reports/pdf/source_to_tap_2001.pdf
- Department of Municipal Affairs and Environment. (2014). *Water Resource Portal*. Retrieved February 12, 2018 from <http://maps.gov.nl.ca/water/>
- Department of Municipal Affairs and Environment. (2017). *Water Resource Portal*. Retrieved February 12, 2018 from <http://maps.gov.nl.ca/water/>
- Dore, M. H. (2015). *Water policy in Canada: problems and possible solutions*. Springer International.
- Drogui, P., & Daghrrir, R. (2015). Chlorine for water disinfection: Properties, applications and health effects. In E. Lichtfouse, J. Schwarzbauer, and R. Didier (Eds.), *CO2 Sequestration, Biofuels and Depollution* (pp. 1-32). Springer, Cham.
- Eggertson, L. (2008). Investigative report: 1766 boil-water advisories now in place across Canada. *Canadian Medical Association Journal*, 178(10), 1261-1263.
<https://doi.org/10.1503/cmaj.080525>
- Exploits Regional Service Board. (2008). *The Exploits Regional Service Board. A Case Study. Grand Falls-Windsor. Newfoundland and Labrador* [PowerPoint slides]. Exploits Regional Service Board.
http://www.mae.gov.nl.ca/waterres/training/adww/smalltown/08_town_of_grand_falls_windsor_march_12,_2008.pdf
- Forest, P. (2006). The legal geography of water exports: a case study of the transboundary municipal water supplies between Stanstead (Quebec) and Derby Line (Vermont). *Quebec Studies*, 42, 91-110.

- Forest, P. (2010a). *A century of sharing water supplies between Canadian and American borderland communities*. Munk School of Global Affairs, University of Toronto. https://munkschool.utoronto.ca/wp-content/uploads/2012/07/Forest_SharingWaterSupplies_POWI_2010.pdf
- Forest, P. (2010b). Inter-local water agreements: Law, geography, and NAFTA. *Les Cahiers de droit*, 51(3/4), 749-770. <https://doi.org/10.7202/045732ar>
- Franch, M., Martini, U., & Buffa, F. (2010). Roles and opinions of primary and secondary stakeholders within community-type destinations. *Tourism review*, 65(4), 74-85. <https://doi.org/10.1108/16605371011093881>
- Frontier Economics Ltd. (2012). *Exploring the links between water and economic growth*. A report prepared for HSBC. https://freshwaterwatch.thewaterhub.org/sites/default/files/final-frontier-report_update18092012_0.pdf
- Furlong, K., & Bakker, K. (2011). Governance and sustainability at a municipal scale: The challenge of water conservation. *Canadian Public Policy*, 37(2), 219-237.
- Gibson, R. (2013). Regional profile of the Northern Peninsula Region, Newfoundland. *Canadian Regional Development*. Working Paper No. 10. Memorial University of Newfoundland, Corner Brook-Canada. http://cdnregdev.ruralresilience.ca/wp-content/uploads/2014/12/Northern_Peninsula-WP-CRD10.pdf
https://www.mae.gov.nl.ca/wrmd/BWA_Reports/BWA_Summary_Community.pdf
- Government of Canada. (2000). *Junior Canadian Rangers*. Retrieved February 18, 2019, from <https://www.canada.ca/en/department-national-defence/services/cadets-junior-canadian-rangers/junior-canadian-rangers.html>
- Government of Newfoundland and Labrador. (2007). *Drinking Water Safety in Newfoundland and Labrador-Annual Report 2006*. from http://www.mae.gov.nl.ca/waterres/reports/drinking_water/annual_report_2006.pdf
- Government of Newfoundland and Labrador. (2008). *Drinking Water Safety in Newfoundland and Labrador-Annual Report 2007*. http://www.mae.gov.nl.ca/waterres/reports/drinking_water/annual_report_2007.pdf
- Government of Newfoundland and Labrador. (2016). *Permit to Construct, Pursuant to the Water Resources Act, SNL 2002 cW-4.01, Section(s) 37, 39, 48*. <https://www.mae.gov.nl.ca/waterres/permits/construct.html>
- Government of Newfoundland and Labrador. (2017). *Drinking Water Safety in Newfoundland and Labrador-Annual Report 2016*. St. John's, NL. http://www.mae.gov.nl.ca/waterres/reports/drinking_water/annual_report_2016.pdf
- Government of Newfoundland and Labrador. (2017). *Final report: Study on Water Quality and Demand on Public Water Supplies with Variable Flow Regimes and Water Demand*;103046.00. CBCL. from http://www.mae.gov.nl.ca/waterres/reports/drinking_water/Demand_Study_Jan_2012.pdf.
- Government of Newfoundland and Labrador. (2018). *Public Consultations on Regional Government Discussion Document*. Department of Municipal Affairs and Environment. St. John's, NL. <http://www.opc.gov.nl.ca/docs/mae/RegionalGovernmentConsultationDiscussionDocument.pdf>

- Government of Newfoundland and Labrador. (2020a). *Boil Water Advisories for Public Water Supplies in Newfoundland and Labrador*.
https://www.mae.gov.nl.ca/wrmd/BWA_Reports/BWA_Summary_Date.pdf
- Government of Newfoundland and Labrador. (2020b). *Drinking Water Safety Initiative (DWSI)*.
https://www.mae.gov.nl.ca/capital_works/drinkingwater.html
- Government of Newfoundland and Labrador. (2020c). *Community Youth Networks*.
<https://www.gov.nl.ca/pep/community-youth-networks/>
- Greater Vancouver Water District and Point Roberts Water District No. 4. (1987) *Agreement Made 28th Day of August 1987 Between Greater Vancouver Water District and Point Roberts Water District No. 4*. Vancouver, BC.
http://www.pointrobortswater.com/images/resolutions/600_series/resolution_616.pdf
- Hanrahan M., Dosu, B. Jr., & Minnes S., (2016). *Government and Community Responses to Drinking Water Challenges and Crises in Rural NL*. Harris Centre Memorial University of Newfoundland. http://www.mun.ca/harriscentre/reports/15-16_report_Hanrahan_Water.pdf
- Haque, C. E., Csapo, S., & Rounds, R. (1999). Regionalization of water infrastructure in Canada: A comparative study of conflict resolution approaches. *Prairie Perspectives: Geographical Essays, Department of Geography, University of Saskatchewan, Saskatoon*, 136-154. http://pcag.uwinnipeg.ca/Prairie-Perspectives/PP-Vol02/PP_Vol-02.pdf#page=144
- Health and Community services, NL. (2017). *Drinking Water Quality*.
 from <http://www.health.gov.nl.ca/health/publichealth/envhealth/drinkingwater.html>
- Hill, C., Furlong, K., Bakker, K., & Cohen, A. (2008). Harmonization versus subsidiarity in water governance: A review of water governance and legislation in the Canadian provinces and territories. *Canadian Water Resources Journal*, 33(4), 315-332.
<https://doi.org/10.4296/cwrj3304315>
- Hrudey, S. (2011). *Safe Drinking Water Policy for Canada- Turning Hindsight into Foresight*. CD Howe Institute Commentary. from <https://www.cdhowe.org/public-policy-research/safe-drinking-water-policy-canada---turning-hindsight-foresight>
- Komppula, R. (2016). The role of different stakeholders in destination development. *Tourism Review*, 71(1), 67-76. <https://doi.org/10.1108/TR-06-2015-0030>
- Kot, M., Castleden, H., & Gagnon, G. A. (2011). Unintended consequences of regulating drinking water in rural Canadian communities: Examples from Atlantic Canada. *Health & Place*, 17(5), 1030-1037. <https://doi.org/10.1016/j.healthplace.2011.06.012>
- Lasker, R. D., & Weiss, E. S. (2003). Broadening participation in community problem solving: A multidisciplinary model to support collaborative practice and research. *Journal of Urban Health*, 80(1), 14-47. <https://doi.org/10.1093/jurban/jtg014>
- Li, X. F., & Mitch, W. A. (2018). Drinking water disinfection by-products (DBPs) and human health effects: Multidisciplinary challenges and opportunities. *Environmental Science and Technology*. 52, 1681–1689. <https://doi.org/10.1021/acs.est.7b05440>
- Luo, X., & Shen, J. (2012). The making of new regionalism in the cross-boundary metropolis of Hong Kong–Shenzhen, China. *Habitat International*, 36(1), 126-135. <https://doi.org/10.1016/j.habitatint.2011.06.009>
- Mandell, M. P. (1999). Community collaborations. *Review of Policy Research*, 16(1), 42-64.

- Markey, S. (2011). A Primer on New Regionalism (No. CRD-4). http://cdnregdev.ruralresilience.ca/wp-content/uploads/2014/12/NR_Primer-WP-CRD4.pdf
- Minnes, S., & Vodden, K. (2014). *Exploring solutions for sustainable rural drinking water systems: A study of rural Newfoundland and Labrador drinking water systems*. Harris Centre Memorial University of Newfoundland. http://www.mun.ca/harriscentre/Rural_Water_Report.pdf
- Minnes, S., & Vodden, K. (2017). The Capacity Gap: Understanding impediments to sustainable drinking water systems in rural Newfoundland and Labrador. *Canadian Water Resources Journal/Revue canadienne des ressources hydriques*, 42(2), 163-178. <https://doi.org/10.1080/07011784.2016.1256232>
- Municipalities Newfoundland and Labrador (MNL). Provincial government announces new municipal infrastructure program. (2017a). <https://municipalnl.ca/article/provincial-government-announces-new-municipal-infrastructure-program/>
- Municipalities Newfoundland and Labrador MNL). (2017b). *The Next Steps in the Regional Government Process*. <https://www.municipalnl.ca/wp-content/uploads/2017/02/Next-Steps-in-Regional-Government.pdf>
- National Research Council. (1997). *Safe water from every tap: improving water service to small communities*. National Academies Press.
- National Round Table on the Environment and the Economy (NRTEE). (2011). *Charting a Course – Chapter 7: Collaborative Water Governance*. <http://nrtee-trnee.ca/charting-a-course-chapter-7-collaborative-water-governance>
- Newfoundland & Labrador Statistics Agency. (2016). *Local Area 71: Strait of Belle Isle*: Census 2001 to 2011: Detailed populations by age and gender*. Government of Newfoundland and Labrador. http://stats.gov.nl.ca/Statistics/Census2016/PDF/Pop_Dwellings_NL_CD_2016.pdf
- O'Connor, D. R. (2002). *Report of the Walkerton Inquiry. Part one: The events of May 2000 and related issues*. Queen's Printer for Ontario. http://www.archives.gov.on.ca/en/e_records/walkerton/report1/index.html
- Peterson, H., & Torchia, M. (2008). Safe drinking water for rural Canadians. *Canadian Medical Association Journal*, 179(1), 55. <https://doi.org/10.1503/cmaj.1080061>.
- Picco B. and Chaulk M, (2010). *Drinking Water Safety Initiative; Potable Water Dispensing Units- Municipal Affairs and Environment*. Ministry of Municipal Affairs and Environment. http://www.mae.gov.nl.ca/waterres/training/Drinking_Water_Workshop/05_Bob_Picco_Mike_Chaulk.pdf
- Robinson, C., Rosenberg, S., Teel, M. K., & Steinback-Tracy, K. (2003). *Interagency Collaboration guidebook: A Strategic planning tool for child welfare and Part C agencies*. <http://jfkpartners.org/Content/PDF/InteragencyGuidebook.pdf>
- Rolling, K., Chant, R. & Gazley, J. (2017). *Regional water and wastewater pilot project* [PowerPoint slides]. http://www.mae.gov.nl.ca/waterres/training/adww/2017/16_GazleyRollingsChant.pdf
- Rural Secretariat. (2012). *St Anthony - Port au Choix Region*. http://www.exec.gov.nl.ca/rural/regional_councils/stanthony_portauchaix.html#ov.

- Simms, A., & Ward, J. (2016). *Regional population projections for Labrador and the Northern Peninsula 2016-2036*. Harris Centre Memorial University of Newfoundland. https://www.mun.ca/harriscentre/PopulationProject/Final_Labrador_Report.pdf
- Statistics Canada. (2016). *2016 community profiles - 2011 census. Newfoundland*. Statistics Canada. <https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/details/page.cfm?Lang=E&Geo1=PR&Code1=10&Geo2=PR&Code2=01&SearchText=Canada&SearchType=Begins&SearchPR=01&B1=All&type=0>
- Statistics Canada. (2017). *Goulds, RPC [Designated place], Newfoundland and Labrador and Newfoundland and Labrador [Province] (table). Census profile. 2016 Census*. Catalogue no. 98-316-X2016001. <http://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/index.cfm?Lang=E>
- Thomas, E. and K. Vodden. (2014) *Fishing Policies and Island Community Development*. Harris Centre Memorial University of Newfoundland. <http://www.mun.ca/harriscentre/reports/arf/2012/12-13-ARF-Final-Vodden.pdf>
- Todd, L., Leask, A., & Ensor, J. (2017). Understanding primary stakeholders' multiple roles in hallmark event tourism management. *Tourism Management*, 59, 494-509. <https://doi.org/10.1016/j.tourman.2016.09.010>
- Towns of Bird Cove, Anchor Point, & Flower's Cove. (2010). *Integrated Community Sustainability Plan*. <https://www.municipalnl.ca/wp-content/uploads/2016/09/bird-cove-anchor-point-flowers-cover-icsp.pdf>
- Vodden, K. (2005). Case Studies in Municipal Service Sharing in Newfoundland and Labrador: Great Northern Peninsula. Series of seven case studies prepared for the Newfoundland and Labrador Federation of Municipalities Community Cooperation Resource Centre.
- Vodden, K. (2015). Governing sustainable coastal development: The promise and challenge of collaborative governance in Canadian coastal watersheds. *The Canadian Geographer/Le Géographe canadien*, 59(2), 167-180.
- Vodden, K., Baldacchino, G. & Gibson, R. (2015). Development in place: A view from the periphery. In K. Vodden, G. Baldacchino & R. Gibson (Eds.), *Place peripheral: Place-based development in rural, island, and remote regions* (pp. 3-20). ISER Books.
- Vodden, K., Catto, N., Irvine, M., Parewick, K., Renaud, N., Turner, K., Chan, S., Collins, G., Skeard, J. Bitterman, K., Keats, T., Keenan, R., Rogers, C., Bragg, D., Planke, K. (2013). *Weather, Climate Change and My Community: A Planning Workbook*. Canada Adaptation Solutions Association and the Department of Environment & Conservation. https://www.turnbackthetide.ca/pdf/7_Steps_Tool.pdf
- Vodden, K., Douglas, D., Markey, S., Minnes, S., and Reimer, B. (Eds.). (2019.) *The Theory, Practice, and Potential of Regional Development: The Case of Canada*. Routledge.
- Vodden, K., Gibson, R., & Daniels, J. (2014). Newfoundland and Labrador provincial regional development policy. *Canadian Regional Development*, 18. <http://cdnregdev.ruralresilience.ca/wp-content/uploads/2013/03/NL-Provincial-Working-Paper-Jan-2014-final.pdf>
- Vodden K., Sarkar A., Holisko S., and Speed D. (2014). *Developing a Community-Based Monitoring Program for Drinking Water Supplies in the Indian Bay Watershed: A baseline study of surface water quality, contamination sources and resident practices and perceptions*. Harris Centre Memorial University of Newfoundland. <https://indianbayecosystem.files.wordpress.com/2014/06/water-report-formatted-march.pdf>

- Waikhom, S. I., & Mehta, D. J. (2015). Optimization of Limbayat Zone Water Distribution System Using EPANET. *International Research Journal of Engineering and Technology*, 2(4), 1495-1498.
- Watercare Services Limited. (2017) *2017 Annual Report; Meeting the demands of change and growth*.
https://www.watercare.co.nz/CMSPages/GetAzureFile.aspx?path=~%5Cwatercarepublicweb%5Cmedia%5Cwatercare-media-library%5Creports-andpublications%5Cannual_report_2017.pdf&hash=9ef35661c24a38d47a2aefeda6cab7df34efa4812577f22f0482d205bdb588d2
- Woolcock, M., & Narayan, D. (2000). Social capital: Implications for development theory, research, and policy. *The world bank research observer*, 15(2), 225-249.
- World Economic Forum (2011). Water Security: The water-food-energy-climate nexus.
http://www3.weforum.org/docs/WEF_WI_WaterSecurity_WaterFoodEnergyClimateNexus_2011.pdf
- World Economic Forum (2017). *The Global Risks Report 2017* [12th ed.]
http://www3.weforum.org/docs/GRR17_Report_web.pdf
- Yin, R. K. (2017). *Case study research: Design and methods*. Sage publications.
- Zainal, Z. (2007). Case study as a research method. *Jurnal Kemanusiaan*, 5(1), 1-6.
- Zirul, C., Halseth, G., Markey, S., & Ryser, L. (2015). Struggling with new regionalism: Government trumps governance in Northern British Columbia, Canada. *The Journal of Rural and Community Development*, 10(2), 136-165.

Appendices

Appendix 1: Project Information

Exploring Regional Approaches to Drinking Water Management as a Potential Solution to Water Management Challenges in The Strait of Belle Isle, NL

Collaborating with communities in the Strait of Belle Isle, this research is a community-based participatory research to explore the possibility of a regional approach to the management of water systems as a potential solution to drinking water management challenges in the region. The project will also explore successful case study examples of regional drinking water approaches elsewhere.

There are multiple drinking water challenges in the region including long-term boil water advisories, high levels of disinfectant by-products, failing infrastructure, and giardia outbreaks. Other problems facing rural water systems include high cost of building and operating treatment plants, failing distribution infrastructure, inadequate source water protection, and limited human and financial capacities. These problems are likely to affect sustainable supply of potable drinking water to rural community residents into the future. These challenges are common where each community independently manages their water supply system. Thus, the need to explore a regional-scale action to more effectively and sustainably manage drinking water in rural Canada.

My research will explore avenues for a regional approach to water management where rural communities with shared needs and/or geographical proximity collaborate (for example; shared infrastructure, capacity building, strategic collaboration) in addressing their water management challenges. The project objectives are:

- Identify current water management challenges in the Strait of Belle Isle
- Identify which aspects of drinking water systems can be delivered regionally
- Identify potential solutions that appear suitable and feasible given technical, geographic, socio-economic and legal/political conditions
- Identify actors and processes required to pursue further analysis and implementation of these regional drinking water initiatives

To achieve these objectives, the research team will conduct interviews with water managers and community leaders in selected communities in the study area, as well as with provincial representatives and other persons with special expertise in the water sector. Research results will be shared with communities in the Straits, Municipalities NL and provincial government agencies through community meetings, workshops and conferences and more broadly within the academic literature.

Researcher: Vincent Chireh

Supervisor: Dr. Kelly Vodden

Funding Agency: Leslie Harris Centre-RBC Water Research and Outreach fund

Contact information: vkchireh@grenfell.mun.ca, 647-332-3565

Ethics Statement: The proposal has been viewed by the Grenfell Campus Research Ethics Board (GC-REB) and was found to follow Memorial University's ethics policy. If you have ethical concerns about the research (such as the way you have been treated or your rights as a participant), you may contact the chairperson of the GC-REB at GCREB@grenfell.mun.ca or by calling (709) 639-2399.

Appendix 2: Consent Form- Water Managers/Community Leaders/Key Informants

Project Title: **Exploring Regional Approaches to Water Management as a Potential Solution to Drinking Water Challenges in the Strait of Belle Isle, Newfoundland.**

Supervisor: Dr. Kelly Vodden (Environmental Policy Institute, Grenfell Campus, Memorial University of Newfoundland)

Researcher/Student: Vincent Chireh (Environmental Policy Institute, Grenfell Campus, Memorial University of Newfoundland)

As part of my master's thesis, I am conducting a research under the supervision of Dr. Kelly Vodden. The study seeks to identify some key challenges facing drinking water management in the Strait of Belle Isle and examine the feasibility of a regional approach in managing water systems. The details of the project are also attached for your information.

You are invited to participate in the study by consenting to be interviewed. More detailed information about the project can be found at <http://ruralresilience.ca/project/currentprojects/regional-government/>. Research results will be shared with communities in the Strait of Belle Isle and provincial government agencies through community meetings, workshops and conferences. Results will be posted on the project website in report format and more broadly within the academic literature.

This interview will last between 45-60 minutes and you can decide to end the interview anytime. Your decision to participate, refuse or withdraw from the process is purely voluntary and has no negative consequences. The researcher will work to ensure that information or data collected will remain confidential and your identity kept anonymous. Unless you prefer otherwise, your name or community will not be used in conjunction with your comments in any publication resulting from this work. However, there might rare instances where readers could attribute some responses to specific communities/participants as participants are recruited from small populations where people may be easily identified by their positions. In such cases, there may be some form of financial risk to participants or their community from the disclosure of some sensitive information regarding problems with their drinking water systems and resulting risks to the public. You have the option to decide how you want to be referred to (either your real identify or disguised identity) in the interview as well as research publications and reports. Aside from taking notes, the researcher will audio-record interview sessions if you give your permission to do so. All documents and data related participants in this research will be stored in password-secured computers and hardcopies stored in locked space only accessible to the researchers who have signed forms of confidentiality. Research content will be kept for at most five years after completion of this study according to Memorial University research guidelines, after which time it will be discarded.

The proposal for this research has been reviewed by the Grenfell Campus-Research Ethics Board and was found to follow Memorial University's ethics policy. If you have ethical concerns about the research (such as the way you have been treated or your rights as a participant), you may contact the Chairperson of the GC-REB through the Grenfell Research Office (GCREB@grenfell.mun.ca) or by calling (709) 639-2399. For further inquiries regarding this interview or the research project in general, please contact Vincent Chireh, principal investigator

(vkchireh@grenfell.mun.ca). Thank you for your time and help in improving Newfoundland and Labrador's drinking water systems, your contribution is truly appreciated!

Your consent means that:

- ⇒ You understand the information about the above research contained in the attached document
- ⇒ You have been able to ask questions about this study
- ⇒ You are satisfied with the answers to all of your questions
- ⇒ You understand what the study is about and what you will be doing
- ⇒ You understand that you are free to withdraw the study within six months of your interview date, without having to give a reason, and that doing so will not affect you now or in the future.

If you give consent, you do not give up your legal rights, and this does not release the researcher from his professional and legal responsibilities

- I agree to be audio-recorded during the interview
- I do not agree to be audio-recorded during the interview
- I agree to the use of quotations and general occupation title to be identified in any publication resulting from this study (occupation title to be used.....)
- I agree to the use of quotations but do not want my title to be identified in any publication resulting from this study
- I do not agree to quotations and do not to use of occupation or work position

Can I contact you for a follow-up interview if I have further questions on regional drinking water approaches for this research?

- Yes
- No

Your signature:

I have read what this study is about and understood the risks and benefits. I have had adequate time to think about this and had the opportunity to ask questions and my questions have been answered.

A copy of this Informed Consent Form has been given to me for my records.

Signature of participant

Date

Consent was obtained orally

I have explained this study to the best of my ability. I invited questions and gave answers. I believe that the participant fully understands what is involved in participating in this study, any potential risks of the study and that he or she has freely chosen to be in the study.

Signature of Principal Investigator

Date

Appendix 3: Interview Guide for Community Leader/Person Managing Water Systems.

Participant code:

Section 1: Introductory Questions:

1. Tell me about the water system you have in this community? (e. g type, source, treatment, distribution)
2. What roles/responsibilities do you have relating to drinking water system?
3. How long have you been doing this work?
4. Have you received any formal training as a water operator? If yes, what level/type of training? Are you certified? If yes, to what level.
5. What motivated you to take up this job?
6. Do you work in other communities outside your community?
7. Who and what other agencies are involved in managing your water system?

Section 2: Current challenges in managing your water system*

8. What are some of the challenges you or the community faces in maintaining this water system?
9. How do these challenges affect water systems and/or water supply in the community?
10. What do you think can be done to address these problems?
11. Who would/should you work with in order to tackle these challenges?

**Explain what is meant by water management to participant if don't know. All activities including planning, developing, distributing and maintaining water systems.*

Section 3: Regional approach to water management

12. Do you think water supply systems can be managed on a regional-scale (together by several communities)?
a) Yes b) No (If No, skip to next section)
13. In which aspects of water supply systems can communities collaborate or share? If already sharing, which areas?

***Tick if mentioned;** *Treatment and distribution infrastructure;* *Source water protection;* *Water quality monitoring* *Human and Financial Capacity;* *Policy and Planning*

Others specify.....

14. What is the extent of a region you would propose to share water services within this area? (Note: a map will be taken to the interview and respondents will have the opportunity to identify specific communities)

15. Who and what agencies will you need to implement the regional initiative(s) mentioned above?

16. What are some of the benefits in sharing or collaborating with other communities in managing water supply systems (regional-scale)?

17. What are some of the challenges in sharing or collaborating with other communities managing water supply systems (regional-scale)?

***Tick if mentioned;** *Technical (Staff and training);* *Geographic (distance and topography);*

Socio-economic; *Legal;* *Political conditions*

Others specify.....

18. What are some of the solutions you would propose to these challenges?
19. Is your community sharing other services regionally? If yes, please explain. Tell us about how these arrangements are working? (successful or not? Challenges?)
20. Do you agree or disagree that we should be moving towards more regional approaches?
 - a) Strongly disagree
 - b) Somewhat disagree
 - c) Unsure
 - d) Somewhat agree
 - e) Strongly agree
21. If a/b, why? Explain
22. If d/e, what might be some of the next steps?

Appendix 4: Interview Guide for Key Informants: Resource Persons in the Water Sector

Participant code:

Section 1: Introductory Questions:

1. How long have you been in this position?
2. Could you describe how your roles/responsibilities relate to rural water systems?

Section 2: Current challenges in managing water system

3. What are some of the key challenges facing the management of rural drinking water systems in the province? *Look for planning, policy, management, human and financial capacity challenges. Probe if any of the above are not mentioned.*
4. What do you see as some solutions to help address these challenges facing rural water supply/management?
5. Who or what agencies would be involved in improving rural water management in the province/region?

Section 3: Regional approach to water management

6. What are communities sharing now? What can you tell me about their experiences?
7. In which aspects of water supply systems can communities collaborate or share?
8. Do you think water supply systems can be managed on a regional-scale (together by several communities)?
 - a) Yes
 - b) No. (If No, skip to next section)

Tick if mentioned; *Treatment and distribution infrastructure;* *Source water protection;*
 Water quality monitoring *Human and Financial Capacity;* *Policy and Planning;*
 Others specify

9. What is the extend of a region you would propose to share water services within this area?
10. What are some of criteria that should be used to delineate regions?
11. Who and what agencies will you need to implement the regional initiative(s) mentioned above?
12. What are some of the benefits in sharing or collaborating with other communities in managing water supply systems (regional-scale)?
13. What are some of the challenges in sharing or collaborating with other communities in managing water supply systems (regional-scale)?

Tick if mentioned; *Technical (Staff and training);* *Geographic (distance and topography);*
 Socio-economic; *Legal;* *Political conditions;* *Others specify...*

14. What are some of the solutions you would propose to these challenges?
15. Is your community sharing other services regionally? If yes, please explain. Tell us about how these arrangements are working? (successful or not? Challenges?)
16. Do you agree or disagree that we should be moving towards more regional approaches?
 - a) Strongly disagree
 - b) Somewhat disagree
 - c) Unsure
 - d) Somewhat agree
 - e) Strongly agree
17. If a/b, why? Explain...
18. If d/e, what might be some of the next steps?