

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

By

Vincent Kuuteryiri Chireh

A thesis submitted to the school of Graduate Studies in partial fulfilment of the requirements for

the degree of

Master of Arts

Environmental Policy Institute

Memorial University of Newfoundland

September 2018

Grenfell Campus

Newfoundland

Copyright ©2018 by Vincent Kuuteryiri Chireh

Abstract

Multiple community collaboration to manage water supply systems among rural communities is fast gaining prominence in rural development literature. It is increasingly difficult for individual communities to provide safe and clean drinking water to their residents due to challenges such as the lack of human and financial capacity, degrading water infrastructure, and high capital investment cost for water infrastructure. This situation could be worsened by challenges typical of rural areas such as declining, aging populations, and the lack of economies of scale. Using a case study approach, my research looks at the prospects in adopting a regional approach to manage water supply systems, particularly with the Newfoundland and Labrador context. A regional approach is defined in this research as any form of collaboration or partnership motivated by common interests, needs or challenges, and permissible by geography to share water supply systems among neighboring communities to ensure clean and safe water supply. This study was situated in the Strait of Belle Isle region in the Great Northern Peninsula in Newfoundland. The study reveals some potentials in the case study region such as sufficient headwaters, the existence of clusters of communities, existing service-sharing initiatives, and the strong social capital that can support a regional water management approach. When these potentials are explored, a regional water system could help address the many water challenges in the region. However, there are noteworthy factors that could impede its implementation: the impacts of place-based dynamics, human and financial capacities, administrative disparities between various scales of communities, and the need for upper-level government's support. Moreover, the findings illustrate that water researchers, governments, and communities need to consider and make provisions to incorporate these conditions when developing water policies that fully realize the benefits of a regional water management approach.

Acknowledgment

First, I would like to thank my family especially Uncle Joseph Yieleh Chireh for his moral and financial support throughout my education. And to my wife, Ophilia Zinale, bravo, for her positive distractions with daily phone calls to share information about the family welfare back home. Second, I am grateful to Dr. Kelly Vodden for agreeing to be my supervisor and her continual guidance and support to achieve this milestone. Her assistance, comments, and thoughts were indeed motivating, and I could not have a better supervisor than her. To my co-supervisor Dr. Sarah-Patricia Breen, I say kudos, for having the hard time to edit and streamline my work to have this thesis completed. Third, I am indebted to The Leslie Harris Centre of Regional Policy and Development, Memorial University for a grant in support from which funded the conduct of this research. Lastly, I appreciate the contributions of all participants in the Strait of Belle Isle region, some Newfoundland and Labrador government officials, and the Towns of Flower's Cove and Anchor Point for collaborating in the study.

Glory be to God, Almighty!

Dedication

This thesis is dedicated to my late dad and mom: Mr. Mahamah Kuuteryiri Chireh and Zenabu N-Yen Chankoe. I believe you people are with the Lord in the big house.

Table of Contents

Abstract.....	i
Acknowledgment.....	ii
Dedication	iii
List of Tables.....	vii
List of Figures	viii
List of Acronyms.....	ix
List of Appendices.....	x
CHAPTER 1: INTRODUCTION	1
1.1: Introduction	1
1.2: Research Problem, Purpose, and Objectives	3
1.2.1: Problem Definition.....	3
1.2.2: Purpose and Objectives of the Research	4
1.3: Justification of the Study.....	5
1.4: Chapter Synopsis	7
CHAPTER 2: LITERATURE REVIEW.....	9
2.1: Introduction	9
2.2: Drinking Water Management in Canada.....	10
2.2.1: Water Governance: Legislation, Policy, and Planning	11
2.2.2: Components of Drinking Water Supply Systems	14
2.2.3: Challenges Affecting Drinking Water Supply Systems	16
2.2.4: Solutions to Challenges of Water Supply Systems.....	18

2.3: Regional Approaches in Perspective	20
2.3.1: Examples of Regional Initiatives in Water Management.....	21
2.3.2: Advantages of a Regional Water Management Approach	25
2.3.3: Challenges of Regional Water Management System.....	26
2.4: Conceptual Approach and Framework Literature	27
CHAPTER 3: METHODOLOGY	31
3.1: Research Design and Justification.....	31
3.2: Description of the Study Area	33
3.3: Sources of the Data	37
3.4: Interview Data Collection Process.....	39
3.5: Ethical Considerations	41
3.6: Data Processing and Analysis	42
3.7: Ascertaining Validity and Reliability of the Study.....	44
3.8: Research Limitations.....	45
CHAPTER 4: RESEARCH RESULTS AND FINDINGS	48
4.1: Key Themes from the Interviews	48
4.2: Characteristics of Water Supply Systems in the Straits.....	49
4.3: Water Management Leadership and Structures in the Straits	54
4.4: Characteristics of Water Management in the Straits.....	56
4.4.1: Challenges of Water Supply Systems	58
4.4.2: Solutions to Water Challenges.....	61
4.5: Examples of (Water) Service-Sharing in the Straits and Related Experiences	63
4.6: Respondents' Views on Regional Approaches.....	67

CHAPTER 5: DISCUSSION.....	69
5.1: Introduction	69
5.2: Regional Approaches to Water Management in the Straits: Potentials and Opportunities	70
5.2.1: Geographical Conditions	72
5.2.2: Socio-Economic Conditions	74
5.2.3: Political/Legal Conditions	77
5.3: Potential Challenges of a Regional Approach.....	79
5.3.1: Geographical Challenges.....	80
5.3.2: Socio-Economic Challenges.....	81
5.3.3: Political/Legal Challenges.....	82
5.4: Recommendations for a Regional Water Management in the Straits.....	87
CHAPTER 6: CONCLUSION	93
6.1: Thesis Summary	93
6.2: General Conclusions	95
6.3: Areas for Future Research.....	98
6.4: Contribution of the Study.....	99
Reference List	101

List of Tables

Table 2.1: The Relationship between New Regionalism and Water Supply Systems	30
Table 3.1: Characteristics of Water Systems in the Straits.....	36
Table 3.2: Recruitment Process of Interviewees	40
Table 4.1: Summary of Key Points on the Characteristics of Water Systems.....	53
Table 4.2: Summary of Key Points on Water Leadership and Structures	56
Table 4.3: Summary of Key Points on Characteristics of Water Management	57
Table 4.4: Existing Regional Service-sharing in the Straits	65
Table 4.5: Summary of Key Points on Regional Approaches	68

List of Figures

Figure 2.1: New Regionalism Framework.....	28
Figure 3.1: Map of the Great Northern Peninsula.....	35

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
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
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
WCS	- Wellington Community Services
WSL	- Water Services Limited
WO	- Water Operator

List of Appendices

Appendix 1: Project Information.....	129
Appendix 2: Consent Form- Water Managers/Community Leaders/Key Informants	131
Appendix 3: Interview Guide for Community Leader/Person Managing Water Systems.	135
Appendix 4: Interview Guide for Key Informants: Resource Persons in the Water Sector	138

CHAPTER 1: INTRODUCTION

1.1: Introduction

Water is abundantly available over much of the world. However, the access, availability, quality, and supply of potable drinking water cannot be assured when there are challenges with the management (World Economic Forum, 2017; Peterson & Torchia, 2008; Eggertson, 2008). Whereas Canada holds 7% of the world's renewable freshwater, about 1% of Canada's rural population (excluding Indigenous communities) cannot access safe and clean drinking water (Adeel, 2017; Hrudey, 2011; Boyd, 2006). There is evidence of water challenges in rural Canada, including the high cost of building and operating treatment plants, aging and failing water infrastructure, high cost of maintaining distribution lines, inadequate source water protection, and limited human and financial capacities (Minnes & Vodden, 2014; Kot, Castleden, & Gagnon, 2011). These issues would lead to poor management of the water systems which could affect the sustainable supply of good quality drinking water in rural communities now and into the future.

Waikhom and Mehta (2015 p. 1494) have defined a water supply system as “a system of engineered hydrologic and hydraulic components which provide water supply”. 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 serve 376 communities and 223 communities have 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 the

lack of finance (Dore, 2015). This poor management can result 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 drinking water management of both the public and private systems (DMAE, 2014).

Any community that lacks the required capacity to manage its water system to expected standards or is unable to develop the capacity such as qualified personnel, expertise, and other resources needs management 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; Hrudehy, 2011). Through a regional approach several communities could share water supply systems (or components of them) based on unique need or geographical convenience by consolidating individual community efforts and limited capacities to resolve water challenges. Limited trained and qualified staff and water equipment could be shared in such regional water management arrangements. Such an approach could restructure smaller and dysfunctional systems into larger, more viable ones to provide safe and clean drinking water at lower cost (Hrudehy, 2011).

Using a case study approach, this study explored the question: how can a regional water management approach be adopted in both public and private water systems to mitigate current water challenges in the Straits? The Straits of Belle Isle region (henceforth the Straits) was selected as the case region used to explore the potential of regional approaches to drinking water management and service provision in rural NL regions. Both public and private water systems were considered in this study because they currently face similar challenges common to rural areas

and water systems in the Straits and NL generally. The study was grounded in new regionalism approach, described further in section 2.4 in Chapter 2.

1.2: Research Problem, Purpose, and Objectives

1.2.1: Problem Definition

As noted above, there are several known challenges associated with water systems, including some specific to or particularly acute in rural Canada (Minnes & Vodden, 2014; Kot, Castleden, & Gagnon, 2011). For example, there is a higher possibility of water-quality issues in smaller water systems managed by volunteer community members, partly due to operational failures resulting from the inadequate expertise needed to properly maintain the water systems (Dore, 2015). Specific to rural NL, Minnes and Vodden (2014) similarly assert that there are profound challenges with small water systems. Long-standing BWAs, high levels of chlorine residuals and giardia outbreaks are some resultant effects of water management challenges that rural communities in NL face (DMAE, 2017).

The literature often focuses on water regulation, water quality, and the health implications of water supply systems, while neglecting the human capacity influence in the delivery of sustainable and safe drinking water (Bereskie, Rodriguez & Sadiq, 2017). Water management challenges have been at the centre of policy discussions, where there have been continuous efforts to find lasting solutions. As noted above, one such recommended potential solution has been for communities to adopt a regional approach to water management where communities could collectively manage whole or aspects of water supply systems to improve water supply (Breen, Minnes & Vodden, 2015; Hrudehy, 2011).

Like other rural regions in NL, the Straits also experiences the water challenges noted above. These issues pose public health threats to rural residents, as well as to community resilience and sustainable development of communities and the region (Butler et al., 2017).

1.2.2: Purpose and Objectives of the Research

My research attempts to address the problems described above by exploring the potential of a regional approach in managing rural drinking water systems and its feasibility in addressing water challenges in rural settings, particularly in the rural NL context. Through a case study approach, I worked with communities in the Straits to explore available opportunities and the stakeholders that would be required to implement a regional approach. The study also investigates the benefits of a regional approach as well as the potential challenges. To explore the potential of a regional approach to drinking water management, the study sets out four objectives. The following specific objectives guided the data collection and analyses processes:

- 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 actors and processes required to pursue further analysis and implementation of regional drinking water initiatives.

1.3: Justification of the Study

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 can manifest into more vibrant and effective water supply systems to minimize or resolve current water challenges and contribute to community and regional development. Recommended solutions to water challenges from this study could have significant consequences for sustainable regional development and 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. As mentioned, some water research has been conducted in NL (Breen, Minnes & Vodden, 2015; Hanrahan, Dosu, & Minnes, 2016; Minnes & Vodden, 2014), but none specific to the Straits region. There have been recommendations in recent literature for further research in the water sector 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, my study aims to address this gap by applying a regional approach in water management and exploring its potential to resolve water challenges in the specific context of the Straits as a case study example. As the first academic research to apply a regional approach in water management in the Straits, it sets the agenda for further discussions and prompts questions for future research both specific to the Straits region, as well as to other rural areas in 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 places (see Chapter 2 for examples). The study broadly adds to existing literature on water management and governance in Canada. In particular, it would contribute to the growing literature in water management that focuses on the human influence on water supply, which helps to fill this research gap as well.

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. This is timely and relevant within Newfoundland and Labrador as challenging demographics (e.g. declining and aging populations) and related human and financial resource limitations have affected the development efforts of many individual communities. On realizing these challenges, the provincial government has often advocated and supported efforts for regional service delivery. Some recent provincial efforts include the regional waste management service (see section 4.6); support for the Regional Water and Wastewater Pilot Program in western, eastern and central NL; and support for four communities (St. Paul's, Cow Head, Parson's Pond and Daniel's Harbor) to share a water operator in western NL (Minnes & Vodden, 2014; Rolling, Chant & Gazley, 2017). Further, the provincial government has organized consultation meetings across the province to seek the input of community members and representatives on the potential for forming regional level governments. Two such workshops were held at Rocky Harbour and St. Anthony to the south and north of the case study region. The provincial government is yet to act on the findings of the consultation exercise. This study offers insight into regional water service-sharing, which can be adopted as part of or even if such a regional government system proposal fails.

Specific to water, regional scale cooperation aims to contribute to efforts to improve the quality and reliability of drinking water supply to 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. As noted above, this research contributes to the broader discussions about municipal service-sharing and the proposed “regional government system” in NL. It is my hope that this research will enhance efforts made by the provincial government, Municipalities NL, and other stakeholders to advance these ongoing discussions on the regional governments system.

1.4: Chapter Synopsis

My thesis is structured into six chapters: (1) general introduction to the study; (2) literature review; (3) methods; (4) results; (5) discussion; and (6) conclusions. Chapter 1 gives a general introduction to the study. It states the research problem, identifies the goal and objectives and discusses the justification for the study. The second chapter maps evidence of recent scholarly works on the study topic: a regional approach to drinking water management. The literature review chapter also discusses the aspects of water supply systems where communities can partner or collaborate, current water management challenges, and the potential solutions. The literature reviewed was focused on NL, but also included other literature from across Canada. Chapter 3 details the methods used in the collection and analysis of the data: research design, sampling process and the study variables including a description of the study site. The type of data, collection

methods, processing, and analytic methods used are also discussed. Some limitations of the study have also been included in this chapter.

Chapters 4, 5, and 6 consist of the results from the data collected, discussion of these results, and the conclusions respectively. Chapter 4 contains results on the current state of water supply systems, administrative arrangements, and associated challenges with water management in the Straits. This information responds to the demands of the first two objectives of the study; to identify current water challenges and to identify the aspects of water supply systems that can be regionalized. It also includes participants' views on how they resolve water challenges and on a regional approach to drinking water management. Some examples of existing service-sharing initiatives in the Straits are also stated in this chapter. Chapter 5 discusses the study findings, their implications, and their significance in relation to new regionalism and existing literature. Particularly, the chapter satisfies the last two objectives of the study; to explore the feasibility of a regional approach amidst technical, geographic, social and political conditions and to identify the actors and processes to adopt a regional approach. Chapter 6 highlights some general conclusions of the study and indicates how and where the study objectives have been addressed in the thesis. The chapter also includes recommended areas for further research, the contributions of the study to research and policy.

CHAPTER 2: LITERATURE REVIEW

2.1: Introduction

With the objective to lay the foundation and guide the design, data collection, and analysis of the research, the following literature review provides an overview of the shifting roles and responsibilities of governments in providing drinking water services. The review also looks at the challenges associated with drinking water management in rural Canada, with a NL focus, and possible solutions with an emphasis on regional approaches as suggested by researchers. The potential of a regional approach is summarized as a potential alternative to current water management. The chapter also includes an exploration of the historical development of the “new regionalism” approach as well as the potentials of regional water management strategies in the literature.

Relevant and up-to-date materials, including peer-reviewed and grey literature, were accessed from the Memorial University of Newfoundland Library catalogue, Scopus, Elsevier, GreenFILE, ProQuest Central, Web of Science core collections, and Google scholar. The keywords used in the search for the articles included: “drinking water”, “water management”, “water governance”, “regional approaches” and “Canada”. The articles retrieved were uploaded into Nvivo 11, a computer software for qualitative data organization and analysis, to code themes for further analysis.

I used a theme-based approach in the review process (Grant, 2009). The theme-based review was chosen over other types of reviews because: 1) it broadly explores existing literature on the subject matter to identify gaps based on themes; 2) it organizes the review based on themes that are relevant to the research; and 3) it is possible to summarize and disseminate review findings

to interested stakeholders: researchers, policymakers, water providers and communities, in the case of this study (Cacchione, 2016; Arksey & O'Malley, 2005). Themes considered in the review process included: drinking water management in Canada; aspects of water supply systems; challenges of current water supply systems; and suggested solutions, including regional approaches.

2.2: Drinking Water Management in Canada

The responsibility on water management to act on the other components of a water supply system makes it a critical part to ensuring water security. In the literature reviewed, water scholars and managers have described current concerns and envisioned future issues providing safe and clean drinking water to Canadians if current water management challenges are not resolved (Peterson & Torchia, 2008; Eggertson, 2008). It has also been discovered that current management strategies in water supply systems have consequences for overall future development considering the central role of water systems and management in infrastructural planning (Connelly, Markey, & Roseland, 2009; Kennedy, Roseland, Markey, & Connelly, 2008). The following section discusses the legislative and regulatory environment, as well as the different roles various levels of government play in water management in Canada. The section also provides a summary of the components of water supply systems, current challenges, and suggested solutions discussed in recent literature.

2.2.1: Water Governance: Legislation, Policy, and Planning

Following the Walkerton and North Battleford waterborne disease outbreaks in 2000 and 2001 respectively there was an increase in public health concern among water management authorities across Canada and a revived effort to safeguard water quality (Charron et al., 2004; O'Connor, 2002). Despite essential reforms to protect and better manage drinking water supplies after these outbreaks, current water systems still require considerable improvement to ensure the continual delivery of safe and reliable drinking water to residents (Black & McBean, 2017).

In Canada water management roles are unequally shared, relative to current capacities, among the different levels of government (Minnes & Vodden, 2017; Government of NL, 2014). It is the responsibility of the federal government to regulate select aspects of water like marine resources, fisheries activities, trans-border waterbodies, navigation, and water for Indigenous people and on federal lands (Zubrycki, Roy, Venema, & Brooks, 2011; De Loë, 2008). The federal role in water security is limited as the Canadian Federal Water Policy and the Canada Water Act of 1970 allocate most water management roles and responsibilities to the provincial and local governments with little federal government support or involvement (Furlong & Bakker, 2011; Bakker, 2007). Generally, the provincial and territorial governments in Canada are expected to perform roles regarding water quality monitoring, water infrastructural funding, and formulation of water action plans and guidelines for compliance by lower-level governments (municipal governments, LSD volunteers and other community leadership) (DMAE, 2016; Hill, Furlong, Bakker, & Cohen, 2008). While the federal government provides voluntary guidelines for water standards, it is the provincial and territorial governments that develop water plans, policies and monitor water quality. The voluntary compliance with federal guidelines and the downloading of responsibilities to lower-level governments, coupled with the inconsistency in water standards and

targets are partly responsible for the inability of local communities to comply (Castleden et al., 2017; De Loe, 2008). For instance, the federal government sets voluntary guidelines for drinking water quality but does not implement or monitor application of the guidelines (Bakker, 2007). Bakker (2007) further indicates that, these guidelines are implemented to varying degrees by provincial and territorial governments who sometimes do not entirely adhere to the guidelines but can use the guidelines to develop provincial water plans. For example, while the NL government precisely adopts the Multi-Barrier Approach (described further below) and the Canadian Guidelines for Drinking Water Quality, British Columbia does not (Christensen, 2011). Possible water challenges that are likely to result from the mentioned inconsistencies include a lack of source water protection, inadequate human and financial resources, ineffective monitoring and supervision of water quality, and failing water infrastructure (Dunn, Bakker, & Harris, 2014; Zubrycki et al., 2011).

In NL, it is the role of the provincial government to enact and implement water quality standards and regulations for public water safety (Butt, 2009). For example, the Department of Municipal Affairs and Environment (chemical parameters) and the Department of Health and Community Services (bacteriological quality) collaborate with other stakeholders to monitor and ensure quality-control of public water supply systems (DMAE, 2017). However, this provincial mandate has often been challenged by several factors (e.g., human and financial inadequacies, human perception, unfavourable geography) which affect water quality (DMAE, 2014).

The NL government adopted the Multi-Barrier Approach produced by the federal government to develop the Multi-Barrier Strategic Action Plan (MBSAP) to protect the safety of public water supply systems (Government of NL, 2014). The MBSAP is a holistic and adaptive framework that engages the collaborative efforts of key provincial departments to reduce public

health risk through the prevention or reduction of water contamination in the whole water supply system (Government of NL, 2016; Canadian Council of Ministers of the Environment (CCME), 2004). The MBSAP has three broad components including water infrastructure, water quality, and water legislation. One strength of this framework is that the failure or weakness of one barrier would be compensated for by the effective operation of subsequent barriers (Department of Environment and the Climate, 2001). The legal provisions that support the management of public water supply systems as contained in the MBSAP can be found in the *Water Resources Act*, the *Municipal Affairs Act*, and the *Municipalities Act* (Eledi, Minnes & Vodden, 2017; Government of NL, 2015). The Department of Municipal Affairs and Environment, Health and Community Services and Services NL have variate collaborative responsibilities in the implementation of the MBSAP (Government of NL, 2017).

Local governments (e.g., communities, municipalities, regional governments) provide and manage water supply systems to provide water for community residents (Adeel, 2017; Furlong & Bakker, 2011; Ivey, de Loë, & Kreutzwiser, 2006). These lower-level governments are in charge of the day-to-day operations of water systems including the mitigation of related water challenges (mentioned earlier) that could threaten water quality (Bradford, Bharadwaj, Okpalauwaekwe, & Waldner, 2016; Boyd, 2006). The protection of source water, provision of water infrastructure and the compliance with water standards and regulations are performed largely by municipal governments and other lower-level authorities (e.g., Local Service Districts and Unincorporated Areas). Adeel (2017) and others argue that these lower-level governments have been allocated water management responsibilities without compensatory support from upper-level governments (federal and provincial governments) to execute this mandate.

2.2.2: Components of Drinking Water Supply Systems

A water supply system can be described as “a system of engineered hydrologic and hydraulic components which provide water supply” (Waikham & Mehta, 2015 p.1494). Different researchers have categorized the components of water supply systems differently over time. Notable among the components of water supply systems are source water, water infrastructure (e.g., for storage, distribution, treatment), human and financial resources, policy and planning, and governance (Minnes & Vodden, 2017; Hrudey, 2011; Davison et al., 2005). This section describes and discusses some of the components of a water supply system.

Source water as a component of water supply systems includes both ground and surface water supply such as springs, rivers, precipitation, aquifers, streams, lakes, and water reservoirs which may then be treated within a water treatment system for domestic and industrial use (Eledi, Minnes, & Vodden, 2017; Waikhom & Mehta, 2015). Due to the vulnerability of source water to contaminants and pollution, the NL government has prioritized source water protection in the Multi-Barrier Strategic Action Plan as the most important barrier to safeguard water quality (Government of NL, 2014). Source water has often been the primary point of entry for most water contaminants from human activity, animal activity, industrial pollution, or the presence of naturally occurring metals (CCME, 2014). Source water protection has been recognized as the first barrier and a potentially inexpensive investment to avoid or reduce water pollution when compared to remediation of contaminated water (CCME, 2014; Patrick, 2009).

Water infrastructure is made up of linear (e.g., distribution, transmission), as well as non-linear (e.g., treatment, pumping stations, water storage) assets (Canadian Infrastructure Report Card, 2016). Water infrastructure is another critical component of the water supply system that can be developed, operated, and supported by the human and financial components to produce

water supply; hence challenges with infrastructure have adverse consequences on the whole water system. Simply put, when there are problems with water infrastructure, the whole water system could be compromised. In rural NL for instance, there are widespread challenges with water infrastructure such as inadequate treatment facilities, old and deteriorating water infrastructure, and inadequate maintenance plans that could have consequences on water supply (Dore, 2015; Speed, 2014b).

The staff and institutions that operate and manage the other components of the water supply system under the guidance of regulations, policies, and plans constitute the human and institutional resource component within the water supply system. The human resource component includes both technical and non-technical people including: engineers, water operators, municipal staff, and community volunteers engaged in administering the water system. Human resources are a fundamental component involved in planning for, and managing water supply systems hence, a well-built human resource is a critical part of sustainable management and quality service delivery (Bogardi & Hartvelt, 2001). In NL, many small water systems do not have qualified, fulltime operators but instead rely on municipal staff or community volunteers who perform necessary duties to provide water supply (Minnes & Vodden, 2017). Minnes and Vodden (2017) further assert that, water supply systems that are operated by such personnel are more likely to experience water quality problems. In many rural communities, it is financially challenging to hire and keep trained and certified water operators, which could affect the supply of safe and clean drinking water to their residents (Dore, 2015). It is important to engage qualified water management personnel to manage water supply systems as their actions have direct consequences on water quality and, the health of the general public (Hrudey, 2011).

2.2.3: Challenges Affecting Drinking Water Supply Systems

The challenges of rural water supply systems, particularly in NL, are complex and systemic. Many rural communities have similar water challenges such as ageing and failing infrastructure, low capacity levels, a lack of asset management, multi-use watersheds, and unenforced water regulations (Vodden, Sarkar, Holisko, & Speed, 2014). It is expected that water management should work to mitigate the impacts of the other water challenges however, current management of small water systems in particular, are disorganized, unaccountable, and do not comply (or implement) with water regulations in Canada (Bereskie, Rodriguez, & Sadiq, 2017). These issues often affect water supply systems in relation to drinking water quality.

As stated, water challenges are systemic, and as such they can be experienced within any component of the water supply system. Common water challenges specific to water infrastructure include ageing distribution lines, the high cost of building or upgrading water infrastructure, and public perception and acceptability of water treatment technologies (Ochoo, Valcour, & Sarkar, 2017; De Loe, 2008). Generally, existing infrastructure, including water infrastructure, cannot support current demand particularly in rural areas where communities are unable to upgrade degraded water infrastructure (Connelly, Markey, & Roseland, 2009). Cooper (2013) reported that about 43% of water and wastewater assets in NL have often outlived their lifespan and are due for upgrades or maintenance.

Related to infrastructure is asset management, which can be defined as the coordinated activities to appreciate the value of assets of an organization or a community (Alberta Association of Municipal Districts and Counties, 2015). An asset management plan provides the roadmap to how local resources can be used to support present and future populations. Asset management is a system that monitors and maintains resources and infrastructure through preventative

maintenance, operation plans, recordkeeping of existing infrastructure, and the overhead costing of projects to enable the sustenance of water infrastructure (CBCL Limited, 2012; Bakker, 2007). However, asset management plans are absent in many communities in NL which affects the nature, cost and rate of maintenance, and the upgrades required to sustain water infrastructure (Dore, 2015; Christensen, 2011).

Another notable water challenge that facilitates other problems within the water supply system is the inadequate capacity required to manage water supply systems effectively. For instance, in many rural communities there are few qualified staff (and no staff in some cases) with the requisite skill set to manage water facilities (Dore, 2015). In other cases, the risks and the lack of incentives for water operators discourages community volunteers from taking up water management responsibilities. Another aspect of the financial challenge is the cost of infrastructure and lack of budgets to support reinvestment (Minnes & Vodden, 2014). These capacity challenges have consequences for the sustainable supply of clean drinking water (Kot, Castleden, & Gagnon, 2011). For example, communities may be unable to fix broken water infrastructure which could result in leaks and water quality issues, as well as water shortages in extreme cases.

There are several challenges specific to rural areas and small towns that can aggravate water problems. These challenges include low population (density), small tax bases, limited economic activities, and the lack of economies of scale (Bereskie, Rodriguez, & Sadiq, 2017). For example, in the Straits region, the low and aging population combined with a lack of industry means a small tax base, which could result in low rate revenues to support system upgrades or hire certified water operators. The declining and aging population could also result in the lack of youth to take leadership positions or be trained as water operators. These situations could ultimately have adverse impacts on water supply.

In the literature, scholars have warned of water quality issues in water supply systems threatened by these challenges (mentioned above), especially in rural areas (Dore, 2015; Hrudey, 2011). However, there are examples where communities have often overcome these challenges by employing multiple strategies to secure potable water. Those that are significant to this study are discussed in the section that follows.

2.2.4: Solutions to Challenges of Water Supply Systems

Potential solutions to address water challenges suggested by researchers and water managers include the revitalization of current water management, restructuring of the water management, and the adoption of a regional approach (Breen, 2016; Hanrahan, Dosu, & Minnes, 2016; Capacity Infrastructure Services Limited, 2012; National Research Council, 1997). The first two, revitalization of current water management and restructuring of the water system, are discussed below, while the third is discussed separately in Section 2.3.

Scholars have suggested that conscious efforts be made by upper-level governments to enhance water policy and planning processes, increase financial and technical support for water infrastructure, and improve water governance to mitigate some of the challenges that water systems face (Hanrahan, Dosu, & Minnes, 2016; Breen & Markey, 2015). For example, Hanrahan, Dosu, and Minnes (2016) recommended the formation of water management committees involving multiple stakeholders to manage water supply systems and that the provincial government increase

the financial and technical assistance offered to rural communities. The introduction of the Public Water Dispensing Unit (PWDU)¹ program in NL was a result of such recommendations.

Another strategy recommended as a potential solution is to restructure the existing water systems where communities sublet the ownership, control, and management of their water system to a third party to provide clean and safe water supply to the residents (Bakker & Munk Centre Program on Water Issues, 2003; National Research Council, 1997). Restructuring water systems can take different forms including: direct ownership; receivership or regulatory takeover; contract service; or support assistance (National Research Council, 1997). In each, some form of water management responsibility is leveraged to a third party be it public (regional or municipal authorities), private (for-profit companies), or public-private partnership (Watercare Services Limited, 2017; Garcia, Younos, & Thompson, 1999). For example, the water supply of four municipalities (Hutt City Council, Porirua City Council, Upper Hutt City Council, Wellington City Council) in The Great Wellington Region in New Zealand was contracted out to Capacity Infrastructure Services Limited (CISL) to administer their water assets and supply water as well as manage wastewater (CISL, 2012). Moreover, the councils of the towns of Waitakere, Ackland, Rodney, Franklin, Papakura, Manukau, and North Shore also in New Zealand signed a Memorandum of Understanding (MOU) with the Auckland regional council (Watercare Services Limited) to deliver water and wastewater services to the residents within the region (Wellington Community Services, 2017). Participating municipalities in these restructuring examples saved on overhead cost for the construction and upgrades of water facilities (WCS, 2017; CISL, 2012).

¹ 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).

However, critics of this model have cited challenges including complexities, disagreements, and power dynamics in regard to the change of ownership of water assets, employment of staff, and disbursement of profits (WCS, 2017; National Research Council, 1997).

2.3: Regional Approaches in Perspective

In recent years, there have been significant motivations for communities to regionally manage resources as an essential part of the evolving application of “new regionalism” as a development approach across the world (Ortiz-Guerrero, 2013). There are many definitions of a regional approach. A regional approach is defined as any form of collaboration among communities within a designated location to jointly manage resources (Douglas, 2013; Wheeler, 2002). This may also involve a “regional scale management approach that reflects pre-determined characteristics based on place, governance, integration, innovation and knowledge sharing, sustainable infrastructure, and the best practices of water management” (Breen & Minnes, 2015 p. 85). The emergence and success of regional governments and regional approaches to regional development in recent years in both developed and developing countries offer some motivation to consider managing water supply systems regionally (World Economic Forum, 2017; Cashaback, 2001). For the purpose of water management and also for this thesis, a regional approach is considered as a water management strategy where 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.

In the literature, a regional approach has been recommended as a strategy to manage complex systems such as water supply systems for quality service delivery (Breen, Minnes, &

Vodden, 2015). Hrudey (2011), for example, suggests that upper-level governments should advise communities and municipalities with small water systems to merge or form alliances into bigger, more sustainable ones, as done in some parts of England and Australia. Breen (2017) argues that a regional approach in managing water systems could result in several communities pooling limited resources together to strengthen their financial, human, political, and technical capacities to provide better drinking water services to their residents. There is evidence in the literature of such place-based, regional initiatives involving communities of variate sizes, capacities, and authority that share aspects of water supply systems as a way to resolve water challenges (see Section 2.3.1). Additionally, many water sources cross community and regional (as well as provincial and national) borders, necessitating a broader stakeholder involvement and collaboration in the management process (Wheeler, 2002).

A regional approach has been (re)emphasized by some researchers due to the ineffectiveness of current water management strategies and the complexities of water challenges that require multiple-community and -stakeholder collaboration (Breen, 2016; Hanrahan, Dosu, & Minnes, 2016). Concerns expressed about future water challenges in single community-managed water systems and the suggestions found in the literature for community collaborations call for a detailed exploration of regional approaches as a potential solution to water challenges. This was the premise that guided the design and development of this research.

2.3.1: Examples of Regional Initiatives in Water Management

There are examples of multi-community collaborations in managing water supply systems in both developed and developing countries, particularly where there are capacity challenges with water management (Hrudey, 2011; Government of Ghana, 1998). In most cases, a single regional

or sub-regional board or committee oversees the operations and management of the water systems to provide water to several communities. For the purpose of this study, the examples of regional water management provided are NL and Canada focused.

There are examples across Canada of regional collaborative initiatives among varying numbers of communities that share major services including, but not limited to water supply (Vodden, 2005b: 2005c: 2005d: 2005e). These collaborations and partnerships occurred based on factors such as proximity of member communities or stakeholders, their current needs, and their resource capabilities. One aspect or a complete water supply system could be shared among few communities (see the Water Operator case below), a sub-region (for example, the case of the Exploits Regional Water Supply), or across a whole, larger region (see the Greater Vancouver Regional District example below).

A notable sharing initiative in water supply systems elsewhere in Canada is in British Columbia- though not a rural example- 21 municipal governments within the Greater Vancouver Regional District (GVRD) jointly own, manage and share water and wastewater supply systems (Bakker & Munk Center of Program in Water Issues, 2003). In this example, the GVRD owns the water supply system, which is administered by a management board made of representatives from member municipalities within the regional district (Forest, 2010a). This collaboration is beneficial to participating municipalities in terms of economies of scale, reduction in human and financial cost, and quality service delivery. Additionally, the control and management of the facility is by member municipalities, which helps to ensure accountability and municipal independence (Bakker & Munk Center of Program in Water Issues, 2003).

A unique example of community collaborations water supply cited in the literature was one that crossed national boundaries. In 1906, two communities in Quebec, Stanstead and Rock Island

communities, and Derby Line community in Vermont, USA started a collaboration to share in drinking water and wastewater management, and trans-border library (Forest, 2006). The International Water Company (IWC), originally started as a private company, supplied treated water from the Holland Pond (USA) to the three municipalities. Subsequently, due to increases in population and water demand, the municipalities acquired and managed some of the water facilities of the company to supply water to their residents (Forests, 2010a). this was through an agreement signed between IWC and the three municipalities in 1996 (Forest, 2006).

At the watershed level, the Collaborative Environmental Planning Initiative (CEPI) was formed in 2003 to foster collaboration among stakeholders to protect the Bras d'Or Lakes and watersheds that traverse several communities on Cape Breton Island in Nova Scotia (Bras d'Or Lakes CEPI, 2011). In this example, a single management board takes charge of the operations to protect the long stretch of the watershed, reducing the human and financial costs which could be incurred if individual communities were managing their sections of the watershed independently (Vodden, 2015; Bras d'Or Lakes CEPI, 2011).

A successful water-sharing initiative in Central NL is the Exploits Regional Water Supply at Grand Falls-Windsor (Government of NL, 2014; Exploits Regional Service Board, 2008). The water supply system was legislated under the Town of Grand Falls-Windsor as per the regional service provisions in the *Municipalities Act*. The system was initiated in 1972 by the Town of Grand Falls-Windsor through a study on the Gau's lake water supply potential to supply treated water to five communities (Grand Falls-Windsor, Bishop Falls, Botwood, Peterview and Northern Arm) (DMAE, 2014). The Town of Grand Falls-Windsor operates the water system in regard to the planning and budgeting, including operations of a water treatment plant and other infrastructure that was constructed with federal funding in 1976, including a 13-km water main line to Grand

Falls-Windsor and Bishop's Falls (Regional Service Board, 2008). In 2005, an 18-km water line was constructed to connect Botwood and Peterview onto the water system. The system has flow meters installed that measure the amount of water supplied to each community and bills are calculated accordingly. The cost of water treatment and distribution as well as other operational costs are shared between member communities based on population. Each member community pays a monthly bill to the Town of Grand Falls-Windsor which is proportionate to their population served (Chireh, in-progress). The Town of Grand Falls-Windsor then uses the rate revenues to offset the cost of treatment and distribution, operational cost, and other administrative expenses. In most communities, households connected to the water system are charged a flat-water tax or rate to be paid monthly or yearly to offset the bill owed to the Town of Grand Falls-Windsor (Exploits Regional Service Board, 2008).

Another example of regional water management in NL is the case of Indian Bay Ecosystem Corporation's (IBEC) work on protecting Indian Bay watershed. The operations of IBEC spans the communities of Indian Bay, Centreville-Wareham-Trinity, and a host of other smaller communities (Breen, 2016). Their approach focuses on watershed protection which is achieved by strengthening research, engaging with communities, and establishing a strong stewardship among actors (Breen & Minnes, 2015). The case of IBEC represents a successful integration and multi-community initiative led by a regionally-established entity to manage watershed and its accompanying economic activities, including trout fishing in the area.

In Central Newfoundland, a regional approach to human capacity can be found around Bonavista and surrounding communities. The Bonavista North Joint Council operates regional water management established on the premise of human resource sharing (Breen, 2016). The council is made up of the communities of Centreville-Wareham-Trinity, Greenspond, Indian Bay,

Lumsden, Musgrave Harbour, and New-WesValley who share one water supply system operated by a single water operator (Breen & Minnes, 2015). Despite the existence of varied water systems in the region (e.g., a hypochlorite system, a treatment plant, and gas chlorination) there were successes in managing water through the collaboration and service-sharing. Improved water record keeping, quick identification of system problems, and increased training activities, among other benefits, can be cited in the region as a result of the regional approach (see Rogers, 2014)

Another successful example of collaboration in water supply includes a case cited by Vodden and Minnes (2014) where a single certified water operator manages the water supply systems in four communities in western NL (St. Paul's, Cow Head, Parson's Pond, and Daniels Harbor). After joining the shared regional water operator approach, the BWA was lifted off three of the communities. Under a similar program in western NL, the regional water/wastewater operator pilot program, several communities were lifted off BWAs that have been in existence for many years (15-20 years) (Rolling, Chant & Gazley, 2017). At the same time, they would save on human and financial costs if each community hired a water operator (Rolling, Chant & Gazley, 2017; Vodden & Minnes, 2014).

2.3.2: Advantages of a Regional Water Management Approach

The examples above demonstrate various advantages to a regional approach to water management, including reductions in overhead and human resource costs, as well as a safe drinking water supply (Hanrahan, Dosu, & Minnes, 2016; Haque, Csapo, & Round, 1999). Other scholars have supported their preference for a regional approach to managing water supply systems with corresponding advantages including enhanced capacities, savings in overhead cost for water

infrastructure, economies of scale, improved quality of services, and improvement in public health (Furlong & Bakker, 2011; Haque, Csapo & Round, 1999).

In a regional water management structure, decisions could involve multiple stakeholders in planning which are more likely to be based on evidence and knowledge sharing. The decisions made from effective stakeholder engagement could result in more local support for water policies and plans, as demonstrated in the IBEC case (see example above). Participating communities are more likely to be able to implement such plans to meet water quality targets and standards (Markey, 2011). In some case, communities in a regional-scale collaboration could formed a unified voice and advocated for amendments to water standards and regulations to match place-specific challenges from upper-level governments (Minnes & Vodden, 2014).

Another notable advantage of a regional-scale collaboration is the prospect of regional asset maintenance programs and plans where the cost of expert technical staff and technologies could be shared to improve water assets management and water service delivery as a whole (Alberta Association of Municipal Districts and Counties, 2015; Dore, 2015). This was illustrated in the case of the Bonavista North Joint Council (see Rogers, 2014).

2.3.3: Challenges of Regional Water Management System

Although several examples of regional water management initiatives have been noted in the preceding section, their operations faced some challenges. In particular, regional collaborations in managing water systems have encountered setbacks such as weak governance structures, uncoordinated policy and planning, and negative demographic and historical antecedents (Furlong & Bakker, 2011). Some joint water systems had challenges in identifying and harmonizing common interest, acknowledging place specificities, and overcoming limited capacities (Peterson

et al., 2010). The success of a regional approach to managing water supply systems, particularly in rural settings, depends much on how these noted challenges can be mitigated.

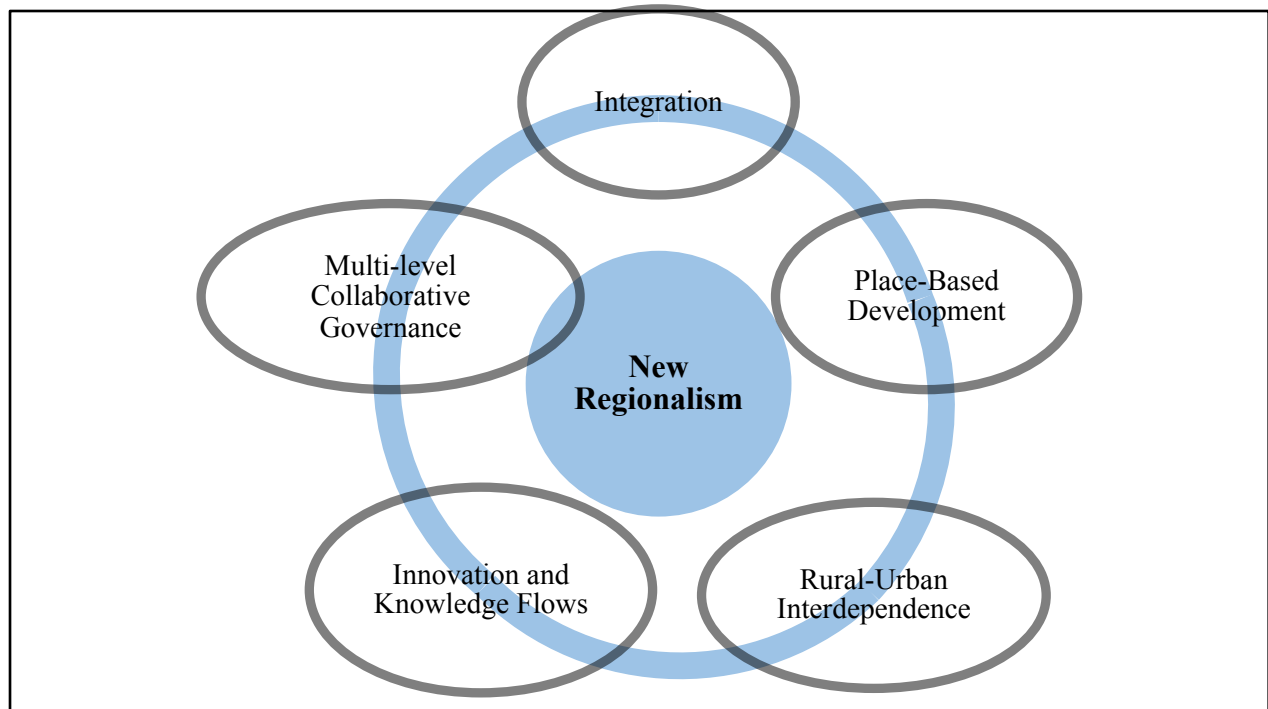
2.4: Conceptual Approach and Framework Literature

This research study is grounded in new regionalism theory, which is discussed in detail below. New regionalism as an approach emerged as a form of regional development strategy. Different scholars have given various definitions of new regionalism. 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. New regionalism considers the region as the central point to plan development through networking. New regionalism is a revolutionized approach to regional development that began in the 1990s in reaction to global political and economic circumstances that occurred in the 1980s and the increased interest by local people to participate in government and resource management (Breen, 2016; Wheeler, 2002). Other factors that were timely for new regionalism to evolve included the shifting roles (resource management and services delivery) of central government systems and administration after the Cold War and the increasing global economic integration in the 1980s (Sunkel & Inotai, 2016). Additionally, the downloading of responsibilities to local governments and the resurgence of locally-initiated development actions justify the revival in research and innovation for regional development approaches (LeSage Jr. & Stefanick, 2004).

New regionalism suggests an integrated and multi-disciplinary approach to resource (including water) management including public buy-in, incorporates place-based knowledge,

knowledge-sharing, and decision-making which involves multiple actors (Zirul, Halseth, Markey & Ryser, 2015; Markey, 2011). Unlike previous approaches to regional development, 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 highlights the significance of local collaboration in shared-services necessitated by capacity/resource disparities and demographic challenges, particularly among rural communities (e.g. the Straits). It further shows the important linkage between safe and sustainable water supply, place specificities and stakeholders' involvement in resource management to the overall (regional) development agenda. These attributes are shown in figure 2.

Figure 2.1: New Regionalism Framework



Source: Adapted from Gibson et al., 2015; Vodden, 2013.

The five themes of the new regionalism approach, as discussed by Gibson et al. (2015), are defined below.

- ***Place-Based Development*** – development that seeks to harmonize the universal capacity endowments of a specific area. New regionalism strives to recognize place uniqueness in planning processes to accelerate development while building social capital for development.
- ***Rural-Urban Interdependencies*** – Municipalities, LSDs and UIAs are interdependent with regards to business activities, shared environment, governance and as a unique region (the Straits). This inter-reliance supports the call for a regional approach to service (including water supply) delivery.
- ***Knowledge, Innovation, and Learning*** – the co-production of knowledge and innovation to tackle new challenges are crucial to emerging regions. Knowledge sharing, and learning are necessary to approaching new and changing development issues especially at the local and regional levels for sustainable development and rural resilience.
- ***Multi-level Collaborative Governance*** – an all-inclusive governance system that incorporates diversity and collaboration among various levels and scales of stakeholders to foster co-construction, decision-making processes, and power balances.
- ***Integration*** – this characteristic of the new regionalism concept embraces inclusivity in development policy and planning. It makes use of relative and normative strategies to find solutions to complex development issues.

The brief description of the themes of new regionalism provided above give a general context in regard to regional development. The use of the new regionalism concept to conduct research in drinking water management is not entirely new (Minnes, Breen, Markey, & Vodden, 2018; Breen, 2018; Breen & Minnes, 2015). The table below gives some description of the relationship identified between the various themes and drinking water. This study builds further on this previous work.

Table 2.1: The Relationship between New Regionalism and Water Supply Systems

New Regionalism Theme	Relation to Drinking Water
Governance	<ul style="list-style-type: none"> ➤ The complex, multi-use and transboundary nature of water and watersheds require a regional-scale governance system. ➤ Support for collective action and decision-making in multi-level and multi-sector networks ➤ Builds local capacity
Integration	<ul style="list-style-type: none"> ➤ Integrated planning process strives to balance between the environment, human activities, and resources for regional development. ➤ Holistic planning could accelerate regional development and sustainability.
Place-based	<ul style="list-style-type: none"> ➤ Place-specific features (e. g social, cultural, economic, physical) should be acknowledged in managing drinking water ➤ Water solutions from such deliberations more likely to address local problems
Innovation and knowledge	<ul style="list-style-type: none"> ➤ Generation and exchange of ideas, skills and technologies among stakeholders and networks in the water sector ➤ Assessment of new governance structures and legislation ➤ Can accelerate potential solutions through new technologies and knowledge
Rural-urban interdependencies	<ul style="list-style-type: none"> ➤ Relationships between urban centres and rural areas may include drinking water ➤ Facilitates the potential for cost-sharing and co-management

Source: Adapted from Minnes, Breen, Markey, & Vodden, 2018. p 81; Breen & Minnes, 2015. p

CHAPTER 3: METHODOLOGY

Chapter 3 of the thesis discusses the methodological approach adopted for the data collection and analysis. This chapter outlines the processes that were used in the study design including data sources, data collection, data analysis, and the report writing process, as well as methodological limitations of the study.

3.1: Research Design and Justification

A case study approach was adopted to explore the potential of a regional approach to managing drinking water supply systems in the Straits. A qualitative research method allows the researcher to employ multiple data collection strategies that will ensure an in-depth investigation of the issues and to give reasons beyond the actions or the numbers as in a quantitative approach (Hennink, Hutter, & Bailey, 2010; Merriam, 2002). Some of the advantages of a qualitative approach include: 1) it allows the researcher to be the main instrument of the data collection process; 2) it allows for data to be collected from multiple sources; 3) participants' expressions are interpreted and analyzed to address the problem or issue; and 4) it permits changes to the research process when necessary to fulfill research goals and objectives (Creswell, 2013). This study used qualitative data collection methods such as interviews and review of literature to achieve the research objectives.

The case study method allows the researcher to conduct an in-depth study of phenomena as well as to explore, explain, and understand an issue(s) by exploring various data sources (Creswell, 2013; Crowe et al., 2011; Baxter & Jack, 2008). The case study approach was chosen because it allows researchers to dig deep into complex, community-based issues (Hancock &

Algozzine, 2016; Gerring, 2006). Moreover, this approach allows researchers to explore both the process and the outcome of the phenomena under study through various data collection and analytical methods (Zainal, 2007). Additionally, the case study research approach has been widely used in other fields of study including sociology (Grassel & Schirmer, 2006), law (Lovell, 2006), public health (Savage et al., 2006), community-based research (Weinberg & Adam, 2003), as well as governance and management (Stewart, 2012; Djurić, Nikolić & Vuković, 2010; Zainal, 2007). The widespread usage of the approach in similar disciplines supports that this approach is appropriate for this research.

When categorizing case studies, Stake (1995; 2000) identifies three types of case studies: the intrinsic, the instrumental, and the collective. According to Stake (2000), the intrinsic case study allows researchers to investigate a single, particular case on its merit with an inherent interest. In this type of case study, the researcher concentrates on the case to bring out its peculiarities. Additionally, although theories can be (re)formed at times within such a study, that has not been part of the goal (Stake, 2000). In an instrumental case study, the researcher focuses on the issue (with little attention on the case) to provide an in-depth study of a particular issue to (re)form a theory (Grandy, 2010). All other aspects (e.g., context, activities) of the case may also be investigated to support the understanding of the issue to meet the study objectives (Grandy, 2010; Stein, Rocco, & Goldenetz, 2000). The main difference between an intrinsic and an instrumental case studies is that, while the former concentrates on the case, the latter focuses on the issue.

The collective case study is a combination of multiple instrumental cases aimed to investigate phenomena or subjects (Yin, 2013). The multiple cases may not have any common features, but their simultaneous study would lead to understanding a bigger case or phenomenon

(Stake, 2000). In collective case studies, several cases or issues can be considered in a single research study to support the generalization of the research findings (Luck, Jackson, & Usher, 2016; Crowe et al., 2011) and this serves as the major difference between the instrumental and the collective case studies.

This research adopted the instrumental case study approach to study the potential of a regional approach to drinking water management. This approach applies well to investigate the problem-solving potential of a regional approach to drinking water challenges in the Straits (see Section 2.2.3). While there are several cases (e.g. school, land, fishing, etc.) in the Straits that can be studied independently or within this research, the main interest of this study is to explore regional approaches to solve water challenges (the issue). In this case, as explained by Stake (1995, p. 16), the “issue is dominant”, meaning that the definition and background of the case(s) are studied to help the researcher achieve the research goal on the issue(s) under investigation (in this case, the potential of a regional approach to managing drinking water systems in NL). Applying the instrumental case study approach to this research will set the methodical foundation to study other ordinary but important aspects (e.g., context, activity) for a comprehensive understanding of the case to produce credible findings.

3.2: Description of the Study Area

My research was conducted in the Strait of Belle Isle, which is located on the Great Northern Peninsula in NL (see Figure 3.1). The region has a population of about 3,292 people

according to the 2016 census, a 7.7% decline from the 2011 population (about 3,545 people)². The region is comprised of 22 communities stretching from Castor River South in the south to Eddies Cove East in the north. The Straits region has a mixture of local government structures, each with varying levels of responsibilities and capacities. There are Unincorporated Areas (UIAs)³, Local Service Districts⁴ (LSDs), and three incorporated municipalities: Bird Cove, Flower's Cove, and Anchor Point in the Straits region (Government of NL, 2014). There are jurisdictional, administrative, and financial differences among these types of communities that can affect their abilities to participate or collaborate in regional water management.

The Strait of Belle Isle was selected as the case study area for several reasons. First, I had prior knowledge and familiarity with the region from previous research conducted in the region. Second, the literature reviewed on drinking water systems in NL revealed instances of multiple water quality issues and water management challenges in the region that were necessary to be investigated (Minnes & Vodden, 2014; Gibson, 2013). Third, the Towns of Flower's Cove and Anchor Point provided letters to pledge their support and willingness to collaborate in the research. The yellow portion in Figure 3.1 shows the study area, the Straits region.

² See http://stats.gov.nl.ca/Statistics/Census2016/PDF/CCS_Community_2016.pdf

³ Unincorporated Areas are small localities that are not covered by the Municipality Act, with no management in place hence, the provincial government provides for their basic service (Gibson, 2013).

⁴ 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

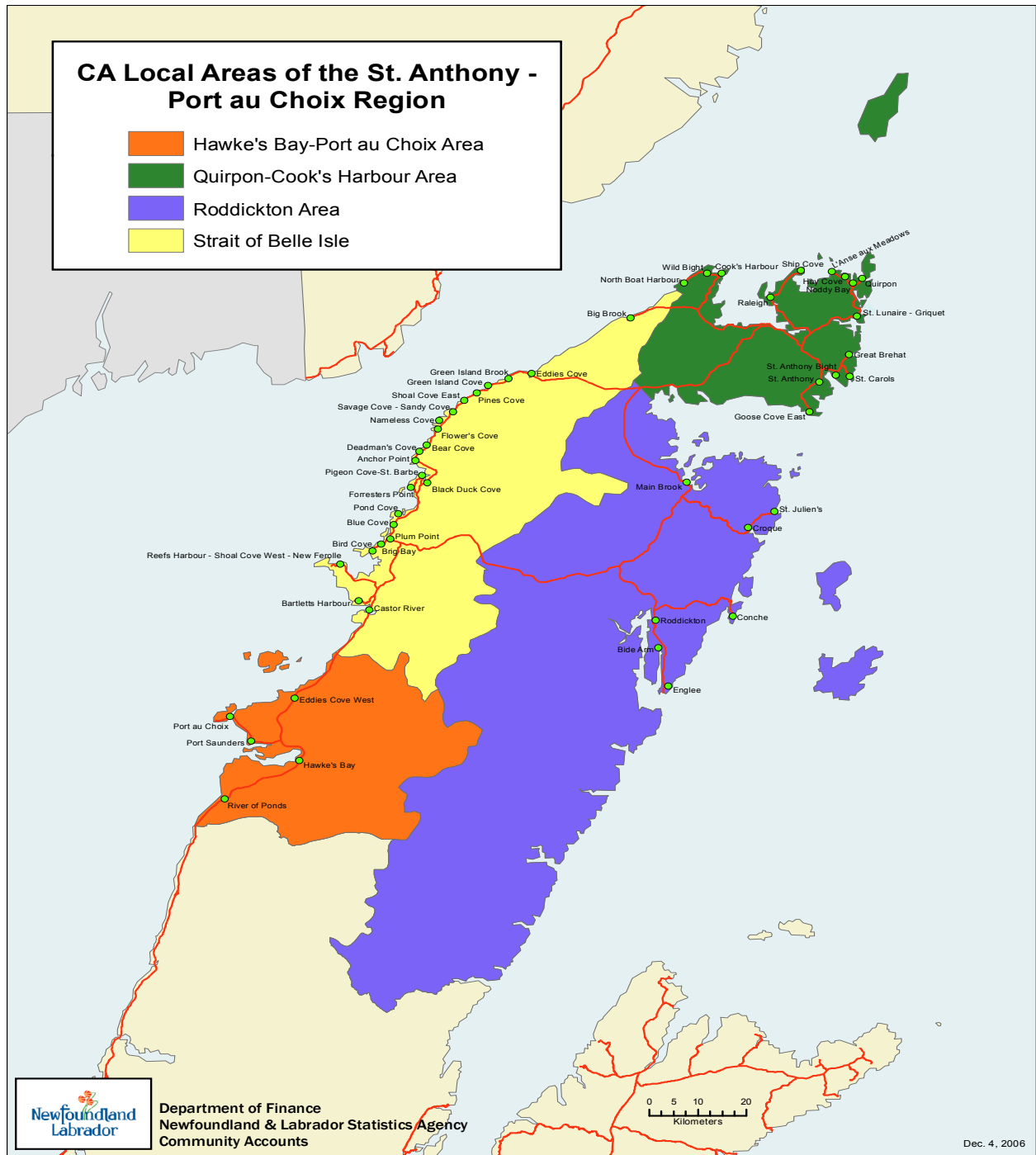


Figure 3.1: Map of the Great Northern Peninsula.
Source: Statistical Service, NL. 2006

Most of the communities in the Straits experience multiple water challenges: aged, weak, and failing water infrastructure; inadequate funds; and the lack of qualified personnel to properly manage water supply systems. These challenges are discussed in chapter 4.

Table 3.1: Characteristics of Water Systems in the Straits

N o.	Supply Area/ Community	Supply and Source Type	Protection/ Chlorination System/ Other Treatment	Population (2016)	BWA	THMs $\mu\text{g/L}$ (2017)	HAAs $\mu\text{g/L}$ (2017)
1.	Flower's Cove	Surface water French Island Pond	Protected/Gas Infiltration gallery	270		147.75	107.47
2.	Nameless Cove	Surface water French Island Pond	From Flower's Cove	69		160.00	112.95
3.	Bear Cove	Ground water Lower Bear Cove	Unprotected/Drilled Liquid	91	Jun 21, 2000		
4.	Forrester's Point	Surface Water Rudges Point	Protected Liquid	208		116.65	45.43
5.	Plum Point	Surface Water Grand Pond	Protected Liquid	112	Dec 17, 1997	237.40:	100.33
6.	Bird Cove	Surface Water Inner Gilmour Pond	Protected/Liquid Infiltration Gallery	179+117	Aug 02, 2011		
7.	Brig Cove	Surface Water Inner Gilmour Pond	Protected/Liquid Infiltration Gallery	117	Aug 02, 2011	124.00	71.50
8.	Green Island Brook	Surface Water Green Island Brook	Unprotected Liquid	202		109.33	53.33
9.	Black Duck Cove	Long Pond - Black Duck Cove Intake	Unprotected Liquid	155	Dec 17, 1997		
10.	Nameless Cove + Flower's Cove	Surface water French Island Pond	Protected /Gas Infiltration gallery	69			
11.	Castor River North	Surface Long Pond (same as Bartlett's Harbour)	Protected Liquid	141	Jan 01, 1991		
12.	Castor River South	Surface water Brook	Unprotected	136	Jan 01, 1991		
13.	Pigeon Cove St. Barbe	Surface water Long Pond Intake #2	Protected Liquid	135	Mar 29, 2018		
14.	Anchor Point (Shared System)	Surface Well Cove Brook	Reservoir Protected Gas Infiltration gallery	314		131.25	102.82
15.	Deadman's Cove	Surface	Protected Liquid	37			
16.	Savage Cove	Surface water Wild Cove Pond	Protected/Liquid Filtration	120			
17.	Sandy Cove	Groundwater	Protected/Liquid	131			
18.	Eddies Cove West	Surface Brook	Unprotected No treatment	70	Apr 10, 2003		
19.	Bartlett's Harbour	Surface water Long Pond (same as Castors River North)	Protected Liquid	129	Apr 29, 1998	0.35	

Source: Adopted from Department of Municipal Affairs and the Environment, 2017.

Furthermore, many communities have small water systems with insufficient disinfection. Table 3.1 presents an overview of the water supply systems in the Straits. Features of the water supply systems stated in the table include the type of water source, treatment, population served, BWA status, and the recordings of THMs and HAAs as of September 2017.

3.3: Sources of the Data

To fulfill the study goal and objectives, my research collected data mainly from primary sources, supported by secondary data. The primary data was collected through interviews with key informants. The targeted population for the interviews was key stakeholders (those people with the responsibility to provide or oversee water supply) in the case study region, including municipal mayors, town managers, water operators, volunteers, and related provincial officials. An online search was conducted to access contact information with potential participants in all the communities in the region. After several follow-ups with emails and telephone calls, 11 people from eight communities were recruited and interviewed. Additionally, four resource persons were interviewed from the Water Resource Management Division of the Department of Municipal Affairs and Environment, the GNP Waste Management Board, and the Regional Water/Wastewater Operator in charge of the western region in NL. The resource persons were interviewed to share their experiences and opinions on water challenges in the Straits (and NL) and recommend solutions thereafter. These interviewees could be seen as providing a different side of “the story” as observers living outside of the affected communities and with experiences working with a wider set of communities in NL. Details of research participants can be found in Section 3.4. Using 15 interviews, the participants responded to a range of questions relating to water management including the current state of water supply systems, current water management

challenges, recommended potential solutions, and identifiable actors and procedures needed to implement a regional approach to water management (see Appendix 3 & 4).

Data was also collected from the review of secondary data sources, including 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), a study to examine local government in the region (Blackmore 2003), as well as notes and minutes from the regional government consultation sessions at Rocky Harbor and St. Anthony held in fall 2017 as part of the provincial consultations being held across NL. The annual reports and the web portal give information in regard to current status of water supply systems, particularly in public water supply systems. Other information obtained from the web portal also included data on BWAs, results of water sampling and testing, DBP recordings, and protected public water supply areas in the various communities. The ICSP and the 2003 Local Government Feasibility study provided information on some service-sharing examples, previous collaborative efforts, and capacity assessment of the region for a regional government (and regional water management) system. Information in the MNL report and the consultation notes and minutes included the views and opinions of communities and municipalities on the intended regional government system in NL (including the GNP region). These documents provided relevant information on water management in the Straits and as a way to triangulate with the interviews conducted, where comments in these documents confirmed or contradicted some of the responses and comments.

3.4: Interview Data Collection Process

Purposive and snowballing sampling techniques were used to recruit participants. These sampling methods allowed for the targeted selection of individuals who have prior knowledge of the subject matter and can give in-depth information (Onwuegbuzie & Collins, 2007). In the use of these sampling methods, participants could volunteer to participate or redirect researchers to other individuals in better positions to provide relevant information (Christensen, 2012). The use of these two sampling techniques was informed by the nature of the research which requires particular people with experiences and knowledge of the topic to be interviewed. Furthermore, the choice was based on the extensive use of these sampling techniques in similar research studies in literature (See McAlearney, Walker, Moss, & Bickell, 2016; Suri, 2011; Marshall, 1996).

A total of 15 participants were interviewed between November 2017 and April 2018. These participants included 11 people from eight communities in the case study region and four resource persons. The 15 interviewees included three municipal mayors, two water operators (i.e., other staff managing water facilities), four LSD volunteers, two UIA volunteers, and four provincial officials. Efforts were made to include participants from all the communities within the Straits; however, representation from each community was not achieved due to non-responsiveness, time limitations, unwillingness, or accessibility constraints. Moreover, it appeared that the difference in accent between prospective respondents and the researcher affected the recruitment process as some potential participants simply declined to participate in the study due to ineffective communication. Participants were recruited by phone as many rural community representatives could not be reached via email.

Table 3.2: Recruitment Process of Interviewees

Number	Case Region	Province	Totals
People contacted	18	15	33
Responses received	15	15	30
Participation confirmed	11	8	18
Participated	11	4	15

Source: Author's Construct

Two semi-structured interview guides were used to interview the participants in the Straits (Appendix 3) and the provincial officials (Appendix 4) respectively. This type of data collection instrument was chosen due to its prolific use in similar research (see O'Keeffe, Buytaert, Mijic, Brozović, & Sinha, 2016; Salmon, 2007; Fontana & Frey, 2005; Longhurst, 2003). This interview guide also ensured that the discussions and knowledge produced were not narrowed to any predetermined scope (Cloke, Johnsen, & May 2005). Probing questions were used in some cases to prompt further details of the issue under discussion. The first interview guide (for community leaders) contained questions about current water challenges in the study region, potential solutions, and the promise in adopting a regional approach to managing water supply systems. The second interview guide (for provincial officials) asked questions about their knowledge, experiences, and views about water management in NL. In most cases, interviews were done face-to-face, although four interviews were done via telephone where face-to-face was not practical due to time/distance and resource restraints. Conducting interviews via the telephone did not compromise the data quality in any way as the discussions were productive and engaged (Sturges & Hanrahan, 2004). It took an average of 45 minutes to complete each interview session, with a range of between 30 minutes to one hour. Where permitted, interview sessions were audio recorded alongside note-taking to mitigate audibility challenges during oral interviews, reducing the possibility of any

information loss (Creswell, 2013). Eleven interviews were audio recorded, and only notes were written for the other four interviews. There was no compensation of any kind for interview time spent as this had the potential to influence participants' responses and would go against the ethics to conduct research in Grenfell College.

3.5: Ethical Considerations

In pursuing knowledge and skills as a student in the conduct of this research, I was careful that community members did not suffer any negative consequences in the long run for their involvement/participation in the research (Butz, 2008; Cloke, Cooke, Cursons, Milbourne, & Widdowfield, 2000). I acknowledged that the Straits is a rural region with multiple developmental challenges such as low population (density), limited economic activities, inadequate supply of safe and clean drinking water. As a result, I had to be careful engaging with communities in a research study that involves such development marginalities (Gibson, 2013; Sinclair & Felt, 1993). I was also aware of the on-going consultations on the formation of regional government system across the province which had a mixed reception among communities, especially in LSDs and UIAs. Therefore, I took measures to approach communities, groups, and individuals in an unbiased, respectful, and mindful manner to ensure that my research did not become an aggravating factor within this context.

To ensure my research followed the appropriate ethical standards, I first completed the online research ethics course and was granted the certificate by the Canadian Panel on Research Ethics (TCPS 2: Tri-Council policy statement on ethical conduct for research involving humans). Second, my research was examined and approved (Certificate no. ref: 200180751) by the Grenfell Campus Research Ethics Board (GC-REB) before I started the fieldwork. I proceeded to collect

the interview data in November 2017 after receiving ethics clearance. Third, every interviewee was provided oral and written information about the project and their participation and agreed to an informed consent form before the start of the interviews. The research information sheet also explained the details of the study as well as the potential benefits and risk of participation in the research. Participants were informed that they could refuse to answer any questions or withdraw entirely from participating in the interview should they feel uncomfortable or unwilling at any time. No participants utilized this caveat to refuse participation in the interview process. However, four interviewees did not consent to be audio recorded, and in these cases, only notes were written for those interviews.

Lastly, I conducted most of the interviews at locations preferred by the participants that were convenient for them to freely express their views and experiences about the topics under discussion. Steps were also taken to ensure the confidentiality and anonymity of the identities of participants and their input throughout the research presentation process. All interview data (notes and recorded audio files) collected from the field were encrypted in a folder on my personal computer and another online in OneDrive which are only accessible to my supervisors and me while hardcopy field notes are locked and key in my supervisor's office.

3.6: Data Processing and Analysis

In research, it is essential to provide a clear outline that defines the methods used to collect and analyze the data to ensure the trustworthiness and credibility of the research process and results (Nowell, Norris, White, & Moules, 2017; Malterud, 2001; Thorne, 2000). Generally, it is necessary to describe the processes employed in analyzing the data to confirm that the study findings were actually based on the data collected (Hancock & Algozzine, 2016; Houghton et al., 2013). Content

analysis and thematic analysis were used in this study to analyze the data collected. The thematic analytical method helps to examine the perspectives of different participants, notice similarities and differences, as well as discover new insights in datasets (Braun & Clarke, 2006). The content analysis method was used to obtain deeper meanings and reasons for the occurrence of phenomena beyond the fundamental discovery of themes in large datasets (Prasad, 2008; Creswell, 2013).

Interview data were processed following a series of procedures including formatting, organizing, and analysis. A total of 15 people were interviewed. I organized the 15 sets of field notes and did verbatim transcription of the 11 audio recorded files into text (Microsoft Office Word 2016) using Express Script Version 5 (a computer transcription software). The two versions of the interviews (notes and audio-transcribed scripts) were compared to reconcile any discrepancies. I used Nvivo 11 software to organize the transcribed data for further analysis. Nvivo 11 is an acceptable computer software for the organization and management of qualitative datasets such as the data in my research (Mistry & Driedger, 2012; Given, 2008; Maxwell, 2008).

With the help of this software, the interview transcripts were organized into themes. Some of these themes were deductively identified from the research objectives and preconceptions from the literature reviewed, and others generated inductively from the interview transcripts to represent ideas (Boyatzis, 1998). Although several themes were first identified, they were subsequently re-categorized into broad themes such as "water facilities", "water challenges", "potential solutions", "challenges or potentials for a regional approach", and "next steps in a regional approach" in the coding process for easy interpretation. After identifying the themes, detailed coding was done in two phases. First, the transcribed data scripts were printed out and hand-coded on the hardcopy scripts. Every interview transcript was repeatedly read through to identify significant statements, comments, and phrases to represent ideas towards the achievement of the study objectives. The

hardcopy coding undertaken discovered new themes aside from those already identified to be included in the subsequent software coding. Second, the coding was done in the software by reading through to identify unique and relevant expressions and manually grouped them under various nodes. Coding was necessary to reduce the chunk of data into manageable amounts for interpretation and analysis. The major themes identified through the coding processes were used in the analysis and presentation of the study findings (see Chapter 5). Finally, exact quotations of interviewees are presented as part of the analysis for purposes of emphasis and evidential relevance to the subject matter.

3.7: Ascertaining Validity and Reliability of the Study

Several strategies were employed to conduct this research to ensure that the findings are “worth paying attention to” (Baxter & Eyles, 1997, p. 506). Strategies including careful planning, scheduling, interviewing, transcribing and analyzing, were used that involved rigorous procedures to collect and analyze the data to produce valid findings as supported by Lincoln and Guba (1985), and Baxter and Eyles (1997). First, I explored and interlinked data from both primary and secondary sources to promote comprehensives, validity, and reliability of the study findings (Bogason & Zølner 2007; Teddlie & Tashakkori 2009). I used data from the review of academic articles and government documents as well as field observations and semi-structured interviews in the case study region. This was done for purposes of comparison to assure the validity and credibility of the processes and the trustworthiness of the issues (Zainal, 2007; Lincoln & Guba, 1985). Second, I used both note-recordings and audio recordings of interview sessions to avoid any loss of data from either method. Non-audible information and observations were also considered in the notes recorded adding to the significance of human subjects as the main source

of data (Baxter & Eyles, 1997). Third, responses from participants in communities operating water facilities were also compared with responses from provincial officials to increase data accuracy and unbiased reporting. Finally, a knowledge brief (a plain language summary of the main findings of the research) was prepared based on the findings, themes, case analysis and proposed solutions to water management challenges and shared with participants. This offered participants the opportunity to make input and comments into the final research work (Creswell, 2013).

3.8: Research Limitations

Although conscious and active planning was done to successfully conduct this research to assure the trustworthiness of its findings, there were methodological and empirical challenges in the fieldwork. In qualitative research involving interviews, trust building between the researcher and the participants is a significant component. Trust provides a conducive environment for both parties to ask and provide experiential information about the research ('Yotti' Kingsley, Phillips, Townsend, & Henderson-Wilson, 2010). However, trust-building as a process requires more time than the one-year timeframe of this research. It is possible that participants could be more willing and able to provide more in-depth data if we had more time together to establish a relationship of trust. In some cases, however, this constraint was minimized as my supervisor and I had prior interactions with some participants through earlier research projects and commitments where some rapport was developed.

This research occurred at a time when the provincial government was also holding public consultations in various communities and municipalities on the formation of regional government system across NL. One such public consultation session was held at St. Anthony (about 77 km north of the study region) shortly before I visited the Straits for data collection. Because of the

close timing, some of the participants misconstrued my research as an attempt to lobby for the provincial government on the regional government proposal. To address this concern, I continually explained to such participants that the primary goal of this research was to identify the potentials for water service-sharing by the communities' design in contrast to the provincial regional government proposal. However, most of the interviewees understood the rationale for the research as one that seeks to explore possible areas of collaboration with regards to water supply systems. They urged for the findings to help provide an alternative to the provincially-imposed regional government, recognizing the potential for the study to contribute to a measured strategy to form a regional government by their design.

Logistical challenges and accessibility to the Straits also acted as a shortcoming to the research. I was able to undertake two field trips (versus four planned) to the case study region to interview participants and to observe their water systems. However, the Straits has no public transport service, and therefore, could only be accessed by private vehicle, which limited the number of visits I could make to the study region. Although communication was not a problem as the English language was the medium of communication in all the interviews, differences in accent between the participants and the researcher presented a little hindrance. These logistical, accessibility and accent differences affected the number of interviews conducted in the research, as well as the communities covered. However, the effects of these constraints were mitigated by the support received from my supervisors and a student researcher who helped facilitate the recruitment and interview processes. My supervisors advised on how to communicate with participants in rural communities while the other student researcher drove me to the field and occasionally interpreted interview questions for participants. Additionally, the impacts of these

challenges were mitigated by the use of secondary sources, such as meeting notes, minutes and reports from the regional government consultation sessions, to complement the interview data.

CHAPTER 4: RESEARCH RESULTS AND FINDINGS

This chapter presents the results and findings of interviews conducted between November 2017 and May 2018. The interviews were supplemented with insights from secondary sources (see Section 3.3). These results are presented in four main sections. Section 4.1 outlines the key themes in the interview guides which were further used to present the results herein. Section 4.2 summarizes some general characteristics of the water facilities in the Straits. Section 4.3 looks at the current managers and management structures and section 4.4 reviews the nature of water management in the study region and related challenges. Section 4.5 provides some examples of regional service-sharing and related experience. Finally, section 4.6 enumerates the viewpoints of the respondents on regional approaches to water management which were used for further discussion in chapter 5.

4.1: Key Themes from the Interviews

The interviews conducted for this study covered four main themes. These themes are explained below.

- ❖ The characteristics of water facilities, including the source, type and age of the water facility, type of treatment, and the components of the water supply systems;
- ❖ Characteristics of the managers of the water systems: who, when, why they assumed responsibility, and what roles they perform. This also includes other stakeholders and departments that assist water managers in carrying out their mandates;
- ❖ The nature of water management, including the challenges, effects, and the past and potential solutions to the water management challenges; and

- ❖ Regional approaches to water management, including various components of water supply systems that can be shared, the benefits, challenges and way forward for a regional water management approach.

Documents and secondary data review provided further insights on each of these themes, as outlined in the sections that follow. The analysis of data relating to each theme is summarized in the ensuing sections and further discussed in Chapters 5 and 6.

4.2: Characteristics of Water Supply Systems in the Straits

Many communities in the Straits have small water systems, mostly managed by uncertified community leaders or volunteers. Summaries of key points from the interviews that speak to the nature of all the components of the water supply system in the Straits can be found in table 4.2. Many communities in the Straits take their water supply mostly from surface water sources (see Table 3.1) for treatment. It was discovered that only eight communities have gazetted⁵ their water sources as public water supply areas⁶ (Government of NL, 2017). The rest of the communities have not gazetted their water sources due to inadequate funds and the bureaucratic challenges involved in the gazettement process. This is illustrated by a provincial official, participant RP01: *I do a lot of work there. There are still smaller communities that do no protection for their water sources. The communities that have gazetted theirs are just on paper, they don't respect the*

⁵ To designate areas that surround present and potential sources of water supply as protected public water supply areas by the Minister for Municipal Affairs and Environment in accordance with Section 39 of the Water Resources Act SNL 2002 cW-4.01 so that no other development can take place within certain boundaries that would cause potential risk to the water source.

⁶ See details at: <http://www.mae.gov.nl.ca/waterres/quality/drinkingwater/pdf/PPWSAs.pdf>

instructions. They don't look after the area. The inability of these communities to adequately protect their water sources could result in water pollution and more likely to reduce water quality if there is no treatment.

In NL, chlorination-based water disinfection is the most commonly used method in the treatment of water (Government of NL, 2017). Similarly, it was discovered that, the use of liquid chlorine and chlorine powder are common in the few water systems that have disinfection units in the Straits. However, the three municipalities (Flower's Cove, Bird Cove and Anchor Point) have chlorine gas systems used in treating their water supplies. The functionality of these chlorine systems is inconsistent due to inadequate funds to procure the chlorine chemical, hire a certified, full-time staff to operate the system, and/or to maintain it. An LSD volunteer, participant SB03, who operates the water system noted:

The system we have doesn't do much. It is just injecting chlorine in. We have got the line. When it just comes out from the pump, from the pond, you inject in the chlorine in then. And we just, well, make sure that the chlorine is to the right level. Yes! A system that was put 49 years ago, you know what kind of system we're talking about then. Hey! it is lucky it's been working.

Most communities have very small water systems⁷ with inadequate treatment that are managed by part-time, untrained staff or volunteer community members (Minnes & Vodden, 2014; Dore, 2015). It was discovered during the data collection that most water facilities were constructed between 40-80 years ago but have received limited or no upgrades in recent years. This is reflected

⁷ Water systems that serve <500 people and provides no treatment other than disinfection.

in a comment from an LSD volunteer, participant SB03: *We have the old type of water house. The system was put in about 47 years ago (1971) during the resettlement period. The system we got there was put in when the resettlement program was started. About 60 years ago.* These aged water facilities are susceptible to regular breakages and leakages and may lead to water losses, increases in expenditure for system upgrades, and ineffective water disinfection.

The majority of the communities, particularly LSDs and UIAs, operate and manage private water systems. Common components in many water supply systems include pumping houses, distribution lines, and storage tanks/reservoirs, each with varied disinfection systems that depends on the community's human and financial capabilities. As described by an LSD volunteer, participant SB08:

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

Two municipalities, Flowers Cove and Bird Cove, share treated water with other communities. The majority of the other communities (LSDs and UIAs) supply untreated water to their residents for domestic use, pumping raw water directly from source to tap. The following statement by an LSD volunteer, participant SB05, illustrates the widespread usage of untreated water or inadequate water treatment systems in the region:

... The system we have doesn't do much. It is a pump down into the pond and it goes up into a reservoir. When it just comes out from the pump, from the pond, we just inject chlorine in then. And we just, well, make sure that the chlorine is to the right level. We never had any filtration systems.

This lack of treatment is in stark contrast to comments from participant SB09, a municipal mayor:

... We have got a 15-horse power pump, we chlorinate, we put in 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, but I don't know what 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.

Due to similar reasons, many LSDs and UIAs do not have adequate disinfection processes which results in the placement of boil water advisories (BWA). 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). While the NL government has several reasons for announcing boil water advisories in the communities, common reasons ascribed in the Straits include: no disinfection systems, disinfection system turned off due to lack of funds, lack of operator training, due to taste, system undergoing maintenance, no chlorine residual detected in water system, and no enough chlorine residual⁸(Government of NL, 2017).

Participant SB06 affirms in this quote how they have been on BWA:

We have been on boil water for some years now. I put the chlorine inside but the 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.

⁸See list of communities under BWA in NL:
http://www.mae.gov.nl.ca/wrmd/BWA_Reports/BWA_Summary_Community.pdf

Additionally, water systems that have chlorination-based disinfection systems regularly record levels of Disinfectant By-products (DBP) higher than limits set in the Guidelines for Canadian Drinking Water Quality (GCDWQ). Particularly, most communities record levels of the two common DBPs- Trihalomethanes (THMs-100g/L) and Haloacetic Acids (HAAs- 80µg/L) higher than the allowable averages in the GCDWQ (see details in Table 3.1). DBPs are the residuals formed when the chlorine used in disinfecting water reacts with humic and fulvic acids in naturally occurring organic materials such as dead plants (DMAE, 2016; Dore, 2015).

Table 4.1 is a summary of key points on the characteristics of water systems from the interviews that were used for the analysis in the Chapter 5.

Table 4.1: Summary of Key Points on the Characteristics of Water Systems

Category of Respondent	Key Point s
Community Leaders	<ul style="list-style-type: none"> • Municipalities serve 200-350 people; and LSD and UIAs serve 50-100 people. • Surface water is the most common water source. • Many of the water systems were constructed 60-100 years ago with little or no upgrades in recent years. • Municipal water systems have disinfection and treatment systems; filtration, chlorination, and silt filtration. • 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 the chlorination systems but do not want to use chlorine. • There are private wells in many LSDs and UIAs.

Source: Author's construct

4.3: Water Management Leadership and Structures in the Straits

There are common characteristics of water management across all the communities in the Straits. The people who oversee the general day-to-day activities of most communities are the same people who manage the water supply systems. It is important to note that community volunteers manage the finances and other services of the LSDs and UIAs, while the three municipalities have hired staff to administer the towns. The three incorporated municipalities are the only towns that are able to keep some full-time and part-time staff. No community in the Straits has been able to hire/retain a certified water operator to manage their water supply system. Instead, town managers and other staff or community volunteers with no or basic water engineering skills double as water operators. It was observed that most of the people in leadership positions have served for over ten years and there are few other people to take up these positions due to a declining and aging population, as well as out migration. According to some respondents, the leadership mantles were handed down to them by the previous generation because there were no other options. An LSD volunteer, participant SB06, shares this about the leadership transition:

I am just a member of the community who looks after the pumping system, and the water infrastructure. I have been in this volunteer position since 1998/1999, about 17-18 years ago. My father was in it and I just had to take over from him. There was no one to take over.

An LSD volunteer who acts as a water operator also noted: *Truthfully, nobody didn't want it. That is the whole fact. No one else would take it. And we had no other choice.* Many of these community leaders have little or no formal training in regard to water management besides informal observations, practicing, and performing basic water management roles. Aside from the paid staff in the three municipalities, volunteers in all other communities are not compensated for their

services. Therefore, they are unable to devote all their time managing the water systems as they have to seek other opportunities to earn a living. Certainly, with no training and the high turn-over of current personnel in charge of the water supply systems in the Straits, there is bound to be water system breakdowns that could affect the quality and quantity of the water supply.

Over the years, some communities (for example Bird Cove and Flower's Cove) have benefited from the provincial government through funding to construct and upgrade water facilities, as well as technical assistance in terms of source water protection, and water quality testing. When asked whether they have ever received any assistance from any organization/department in resolving their water challenges, a municipal mayor, participant SB07 said:

... We have been lucky enough to apply for funding and get some funding from government, for example, replacing; we got two pumps and replacing one pump that needed to be replaced. And some other pipes that needed to be replaced and able looking up to the kind of funding to replace them.

Aside from the provincial support, communities often seek the services of neighbouring communities, local contractors or private companies in managing and upgrading their water supply systems. Particularly, Flowers Cover, Bird Cove, and Anchor Point have ever engaged the services of K&D Pratt and Francois Maase from Corner Brook and St. Johns to supply some water equipment or to fix their broken-down water systems. This is supported in the remarks by a municipal mayor, participant SB09:

Well! We don't have the expertise to do the proper maintenance of the equipment at all. Normally, what we do is ... to contact some body to come in from St Johns or Corner Brook to maintain the system ... K&D Pratt, he supplied a lot of the equipment that are on

post and... François Masse has been up in the east, he could be here next week to install the flow meters.

In summary, some notable points from the interviews in regard to the water management leadership and structures in the Straits are shown in table 4.2.

Table 4.2: Summary of Key Points on Water Leadership and Structures

Category of Respondent	Key Point
Community Leaders	<ul style="list-style-type: none"> • Most leaders have held the positions between 10-20 years. • While the Council (mayors) give policy direction, the town managers and other community volunteers maintain the water systems. • Some take up leadership positions because there are no options. • None of the people operating the water system are a certified water operator. • The federal and provincial government, private companies, and neighboring communities often help to resolve some of the water problems
Provincial Officials	<ul style="list-style-type: none"> • Departments that assist communities to manage their water systems: regional service board, Water Resource Management Division, Department of Municipal Affairs. • Roles include: operator education, training and certification; sampling and testing, implementation of the water operator pilot program, and management of regional waste program. • Most have held positions for 2-5 years; one has over 20 years of experience. • High turnover of volunteer operator.

Source: Author's construct

4.4: Characteristics of Water Management in the Straits

This section outlines some of the water management characteristics in the region as captured in the interviews (see Table 4.3). Specifically, the challenges that confront the

management of the water systems, the effects, and the strategies often employed to access drinking water have been discussed.

Table 4.3: Summary of Key Points on Characteristics of Water Management

Category of Respondent/ Key Point	Water Challenges	Solutions
Community Leaders	<ul style="list-style-type: none"> • Aged water lines cause many breaks and leakages and unstable chlorine levels leading to BWA. • Difficult to locate leaks especially during the winter and to dig /frozen ground to fix leaks. • Difficult to raise 10% of overhead cost to earn the 90% provincial funding. • Inclement weather also affects water systems. • Low population effects human and financial capacities of communities. 	<ul style="list-style-type: none"> • Some communities have received provincial funding for system upgrades. They often repair damaged water systems by themselves or hire the services of private companies. • Only one municipality has a leak detection device. The rest use water spills on the ground or chlorine levels to find leaks. • In rare cases, bottled water is relied upon as an alternative 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 population resulting in low taxes and low revenues. • Aged infrastructure is failing, which increases maintenance cost for communities. 	<ul style="list-style-type: none"> • Community education is needed on water quality and standards. • Engineering solutions are required in most communities to restore water systems.

Source: Author's construct

4.4.1: Challenges of Water Supply Systems

Water challenges are complex and each one facilitates the next! – Participant RP02. The quote above reveals an important element for this study: embedded challenges that may require a change in approach to water management that addresses the integrated and interrelated aspects of water systems. These water challenges are complex, with one leading to another and consequences that threaten human livelihood and public health.

Many respondents noted that most communities are unable to hire qualified personnel to manage the water systems due to the absence of expert staff as well as the lack of funds. This is supported by the following statement from a municipal mayor, participant SB07:

.... we do have a part-time water operator; he is not trained but learned it from previous operator. He just does basic stuff... takes care of chlorination, and readings. Anything above and beyond 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. 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!

This was echoed in a statement by a provincial official, participant RP02: *... most areas 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...* The possible results are that, the water systems are being managed either by town managers, part-time staff, or community volunteers. The outcome of water systems under such management can sometimes result in serious

water quality issues hence, a threat to public health (Dore, 2015). To a more significant extent, the inadequate human and financial resources affect the overall functionality of most municipalities, LSDs, and UIAs.

One other notable challenge has been the aging and failing water infrastructure. As noted earlier, most of these facilities were constructed over 60 years ago and have since received little or no upgrades. These old facilities are susceptible to breakages and leakages which affects carriage capacity to support current demand. Particularly, the failing water distribution lines experience regular breakages, which affects the supply of good quality water in most communities. 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?* Water systems with regular breaks and leaks will often result in water losses and if communities are unable to fix them, the water supplied to residents may be contaminated. For instance, in chlorination-based disinfection systems, chlorine is lost during water spills reducing the effectiveness of the chlorine chemical in such systems. Chlorination-based disinfection was found to be the standard, common, and most straightforward water treatment method in the Straits.

The pollution and contamination of water sources from human and animal activities, and extreme weather conditions were noted as major challenges related to water treatment and inadequate source water protection. As described above, many communities in the case study region use surface water as their water source (see Table 3.1 for details). The open nature of surface water sources when not protected makes them more vulnerable to contamination and pollution either through human, industrial, or animal activities within the water system. According to a provincial official, participant RP01, the inadequate planning for source water protection could

compromise the quality of many water sources. In such instances, water treatment becomes complicated and expensive for some communities, particularly considering the low levels of financial and technical capacities. For example, according to an LSD volunteer, participant SB04, some ponds, brooks, and lakes that serve as water sources often cave-in particularly during cold winter seasons, depositing silt, mud, and mires in the basins. The presence of such impurities in the water system is likely to make water treatment options more complicated and expensive, thereby increasing the cost of water treatment and the potential for waterborne diseases if residents are unable to treat but still drink the contaminated water.

The dislike for chlorination-based disinfection method of water treatment by residents in some communities also affects the quality of water supply. While the use of chlorine minimizes the microbial impact in water, it can have side effects on human health when the by-products are in excess (Drogui & Daghrir, 2015). According to a provincial respondent there is 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 is evident in the statement by a provincial official, participant RP04:

... in a community like -name, where there is nothing commercially going on, there is nothing to drive them, residents are happy, they don't want to chlorinate the water. They claim the water from the springs or brooks is sweet in the mouth. They have got the chlorine devices, but they won't use them. You know, if I can remember, it was supplied to every community around 2000/2001. Many of them might be heavily smoking, drinking alcohol, and taking drugs, but definitely the water is going to kill them. The chlorine is going to kill them. Not through the cigarette or the drugs, no, no, chlorine is going to bring cancer. It is funny, right?

Although public health studies have often observed a link between the long-term consumption of water treated with chlorine and cancer risk, there has not been any clear evidence to that effect (Li & Mitch, 2018). The response above also speaks to a number of issues, including the fact that the absence of business entities or commercial activities such as motels, restaurants, and tourist destinations that require good quality water to operate could contribute to the lukewarm attitude towards improving the community's water supply.

4.4.2: Solutions to Water Challenges

Despite these challenges, water managers in the Straits have explored other options to resolve the most urgent problems that risk the supply of quality drinking water. For instance, many communities have devised means such as engaging the services of volunteer community members, the provincial government, neighbouring communities, and private companies to assist in addressing these issues. These solutions are discussed below. In regard to community administration to provide vital services, rural community members in the Straits are often show positive attitude to lead their communities. Particularly, in most LSDs and UIAs, leadership roles are performed by community volunteers including the operation and maintenance of water systems. It was discovered that a significant potential in these rural communities is the communal and volunteerism spirit, among residents in times of challenges. For example, 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, who volunteered to help fix a leakage in a pump line 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, first time in a while we had an excavator.* In some circumstances where

the water problem is beyond the technical capacity of community members, they call on neighboring communities for assistance. This is evident in the comment by a municipal mayor, participant SB07: ... *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, but we are not actually sharing any services as such right now.*

The provincial government has often come to the aid of rural communities through programs such as the Municipal Capital Works (MCW) funding program, Emergency Funding Program, and the regional water operators pilot program to improve their water supply in recent years. For instance, it was discovered that, towns like Anchor Point, Bird Cove, Flower's Cove, and Black Duck Cove have benefited from the MCW funding program to build or upgrade their water infrastructure in recent years. This is evident in the statement by a municipal mayor, participant SB07:

... We have been lucky enough to apply for funding and get some funding from the government, for example, replacing; we got two pumps and replacing one pump that needed to be replaced. And some other pipes that needed to be replaced and we are looking up to the kind of funding to replace them....

This statement expresses the relevance of the multi-level collaborative governance theme of new regionalism that was discussed in the earlier chapter (see Section 2.4). Other water responsibilities of the government to rural communities include water sampling and testing, and the training and certification of water operators. According to a provincial official, participant RP01, an environmental hydrologist has been designated in the GNP and Labrador to collect and test water samples and also in charge of permitting for source water protection. This is supported in a statement by a town manager who acts as a water operator, participant SB02: "*Well, the water*

system has the chlorination-based disinfection. The water has always been tested every month and we have got, and we have the Service NL doing all those readings monthly. Every month, we got our water checked and we use to have good readings. Pretty well!”

The ensuing discussions have highlighted some water sharing examples and proposed solutions to drinking water management in the Straits. These proposed solutions reveal important themes of new regionalism and speak to the potential for regional approaches to managing water.

4.5: Examples of (Water) Service-Sharing in the Straits and Related Experiences

The idea of a regional approach to service provision is not entirely new to the people of the Straits. There are examples of service-sharing initiatives (see detail in section 4.6) among communities based on geographic proximity or common need/interest in water supply, but also other services like waste management, fire services, and youth networks. Table 4.4 summarizes current service-sharing examples mentioned in the interviews. Other examples of collaboration among communities referred to in secondary documents include the St. Barbe Community Youth Network (14 communities -Castor River South to St Barbe), Bird Cove/Pond Cove Fire Department, and the GNP Joint Council (16 towns represented by their mayors) (Towns of Bird Cove, Anchor Point, & Flower’s Cove, 2010; Blackmore, 2003). The ICSP developed by the Towns of Bird Cove, Anchor Point, and Flower’s Cove is also in itself an example of collaboration. Shared services noted as formal initiatives in table 4.4 refer to those entered into through a signed agreement among communities that could be supervised by community representatives or by upper-level governments. The informal initiatives include service-sharing among communities without any signed agreement, relying instead on verbal negotiations and understanding.

These examples of service-sharing in the Straits offer some inspiration to the people that regional water management based on the communities' design would work. This is evident in the statement by a municipal mayor, participant SB01: ... *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* ... Another statement that points to this was by a municipal mayor, participant SB07:

... But there is opportunity there, we currently share fire service for example between the five communities in this small catchment area, so one municipality and four LSDs and Unincorporated areas in some cases share regional fire services. We do that quite well again now. So, there could be an opportunity to share even with those LSDs with a regional water operator...

Table 4.4: 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 where Flower's Cove sells treated water to Nameless Cove at a fee calculated based on the amount of water consumed. • Each community manages their distribution lines and water 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 of the chlorine levels, upgrades for distribution lines, and collection of water service fees to offset the bill owed Bird Cove. • Inadequate funding and the loss of water from breakages were reported as the 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.
Consultations on water works and sharing of water equipment	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	<ul style="list-style-type: none"> • A formal arrangement administered by the Northern Peninsula Services Board. • Volunteers are from member communities.
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. • It has a management that administer the finance and services of the department.
The NorPen Waste Management Authority ⁹	22 communities	<ul style="list-style-type: none"> • It was formed based on recommendations by an engineering feasibility study on waste management and to implement the Provincial Waste Management Strategy.

⁹For additional details see: <http://www.envision.ca/webs/nwm/>

Service	Communities	Brief Description
		<ul style="list-style-type: none"> • It has three subregions including: Subregion 1 (St. Anthony – L'Anse Aux Meadows): Subregion 2 (Main Brook - Englee): and Subregion 3 (the Straits) (Eddies Cove East - Castors River South). • The authority is administered by a seven-member board who represent each of the three subregions and a hired coordinator who oversees the day-to-day supervision of the program. • Residents are charged fees for the garbage collection and for administrative expenses.
Regional Community Youth Centre	11 communities (Anchor Point to Eddies Cove)	<ul style="list-style-type: none"> • The centre is at Flower's Cove. • It is administered by elected youth executives from the 11 communities. • The youth activities include youth leadership, youth engagement, and civic engagement. • Their activities are funded by the NL government.

Source: Author's construct; Blackmore (2003); Towns of Bird Cove, Anchor Point, & Flower's Cove (2003)

A town manager, participant SB02, adds:

Well! We sell water to Nameless Cove. It's an LSD. It is just down the road. We supply them with water, but we charge them. There is a fee for what they use. Outside, we don't have any other connection with any other community except in waste management and firefighting services and community network. Those three are regionalized but the water is not regionalized. There is a regional volunteer fire department for the 13 communities, it is from Eddies Coast East to Anchor Point. There is a Community Youth Network which services the 13 communities and the Northern Pen Waste Disposal which services the sub region. But the water, we sell to only Nameless Cove.

The success of the joint services was assessed by participants in relation to the current quality of services they receive, and the cost involved. The respondents evaluated some joint services as successful while others have been confronted with challenges. Not all examples were positive. This is reflected in the statement by a municipal mayor, participant SB07:

... we currently share fire service for example between the five communities in this small catchment area, so one municipality and four LSDs and Unincorporated in some cases share regional fire services. We do that quite well again now... The waste management is huge; it is a bigger region as well. Absolutely which is what the entire province do as well, but that probably even would not be a correct example as of now because it is not really working well as expected.

Based on participants' responses, the waste management service appears to be facing difficulties in regard to the quality of service delivered.

4.6: Respondents' Views on Regional Approaches

The experiences from the existing service-sharing arrangement in the Straits have the potential to influence respondents' views on regional approaches in managing water systems. Respondents shared their views on potential areas of regional collaboration, some benefits, and potential challenges to a regional water management. These have been summarized in table 4.5 and have been used for further discussions in chapter 5.

Table 4.5: Summary of Key Points on Regional Approaches

Community Leaders	Provincial Official
<p style="text-align: center;">Regional Approach</p> <ul style="list-style-type: none"> • Aspects of the water system that can be shared; water supply, distribution lines, water operator, source water protection, water quality monitoring, and logistics within reasonable distances. <p style="text-align: center;">Benefits</p> <ul style="list-style-type: none"> • Water service-sharing such as water operator, and logistics can deliver quality water supply for less. <p style="text-align: center;">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 show of interest and support by the provincial government. • Unfavorable geography, long distances between communities, and hard underlying rock. • Perception of loss of identity, sovereignty, and independence by small communities to bigger ones. • Different administrative setups of the communities (municipalities, LSDs and UIAs) with variate capacities. Challenges to reach a consensus on variate communities' needs/interest. <p style="text-align: center;">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 style="text-align: center;">Recommendations</p> <ul style="list-style-type: none"> • Small clusters of communities should be considered for a regional approach. • Provincial government should lead the process through consultations, policy reforms, financial support, human resources, and logistical support. • Should begin with a pilot sharing of one component of the water system. 	<p style="text-align: center;">Regional Approach</p> <ul style="list-style-type: none"> • It would depend on distances, quantity of potable water, condition of infrastructure, and tax base. <p style="text-align: center;">Benefits</p> <ul style="list-style-type: none"> • The ability to have someone continuously monitoring and checking on the water system. • It would reduce the cost of supplying quality drinking water to communities and they could also come off a boil water advisory. <p style="text-align: center;">Challenges</p> <ul style="list-style-type: none"> • How and where to get the skill 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 style="text-align: center;">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 • Upper-level governments should intervene through financial and technical support.

Source: Author's construct

CHAPTER 5: DISCUSSION

5.1: Introduction

The need to provide Canadians with safe and clean drinking water has received much attention over the years (Dore, 2015). A lot of research has delved into exploring the challenges that confront water supply systems (Hanrahan, Minnes, & Dosu, 2016; Minnes & Vodden, 2014). Some scholars have recommended solutions such as incremental improvements of current water management and even more ambitious strategies to restructure water management systems (Castleden et al., 2017; Hanrahan, Dosu, & Minnes, 2016; Dore, 2015; Bakker & Munk Centre Program on Water Issues, 2003). This thesis explores one such suggested solution, to adopt a regional approach to managing water systems. In this thesis, a regional approach is defined as any form of collaboration among communities within a designated location to jointly manage water supply systems to provide good quality drinking water for the populace. This collaborative approach could be formal or casual and in all or one of the components of the region's water supply system. Particularly, the thesis explored the potentials embedded in a regional water management approach by building on the themes of new regionalism: multi-level collaborative governance, place-based development, integration, innovation and knowledge sharing, and rural-urban interdependence (Gibson et al., 2015; Vodden et al., 2014). This study has found varied characteristics in the Straits that can be associated with the themes of new regionalism, as discussed further below where appropriate.

The following discussion is based on the findings presented in Chapter 4. The findings are further interpreted and synthesized in line with the themes of new regionalism to examine the potential of a regional approach to resolving water challenges. This chapter further investigates

the potentials and opportunities that can be maximized to support regional water management, along with the challenges that have been or may be encountered in the process. These issues are discussed based on the geographical characteristics of the place, socio-economic conditions, and political/legal issues. These conditions/factors were derived from the objectives of the research.

5.2: Regional Approaches to Water Management in the Straits: Potentials and Opportunities

Previously, there have been little achievement when communities attempted to individually solve their water problems, as evident in the widespread BWAs and high levels of DBPs that have been periodically recorded across many communities in the Straits (see Table 3.1). The search for an integrated, far-reaching solution that involves several communities and incorporates the entire water supply system appears to be a potential way forward. The region, which involves a group of communities sharing and working together (collaboration), is a central focus of new regionalism. As discussed in Chapter 2, this collaboration (as a region) can lend valuable gains to governance in an area, including enhanced capacities, savings in overhead cost (e.g. for water supply systems), economies of scale, improved quality of services, and improvement in public health (Furlong & Bakker, 2011; Haque, Csapo, & Round, 1999).

In the Straits, many of the interview participants acknowledged the benefits of service-sharing initiatives, particularly regional water management. For instance, a respondent, participant SB07, noted that:

To me, I guess, there are a number of benefits around cost savings; I think there is potential cost savings, a better high quality, more high-quality service. Absolutely, right now we are all separated as towns just ordering our chlorine. Maybe there is some savings ordering in

bulk as a group. ... now we have enough part-timers, we have to make 1 or 2 full time staff if we join together they could be fully trained regional water operator in a full-time basis not somebody who is a part-time water operator and part-time fisherman and a part-time everything else.

The quote above explains how a regional approach may be beneficial in solving the water challenges in the communities, such as cost saving through bulk buying. As cited in Vodden and Minnes (2014), neighbouring communities could pool limited resources together to employ a single but trained and qualified water operator to manage the water systems in several communities as done in western NL (see Section 2.3.1). Hence, in a well planned and executed regional approach to water management, communities can combine limited resources to finance the training, hiring, and retention of qualified and certified personnel such as water operators, engineers, and planners, to development proper asset management plans for the Straits. In such instances, according to a provincial official, participant RP02, there is the ability to come off a boil water advisory and improve drinking water quality at reduced costs to communities. A majority of the respondents acknowledged that a regional approach that allows for place-specific planning of water services and collaboration across various levels of governments in an integrated manner could solve water challenges. In the paragraphs that follow, specific potentials and opportunities for regional-based water management in the Straits, as revealed by the study, are outlined based on geographic, socio-economic, political/legal, and technical considerations.

5.2.1: Geographical Conditions

Geography is an integral component of new regionalism theory, as manifested in the place-based theme for example. The new regionalism concept emphasises the importance of development that builds on place-based strengths (Gibson et al., 2015), and the Straits has a great potential towards achieving this. The clusters and close proximity of communities, and the existence of sufficient headwaters in the Straits were identified as relevant place-based geographical characteristics that could support a regional water system, and therefore a feature that offers potential to reflect the place-based development theme of new regionalism. The Straits stretches over 80 kilometres of land. When considered as a whole, sharing water supply systems, particularly a treatment plant or distribution lines, could be expensive and difficult. However, there are several smaller clusters of communities within close proximity that share familiar place-based characteristics, for example source water bodies, which could support regional water management. This is reflected in the following comment by a municipal mayor, participant SB01:

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 communities than get source water from Cross-Country and draw a line to Eddies Cove.

As noted in Chapter 4, a group of 13 communities from Eddies Cove East to the Town of Anchor Point (ten kilometres apart) currently share a volunteer fire service department and a youth network, which provides common ground to build upon. From Pigeon Cove-St. Barbes to Forrester's Point and from Pond Cove to Brig Bay are other smaller clusters within a five-kilometre range that can conveniently share water supply systems barring any significant human/social

and/or financial differences (potential challenges discussed further in Section 5.3). In each of the cases, the distances between these communities appear convenient to share water as compared to the 18-km water distribution line that serves five communities in the Exploits Regional Water Supply example (see Section 2.3.1). These attributes tend to support the argument by proponents of new regionalism that considering unique aspect of place in planning processes can accelerate development (in this case development of regional water systems).

Multi-community collaborations in managing water supply systems appear more feasible where source water is sufficient to meet the high-water demand 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 advantage for constructing a shared water system within these shorter distances. This can 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 if located within close distance. The potential of sharing human resources within a cluster of communities in the Straits, the study has revealed, is an experience that already exists. The operations of the Straits fire department that serves 13 communities is a typical example of existing human resource sharing. The close proximity of communities would significantly reduce the financial cost to traverse water distribution lines across long distances as well as the human resource demands to serve neighbouring communities.

5.2.2: Socio-Economic Conditions

Socio-economic conditions are also important according to the new regionalism theory. Themes such as multi-actor and multi-community collaboration, governance interactions, and integration have both implicit and explicit socio-economic conditions embedded in their practice. For example, the nuances associated with social interactions manifest in communities, each with their own identities, when they attempt to collaborate to pursue similar goals (Daniel et al., 2015). In the Straits, some current socio-economic conditions provide opportunities for regional water management: 1) there are established relationships through existing service-sharing among some communities, 2) there exist common water challenges among communities in the Straits that provide common interests, and 3) communities have some level of consensus on regional approaches as the solution to water challenges. These conditions illustrate strong social relationships, which can be drawn upon as a resource (or place-based asset) in further developing a regional approach to drinking water management.

To begin with, existing examples of multiple community collaborations provide vital services in the Straits region and illustrate the shared environment and attribute of collaborative governance and rural-urban interdependencies that are discussed in new regionalist literature. These examples could offer lessons and motivation for similar partnerships in managing water supply systems, enhancing trust among communities and leading to more likely voluntary participation in a regional system (e.g. more multi-community systems within the larger region and/or expansions to existing ones). The successful examples offer optimism among the many communities experiencing water challenges that a viable option would be to combine individual-community strengths and resources, as witnessed in these previous experiences. The current service-sharing activities also bring forth the potential for building on and strengthening rural-

urban interdependence within the region, with already existing examples of larger and smaller communities working successfully together over time.

These efforts also demonstrate common interests in the region. It was observed that most services currently shared among communities were based on common challenges of the past which required a search for solutions, resulting in collaborations and partnerships among affected communities to provide quality services. Further, most of the respondents agreed that a regional water system could mitigate the common water challenges and other development marginalities that confront the Straits. This collective consideration of a regional approach as the solution to water challenges and the mutual co-existence (discussed below) among communities has created strong social ties that may allow the issue of drinking water systems and provision of clean, safe drinking water as a broader regional concern. Building strong social ties means "to go beyond the adversarial politics of competing interest" (Lasker & Weiss, 2003 p. 24). Given this common interest identified, it paves way to explore the next steps to adopt a regional water management approach to solve these challenges. This is reflected in the remarks by a municipal mayor, participant SB07: *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. The leaders in the various municipalities, LSDs and UIAs as well as government officials do appreciate that with the present contextual situation (small tax bases, low revenues, aged/retiree population) in each community, it would be difficult for communities to individually address their water challenges.

This study has revealed that there is a common identity and cordial relationships among neighbouring communities that speaks to the social capital in the region. This self-identification as a region or a common place fosters social capital, defined by Woolcock and Narayan (2000 p.

2) as “the norms and networks that enable people to act collectively.” Inherent in social capital are significant attributes such as trust, norms and networks that facilitate collaboration and partnership especially in times of crisis or problem-solving (Hauberer, 2011). Hauberer (2011) further argues that an integral aspect of social capital is reciprocity, which inspires negotiation, consensus, and the sustenance of subgroups in a social system. This was reflected within the interviews, including a comment by a town manager acting as a water operator, participant SB02:

Yes! It was a pump. I gave him a pump when their water was low, so he came down to pick up a pump from me, so I gave him a pump. We don't charge them. What I ask them to do was that, when you finish with the pump, you just take it back to the garage and make sure it's serviced, right! And you bring it back to us. And we have done that with several communities. We are always on the soft part. And anybody who gets the stuff got to help.

You need to do it, because you don't know when you're going to need someone's help.

It was observed that community members and neighboring communities see one another as a safety net in times of need. The communal and assistive nature of neighboring communities coming together to resolve development challenges demonstrates the presence of social capital and the potential to draw on this regional asset to adopt the regional water management approach.

The volunteering spirit and willingness to offer help in the form of money, time, and labour during critical water challenges (e. g., broken pipelines, collapsed brooks) are evidence of strong social relations that could facilitate the implementation of a regional water management strategy.

There has been other informal support offered by neighbouring communities in terms of equipment or consultancy services. This is reflected in the comment by a municipal mayor, participant SB07:

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, but we are not actually sharing any services as

such right now. The strong social ties present in the region, as the study has revealed, could help facilitate knowledge flows when communities work together. Also, the relationship that exists among communities could offer great potential for dialogue that will aid in developing compromises and consensus in the collective interest of the region to tackle water challenges. This may explain why there is a growing consensus in the region on potential successful regional approaches to water management, as the study has shown. These features would encourage co-construction of knowledge and decision-making processes among stakeholders to accelerate development, consistent with the multi-level governance, the place-based development and the knowledge sharing themes of new regionalism.

Notwithstanding the deep-rooted doubts about implementation, the consensus among actors in the region, coupled with experiences of existing service-sharing noted earlier, could facilitate a comprehensive approach that builds on the principle of integration and collaboration in new regionalism (Zirul et al., 2015). The existing consensus could also facilitate co-production of knowledge and innovation to tackle the existing problems, or to find feasible ways of successfully setting up regional water management (Breen, 2018). The existing bonds, or social capital, between communities could also help strengthen the belief in the region, which is experiencing a number of serious development challenges as described in Chapter 4. This social capital has the potential to enhance shared services, which could make the region more resilient.

5.2.3: Political/Legal Conditions

New regionalism is political. It is largely based on governance and administration, which cannot be completely separated from politics (Söderbaum, 2017; Börzel & Risse, 2016). Gibson (2015) argues that upper-level government support could facilitate regional approaches at the local

level. Gibson's (2015) assertion could prove vital for regional water management in the Straits. This study found that the provincial government has been supporting and collaborating with rural communities for many years, particularly in the programs that are directed towards capacity building for communities to solve their water challenges. The provincial government has noticed the multiple water challenges and other development deficiencies in rural NL, including the Straits region, over the years and the inability of individual communities to address these challenges. This acknowledgement was confirmed in the following statement by a provincial official, participant RP04:

We know the water problems these communities face, and we know they cannot come out of BWA. Government has always tried to help them. In 2001/2002, government gave out chlorination-based disinfection systems, but they have packed them. They don't want chlorine in their water. I go there to conduct one-on-one training with some of the water operators. Most of them are fishermen. When I go to train one, they don't meet him the next time round. I meet a different person. That is one of the challenges.

The provincial government has often tried to support rural communities to overcome the water challenges, particularly support for regional based initiatives (DMAE, 2016). For instance, the Province of NL has supported the implementation of a regional water/wastewater operator pilot program in Central, Western and Eastern regions (Rolling, Chant & Gazley, 2017; DMAE, 2016). Further to this, it was discovered in the interviews that the provincial government provided the remuneration of the water operator for the first year in the shared water operator case example in western NL (see Section 2.3.1). The NL government 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. This

engagement by the provincial government could provide the basis for multi-level regional water governance.

The described supportive roles of the government provide a potential for setting into motion multi-level collaborative governance, which taps into local and provincial government commitments to solve the current challenges in the system with a focus on the regional scale. Notwithstanding the great potential that government support and other opportunities discussed bring to the Straits to 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.

5.3: Potential Challenges of a Regional Approach

While potentials of regional collaborations and partnerships are evident from the results of this study, efforts to bring together independent individuals, organizations, or communities to work and share goods and/or services can be challenging. The literature (e.g. Robinson, Rosenberg, Teel & Steinback-Tracy, 2003; Mandel, 1999) and this study have shown that in seeking an effective collaborative water sharing agenda among communities, certain challenges must be expected, and possible resolutions considered upfront. Many of the challenges that currently affect water supply systems are likely to hinder the adoption of a regional approach as well if proactive measures are not put in place. However, other challenges, discussed below, are peculiar to regional approaches and/or the Straits region that would particularly impede the adoption of a regional water management system.

5.3.1: Geographical Challenges

As earlier noted, geography is an important factor in the success of regional efforts, including regional water management. While place-specificities could present potential in regional collaborations, there are other negative regional dynamics that could affect partnerships. For instance, the study found that unfavourable geographic elements in the region such as long distances between some communities, uneven landscape, and the hardness of the underground rock can present challenges to regional water management. It was revealed in the interviews that if the whole Straits (about 80 kms from Castor Rivers to Eddies Cove East) were considered, it could be expensive or even impossible to share all aspects of the water supply system. For example, the long distribution lines required to serve communities that are far apart, according to interviewees, would present maintenance challenges. This would be especially difficult during winter seasons when water distribution lines would freeze, or breakages occur that need to be located and fixed. In the GVRD case example, water mains have to traverse over 500 kilometers to supply water to other municipalities (Bakker & Munk Center of Program in Water Issues, 2003). The ability to share water supply over a long stretch in the GVRD is likely related to the human and financial resource capacities of the municipalities involved, however, along with more favourable climatic and geological conditions. Hence, replicating such models should be done cautiously, especially when it involves small communities with limited resources-as in the case of the Straits.

Additionally, some participants expressed concerns about the hard rock beneath the ground that could affect the laying of water distribution lines in some communities. These concerns could be related to the harsh natural conditions of the region. Physically, the Great Northern Peninsula consists of fjords, outcrop and underlying sedimentary rocks (limestone and dolostone), and mountains (Gibson, 2013; Colman-Sadd, Hayes, & Knight, 1990). While the problem of long

distances between communities could be mitigated by sharing water supply only among communities within close proximities, the issue of the hard-underground rock could still pose a challenge to adequate laying of water lines and increase the cost of water line installations for rural communities.

5.3.2: Socio-Economic Challenges

Other possible limitations to a regional water management system are the social beliefs and demographic trends of the Straits. As noted in Chapter 4, interviewees revealed that programs that sought to improve water quality through chlorination have failed due to the misconception among rural folks that chlorine changes the natural taste of water and could also have health effects. This belief could also be used by residents to suggest that investments in regional water systems are unnecessary.

As discussed above, the population of the Straits is rapidly declining and aging according to Statistics Canada (2017). This problem does not only affect the economic viability of the region but also the human resource capacity and capabilities to establish and manage water systems that require much human and capital resource investment. The resultant effect of this problem would be a small tax base (where economic activities are limited), hence low revenues to fund development activities. As stated in Chapter 4, communities need to raise 10% to 30% of project cost upfront to be able to access the MCW funds (DMAE, 2016). In the Straits, where many communities have aged and low populations with few or no economic activities, it could be difficult to raise 10% of a project cost to qualify for even the 90% funding from the provincial government. A municipal mayor, participant SB07, explained:

... We've been trying to apply for funding where we can. We are a small community and you know, 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. We have other LSD that don't have any tax base, they don't collect tax ...

Larger communities that serve large populations would be better able to generate their percentage contribution to benefit from the MCW. A regional water system that can serve a larger population would, however, require the communities in the Straits to provide a greater percentage (20%-30%) of project cost. With the current economic situation of the region this could be a deterrent to regional water management.

Apart from the financial challenge presented by current population dynamics, it was observed that most communities are home to seniors and retirees. A regional water management approach would require multiple stakeholders and trained technical personnel and strong local leadership to oversee its implementation. Given the high number of aged people and the characteristics of current water managers in most communities, the future looks bleak in regard to the availability of the human resources to sustain water supply systems be it under individual community or regional water management. However, a regional water management system offers a solution to this challenge as the few active (and ideally trained) individuals within a regional population could manage a larger, more vibrant water system to supply aging community populations.

5.3.3: Political/Legal Challenges

As discussed previously, it is proper that, locally-based initiatives need upper-level government support, acceptance, and funding to succeed (Bogardi & Hartvelt, 2001). Considering

the current capacity (human and financial) level of the Straits, communities would need upper-level governments to increase their financial and technical support particularly in a regional water management system (which would increase water demand and quality). In any case, provincial and federal governments with greater human and financial capacities are better placed to support lower-level governments with the trained personnel, expertise and finances. Having acknowledged the supportive role of the provincial government above, many community leaders believe that there is the need for more support and political will to implement effective multi-community collaboration in water supply systems. This call from local leaders (lower-level governments) is grounded in the concept of multi-level collaborative governance within the new regionalism approach. As discussed in Chapter 2, Gibson (2015) explains that multi-level collaborative governance involves consensus building and collaboration through engagement among diverse stakeholders at the various scales.

After recounting how the current unstable demographics in the Straits are likely to aggravate current water problems, one provincial official, participant RP04, suggested that the only way to have quality water supply in rural communities would be to impose a regional water system on them, similar to the approach taken in the garbage collection program. The view of most community respondents, however, and one consistent with the collaborative governance idea is that, the government should allow neighboring communities to decide, or at minimum have significant input into and decide together with other levels of government, what services they can share with which communities.

While new regionalism promotes rural-urban interdependence in regional development, the disparities in capacities and responsibilities among the various scales of communities¹⁰ in the Straits could instead impede community collaborations. The inequalities in community administration, human resources, and the right to charge taxes are significant potential barriers to a regional water management strategy. Whereas municipalities would accept to commit and pay tax (increases) or service fees to finance regional water management activities to access quality water supply, LSDs and UIAs would have difficulties to accept the new charges which would affect their commitment given that they have limited rights to charge taxes. This is evident in the statement by a municipal mayor, participant SB07:

The biggest challenge, I guess for us is the political framework of UIAs, LSDs and municipalities... Even in dealing with the LSD adjacent to us, the one that we currently supply water, we run into issues from time to time over the years in collecting fees and getting them to understand the operations of it. A lot of all these other communities while they have LSD on paper, they are not functioning as LSDs should really function. ... we have got an unnecessary free playing field that is going to come between LSDs and municipalities. And maybe in some place, right on the side of the LSDs, they are not having two ways of coming to the table as they are often scared of having to pay property taxes or extra fees or whatever as municipalities.

¹⁰ 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, form governments, and provide essential services, the LSDs and UIAs have no formal government structures, have limited or no jurisdiction to charge taxes, and as a result rely on voluntary responsibilities to provide essential services to their residents.

The inequalities in administrative responsibilities, expertise, and financial capacities between municipalities and LSDs (and UIAs) can serve as initial disincentive to community collaborations that involve resources or cost sharing (Martin, 2007). There are likely to be difficulties for consensus and compromises among the varying communities in regard to the sharing of cost and benefits (who gets what, when, how, how much, and who pays). There would be disagreements on fairness in terms of monetary contributions and the quantity, and quality of water supply. The disparities may also make it difficult to collect service fees and charges particularly in LSDs and UIAs that do not pay any taxes or fees now. This is reflected in the following statement by a municipal mayor, participant SB07: *In ... LSD name..., they have a lot of water leaks that we are trying to address; we can address directly trying through the LSD, but it is not always easy. They don't pay any taxes which affects their finances.*

Aggravated by these disparities, participants described views such as larger communities (municipalities) “*exploiting us to their benefit*”, or smaller communities or LSDs/UIAs being a “*parasite to our already established water system*”. That is to say that, LSDs and UIAs often presume that their participation in a regional water supply system will only introduce or increase their taxes and fees without any improvement in their current water situation. An LSD volunteer, participant SB04, speaks to that: *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.* Regarding the unwillingness of LSDs and UIAs to join a shared water system a municipal mayor, participant SB07, adds: *And maybe in some place, right on the side of the LSDs, they are not having two ways of coming to the table as they are often scared of having to pay property taxes or extra fees or whatever as municipalities.* It was discovered that LSDs and UIAs normally presume that municipalities will share their high municipal operational cost with them without any benefits. It

was also observed that municipalities with well-established water systems on the other hand, assume that LSDs and UIAs are primarily entering into the regional water initiative to get a free-ride from their water supply systems. Hence, there appears to be an oppositional stance between LSDs and UIAs on one side and municipalities on the other side. When stakeholders assume such opposing viewpoints, it will affect consensus building, trust and commitment, which are crucial ingredients for collaborations such as the regional approach to drinking water management. This unhealthy relationship between smaller and larger communities in the Straits tends to demonstrate the other side of the rural-urban interdependence theme of new regionalism that could impede regionalization.

Interviewees also mentioned the bureaucratic challenges present in acquiring land from the Crown to undertake private developments, be it for business or for residential purposes. That is, the land acquisition process is expensive and takes time, which serves as a disincentive for new people and returnees as well as community business opportunities that would boost the local economy to improve rate revenues and service fees to finance water supply systems. This is supported in the following quote by a municipal mayor, participant SB01:

... if someone wants to buy crown land or you apply for crown lands ... They put your application in the desk and put something on it and it sits there for more than 6 months. We (municipalities) could do it in two months and it takes them (provincial officials) two years. We own the land and we say, we need it surveyed and you got to pay for the surveyor. Hey! you want to build a house, this is the piece of land that you can have, get it surveyed. You have got two years to build the house. If the space stays and the person go away, he can sell it to someone else. We've got to tax residents or the businesses. If you have a business, we can get GST. Crown land is a very difficult area in NL, ... And unless the

province releases the crown lands to municipalities within their own boundaries, it is going to be chaos.

In critically examining the Straits for regional water management, there are stronger potentials than there are challenges envisioned. Potentials such as the strong social capital and common need, abundant source waters, and clusters of communities offer a foundation for the success of a regional approach to managing water supply systems. Additionally, the support pledged by the provincial government for water services offers opportunities that can help to overcome the challenges: geographic, socio-economic and political. The issue at hand is, *what to do next?* This has been addressed in the next section. The following section attempts to discuss what community leaders and NL officials think are the next steps towards a regional approach to managing drinking water supply systems.

5.4: Recommendations for a Regional Water Management in the Straits

How can a successful regional approach to water management be achieved in the Straits? The discussion in this section answers this question based on identified context-specific operational possibilities, an idea built on the new regionalist theme of place-specificity. Study participants highlighted some important steps and procedures, mostly linked to earlier challenges mentioned, on how a regional approach could be initiated and successfully implemented in the Straits region. The discussions that follow explore how a regional approach can be achieved.

The multi-level, integrative and interdependent nature of a regional approach requires that the stakeholders and their corresponding roles be identified and discussed (Franch, Martini, & Buffa, 2010). Therefore, it is significant to identify the stakeholders, their roles, and capacities to

assist in the implementation of a regional water management approach. Stakeholders can be classified as primary and secondary depending on their comparative salience with respect to power, legitimacy, and urgency (Franch, Martini, & Buffa, 2010). Although secondary stakeholders are significant in accomplishing the goals and objectives of an organization or program, primary stakeholders are those directly involved and affected by the operational outcomes (Todd, Leask, & Ensor, 2017; Komppula, 2016). The study has revealed some stakeholders and the roles they can play to facilitate a regional approach in the Straits. Community leaders, residents, and the technical people who will be directly involved, impacted and own the would-be regional water management system were identified by interviewees as the primary stakeholders. Invariably, it is appropriate that this group of stakeholders devote time, leadership, funds and commitment to implement any form of sharing that will occur within the water supply system. As stated, residents have been contributing monies, paying service fees, volunteering labor and sharing equipment to keep the water systems running in most communities in the Straits. According to participants, the federal and provincial governments, private companies, neighboring communities could be classified as secondary stakeholders. Even though this group of stakeholders would be affected indirectly by the operations of the water supply system, their contributions are equally necessary.

An all-inclusive governance system that integrates the efforts and support of various stakeholders could enhance the development process of a region. This would involve the support, commitment and contribution of upper-level governments, which could be key constituents in the effective adoption of a regional approach. Many respondents expressed their appreciation of the support and contributions from the provincial government and private companies (e.g. engineering services) over the years and in discussing the way forward in a regional approach. They

(respondents) further noted that the provincial government should support the water service-sharing initiatives (as discussed earlier) and be proactive in offering this support. This view expressed by participants on government confirms the assertion that the success of many regional-based initiatives or service-sharing initiated by lower-level organizations or communities would require the support of upper-level governments and authorities (Bogardi & Hartvelt, 2001). According to the results of this study, government's role could be in the form of funds, technical assistance, and/or policy and legislative reforms. In terms of process, first, it was suggested by participants that some legislative and policy reforms be made to revitalize and (re)activate LSDs and UIAs to be operational. The provincial government should ensure that LSDs and UIAs function effectively to be able to contribute in regional-based water management as municipalities would do. Second, some interviewees have called on the provincial government to introduce incentives/disincentives in place to encourage towns and communities into more regional approaches to service delivery and eventually to a regional government in the Straits.

In terms of the legislation and regulatory role of government in initiating a regional approach, some respondents noted how bottlenecks in land access could affect the process. As previously mentioned, the difficulty to lease and release crown lands in municipalities and other lower-level government jurisdictions for developmental projects has stalled business activities and infrastructure projects, including water supply. The call for policy and/or legislation to decentralize the process of leasing and releasing Crown lands is seen as a way to facilitate the establishment of businesses and private homes to encourage the return of young families. This would contribute in diverse ways to improve the economies of communities in terms of tax revenue, human resources, and access to other services. The revelation of the potential diverse roles government can play to initiate and facilitate processes towards a regional water management system speaks to the multi-

level collaborative governance theme of the new regionalism approach. However, respondents acknowledged that government's role must still recognise the differences in the area and should tailor efforts to place specific initiatives.

Consistent with the place-based development idea in new regionalism, many interviewees acknowledged that regional solutions ought to respect and consider place differentials and needs. Particularly, each area should be assessed separately to identify peculiarities and unique characteristics to develop the potentials for water service-sharing. This idea was also emphasised in the MNL consultation report (Municipalities NL, 2017) and by participants in the NL government consultation meetings in St Anthony and Rocky Harbour in the Northern Peninsula. In effect, factors such as available human and financial resource capacities and capabilities, and the histories and geography of the region should be factored into plans to implement a regional approach. In that regard, interviewees noted that for a regional government to be successful in the Straits, the nature, scope, and style of operation of water management options should emanate from the community level and then be supported and have collaboration by upper-level governments and other actors.

Related to this theme, participants argued that the provincial government should change its approach in forming the regional governments. In addition to the significant expressions made by participants, especially in LSDs and UIAs communities, that government should not force regional efforts (as discussed above), participant SB05 and *No single solution fits all!* - Participant SB08. To them, instead of considering the whole Straits for a regional water sharing initiative, the collaboration should be done in clusters that acknowledge place similarities in terms of geography, history, and capacity; that is, communities closest to one another e. g. Plum Point, Bird Cove and Brig Bay; Black Duck Cove, Forrester's Point and St. Barbe for a start. The clustering

recommendation is likely to curb the envisaged long-distance challenge against a regional approach. Also, water supply sharing among communities in close proximity would involve fewer communities, which has the potential to aid in consensus building despite diverse interest/needs.

To achieve this consensus and be cautious in the implementation, some respondents argued for a pilot program as a test-bed. Although lessons from existing service-sharing examples could offer motivation, limited experiences in multiple community water sharing could still hinder a potential regional water management system. Therefore, for collaboration in water supply, some participants suggested that the provincial government should begin with a pilot program involving a greater number of communities for one aspect of the water supply system (e. g., a joint water supply or employing a water operator) and if successful, it could then be rolled out to cover other communities within the region and/or other aspects of water supply. A regional water/wastewater operator pilot program that is ongoing in selected communities in central, western and eastern NL should also be evaluated to ascertain the success and replicability in other areas including the Straits. Through the pilot program, several communities have been taken off the BWAs while others have improved maintenance practices on their water infrastructure (Rolling, Chant & Gazley, 2017). As discussed in Chapter 2, there are also other successful examples of regional water management in the literature to draw inspiration from in the design of such a pilot, keeping in mind that place-based factors are significant in the successes of human and community partnerships.

The recommended regional approach for the Straits region would require a bottom-up initiative based on the design of member communities with support from upper-level governments. The success of a regional approach in the area may also depend on other factors, including identifying the stakeholders, their roles, and capacities to assist in a regional-scale water

management effort. Other suggestions to consider in adopting a regional approach include: establish an all-inclusive governance system that integrates the efforts and support of various stakeholders; pilot regional water management as a test-bed; and to consider the unique characteristics of each place in terms of geography, history, and capacity in system design. These recommendations should provide a platform for further dialogue among various levels of government and within the region more broadly to build consensus on pursuing a regional approach to water systems and other municipal services.

Beyond the support for regional water service-sharing, provincial officials and municipal respondents have also recommended a regional government in the Straits within reasonable defined locations that could be administered by community representatives. They argued that a regional government presents better chances and opportunities to resolve the many development challenges facing the region. The following quote in the Local Government Feasibility Research Findings supports this demand and illustrates 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)

CHAPTER 6: CONCLUSION

This chapter contains a summary and conclusions that can be deduced from the study findings (Chapter 4) and discussions (Chapter 5). Section 6.1 summarises where the objectives of the study have been addressed in the thesis while section 6.2 presents key conclusions of the research. Section 6.3 suggests areas for further research and, finally, section 6.4 outlines some of the contributions that the study has made in regard to literature, policy and practice.

6.1: Thesis Summary

This section summarizes how the thesis has addressed the four objectives of the research outlined in Chapter 1. The first objective of the research was to identify water challenges that confront communities in the Straits. Findings for this are contained in the literature, the results and the discussion sections. In section 2.2.3 in the literature review chapter (Chapter 2), I have discussed general water challenges reported by water researchers in Canada and NL that are peculiar to rural areas including the Straits. In Chapter 5, I discussed water challenges specific to the Straits region, while section 5.5 explains the potential challenges against a regional approach to water management. Common water challenges notable to the case study region include regular leakages in old water lines, inadequate capacities, inclement weather, and the absence of fulltime certified water operators, impacts of extreme weather conditions, widespread BWAs, and dislike for chlorination-based disinfection (see Section 5.1).

The second objective of the study was to identify aspects of the drinking water system that can be delivered on a regional-scale. Chapter 2, section 2.2.2 defines and gives the description of the various components of a water supply system: water infrastructure, human and financial

resources, source water, water policy and planning and water quality monitoring. Then, in table 4.6 in the results and findings chapter (Chapter 4) respondents identified the aspects of a water supply system such as water management (water operators, water equipment, and expertise), water supply (water facilities and distribution lines) and water sources that could be shared among communities in the Straits.

The central theme of the research, a regional approach to water management, has been extensively discussed in Chapters 2 (see Section 2.3.0) and 5 (see Section 5.3). These sections addressed my third research objective, which sought to explore the viability of regional water management given technical, geographic, socio-economic and legal/political conditions. In Chapter 2, the discussions are based on the views of water scholars with regards to regional water management. Numerous articles have recommended regional approaches to managing water supply systems, particularly in rural areas, for benefits such as quality service delivery, enhanced rural resilience and economies of scale (Breen, 2018; Vodden & Minnes, 2014). In discussing the case of the Straits in Chapter 5, a regional water management approach was viewed by most respondents as a viable alternative to manage water systems but what remains unanswered is how to go about it. Suggestions for starting points include: 1) to identify the stakeholders, their roles and capacities for a regional water system; 2) that upper-level governments should lead and support the regional approach process; 3) to recognize place specificities of the various communities; 4) to consider the collaborations in clusters versus the entire Straits; and 5) to start with a pilot as a test-bed. Regardless, regional approaches as a solution to water challenges are bound to face challenges such as the geographic, socio-economic and political issues outlined in section 5.3.

The last objective of the study, to identify the actors and process needed to implement a regional water management approach, was addressed in sections 4.3 in Chapter 4 and 5.4 in Chapter 5. Various stakeholders that were identified to play vital roles in a regional water management initiative include: community leaders and residents, upper-level governments, and private companies. Many interviewees have suggested that the provincial government change its current approach, from a regional government system to service-sharing for a start.

6.2: General Conclusions

The findings from this study on drinking water management have confirmed several assertions in the literature. Generally, it can be concluded from this study that small water systems in communities managed by uncertified water operators and with limited financial support are more likely to face water quality issues than water systems managed by certified water operators with adequate finances. This is evident in the many water challenges that confront these water systems, with widespread impacts such as high levels of DBPs and long-term BWAs. This is reflected in the literature where scholars warned of water quality issues in small water systems that face human and financial challenges (Hrudey, 2011; Kot, Castleden, & Gagnon, 2011).

It can be concluded that two major issues push for a regional water management approach in the Straits. First, individual community efforts to resolve water challenges have often resulted in futility. For instance, it was revealed in the study that LSDs that currently share water supply with other municipalities are better able to access clean drinking water now, perhaps at a reduced cost (see Table 3.1 on water quality index). For example, several communities in western NL that were under BWAs for several years were lifted off after joining the regional water/wastewater operator pilot program (see Rolling, Chant, & Gazley, 2017). Second, the provincial government

is encouraging communities to start water sharing initiatives and has shown the interest to support such efforts. There could be benefits in such collaborations such as cost saving on overhead cost, enhanced capacities, economies of scale, and improved water quality to rural communities.

In advocating for a regional approach to manage water systems, it was discovered that LSDs and UIAs have some reservations on the implementation. While they were in favour of a regional approach, its implementation would come with increases in taxes and other service fees. These charges would appear new and exorbitant for LSDs and UIAs against their current financial capacities. Furthermore, the disparities in regard to capacity and responsibility among different communities and in particular, the limited resources of LSDs and UIAs makes it difficult to collaborate with incorporated municipalities with relatively high capacities and responsibilities. Capacity differences (human and financial) are more likely to be major impediments to the regional water management initiative that may involve the contribution of money, sharing of cost and responsibility than any other factors.

Despite such challenges, there are prospects in the Straits that can be developed and maximized to facilitate the implementation of a regional water management approach, as outlined in section 5.2. These prospects ought to be developed considering place-specific characteristics and the need to build on existing service-sharing initiatives. The findings of this study show that the role of previous experiences and related relationships in communities in facilitating regional water management cannot be underestimated. However, these potentials could be undermined by systemic challenges in some communities. In critically assessing the Straits region, there are more potentials to support a regional approach than there are challenges. The challenges can, however, be overturned into potentials if communities are creative, innovative, willing and committed to a common course as a region versus as individual communities. For instance, if communities

reconcile their differing interest and come together at a regional-scale, pooling limited resources and efforts and lobbying upper-level governments collectively, there is potential for breakthrough in addressing their capacity challenges.

Even though every component of the water supply system can be shared among multiple communities, the sharing process presents variate challenges when funding, expertise, and geography are considered. For instance, it would be difficult to share water supply and water distribution lines across the 80-km stretch of the Straits, particularly considering the cold winter weather and the underground hard rock. Therefore, the collaborations should be done in clusters to help in mitigating this challenge. In addition to sharing water supply in clusters of neighbouring communities, it was strongly recommended that a pilot program for a joint water supply system should be started to test its viability.

Finally, although respondents acknowledged the supportive role and interventions by upper-level governments to resolve water challenges in the Straits, communities continue to urge for more support in adopting a regional approach to water management. The provincial government has often proposed a regional government system where communities would share all services (e.g., fire departments, tourism, waste management), including the management of water supply systems. The findings in this thesis point to a similar proposal for communities to jointly manage water supply systems. The disconnection between the two proposals resides in the design/nature of partnership or collaboration. While this research suggests that communities voluntarily form partnerships to share water supply systems, the provincial government proposes to demarcate boundaries for communities within the same region/enclave to form a regional level of government (thus, to share services including water supply systems).

6.3: Areas for Future Research

Whereas the study met its goal and objectives, it has also raised questions that need further investigation and could stimulate future research regarding drinking water management in the region. There is the need for research to:

1. Identify a comprehensive approach, a clear roadmap, on the implementation of the discussed regional approach to rural water management.
2. (Re)define the borderlines of the regional approach in ways that differ from the conventional and government-led proposed regional government system (in NL) to accommodate local input and to win the support and interest of rural communities. Specific boundaries (e.g. clusters of communities) required for water systems should be considered, which may lie within larger regional administrative boundaries.
3. Propose an appropriate platform where opposing viewpoints of municipalities and LSDs (including UIAs) on the process and shared benefits of a regional water management approach could be further discussed to reach a consensus and foster collaboration as both parties currently presume unequal benefits, which could inhibit the implementation of a regional approach.
4. Validate the claim that communities dislike chlorination-based water disinfection methods and the linkage(s) with the risk of cancer.

6.4: Contribution of the Study

My research aimed to contribute to existing literature, inform policy and improve practice on the water management strategies, particularly in rural settings. The findings and conclusions in this research have contributed to advancing the field of rural development broadly, and rural water management in particular. The study has advanced knowledge in how rural people manage their water challenges to access good quality water supply, and the potential to share aspects of water supply systems with other communities to minimize water challenges. The revelation of existing, primarily informal service-sharing activities in the Straits, and how social capital plays into the picture illuminates the important role of this variable in rural development and resilience.

The study is the first academic research conducted on water supply systems in the Straits, bringing out the similarities in water challenges in the various communities and the inefficiency of individual community efforts which serves as a basis for collaboration. An inventory of water systems, common water challenges, possible solutions and the nature of water management in the Straits as revealed by this research further expands the literature on drinking water issues in rural NL. The issues raised in the research suggests areas where further research could be undertaken to advance rural water management in the region, and across the country.

Regarding policy, this research provides input to inform the formulation or reformation of policy and provincial funding programs for essential services in rural areas. It further suggests bottom-up approaches to regional planning and development that incorporate local knowledge and place-specificities. The findings, for example on the support for a potential regional approach in the Straits and the role respondents expect from government can help inform a viable strategy to initiate a regional governance model. Additionally, the research findings have provided information on the relevance and the potential of community buy-in on provincial policies and

plans. Hence, the study findings could enhance conventional top-down approaches to implementing water management and governance policies by encouraging the incorporation of practices such as collaboration, empowerment, and partnership among researchers, industry and communities in addressing water challenges.

Finally, the study has revealed existing issues in the communities that, if addressed, can enhance local government activities in the area and beyond. For instance, understanding the challenges, potentials, and possible sharing opportunities in water supply systems can help communities gauge their preparedness for regional service-sharing and identify new potential solutions for addressing drinking water concerns. The examples cited in the research and the benefits accruing to member communities would offer some motivation and drive towards adopting a regional water management approach in the Straits.

Reference List

- ‘Yotti’Kingsley, J., Phillips, R., Townsend, M., & Henderson-Wilson, C. (2010). Using a qualitative approach to research to build trust between a non-Aboriginal researcher and Aboriginal participants (Australia). *Qualitative research journal*, 10(1), 2-12. <https://doi.org/10.3316/QRJ1001002>
- Adeel, Z. (2017). Placing Canada’s water policies in an international context. In *Water Policy and Governance in Canada* (pp. 99-120). Springer International Publishing: Basel-Switzerland.
- Alberta Association of Municipal Districts and Counties. (2015). *Asset Management for Municipalities in Alberta; Navigating the Asset Management Journey*. Alberta. Canada. Retrieved May 20, 2018, from <http://www.aamdc.com/images/AAMDC%20-%20AM%20Report%20-%20Final%20-%20Web%20Version.pdf>
- Alshenqeeti, H. (2014). Interviewing as a data collection method: A critical review. *English Linguistics Research*, 3(1), 39, 39-45. doi: <https://doi.org/10.5430/elr.v3n1p39>
- Arksey, H. & O’Malley, L. (2005). Scoping studies: towards a methodological framework. *International Journal Social Research Methodology* 8(1), 19–32. <https://doi.org/10.1080/1364557032000119616>
- Bakker, K. (Ed.). (2007). *Eau Canada*. UBC Press: Vancouver-Canada.
- Bakker, K., & Munk Centre Program on Water Issues. (2003). *Good governance in restructuring water supply: a handbook* (p. 44). Federation of Canadian Municipalities: Ottawa-Canada.
- Baxter, J. & Eyles, J. (1997). Evaluating qualitative research in social geography: establishing ‘rigour’ in interview analysis. *Transactions of the Institute of British Geographers*, 22(), 505–525. Retrieved February 20, 2018, from <https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.0020-2754.1997.00505.x>

- Baxter, P., & Jack, S. (2008). Qualitative case study methodology: Study design and implementation for novice researchers. *The qualitative report*, 13(4), 544-559. Retrieved June 12, 2018, from <https://nsuworks.nova.edu/tqr/vol13/iss4/2>
- 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. doi: 10.1007/s00267-017-0873-9
- Black, K., & McBean, E. (2017). First Nations' water sustainability and security strategy: Tools and methodologies for community-driven processes for water treatment in Indigenous communities. *Technology in Society*, 5(), 57-65. doi: 10.1016/j.techsoc.2017.04.004
- Blackmore, F. E. W. (2003). *Research findings: Local government in the Straits*. Grand Falls-Windsor, Newfoundland.
- Bogardi, J., & Hartvelt, F. (2001). Towards a strategy on human capacity building for integrated water resources management and service delivery. Bonne, Germany. Retrieved May 28, 2018, from <https://www.ircwash.org/sites/default/files/204.0-01TO-17880.pdf>
- Bogason, P., & M. Zølner. (2007). *Methods for network governance research: An introduction*. In *methods in democratic network governance*, edited by P. Bogason and M. Zølner, 1–20. Palgrave MacMillan: Houndmills and Basingstoke- UK:
- Börzel, T. A., & Risse, T. (Eds.). (2016). *The Oxford handbook of comparative regionalism*. Oxford University Press.
- Boyatzis, R. (1998). *Transforming qualitative information: Thematic analysis and code development*. Sage: Thousand Oaks, California-United States.
- Boyd, D. R. (2006). *The Water We Drink: An International Comparison of Drinking Water Quality Standards and Guidelines: A Report Prepared for the David Suzuki Foundation*. David

- Suzuki Foundation: Vancouver-Canada. Retrieved May 28, 2018, from <http://davidrichardboyd.com/wp-content/uploads/Water-We-Drink-ENG.pdf>
- Bradford, L. E., Bharadwaj, L. A., Okpalauwaekwe, U., & Waldner, C. L. (2016). Drinking water quality in Indigenous communities in Canada and health outcomes: A Scoping review. *International journal of circumpolar health*, 75(1), 32336. doi: [10.3402/ijch.v75.32336](https://doi.org/10.3402/ijch.v75.32336)
- Bras d'Or Lakes Collaborative Environmental Planning Initiative. (2011). *The Spirit of the Lakes Speaks*. Retrieved February 28, 2018, from <http://brasdorcepi.ca/wp/wp-content/uploads/2011/07/Spirit-of-the-Lake-speaks-June-23.pdf>
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(3), 77–101. doi:10.1191/1478088706qp063oa
- Breen, S. (2018). Exploring a new regionalism-based approach to managing drinking water systems in rural regions, *Society & Natural Resources*, 31(6), 698-716, doi: [10.1080/08941920.2017.1423432](https://doi.org/10.1080/08941920.2017.1423432)
- 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. P. W. (2017). *From Staples Theory to New Regionalism: Managing Drinking Water for Regional Resilience in Rural British Columbia*. (Doctoral dissertation, Simon Fraser University).
- Breen, S.-P., & Minnes, S. (2013). Water and watershed management: A regional development perspective (No. CRD-7). Corner Brook. Retrieved 20 April 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*. Grenfell Campus – Memorial University, Corner Brook, NL-Canada. Retrieved February 28, 2018, from https://www.mun.ca/harriscentre/reports/Breen_Water_13_14_Final.pdf

Butler, D., Ward, S., Sweetapple, C., Astaraie-Imani, M., Diao, K., Farmani, R., & Fu, G. (2017). Reliable, resilient and sustainable water management: The safe and sure approach. *Global Challenges*, 1(1), 63-77. doi: 10.1016/j.healthpol.2013.02.009

Butt, K. (2009). *Drinking water quality research summary and suggested priorities report*. Harris Centre, St. John's- Canada. Retrieved May 28, 2018, from <https://www.mun.ca/harriscentre/funding/water/WaterResearchInventory.pdf>

Butz, D. (2008). Sideline by the guidelines: Reflecting on the limitations of standard informed consent procedures for the conduct of ethical research. *ACME: An International E-Journal for Critical Geographies*, 7 (2), 239-259. Retrieved May 26, 2018, from <https://brocku.ca/social-sciences/geography/wp-content/uploads/sites/152/Butz-ACME-2008-Sideline-by-the-Guidelines.pdf>.

Cacchione, P. Z. (2016). The evolving methodology of scoping reviews. *Clinical Nursing Research*, 25, 115-119. doi: 10.1177/1054773816637493.

Canadian Council of Ministers of the Environment, (2004). *“Source to Tap: The multi-barrier approach to safe drinking water”*. Prepared by the Federal Territorial Committee on Drinking Water. Retrieved May 26, 2018,

https://www.ccme.ca/en/resources/water/from_source_to_tap_the_multi_barrier_approach.html

Canadian Infrastructure Report Card 2016. (2016). Retrieved June 20, 2017, from http://www.canadainfrastructure.ca/downloads/Canadian_Infrastructure_Report_2016.pdf#page=16

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://portal.huttcity.govt.nz/Record/ReadOnly?Uri=2875623>

Cashaback, D. (2001). *Regional district governance in British Columbia: A case study in aggregation*. Institute of Governance. Vancouver. Retrieved May 20, 2018, from <https://www.slrd.bc.ca/sites/default/files/pdfs/Regional%20District%20-%20Bish%202001.pdf>

Castleden, H., Hart, C., Cunsolo, A., Harper, S., & Martin, D. (2017). Reconciliation and relationality in water research and management in Canada: Implementing Indigenous ontologies, epistemologies, and methodologies. *In Water Policy and Governance in Canada* (pp. 69-95). Springer International Publishing: Basel-Switzerland.

CBCL Limited. (2012). *Managing municipal infrastructure in a changing climate*. St. John's. Retrieved February 12, 2018, from <http://www.municipalnl.ca/userfiles/files/DEC-00306-InfrastructureWorkbook%28Web-EmailQuality%29.pdf>

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. doi: [10.1080/15287390490492313](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, Brandon University, NB. Retrieved 12 June 2018, from http://rplc-capr.ca/wp-content/uploads/2015/04/DrinkingWaterManagement_LiteratureReview_VincentChireh.pdf
- 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.
- Christensen, J. (2012). "They want a different life": Rural northern settlement dynamics and pathways to homelessness in Yellowknife and Inuvik, Northwest Territories. *The Canadian Geographer*, 56(4),19-438. <https://doi.org/10.1111/j.1541-0064.2012.00439.x>
- Cloke, P., Cooke, P., Cursons, J., Milbourne, P. & Widdowfield, R. (2000). Ethics, reflexivity and research: Encounters with homeless people. *Ethics, Place and Environment*, 3(2), 133-154. <https://doi.org/10.1080/713665889>
- Cloke, P., Johnsen, S. & May, J. (2005). Exploring ethos? Discourses of 'charity' in the provision of emergency services for homeless people. *Environment and Planning A*, 37(), 385-402. [doi:10.1068/a36189](https://doi.org/10.1068/a36189)
- Colman-Sadd, S. P., Hayes, J. P. & Knight, I. (1990). Geology of the Island of Newfoundland. *Newfoundland Department of Mines and Energy*, Map 90-01. Retrieved on February 20, 2018 from https://www.nr.gov.nl.ca/nr/mines/investments/geology_map_nl.pdf
- Columbia Basin Trust, (2016). *Columbian basin water smart initiative; Building sustainable futures for community water use*. British Columbia. Retrieved August 22, 2017, from

https://ourtrust.org/wpcontent/uploads/downloads/201612_WaterSmart_Summary_FINAL.pdf

Connelly, S., Markey, S., & Roseland, M. (2009). Strategic sustainability: Addressing the community infrastructure deficit. *Canadian Journal of Urban Research*, 18(1), 1-23.

Cooper, T. (2013). *Creating and crumbling: Municipal infrastructure strategic risks*. Prepared for Municipalities Newfoundland and Labrador. Retrieved May 20, 2017, from <http://www.municipalnl.ca/userfiles/files/Municipal%20Infrastructure%20Rpt%20Tom%20Cooper.pdf>

Creswell, J. W. (2013). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage Publications, Incorporated. London-UK

Crowe, S., Creswell, K., Robertson, A., Huby, G., Avery, A., & Sheikh, A. (2011). The case study approach. *BMC medical research methodology*, 11(1), 100. <https://doi.org/10.1186/1471-2288-11-100>

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*. A Harris Centre Report. St John's. Retrieved February 12, 2018, from 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. Retrieved February 12, 2018, from <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*. Geneva: 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. St Johns, NL. Retrieved August 22, 2017, from http://www.mae.gov.nl.ca/waterres/training/adww/smalltown/13_paula_dawe_gander_2008_potable_water_dispensing_units.pdf
- De Janvry, A., & Kassam, A. H. (2001). Advantages and added value of the regional approach to research for the International Agricultural Research System. *Reunion FORAGRO Sobre Prioridades Regionales de Investigacion, CIMMYT, Mexico DF*, 2. Retrieved August 20, 2017 from <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.528.743&rep=rep1&type=pdf>
- De Loe, R. (2008). *Toward a Canadian national water strategy*. Rob de Loë Consulting Services. Guelph, ON: Retrieved May 20, 2018, from <http://deslibris.ca/ID/213747>
- De Loë, R. C., 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>
- 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: Vancouver, B.C-Canada.

Department for Communities and Local Government, UK, (2006). *Structures for collaboration and shared Services*. Retrieved February 12, 2018, from <https://www.bipsolutions.com/docstore/pdf/13728.pdf>

Department of Environment and Climate Change, Government of NL. (2017). *Boil Water Advisories*. Retrieved January 23, 2017, from <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*. West Block, St. John's, NL. Retrieved February 12, 2018, from <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_FI_NAL_REPORT.pdf

Department of Municipal Affairs and Environment. (2001). *Source to tap - water supplies in Newfoundland and Labrador*. Department of Environment and Conservation, 2001, St John's, NL. -Canada.

Department of Municipal Affairs and Environment. (2014). Water Resource Portal. Retrieved February 12, 2018 from <http://maps.gov.nl.ca/water/>

Djurić, I., Nikolić, Đ., & Vuković, M. (2010). The role of case study method in management research. *Serbian journal of management*, 5(1), 175-185.

Dore, M. H. (2015). *Water policy in Canada: problems and possible solutions*. Springer International, Basel-Switzerland. doi: [10.1007/978-3-319-11032-5](https://doi.org/10.1007/978-3-319-11032-5).

Douglas, D. (2013). Regional Development Policy and Planning in Ontario, 1940-2013. *Canadian Regional Development*. Working Paper No. 19. Memorial University of Newfoundland,

- Corner Brook. Retrieved 12 June 2017, from <http://cdnregdev.ruralresilience.ca/wp-content/uploads/2013/03/Eastern-Ontario-innovation-report-FINAL.pdf>
- Drogui, P., & Dagherir, R. (2015). Chlorine for water disinfection: Properties, applications and health effects. In *CO2 Sequestration, Biofuels and Depollution* (pp. 1-32). Springer, Cham. Basel-Switzerland
- Dunn, G., Bakker, K., & Harris, L. (2014). Drinking water quality guidelines across Canadian Provinces and Territories: Jurisdictional variation in the context of decentralized water governance. *International journal of environmental research and public health*, *11*(5), 4634-4651. doi:[10.3390/ijerph110504634](https://doi.org/10.3390/ijerph110504634)
- Economics, F. (2012). Exploring the links between water and economic growth. *A report prepared for HSBC by Frontier Economics*. London. UK. Retrieved 12 June 2017 from https://freshwaterwatch.thewaterhub.org/sites/default/files/final-frontier-report_update18092012_0.pdf
- Eggertson, L. (2008). *Investigative report: 1766 boil-water advisories now in place across Canada*. *CMAJ*. *178*(10),1261-3. doi: [10.1503/cmaj.080525](https://doi.org/10.1503/cmaj.080525)
- Eledi, S. B., Minnes, S., & Vodden, K. (2017). Source water protection in rural Newfoundland and Labrador: Limitations and promising actions. *Water*, *9*(8), 560. <https://doi.org/10.3390/w9080560>
- Environment Canada. (2010). *2010 Municipal Water Use Report*. Government of Canada, En11-[2/2006E 978-1-100-16172-3](https://doi.org/10.2276/2/2006E978-1-100-16172-3).
- Exploits Regional Service Board. (2008). The Exploits Regional Service Board. *A Case Study*. Grand Falls-Windsor. Newfoundland and Labrador. Retrieved May 20, 2018, from

http://www.mae.gov.nl.ca/waterres/training/adww/smalltown/08_town_of_grand_falls_windsor_march_12,_2008.pdf

Fontana, A., & Frey, J. H. (2005). The interview: From mental stance to political involvement. *The Sage handbook of qualitative research*. Sage: London-UK.

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.

Forest, P. (2010b). Inter-local water agreements: Law, geography, and NAFTA. *Les Cahiers de droit*, 51(3-4), 749-770. doi:[10.7202/045732ar](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>

Furlong, K., & Bakker, K. (2011). Governance and sustainability at a municipal scale: The challenge of water conservation. *Canadian Public Policy*, 37(2), 219-237.

Garcia, K., Younos, T. M., & Thompson, C. (1999). Restructuring strategies for small water systems: Virginia small water systems co-operative. Retrieved May 20, 2017, from https://vtechworks.lib.vt.edu/bitstream/handle/10919/49461/VWRRC_sr199915.pdf?sequence=1

Gerring, J. (2006). *Case study research: Principles and practices*. Cambridge., UK. Cambridge university press.

- 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. Retrieved April 20, 2018, from http://cdnregdev.ruralresilience.ca/wp-content/uploads/2014/12/Northern_Peninsula-WP-CRD10.pdf
- Given, L. M. (Ed.). (2008). *The Sage encyclopedia of qualitative research methods*. Sage Publications.
- Government of Ghana. (1999). Community Water and Sanitation Agency Act, 1998. Parliament of Ghana, Accra. Ghana. Retrieved 24 May 2017, from <http://www.cwsa.gov.gh/downloads/Act564.pdf>
- Government of Newfoundland and Labrador. (2007). *Drinking Water Safety in Newfoundland and Labrador-Annual Report 2006*. St. John's, NL. Retrieved April 20, 2018, 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*. St. John's, NL. Retrieved April 20, 2018, from http://www.mae.gov.nl.ca/waterres/reports/drinking_water/annual_report_2007.pdf
- Government of Newfoundland and Labrador. (2017). *Drinking Water Safety in Newfoundland and Labrador-Annual Report 2016*. St. John's, NL. Retrieved April 20, 2018, from 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. Retrieved April 20, 2018, 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. Retrieved April 20, 2018, from <http://www.ope.gov.nl.ca/docs/mae/RegionalGovernmentConsultationDiscussionDocument.pdf>
- Grandy, G. (2010). Instrumental case study. *Encyclopedia of case study research, 1*, 473-475.
- Grandy, G. (2010). Instrumental case study. *Encyclopedia of case study research, 1*, 473-475.
- Grant, M. J., & Booth, A. (2009). A typology of reviews: An analysis of 14 review types and associated methodologies. *Health Information and Libraries Journal, 26*(2), 91-108. doi:[10.1111/j.1471-1842.2009.00848.x](https://doi.org/10.1111/j.1471-1842.2009.00848.x)
- Grassel, E., & Schirmer, B. (2006). The use of volunteers to support family caregivers of dementia patients: results of a prospective longitudinal study investigating expectations towards and experience with training and professional support. *Zeitschrift Fur Gerontologie Und Geriatrie, 39*(3), 217-226. doi: [10.1007/s00391-006-0313-6](https://doi.org/10.1007/s00391-006-0313-6)
- 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. Retrieved 20 June 2017, from http://www.pointrobortswater.com/images/resolutions/600_series/resolution_616.pdf
- Hancock, D. R., & Algozzine, B. (2016). *Doing case study research: A practical guide for beginning researchers*. Teachers College Press. New York.
- Hanigan, D., Zhang, J., Herckes, P., Krasner, S. W., Chen, C., & Westerhoff, P. (2012). Adsorption of N-nitrosodimethylamine precursors by powdered and granular activated carbon. *Environmental science & technology, 46*(22), 12630-12639. doi: [10.1021/es302922w](https://doi.org/10.1021/es302922w)

- 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. Retrieved May 20, 2018, from http://pcag.uwinnipeg.ca/Prairie-Perspectives/PP-Vol02/PP_Vol-02.pdf#page=144
- Harahan M., Dosu Jr B., & Minnes S., (2016). *Government and Community Responses to Drinking Water Challenges and Crises in Rural NL*. Harris Centre, St. John's. Retrieved April 20, 2018, from http://www.mun.ca/harriscentre/reports/15-16_repor...
- Harris, M., & Khonje, W. H. (2011). Regional approaches in sustainable development. *Tools for Mainstreaming Sustainable Development in Small States*, 64-83. Commonwealth Secretariat-UK. Retrieved April 20, 2018, from <http://dx.doi.org/10.14217/9781848591042-en>
- Hauberer J. (2011). *Social Capital Theory: Towards a methodological foundation*. Wiesbaden: Springer Fachmedien Wiesbaden GmbH. doi: 10.1007/978-3-531-92646-9
- Health and Community services, NL. (2017). *Drinking Water Quality*. Retrieved April 20, 2018, from <http://www.health.gov.nl.ca/health/publichealth/envhealth/drinkingwater.html>
- Hennink, M., Hutter, I., & Bailey, A. (2010). *Qualitative research method*. Sage Publications, Incorporated. London-UK
- 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. doi: [10.4296/cwrj3304315](https://doi.org/10.4296/cwrj3304315)

- Houghton C., Casey D., Shaw D., & Murphy L. (2013). Rigor in qualitative case-study research. *Nurse Researcher (through 2013)*, 20(4), 12. Retrieved May 20, 2018, from <https://search.proquest.com/docview/1317920491?accountid=12378>
- Hrudey, S. (2011). *Safe Drinking Water Policy for Canada- Turning Hindsight into Foresight*. Toronto, ON. Retrieved January 20, 2018, from <https://www.cdhowe.org/public-policy-research/safe-drinking-water-policy-canada---turning-hindsight-foresight>
- Hrudey, S. E., & Fawell, J. (2015). 40 years on: What do we know about drinking water disinfection by-products (DBPs) and human health? *Water Science and Technology: Water Supply*, 15(4), 667-674. doi: [10.2166/ws.2015.036](https://doi.org/10.2166/ws.2015.036)
- Hrudey, S. E., Backer, L. C., Humpage, A. R., Krasner, S. W., Michaud, D. S., Moore, L. E., Singer P. C., & Stanford, B. D. (2015). Evaluating evidence for association of human bladder cancer with drinking-water chlorination disinfection by-products. *Journal of Toxicology and Environmental Health, Part B*, 18(5), 213-241. doi: [10.1080/10937404.2015.1067661](https://doi.org/10.1080/10937404.2015.1067661)
- Isard, W. (1957). The value of the regional approach in economic analysis. In *Regional Income* (pp. 69-86). National Bureau of Economic Research. Retrieved January 20, 2018, from <http://www.nber.org/chapters/c7601.pdf>
- Ivey, J., de Loë, R., & Kreutzwiser, R. (2006). Planning for source water protection in Ontario. *Applied Geography*, 26(3-4), 192-209. <https://doi.org/10.1016/j.apgeog.2006.09.011>
- Janssen, W., Kassam, A., & de Janvry, A. (2003). A regional approach to setting research priorities and implementation: Towards satisfying national, regional and global concerns. *Journal of agricultural & food information*, 5(2), 67-100. Retrieved January 20, 2018, from <https://gspp.berkeley.edu/assets/uploads/research/pdf/Ag-FoodInformation.pdf>

- Kennedy, E., Roseland, M., Markey, S., & Connelly, S. (2008). *Canada's looming infrastructure crisis and gas tax agreements: Are strategic connections being made?* Working paper No. 2. Vancouver-Canada.
- 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. doi: [10.1016/j.healthplace.2011.06.012](https://doi.org/10.1016/j.healthplace.2011.06.012)
- Kreutzwiser R. D. & de Loë R. C., (2002). Municipal capacity to manage water problems and conflicts: the Ontario experience. *Canadian Water Resources Journal / Revue canadienne des ressources hydriques*, 27 :1, 63-83, doi: [10.4296/cwrj2701063](https://doi.org/10.4296/cwrj2701063)
- 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. doi:[10.1093/jurban/jtg014](https://doi.org/10.1093/jurban/jtg014)
- LeSage Jr, E. C., & Stefanick, L. (2004, June). New Regionalist Metropolitan Action: The Case of the Alberta Capital Region Alliance. In *Canadian Political Science Association meetings, Winnipeg*. Retrieved 12 June 2017, from <https://www.cpsa-acsp.ca/papers-2004/Stefanick-LeSage.pdf>
- 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. doi: [10.1021/acs.est.7b05440](https://doi.org/10.1021/acs.est.7b05440)
- Lincoln, Y., & Guba, E., G. (1985). *Naturalistic inquiry*. Sage: Newbury Park, CA-USA.

- Ling, J., Zhang, H., & Husain, T. (2016). *Safe Drinking Water Supply for Small & Rural Communities in NL with a Case Study of Pouch Cove*. Harris Centre, St. John's. NL. Retrieved May 20, 2018, from http://research.library.mun.ca/12341/1/Final-RBC_Water_2013-14.pdf
- Longhurst, R. (2003). Semi-structured interviews and focus groups. *Key methods in geography*, 117-132. Sage: London-UK.
- Lovell, G. I. (2006). Justice excused: The deployment of law in everyday political encounters. *Law & Society Review*, 40(2), 283-324. Retrieved May 20, 2017, from <http://www.jstor.org/stable/3840503>
- Luck, L., Jackson, D., & Usher, K. (2006). Case study: A bridge across the paradigms. *Nursing inquiry*, 13(2), 103-109. <https://doi.org/10.1111/j.1440-1800.2006.00309.x>
- 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>
- Malterud, K. (2001). Qualitative research: Standards, challenges, and guidelines. *The Lancet*, 358, 483–488. doi:10.1016/S0140-6736(01)05627-6
- 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). Corner Brook. Retrieved on 20 March 2018, from http://cdnregdev.ruralresilience.ca/wp-content/uploads/2014/12/NR_Primer-WP-CRD4.pdf
- Marshall, M. N. (1996). Sampling for qualitative research. *Family practice*, 13(6), 522-526. doi: <https://doi.org/10.1093/fampra/13.6.522>

- Martin, G. R. (2007). Municipal reform in New Brunswick: Minor tinkering in light of major problems. *Journal of Canadian studies*, 41(1), 75-99. Doi-
<https://doi.org/10.3138/jcs.41.1.75>
- Maxwell, J. A. (2008). Designing a qualitative study. *The SAGE handbook of applied social research methods*, 2, 214-253.
- McAlearney, A. S., Walker, D., Moss, A. D., & Bickell, N. A. (2016). Using qualitative comparative analysis (QCA) of key informant interviews in health services research: Enhancing a study of adjuvant therapy use in breast cancer care. *Medical care*, 54(4), 400. doi: 10.1097/MLR.0000000000000503
- Merriam, S. B. (2002). Introduction to qualitative research. *Qualitative research in practice: Examples for discussion and analysis*, 1, 1-17. Wiley-USA.
- Minnes, S., & Vodden, K. (2014). Exploring solutions for sustainable rural drinking water systems: *A study of rural Newfoundland and Labrador drinking water systems. The Harris Centre: St. John's-Canada*. Retrieved May 20, 2018, from
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>
- Minnes, S., Breen, S.-P., Markey, S., & Vodden, K. (2018). Pragmatism versus potential: New regionalism and rural drinking water management. *The Journal of Rural and Community Development*, 13(2), 76–99

- Mistry, B. & Driedger, S.M. (2012). Do the leads tell the whole story? An analysis of story leads of the Walkerton, Ontario E. coli contamination of drinking water supplies. *Health, Risk & Society*, 14(6), 583–603. <https://doi.org/10.1080/13698575.2012.701275>
- Municipalities Newfoundland and Labrador. (2017). *The Next Steps in the Regional Government Process*. St. John's. NL. Retrieved June 2, 2017, from <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. Washington, D.C-USA.
- National Round Table on the Environment and the Economy (NRTEE). (2011). *Charting a Course – Chapter 7: Collaborative Water Governance*. Retrieved June 2, 2017, from <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, St. Johns-Canada. Retrieved 20 June 2017, from http://stats.gov.nl.ca/Statistics/Census2016/PDF/Pop_Dwellings_NL_CD_2016.pdf
- Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic analysis: Striving to meet the trustworthiness criteria. *International Journal of Qualitative Methods*, 16(1), 1-13. doi: [10.1177/1609406917733847](https://doi.org/10.1177/1609406917733847)
- O'Connor, D. R. 2002. *Report of the Walkerton Inquiry. Part one: The events of May 2000 and related issues*, Toronto: Queen's Printer for Ontario. Retrieved May 20, 2018, from http://www.archives.gov.on.ca/en/e_records/walkerton/report1/index.html

- O'Keeffe, J., Buytaert, W., Mijic, A., Brozović, N., & Sinha, R. (2016). The use of semi-structured interviews for the characterisation of farmer irrigation practices. *Hydrology and Earth System Sciences*, 20(5), 1911-1924. <https://doi.org/10.5194/hess-20-1911-2016>
- Ochoo, B., Valcour, J., & Sarkar, A. (2017). Association between perceptions of public drinking water quality and actual drinking water quality: A community-based exploratory study in Newfoundland (Canada). *Environmental research*, 159, 435-443. <https://doi.org/10.1016/j.envres.2017.08.019>
- Onwuegbuzie, A. J. and Collins, K.M.T. (2007). A typology of mixed methods sampling designs in social science research. *The Qualitative Report*, 12(2), 281-316. Retrieved May 20, 2017, from <https://nsuworks.nova.edu/tqr/vol12/iss2/9>
- Ortiz-Guerrero, C. E. (2013). The new regionalism: Policy implications for rural regions. *Cuadernos de Desarrollo Rural*, 10(SPE70), 47-67. Retrieved on May 20, 2017 from http://www.scielo.org.co/scielo.php?script=sci_arttext&pid=S0122-14502013000100003
- Pahl-Wostl, C., Craps, M., Dewulf, A., Mostert, E., Tabara, D., & Taillieu, T. (2007). Social learning and water resources management. *Ecology and society*, 12(2)5-10. Retrieved May 20, 2017, from <http://www.ecologyandsociety.org/vol12/iss2/art5/>
- Patrick, R. J. (2009). Source water protection in a landscape of 'new era' deregulation. *Canadian Geographer*, 53 (2),208-221. doi: [10.1111/j.1541-0064.2009.00254.x](https://doi.org/10.1111/j.1541-0064.2009.00254.x)
- Peterson, A. N. N., Walker, M., Maher, M., Hoverman, S., & Eberhard, R. (2010). New regionalism and planning for water quality improvement in the Great Barrier Reef, Australia. *Geographical Research*, 48(3), 297-313. <https://doi.org/10.1111/j.1745-5871.2009.00634.x>
- Peterson, H., & Torchia, M. (2008). Safe drinking water for rural Canadians. *Canadian Medical Association Journal*, 179(1), 55-55. doi: [10.1503/cmaj.1080061](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, St Johns, NL. Retrieved 20 June 2017, from http://www.mae.gov.nl.ca/waterres/training/Drinking_Water_Workshop/05_Bob_Picco_Mike_Chaulk.pdf
- Prasad, B. D. (2008). Content analysis. *Research methods for social work*, 5. Retrieved on 20 June 2017, from <http://www.css.ac.in/download/content%20analysis.%20a%20method%20of%20social%20science%20research.pdf>
- Ritchie, J. (2003). *Applications of qualitative methods to social research*. In Ritchie, J. & Lewis, J. (ed) *Qualitative research practice: A guide for social science students and researchers*. SAGE publications: London-UK. Retrieved 12 June 2017, from https://mthoyibi.files.wordpress.com/2011/10/qualitative-research-practice_a-guide-for-social-science-students-and-researchers_jane-ritchie-and-jane-lewis-eds_20031.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*. Retrieved March 3, 2017, from <http://jfkpartnerss.org/Content/PDF/InteragencyGuidebook.pdf>
- Rockström, J. (2003). *Rethinking water management: innovative approaches to contemporary issues*. Routledge: London-UK.
- Rolling, K., Chant, R. & Gazley, J. (2017). Regional water and wastewater pilot project. Retrieved May 20, 2018, from http://www.mae.gov.nl.ca/waterres/training/adww/2017/16_GazleyRollingsChant.pdf

- Rothwell, N. (2006). Canada's watersheds: *The demographic basis for an urban-rural dialogue* (no. 6) (vol. 6). Statistics Canada: Ottawa-Canada
- Rural Secretariat. (2012). St Anthony - Port au Choix Region. Retrieved March 3, 2017, from http://www.exec.gov.nl.ca/rural/regional_councils/stanthony_porta Choix.html#ov.
- Sabatier, P., Focht, W., Lubell, M., Trachterberg, Z., Vedlitz, A., & Matlock, M. (2005). *Swimming upstream: Collaborative approaches to watershed management*. (P. A. Sabatier, Ed.). MIT Press. Cambridge, Mass-USA.
- Sadiq, R., & Rodriguez, M. J. (2004). Disinfection by-products (DBPs) in drinking water and predictive models for their occurrence: A review. *Science of the Total Environment*, 321(1-3), 21-46. doi: [10.1016/j.scitotenv.2003.05.001](https://doi.org/10.1016/j.scitotenv.2003.05.001)
- Salmon, A. (2007). Walking the talk: How participatory interview methods can democratize research. *Qualitative Health Research*, 17(7), 982-993. doi: [s 10.1177/1049732307305250](https://doi.org/10.1177/1049732307305250)
- Savage, C. L., Xu, Y., Lee, R., Rose, B. L., Kappesser, M., & Anthony, J. S. (2006). A case study in the use of community-based participatory research in public health nursing. *Public Health Nursing*, 23(5), 472-478. doi: [10.1111/j.1525-1446.2006.00585.x](https://doi.org/10.1111/j.1525-1446.2006.00585.x)
- Scott, J. W. (2008a). Introduction. In Scott, J.W. (ed.) *De-coding new regionalism. Shifting socio-political contexts in Central Europe and Latin America*. *Ashgate*, Farnham, 3-16. Taylor and Francis Group: Abigdon-UK.
- Simms, A., & Ward, J. (2016). *Regional population projections for Labrador and the Northern Peninsula 2016-2036*. The Harris Center for Regional Development and Policy, Memorial University. St. John's- Canada. Retrieved January 28, 2018, from https://www.mun.ca/harriscentre/PopulationProject/Final_Labrador_Report.pdf

- Sinclair, P., & Felt, L. (1993). Coming back: Return migration to Newfoundland's Great Northern Peninsula. *Newfoundland Studies*, 9(1), 1–25. Retrieved 20 June 2017, from file://curly/users\$/abduhrahima/Downloads/931-2028-2-PB.pdf
- Söderbaum, F. (2017). *The new regionalism in Africa*. Routledge.
- Speed D., (2014b). *Water Operators Survey Report*. Environmental Policy Institute, Memorial University. Retrieved 20 June 2017, from <http://nlwater.ruralresilience.ca/wp-content/uploads/2013/04/Water-Operator-Write-FINAL.pdf>
- Stake R. E. (1995). *The art of case study research*. Thousand Oaks, CA: Sage Publications, Inc.
- Stake R. E. (2000). Case studies. In *Handbook of qualitative research*, eds NK Denzin and YS Lincoln, 435–454. Thousand Oaks, CA: Sage.
- Statistics Canada. (2016). 2016 community profiles - 2011 census. Newfoundland: Statistics Canada: Ottawa-Canada.
- Statistics Canada. (2017). *Goulds, RPC [Designated place], Newfoundland and Labrador and Newfoundland and Labrador [Province] (table). Census profile. 2016 Census*. Statistics Canada catalogue no. 98-316-X2016001. Ottawa. Retrieved August 2, 2017, from <http://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/index.cfm?Lang=E>
- Stein, D., Rocco, T. S., & Goldenetz, K. A. (2000). Age and the university workplace: A case study of remaining, retiring, or returning older workers. *Human Resource Development Quarterly*, 11(1), 61-80.
- Stewart, J. (2012). Multiple-case study methods in governance-related research. *Public Management Review*, 14(1), 67-82. doi- <https://doi.org/10.1080/14719037.2011.589618>
- Sturges, J. E., & Hanrahan, K. J. (2004). Comparing telephone and face-to-face qualitative interviewing: A research note. *Qualitative research*, 4(1), 107-118.

- Sunkel, O., & Inotai, A. (2016). *Globalism and the new regionalism* (Vol. 1). Springer. Charm-Switzerland.
- Suri, H. (2011). Purposeful sampling in qualitative research synthesis. *Qualitative Research Journal*, 11(2), 63-75. <https://doi.org/10.3316/QRJ1102063>
- Teddlie, C., and A. Tashakkori. (2009). *Foundations of mixed methods research: Integrating quantitative and qualitative approaches in the social and behavioral sciences*. Sage Publications Inc: Thousand Oaks, CA-USA.
- Thorne, S. (2000). Data analysis in qualitative research. *Evidence Based Nursing*, 3(), 68–70. doi:[10.1136/ebn.3.3.68](https://doi.org/10.1136/ebn.3.3.68)
- Todd, L., Leask, A., & Ensor, J. (2017). Understanding primary stakeholders' multiple roles in hallmark event tourism management. *Tourism Management*, 59(), 494-509. doi: [10.1016/j.tourman.2016.09.010](https://doi.org/10.1016/j.tourman.2016.09.010). ISSN 0261-5177
- Toonen, T. A. J. (2011). *The (changing) role of national government in multi-level (water) governance*. In *Principles of good governance at different water governance levels: Colloquium held on 22 March 2011 in Delft, the Netherlands*. UNESCO-IHE.
- Towns of Bird Cove, Anchor Point, & Flower's Cove. (2010). *Integrated Community Sustainability Plan*. Retrieved 20 June 2017, from <https://www.municipalnl.ca/wp-content/uploads/2016/09/bird-cove-anchor-point-flowers-cover-icsp.pdf>
- Usadolo, S. E., & Caldwell, M. (2016). A stakeholder approach to community participation in a rural development project. *Sage Open*, 6(1),1-9. doi- [10.1177/2158244016638132](https://doi.org/10.1177/2158244016638132)
- 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, St. John's-Canada.

Vodden, K. (2005a). *Municipal Service Sharing Case Studies- Excerpts on Municipal Cooperation in Economic Development in Newfoundland and Labrador.* Prepared for Municipalities Newfoundland and Labrador. St. John's-Canada. <https://www.municipalnl.ca/wp-content/uploads/2016/09/municipal-service-sharing-case-studies-on-economic-development.pdf>

Vodden, K. (2005b). *New World Island Municipal Service Sharing Case Study.* Prepared for Municipalities Newfoundland and Labrador. St. John's. Retrieved 22 June, 2017, from <https://www.municipalnl.ca/wp-content/uploads/2016/09/municipal-service-sharing-case-studies-on-economic-development.pdf>

Vodden, K. (2005c). *Northeast Avalon Municipal Service Sharing Case Study.* Prepared for Municipalities Newfoundland and Labrador. St. John's. Retrieved 22 June 2017, from [http://www.municipalnl.ca/userfiles/files/Northeast Avalon Service Sharing Case Study.pdf](http://www.municipalnl.ca/userfiles/files/Northeast%20Avalon%20Service%20Sharing%20Case%20Study.pdf)

Vodden, K. (2005d). *St. Paul's to Bellburns - Great Northern Peninsula Municipal Service Sharing Case Study.* Prepared for Municipalities Newfoundland and Labrador. St. John's.

Vodden, K. (2005e). *Trinity Bay North, Little Catalina and the Cabot Loop Municipal Service Sharing Case Study.* Prepared for Municipalities Newfoundland and Labrador. St. John's. Retrieved from [http://www.municipalnl.ca/userfiles/files/Trinity Bay North Case Study reduced.pdf](http://www.municipalnl.ca/userfiles/files/Trinity%20Bay%20North%20Case%20Study%20reduced.pdf)

Vodden, K. (2009). *New Spaces, Ancient Places: Collaborative Governance and Sustainable Development in Canada's Coastal Regions.* Simon Fraser University. Canada.

- 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). St. John's, Newfoundland and Labrador: ISER Books.
- Vodden, K., Gibson, R., & Daniels, J. (2014). Newfoundland and Labrador provincial regional development policy. *Canadian Regional Development*, 18. Retrieved May 20, 2018, from <http://cdnregdev.ruralresilience.ca/wp-content/uploads/2013/03/NL-Provincial-Working-Paper-Jan-2014-final.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(04).
- Watercare Services Limited. (2017) 2017 Annual Report; *Meeting the demands of change and growth*. Auckland. New Zealand. Retrieved on May 20, 2018 from https://www.watercare.co.nz/CMSPages/GetAzureFile.aspx?path=~%5Cwatercarepublicweb%5Cmedia%5Cwatercare-media-library%5Creports-and-publications%5Cannual_report_2017.pdf&hash=9ef35661c24a38d47a2aefeda6cab7df34efa4812577f22f0482d205bdb588d2
- Weinberg, A. S. (2003). Negotiating community-based research: A case study of the "Life's Work" project. *Michigan Journal of Community Service Learning*, 9(3), 26-35. <http://hdl.handle.net/2027/spo.3239521.0009.303>

- Wellington Community services, (2017). Retrieved May 20, 2018, from <https://www.newzealandnow.govt.nz/regions-nz/wellington/community-services>.
- Wheeler, S. M. (2002). The new regionalism: Key characteristics of an emerging movement. *Journal of the American Planning Association*, 68(3), 267-278. <https://doi.org/10.1080/01944360208976272>
- 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. Retrieved May 20, 2018, from http://www3.weforum.org/docs/WEF_WI_WaterSecurity_WaterFoodEnergyClimateNexus_2011.pdf
- World Economic Forum (2017). *The Global Risks Report 2017. 12th Edition*. Retrieved May 20, 2018, from http://www3.weforum.org/docs/GRR17_Report_web.pdf
- Yan, M., Wang, D., Ma, X., Ni, J., & Zhang, H. (2010). THMs precursor removal by an integrated process of ozonation and biological granular activated carbon for typical Northern China water. *Separation and Purification Technology*, 72(3), 263-268.
- Yin, R. K. (2017). *Case study research: Design and methods*. Sage publications: London-UK.
- Zainal, Z. (2007). Case study as a research method. *Jurnal Kemanusiaan*, 5(1). Retrieved May 20, 2018, from http://psyking.net/htmlobj-3837/case_study_as_a_research_method.pdf
- 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.

Zubrycki, K., Roy, D., Venema, H. D., & Brooks, D. B. (2011). *Water security in Canada: responsibilities of the federal government*. International Institute for Sustainable Development. Winnipeg, Canada.

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 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 out 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?