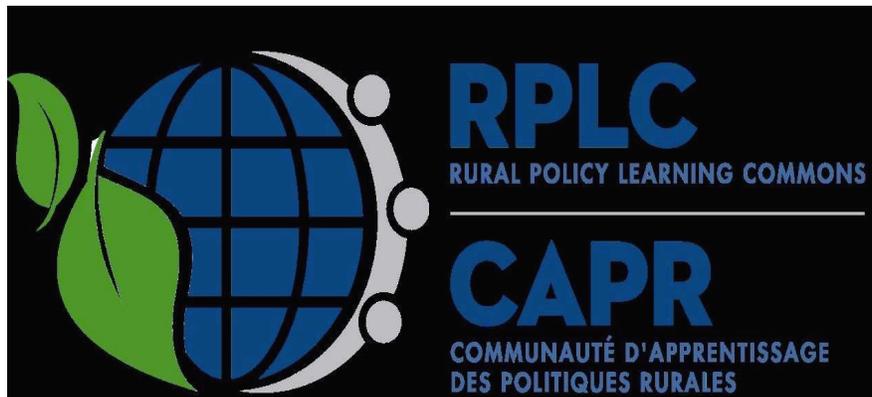


**EXAMINING REGIONAL APPROACHES TO DRINKING  
WATER MANAGEMENT IN RURAL CANADA;  
NEWFOUNDLAND AND LABRADOR:**

**A LITERATURE REVIEW**

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## **Abbreviations**

BWA	- Boil Water Advisory
CISL	- Capacity Infrastructure Services Limited
DMAE	- Department of Municipal Affairs and Environment
GCDWQ	- Guidelines for Canadian Drinking Water Quality
GNL	- Government of Newfoundland and Labrador
HCS	- Health and Community Services
LED	- Local Economic Development
LSD	- Local Service Districts
MBSAP	- Multi-Barrier Strategic Action Plan
MCP	- Municipal Capital Works
NL	- Newfoundland and Labrador
WCS	- Wellington Community Services
WSL	- Water Services Limited

## **Abstract**

There has been a growing concern among water managers, researchers and users alike in the past decade over the quality and quantity of drinking water supply especially in rural Canada. There is evidence of challenges with water infrastructure, management as well as regulations and policies that guide the administration of public water supplies. This summary of relevant literature examines regional approaches to drinking water management in existing literary works in rural Canada, especially Newfoundland. The review is part of a larger research project which adopts a community-based participatory research approach to assess how communities can collaborate in managing drinking water systems in rural Canada, focusing on The Strait of Belle Isle in the Great Northern Peninsular region of Newfoundland and Labrador. I reviewed articles (peer-reviewed and grey literature), books and other visuals on water management systems in Canada (Newfoundland and other rural parts) and elsewhere sourced from online databases and conducted analysis using Nvivo software.

In this review, themes identified and discussed include current challenges facing drinking water management and potential solutions to these challenges. Additionally, “regional approach” has been discussed in detail as the central theme of my larger research project. Successful case examples of regional approaches identified in literature were discussed with comments on the appropriate option for provincial and municipal water management. However, more research is required to explore the conditions, procedures, and actors required to execute a regional approach in water management to attain sustainable supply of drinking water in rural Canada.

## **Introduction**

Water is life. While water covers two-thirds of the earth, it has been ranked as the third highest risk the world faces currently due to inadequate availability of quality freshwater (World Economic Forum, 2017). Although Canada has a substantial amount of freshwater, managers and water researchers predict future challenges in the sustainable supply of good quality drinking water amidst current management deficiencies (Peterson & Torchia, 2008; Eggertson, 2008). The management of water supply systems appears to be an integral part of the water supply chain therefore, management challenges will likely compromise water quality and quantity. The current water management approach in Canada has been criticized by both water researchers and users as being fragmented, with unenforced laws and unimplemented policies, uncoordinated efforts, and inadequate governmental support resulting in poor maintenance of water infrastructure, human and financial problems, multi-use watersheds, and ineffective water quality monitoring (Minnes and Vodden, 2017; Castleden et al., 2017; Breen and Markey, 2014). Municipalities and communities are often unable to resolve these challenges which usually result in compromises in water quality and quantity; long-term BWAs, high levels of disinfectant by-products, contaminated drinking water sources, an outbreak of giardia and other waterborne diseases (Bradford, 2016; Eggertson, 2008; Boyd, 2006;).

The purpose of this review was to explore the scope of literature in relation to drinking water management challenges and potential solutions in rural Canada, focusing on regional approaches as the best practice. To achieve the purpose of this review, several articles (peer-reviewed and grey literature) on drinking water management and regional approaches in and outside of Canada were accessed on online databases. Preference was however given to articles on water management in rural Canada as well as Newfoundland and Labrador (NL) water management as this review forms the bases to explore regional approaches into detail in my current research project. Subsequent sections of the review present discussions and analysis of the literature on current challenges of drinking water management, potential solutions to water management challenges and regional approaches as a suitable alternative to manage drinking water especially in rural settings (Breen et al., 2015; Hrudey, 2001). Although regional approaches to water management, especially in rural communities, has often been suggested, there remain lapses in proposing concrete resolutions on the conditions, procedures, and actors required in the adoption and implementation of this model.

An attempt will be made towards addressing such lapses in the ensuing primary-sourced data research to be conducted following this literature review.

## Method

The main objective of this literature review is to examine regional approaches to water management as a possible solution to water management challenges in rural Canada, focusing on the NL specific context. Specific objectives include identification of current water management challenges, potential solutions recommended by other researchers in the field, and finally examining the status of regional approaches to drinking water management as one of the potential solutions. To achieve this objective, I used a theme-based approach to review scholarly articles, books, and visuals in Canada preferentially in NL. This theme-based review was chosen over other types of reviews (methodology, theory, temporal or chronological) because it will give details and extent of literary work in this field and contribute to knowledge mobilization to interested stakeholders such as policymakers, water providers and communities (Arksey & O'Malley, 2005). This review used articles (peer-reviewed and grey literature) from the 1980s to present day that specifically focused on drinking water management challenges and regional approaches as an appropriate alternative to water challenges. This summary of literature review makes use of existing knowledge in the water sector to examine regional approaches in water management as done by Murray and Begler (2009).

This literature review process began with an online search in Google Scholar, google.com and Memorial University of Newfoundland (MUN) Libraries delving into scientific journals with Canadian content relevant to the subject matter. I conducted a search for journals in databases including Scopus, Web of Science, ScienceDirect, ProQuest, Elsevier, and other internet sources. The articles were accessed from journals as such as the Water Journal, Canadian Water Resources Journal, Journal of Rural and Community Development, Health Policy, Journal Environmental Planning and Management, Canadian Geographer, Directory of Open Accessed Journals (DOAJ), among others. Searches were conducted using the following keywords “drinking water”, “management challenges”, “regional approaches”, “Canada” and “Newfoundland and Labrador”. A number of specific articles were selected based on a quick scan through the titles and abstracts of articles found in all databases considered in the initial search. Similarly, grey literature (e.g., government and organization reports, conference papers, preparations) were also accessed online to complement peer-reviewed articles. Relevant articles were accessed and uploaded into Nvivo 11 for analysis.

To begin with the analysis of the articles, I developed themes and subthemes that included aspects of drinking water systems, challenges of water management, solutions to water

management challenges, and regional initiatives in water management, from the review topic aimed at meeting my objectives. A search was then directed at how each theme was addressed by authors by thoroughly reading through all articles in uploaded into the Nvivo software to code relevant words, phrases and paragraphs. Themes and subthemes were exported into Microsoft office word 2010 for purposive reading to gain an understanding of the discussions in the articles to decipher relevant information for further analysis to meet the review objectives. Although described sequentially in a linear form, the review process was iterative in nature to ensure a compressive assessment of literature (Bradford et al, 2016; Bryden, 2013). Hence, sections covered in this piece include identification of various components of water supply systems, current water management challenges, recommended solutions, and an elaborative exploration of regional approaches in drinking water management with some recommendations from on the papers reviewed.

## **1.0: Drinking Water Management in Canada**

### ***1.1: Introduction***

This section discusses the legal provisions that outline responsibilities regarding drinking water management among the various levels of government in Canada. These discussions are centered on the amount of responsibility allotted by laws and conventions on the federal and provincial governments as well as municipalities in relation to water governance and management. Components of water management systems have also been discussed.

Water is a necessity for the survival of humankind, particularly drinking water as it aids good health and supports socio-economic activities of the people. While water appears abundantly available the world over including Canada, access to good quality and sustainable drinking water cannot be assured when its management faces challenges. Although Canada has a substantial wealth of freshwater, about 1% of its rural population (without including First Nations where the number is substantially higher) do not have access to safe drinking water (Adeel, 2017; Hrudey, 2008; Boyd, 2006). In Canada, the supply and control of water systems is a shared responsibility among the various levels of governments; federal, provincial and municipal/local service districts (Vodden and Minnes, 2017; Multi-Barrier Approach, 2004).

### ***1.2: Water Governance; Legislation, Policy and Planning***

There has been a renewed attention and public health concern among federal, provincial and municipal authorities to provide safe drinking water to Canadians after the Walkerton and North Battleford drinking water outbreaks in 2000 and 2001 (Hrudey, 2011; O'Connor, 2002). Although significant efforts have been made to improve the shortfalls of drinking water supplies after these incidents, further improvements in water management systems are still needed to continually assure households of reliable and safe drinking water (Hrudey, 2011).

The provisions in Canada's federal water policy (latest been the Canada Water Act of 1970, and the Federal Water Policy) (Bakker & Cook, 2011; Bakker, 2007) exonerates the federal government of much direct water management responsibilities. However, significant water management roles (provision of water infrastructure, source water protection, capacity building, water quality monitoring, etc.) are performed by provincial and municipalities governments and which lead to substantial vertical and lateral variations in water governance, legislation and

policies across the provinces (Hill et al., 2008 p. 320). Every province (Territories have not been included in this review) in Canada has a different legal establishment which governs the operations of public water supply systems. In NL for example, the Water Resources Act (2002, 2003, 2004, 2005), the Municipal Affairs Act, Public Health Act (1996) and the Municipalities Act (1999), Environmental Protection Act (2002, 2005), Labrador Inuit Land Claims Agreement Act (2005) serve as the legal bases within which public drinking water systems operate, whilst Section 39 of the Water Resources Act SNL 2002 cW-4.01 specifically provides for Protected Public Water Supply Areas (Eledi, Minnes and Vodden, 2017; DMAE, 2017). Additionally, adherence to federal regulations and policies on water management by provincial governments are voluntary though they serve as guides for developing province-specific water policies and strategies (Bakker, 2007). Notably among these are the explicit adoption of the Multi-Barrier Strategic Action Plan and the Canadian Guidelines for Drinking Water Quality by Newfoundland and Labrador, however, British Columbia adopts none of these initiatives (Christensen, 2011).

Whilst the Federal government has absolute control over trans-border waterbodies, fishing, naval water bases and other public spaces (recreational waterbodies) across most of the provinces, the provinces and municipalities take complete charge of providing potable drinking water to their residents (Hrudey and Cook, 2011; Hanrahan, Dosu and Minnes, 2016; Breen, 2016; Vodden and Minnes, 2014). Municipalities and communities are overburdened and challenged especially in rural communities considering their human and financial capacity levels (Hanrahan, Dosu and Minnes, 2016).

The variety of management approaches, however, appear disjointed and uncoordinated in nature which creates unintentional lapses in management and failures in adherence to quality assurance guidelines (Bereskie, Rodriguez & Sadiq, 2017). There has been a gradual paradigm shift from “government to governance” in managing drinking water systems in Canada, particularly in Newfoundland and Labrador where the provincial responsibilities are limited to supporting water infrastructure and providing regulations (Hanrahan, Dosu and Minnes, 2016 p. 12). The Department of Municipal Affairs and Environment under the Municipal Capital Works (MCP) program provide funding up to 90% for the construction of municipal water infrastructure for qualified municipalities according to some defined eligibility criteria (Adeel, 2017).

Weak governance structures and weak capacity in complying with drinking water regulations have adverse implications for drinking water security in rural communities across Canada (Kot, Castleden, & Gagnon, 2011). Breen and Markey (2015) also observe that inadequate drinking water

systems have long been acknowledged as part of the infrastructural problems that confront the country and attribute the challenging situation of rural water management to the downloading of water management responsibilities from provincial to local governments without corresponding support (Breen and Markey, 2015). Good water governance, particularly under a collaborative approach will allow for a more localized planning process, promote better-informed, place-based decisions, and facilitate the involvement of a wider range of stakeholders (NRTEE, 2011).

### ***1.3: Components of Drinking Water Supply Systems***

Water supply systems can be described as both soft and hard activities or processes that interact in the provision of safe drinking water. Different scholars have classified water supply systems differently over time. Several scholars have recognized components of drinking water systems involving water sources, water infrastructure (treatment and distribution), capacity building, water quality monitoring; and policy and planning (Vodden and Minnes, 2017; Hrudey, 2011). Other aspects include water harvesting processes, controlled storage, safe home storage and point-of-use treatment (Davison et al, 2005). Water researchers and water managers have often recommended a regional or integrative approach in managing water components as doing so discretely will likely affect the delivery of clean and safe public drinking water.

#### *Source Water*

Source water is described as unrefined water supplies (i.e., ground and surface) including streams, lakes, ponds, springs, rivers, aquifers, and precipitation treated through water systems for public consumption (Eledi, Minnes and Vodden, 2017). Water collected from these sources is then treated through public water supply systems and supplied to the public or sometimes privately treated by individuals at home. Human activities (e.g., farming, other land development within water supply areas), animal activities and naturally occurring metals are the major causes of source water contamination or pollution. To ensure the supply of good quality drinking water, efforts must first be put into preventing contaminants from polluting water source, as it is less expensive to protect source water than remediate polluted water (Patrick, 2009). In Canada, lands and other natural features in and around waterbodies useful to the hydrological cycle are considered as water supply areas and should ideally be protected (Kreutzwiser & de Loë, 2002). However, efforts to protect water supply areas are strictly competed by other land uses including agriculture and infrastructural development. The protection of water sources is critical in ensuring water quality as most sources are open hence, vulnerable to both anthropogenic and chemical contaminants.

Patrick (2009) adds that it's less expensive and convenient to protect a water source from effluence than it is to treat contaminated water.

### *Water Infrastructure*

Water infrastructure is the hard components of the water management system including both linear (i.e. distribution and transmission pipes) and non-linear assets (e.g., water treatment plants, water pumping stations, and water reservoirs) (Canadian Infrastructure Card, 2016). The distribution component of water infrastructure includes pipes, pumps, hydrants, valves, water mains, tanks, and faucets whilst the treatment also include with disinfectants, coagulants, point-of-use water filters and PWDUs (Vodden and Minnes, 2014; Vodden and Minnes, 2017; Multi-Barrier Approach, 2004; Department of Environment and Conservation, 2010). One of the major challenges facing water delivery service in rural Canada, especially NL has been insufficient, aging/failing water infrastructure; and lack of maintenance plans for water infrastructure in both municipalities and LSDs (Keenan and Whelan, 2010; Breen, 2016; Speed, 2014b).

### *Human and Financial Capacity*

Human and financial capacity include the soft components (e.g., human institutions and actors) of the water delivery chain in charge of operating and managing water assets through regulations, policies, and plans. Professionals such as planners, engineers, water systems operators, water management committees, municipal and Local Service Districts (LSDs) staff, as well as monetary provisions are required in the management process to ensure the supply of good quality water. The efficiency of the water supply system appears to be largely dependent on the efficacy and adequacy of the human and financial resources. Hrudey (2011) emphasized that those engaged in managing water systems to provide quality drinking water need to be trained, supported and compensated appropriately to deliver as our health depends on them.

### *Monitoring and Evaluation; Water Quality Testing, Boil Water Advisory*

In Canada, much of water management and governance duties including monitoring, maintenance, and evaluation of water supply systems fall within the provincial authority. Whilst the federal government provides Guidelines for Canadian Drinking Water Quality, supervision and enforcement rest with every province to develop an appropriate strategy for implementation to guarantee the supply of public drinking water. The responsibility for monitoring and quality control of public water supply systems in Newfoundland and Labrador, for example, rests with provincial departments: Department of Municipal Affairs and Environment (chemical parameters) and Department of Health and Community Services (bacteriological quality) and also with local

governments (DMAE, 2017). In NL, the ineffectiveness of monitoring, supervision, and testing of water systems due to several reasons including distance, human and financial capacities, etc. This has contributed to many communities within the region to consistently test higher levels of disinfectant by-products (e.g., haloacetic acid (HAA) compounds and trihalomethanes (THMs) than the Health Canada guidelines recommendation, as well as long-term boil water advisories (DOEC, 2014; DMAE, 2017).

## **2.0: Challenges of Drinking Water Systems.**

This section discusses the current challenges that affect the sustainable supply of good quality drinking water in rural Canada with a focus on Newfoundland. As stated previously, my emphasis placed on rural Canada (see methodology), whilst highlighting rural Newfoundland in some cases to identify existing lapses or positives on current water management in rural settings in literature to inform the design options for ensuing researches. Water management systems in other rural areas in Canada were also considered to compare and contrast with the Newfoundland scenario in order to inform a case for generalizations or otherwise. Bereskie, Rodriguez & Sadiq (2017 p. 1) describe the present arrangement of water management as “fragmented, leading to governance gaps, duplication of efforts, and an absence of accountability and enforcement”. The authors further acknowledge the challenges that threaten water systems which often affect the quality and quantity of public water supply (Bereskie, Rodriguez & Sadiq, 2017). These challenges could be as a result of human activities (e.g., management gaps, perception, beliefs), animal activities as well as natural occurrences (e.g., geological disorders, climate changes, precipitation). The challenges with drinking water systems are complex in nature as they occur at every level within the water supply system from source to tap as well as across all governance levels.

Water management challenges are often widespread in rural communities in aspects such as high cost of building and operating treatment plants, aging/failing distribution infrastructure, inadequate source water protection, inadequate human and financial capacity, poor water conservation, and governance gaps (Bereskie, Rodriguez & Sadiq, 2017; Breen and Markey 2015; Minnes & Vodden, 2014; Kot, Castleden, & Gagnon, 2011). Weak governance structures and low capacity in complying with drinking water regulations, resulting in some instances from lack of qualified personnel and volunteerism (in LSDs), have implications for drinking water security in rural communities across Canada (Kot, Castleden, & Gagnon, 2011).

The water management problem is more prevalent in rural Canada especially Newfoundland and Labrador partly due to consequences of other rural-based problems such as lack of economies of scale, declining population, low population density, reduction in the tax base, inadequate human capacity, among others (Breen, 2016; Breen and Markey, 2015). These rurally based challenges deteriorate the current water management situation (Bereskie, Rodriguez & Sadiq, 2017). These situation has often being escalated by the huge financial investment required in resolving these challenges with water systems (Minnes & Vodden, 2014; Kot, Castleden, & Gagnon, 2011;).

Table 1 presents an organized summary of water management challenges from literature reviewed grouped into various thematic areas.

*Table 1: Drinking Water Challenges*

Infrastructure (treatment and distribution)	<ul style="list-style-type: none"> <li>➤ High cost of providing and maintaining water infrastructure</li> <li>➤ Aging/degrading water infrastructure</li> <li>➤ Quality and cost of water treatment technologies</li> <li>➤ Public acceptability of water treatment technologies</li> </ul>
Capacity (all levels)	<ul style="list-style-type: none"> <li>➤ Inadequate human capacity (qualified staff, appropriate skills, compensation)</li> <li>➤ Inadequate financial capacity (lack of money, funding access and continuity, investment)</li> </ul>
Planning and management	<ul style="list-style-type: none"> <li>➤ Inadequate planning</li> <li>➤ Lack of asset management (data, adequate rates)</li> <li>➤ Planning complexities (multiple plans, levels of planning)</li> <li>➤ Source water protection (lack of/not implemented, multi-use)</li> </ul>
Place	<ul style="list-style-type: none"> <li>➤ Physical setting (size, number, location of systems)</li> <li>➤ Historical resource use/practices</li> <li>➤ Change in community (existing system not meeting needs)</li> <li>➤ Place-based features not considered in policy, regulation, standards, programs, etc. (consistency and uniformity vs. flexibility and uniqueness)</li> <li>➤ Rural access to laboratory services</li> </ul>
Water Quality	<ul style="list-style-type: none"> <li>➤ Many and long-term boil water advisories</li> <li>➤ High levels of disinfectant by-products</li> <li>➤ Perception and understanding of treatment methods (e.g., chlorine)</li> <li>➤ Easy access to alternate water sources (e.g., roadside springs)</li> </ul>
Standards and Regulation	<ul style="list-style-type: none"> <li>➤ Complexity and inconsistencies of existing guidelines</li> <li>➤ Non-compliance with changing legislation and policies</li> <li>➤ Risk adverse regulation defining ‘adequate’ treatment</li> <li>➤ Liability (at all levels)</li> <li>➤ Evidence (sources of knowledge)</li> <li>➤ Lack of/issues with monitoring and reporting</li> <li>➤ Implementation and enforcement</li> </ul>

Sources: (Breen & Minnes, 2013; Breen, 2013; Minnes & Vodden, 2014; Return on Insight, 2012, 2013; Vodden et al., 2015)- Adopted from Breen (2016 p. 19).

### **3.0: Potential Solutions to Challenges of Water Systems**

This section provides brief descriptions of alternative solutions to challenges facing drinking water systems in literature. Several alternatives were discovered during the review process, but more prominent amongst them are the incremental improvement of current management models, contracting or amalgamation/joint ventures and regional approaches (Breen, 2016; Breen and Minnes, 2015; Vodden et al., 2015; Vodden and Minnes, 2014; CISL, 2012; Hrudey, 2011). Though mentioned in some articles, maintaining the status quo has never been seen as a viable option to resolve water management challenges. Regional approaches (see section 3.4) have been highlighted because of the failure of current water management models and to lay some foundation for further research on its feasibility especially in rural settings.

#### ***3.1: Incremental Improvement of Current Water Management***

One of the potential solutions recommended in the literature in order to ensure the sustainable supply of clean and safe public water supply systems is the revitalization of the current management system (Hanrahan, Dosu and Minnes, 2016). Many researchers have suggested incremental improvements in policy and planning, increased financial and technical support for water infrastructure, as well as enhance governance structures (Hanrahan, Dosu and Minnes, 2016; Breen and Markey, 2015). For instance, in NL, aside from the Multi-Barrier Strategic Action Plan (MBSAP), suggestions have also been made to provide a water management plan for every component of the water supply system in an integrative manner; formation of multilevel water management committees as well as increase financial and technical support for rural communities especially for LSDs with limited resources (Hanrahan, Dosu and Minnes, 2016). Some of these recommendations resulted in the introduction of the Public water Dispensing Unit (PWDU), a mobile water systems which supply safe and clean drinking water from a central location in communities (<500 population) facing water quality and accessibility challenges in NL (Picco, Chaulk, 2010; Dawe, 2010; Miller et al., 2009;).

#### ***3.2: Contracting, Amalgamation or Formation of Joint Ventures***

Another suggestion cited in the literature by some researchers in managing water systems challenges is to adopt a water management model similar to privatization or commercialization of drinking water systems. The literature reviewed mentioned examples where municipalities/communities contract or lease out water management to third parties in the form of

independent companies or entities formed by the amalgamation of various councils or municipalities (WSL, 2017; CISL, 2012). These entities provide, maintain and operate municipal water assets to supply water services to their designated populace (WSL, 2017; CISL, 2012). In the first scenario, an independent company takes over the ownership and management of water assets and water supply services of all stakeholder-municipalities or communities to supply water to their residents on commercial bases in a bid to make profit. For instance, a private water company, Capacity Infrastructure Services Limited (CISL) was contracted by four municipalities (Hutt City Council, Porirua City Council, Upper Hutt City Council, Wellington City Council) to take ownership and management their water assets and operations to provide water and wastewater services to the councils (Wellington Community Services, 2017; CISL, 2012). Watercare Services Limited (whole owned and controlled by the Auckland Council) also signed an agreement with the Auckland regional council (an amalgamation of the previously Rodney, North Shore, Waitakere, Auckland, Manukau, Papakura and Franklin Councils) to manage and provide water and wastewater services to the people within the region (WCS, 2017; CISL, 2012).

Watercare Services Limited;

*Develops and executes its own Assets Management Plan, which outlines proposed activities in respect of the maintenance and repair of existing assets; the renewal of existing assets; the upgrading or extension of the performance or capacity of existing assets; the acquisition and construction of new assets (CISL, 2012 p. 55)*

However, these kinds of water management models have been cited to face several challenges such as disputes on transfer of assets ownership, deployment, sharing of dividends, as well as residents' perceptions that privatizing drinking water could compromise the quality of service delivery (CISL, 2012).

### ***3.3: Regional Approaches to Drinking Water Management***

#### ***3.3.1: Introduction***

The section comprises a summary of literature including discussions, analytical deductions and examples on regional approaches to drinking water management in Canada, focusing on Newfoundland. This includes reasons or motivations that support the call for regional approaches in drinking water management, potential benefits in adopting regional approaches, as well as anticipated challenges and corresponding recommended solutions to the barriers against the success of a regional approach in managing rural water systems in Canada. A regional approach

could include communities within a defined geographical location or with common challenges/needs working together to share aspects of water supply services including water infrastructure, source water protection, capacity building, water quality monitoring, policy, and planning, among others (Breen et al., 2015; Hrudey, 2011).<sup>1</sup>

Hrudey (2011) suggests that future water-quality failures are most likely in smaller systems with an inability to operate water systems effectively, pointing to inadequate capacities. Hrudey (2011) further suggests that in some parts of England and Australia large and regional water authorities now provide small communities' drinking water and that, where applicable, provincial drinking water policies should encourage the consolidation of smaller systems into larger more viable operations to provide water to neighboring communities. The gap between the dominant single community or system approach and the highlighted need for regional-scale action raises the question of if, and how, a regional approach could be applied to more effectively in sustainably managing drinking water in rural Canada (Breen et al. 2015).

### ***3.3.2: Reasons for a Regional Approach in Drinking Water Management***

Presently, regional approaches to resource management have become an integral component of the emerging “New regionalism” across the world (Ortiz-Guerrero, 2013). The emergence and success of regional governments and regional approaches to regional and rural development in both developed and developing countries is a motivation to consider the concept in managing water systems in rural Canada. A considerable literature reviewed indicates that current drinking water management models exacerbate existing water systems’ challenges that confront the sector, thereby compromising regional development and resilience, hence the need to explore an alternative - a regional approach (Bereskie, Rodriguez & Sadiq, 2017; Breen, 2015; Kreutzwiser & de Loë, 2002;). There are enough reasons to support the call for the adoption of regional approaches in managing public water supplies as a potential solution to water management crisis in rural Canada. Primarily, the existence of water sources (e.g., rivers, lakes, stream, watersheds, aquifers) across communities, regional and sometimes national borders requires broader collaboration and participation among stakeholders to successfully deliver safe and clean drinking water to the public (Vodden and Minnes, 2014; Breen and Minnes, 2015). For example, the existence of the Bras d’Or Lakes and watershed lands traversing many towns and communities including First Nation communities in Cape Breton Islands of Nova Scotia, necessitated the proclamation of the Bras d’Or Charter which committed all stakeholders to the Collaborative Environmental Planning Initiative (CEPI) in 2003 (Bras d’Or Lakes CEPI, 2011). This initiative

came with a formal management structure to work to ensure the “protection, maintenance, and enhancement of the Bras d’Or Lakes watershed” (Bras d’Or Lakes CEPI, 2011 p. 6). These and other examples of regional approaches to source water management and protection (See Table 3).

The complexity of water management challenges that affect all components of water systems coupled with the intertwined nature of these components presents a potential for a regional approach to these challenges to ensure safe and clean public water supply. Moreover, combining capacities especially in rural settings could offer a better option to address some of the challenges related to human resource inadequacies in managing drinking water systems (Vodden and Minnes, 2014; Breen and Minnes, 2015).

Another point worth noting has been the predicted effects of recent population decline to the human resource capacities and financial strengths (decline in tax base) of rural communities especially in NL, against the high cost involved in providing and maintaining water systems if communities are left alone. A regional approach could offer an opportunity for communities to pull limited resources together to share water supply services which would hitherto be difficult for single communities to afford. Other favorable conditions for the adoption of regional approaches in water management include apparent benefits from collaboration; communities quest for development, spirit of volunteerism and leadership among residents and the clear indication of provincial assistance in terms of policy and financial capacities (Vodden and Minnes, 2014; Breen and Minnes, 2015; Vodden 2005a). These benefits are explored further in the section that follows.

### ***3.3.3.: Benefits of Regional Approaches in Water Management***

Considering the myriad of rural drinking water challenges discussed in previous sections and the need for a regional approach in managing rural water supply, available literature has issued enormous benefits or profits (see Table 2) to be derived for its adoption. This is more appropriate in drinking water management especially in rural settings overwhelmed with problems such as declining population, governance issues, inadequate human and financial capacities and lack of economies of scale (Breen, 2016; Ivey et al., 2006; Furlong & Bakker, 2011). Adopting a regional approach to water management presents a potential to enhance rural resilience and would contribute to achieving regional development at large. Potential benefits of adopting a regional approach in water management includes reduction in financial expenditure (to each community) on water infrastructure, new/improved infrastructure, critical mass of resources and water management best practices contributing towards improving water quality supply; improved public health (Breen, 2016; Breen and Minnes, 2015; Vodden and Minnes, 2014).

A regional approach could involve collaborations, partnerships, associations, alliances, and cooperation among several communities in one or more components of drinking water systems would potentially reduce the financial burden of single communities in providing water infrastructure, watershed management, and financial resources to keep technical staff as individual communities. Collaboration among several communities will strengthen their bidding power, provide a stronger advocacy voice and influence in the decision making machinery of senior levels of government for developmental projects; the 90% provincial funding for water infrastructure and the Federal Assets management program (Adeel, 2017).

Moreover, regional-scale efforts that are well planned and practiced could improve the water infrastructure condition in the area as limited rural financial resources pulled together will be in a better position to provide new and/or replace aging infrastructure. Several examples exist in NL where some communities share drinking water with other neighboring communities who otherwise could not afford if left alone. For instance, Flower's Cove provides water to Anchor Point and Deadman's Cove; and Grand Falls Windsor Public water supply; Regional Water Operators program; among others (Vodden and Minnes, 2014).

Institutionalizing regional approach in water management could also foster improved training and retention of qualified and certified technical personnel especially water operators, planner, engineers with proper secession plans within the region. Aside from the cost-benefit of keeping a single water operator in charge of several communities' water supply systems, the ability to support the training and certification of such personnel with appropriate remuneration appears promising and suitable in regional approaches. For example, Vodden and Minnes (2014) mention Mr. Wanye Bennette who manages water supply systems in four communities in central NL and the training of water systems operators in the peer-to-peer training program in the Kootenay region in BC (Vodden and Minnes, 2014; Breen, 2015).

As stated in previous sections, regional approaches offer an appropriate strategy for managing drinking water systems as it presents potential solutions to current water systems challenges that occur within the present management system.

The available literature provides evidence of the success of regional approaches in resolving water management challenges some of which are illustrated in table 2 (Breen and Minnes, 2015).

Table 2: Benefits or Profits of Regional Approaches in Water management.

Area	Benefits
Capacity (includes: financial, human, social, political, institutional, technical, etc.)	<ul style="list-style-type: none"> <li>➤ Gain economies of scale via sharing of resources</li> <li>➤ Increase knowledge flow</li> <li>➤ Enhance technical capacity for those making decisions through: knowledge exchanges, promoting water networks and formal/informal sharing and learning opportunities</li> <li>➤ Cooperative, regional-scale education for the general public to increase the understanding of potential benefits of good water governance</li> </ul>
Governance, planning and management	<ul style="list-style-type: none"> <li>➤ Region-wide planning will enhance consensus and support hence, implementation of water management plans and policies</li> <li>➤ Regional data sharing programs and strategic regional approach to help create better drinking water plans</li> <li>➤ Regional protection of source water to enhance drinking water quality</li> <li>➤ New institutional structures that support regional planning as existing structures are inappropriate</li> <li>➤ New governance structures formed in water and watershed management that are multi-level and multi-sector, top-down and bottom-up and that deal with the disconnect between power and responsibility, as well as overlapping and multiple jurisdictions</li> <li>➤ Acknowledge that structures such as source water protection committees take time to develop and have transaction costs, but can result in increased resilience, capacity and trust</li> <li>➤ Facilitating collaborative governance arrangements involving rural and urban communities in order to counter perceptions of command and control from urban centres and recognize that i) urban centres require rural resources – including water supplies and ii) rural areas need appropriate policy.</li> </ul>
Place	<ul style="list-style-type: none"> <li>➤ Recognize uniqueness of watersheds - consideration of place and the biophysical, social, cultural and economic factors is critical for sustainable planning</li> <li>➤ Collaborative regional governance structure to facilitate recognition of place and help address local situations</li> </ul>
Standards and regulations	<ul style="list-style-type: none"> <li>➤ Regional innovation and learning - improve innovation to address issues of compliance, demands, conservation, etc.</li> <li>➤ Present a united front to the province (e.g., requests for changes to regulations, for local involvement in provincial decision making)</li> </ul>
Asset management	<ul style="list-style-type: none"> <li>➤ Regional maintenance programs (sharing of human resources that have the certification to undergo sophisticated asset management activities)</li> <li>➤ Regional sharing of asset management technology (e.g., leak detection equipment) to encourage efforts and make such activities more accessible</li> </ul>
Sustainability or resilience	<ul style="list-style-type: none"> <li>➤ The infrastructure deficit, including aging and degrading water systems is noted as an impediment to sustainability, but also as an opportunity to tackle problems</li> </ul>

	<p>regionally (e.g. conservation/demand side management, appropriate level of service, climate adaptation and mitigation strategies)</p> <ul style="list-style-type: none"> <li>➤ Community cooperation is seen a component of local government sustainability</li> <li>➤ Regional innovation and learning - need for innovation to address issues of compliance, demands, conservation, etc.</li> </ul>
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Source: Adopted from Breen (2016 p. 40)

**3.3.4: Potential Challenges of a Regional Approach**

This part of the review outlines some of the envisaged challenges or problems likely to hinder the adoption and execution of a regional approach to drinking water management in rural Canada. To adopt a regional approach in managing water systems whether large-scale or among few communities will require some blueprints such as the identification of common interest or need, placed-based, human and financial capacities and commitment to the collaborative agenda. Therefore, when some of these conditions are not fulfilled, adopting a regional approach to water management would be difficult. Though the emergence of regional approach (and regional governance at large) can be traced back to mid 20<sup>th</sup> century, its adoption has been confronted by several challenges related to the aforementioned conditions as well as existing governance structures, policy and planning, population and historical antecedents (Bakker, 2011; Breen and Minnes, 2015; Breen, 2016; Peterson et al, 2010).

There were also reported issues of unwillingness and lukewarm attitude of some communities to collaborate as they want to main their independence as a municipality or community whilst feel subordinated by larger and powerful communities or municipalities. Scott (2008a, 3) mentions in Peterson et al (2010), the “difficulties of policy integration across these various scales due to ‘compartmentalised policy delivery, the exclusion of many relevant stakeholders and jurisdictional fragmentation” (Peterson et al, 2010 p. 298). Bakker (2011) in a conference paper also argues that for communities to collaborate in managing water, stakeholders need to define common benefits, maintain a stable funding and exhibit a sense of shared commitment to support the process (Bakker, 2011).

**3.3.5: Examples of Regional Initiatives in Water Management**

This literature review has revealed a few successful regional-scale development initiatives in NL and Canada in general. Regional collaborative initiatives could involve major service sectors such as Local Economic Development (LED), drinking water systems management, fire services, waste management or a single component within a major sector (Vodden and Minnes, 2014; Hanrahan, Dosu and Minnes, 201; Breen, 2016; Breen and Minnes, 2015). A few communities

collaborate or share water distribution infrastructure or water systems operator (e.g., St. Paul's, Cow Head, Parson's Pond and Daniels Harbour water systems managed by one systems operator) to sub-regional and regional level watershed management (Vodden and Minnes, 2015; Breen, 2015). A few other successful examples of regional approaches to water management have been compiled from various literature in NL, and other parts of Canada.

*Table 3: Examples of Regional Initiatives*

Major Theme	Newfoundland/Canada
Governance	<p><b>Indian Bay Ecosystem Corporation</b> – a non-profit community organization with the goal of protecting the Indian Bay watershed through research, community engagement, and sound stewardship. Serves the towns of Indian Bay and Centreville-Wareham-Trinity and is utilized by several other communities: <a href="http://indianbayecosystem.com">http://indianbayecosystem.com</a></p> <p><b>Regional District Governance Structure</b> – this regional governance system provides governance and services to unincorporated areas, as well as serving as a platform for regional collaboration. Regional districts are able to operate multiple water systems throughout their territory, allowing for collaboration and shared resources. For example the Regional District of Central Kootenay operates 19 systems: <a href="http://www.rdck.ca/EN/main/services/water/rdck-water-systems.html">http://www.rdck.ca/EN/main/services/water/rdck-water-systems.html</a></p>
Capacity Building	<p><b>Bonavista North Joint Council</b> – council includes representation from Centreville-Wareham-Trinity, Greenspond, Indian Bay, Lumsden, Musgrave Harbour, and New-Wes Valley. Which helped facilitate the regional operator program: <a href="http://www.env.gov.nl.ca/env/waterres/training/adww/2014/11_Churence_Rogers.pdf">http://www.env.gov.nl.ca/env/waterres/training/adww/2014/11_Churence_Rogers.pdf</a></p>
Source Water protection	<p><b>Gander River Ecosystem Corporation</b>- Originally called the Gander River Management Association, this community organization formed to protect and manage the Gander River and includes stakeholders from the smaller towns of Appleton, Gander Bay and Glenwood as well as the more urban municipality and regional centre of Gander. In 2008 the Gander River Management Association disbanded, however has recently reformed as the Gander River Ecosystem Corporation. <a href="http://cdnregdev.ruralresilience.ca/wpcontent/uploads/2014/11/VignetteWatershedGovernanceGanderNov2014.pdf">http://cdnregdev.ruralresilience.ca/wpcontent/uploads/2014/11/VignetteWatershedGovernanceGanderNov2014.pdf</a> <a href="https://www.facebook.com/pages/Gander-River-Ecosystem-Corporation/315257245323037?sk=info&amp;tab=overview">https://www.facebook.com/pages/Gander-River-Ecosystem-Corporation/315257245323037?sk=info&amp;tab=overview</a></p> <p><b>The Okanagan Basin Water Board</b> – It was initiated in 1968, and mandated with the tasks of identifying and resolving critical water issues within the Okanagan watershed. The Board of Directors includes representatives from the three Okanagan regional districts, the Okanagan Nation Alliance, the Water Supply Association of BC and the Okanagan Water Stewardship Council – a multi-stakeholder group established by the Board to provide</p>

	<p><i>independent science-based advice on water issues. <a href="http://www.rdos.bc.ca/regional-government/other-boards-and-programs/okanagan-basin-water-board/">http://www.rdos.bc.ca/regional-government/other-boards-and-programs/okanagan-basin-water-board/</a></i></p> <p><b>Kootenay Lakes Partnership</b> – <i>formed to address development pressure on Kootenay Lake, impacting a number of stakeholders, both rural and urban. The diverse partnership includes the City of Nelson, the surrounding Regional District of Central Kootenay, First Nations, the Province of British Columbia, CBT, and others. Their mandate is to develop integrated and collaborative approaches to lake management planning, with consideration to the multiple uses and values associated with the lake. <a href="http://www.kootenaylakepartnership.com/">http://www.kootenaylakepartnership.com/</a></i></p> <p><b>Bras d’Or Lakes Collaborative Environmental Planning Initiative (CEPI)</b>  <i>The Bras d’Or Lakes Collaborative Environmental Planning Initiative (CEPI) was initiated in 2003 by a group made up of representatives from federal and provincial government, First Nations groups, community groups, academics, and residents. Two years later, the Bras d’Or charter was signed by these stakeholders. Unlike many provinces, Nova Scotia does not have an overarching ‘blueprint’ for collaborative watershed governance; CEPI therefore operates according to the rules and principles it has set out for itself, rather than according to provincial mandates. CEPI is unique in that it incorporates expertise from both Western Science and First Nations knowledge, an approach referred to as “two-eyed seeing”. The ‘two-eyed seeing’ approach is reflected in the seven core principles outlined in CEPI’s Spirit of the Lakes document. <a href="https://brasdorcepi.ca/cepi-homepage/bras-dor-charter/">https://brasdorcepi.ca/cepi-homepage/bras-dor-charter/</a></i></p>
Water Infrastructure	<p><b>Exploits Regional Water Supply Committee (formerly Exploits Regional Services Board).</b>  <i>A committee established to oversee among other tasks (landfill operations), the treatment and supply of water sourced from Peter’s river in the Grand-Falls Windsor region. Participating communities include the towns of Grand-Falls Windsor, Bishops Falls, Botwoods and Peterview. It has an unincorporated committee made of two community reps from each participating community whose activities and remunerations are supervised and borne by the Town of Grand-Falls Windsor. Member communities pay monthly bill for water services provided to them by the board to cater for operation cost.</i>  <a href="http://www.mae.gov.nl.ca/waterres/training/adww/smalltown/08_town_of_grand_falls_windsor_march_12_2008.pdf">http://www.mae.gov.nl.ca/waterres/training/adww/smalltown/08_town_of_grand_falls_windsor_march_12_2008.pdf</a>. <a href="http://www.gfwadvertiser.ca/news/local/2016/2/26/new-name-same-responsibilities-chairma-4448944.html">http://www.gfwadvertiser.ca/news/local/2016/2/26/new-name-same-responsibilities-chairma-4448944.html</a></p> <p><b>Greater Vancouver Regional District, British Columbia and Point Roberts Water District, Washington.</b>  <i>Sharing water services could take international scale eased by relationship, proximity and/or economic advantage of supplying portable water across borders. In the mid 1980s, the</i></p>

*Greater Vancouver Regional District, British Columbia signed an agreement with Point Roberts Water District, Washington to supply a capped 3,182.2 cubic metres per day from the Seymour Lake (Forest, 2010a). The population of Point Roberts had increased due to summer holiday-makers coupled with scarce surface water and reduced well outputs which threatened development at the time (Forest, 2010b). Left with no alternative after water was trucked from Blaine at a very high cost over a distance of 40 kilometers, British Columbia finally signed an official contract to supply limited quantity of water (3,182.2 m<sup>3</sup>/day- below the State of Washington standards) to Point Roberts through a 1.3 kms pipeline and a 22,730 m<sup>3</sup> reservoir as provided in the Agreement (1987). This was solely funded by the beneficiary district- Point Roberts whilst GVWD takes ownership. The contractual agreement on water utility charges did not favor Point Roberts as the district pays a fixed amount even for less water used during the winter months.*

***Stanstead, Quebec and Derby Line, Vermont***

*Forest (2010) presents another inter-local water transfers among Stanstead and Rock Island communities in Quebec and Derby Line community in Vermont, USA. The regional collaboration that exist between the communities' dates back to 1906 in drinking water and wastewater management as well as transboundary library. Initially established by local businessmen based in Vermont, the International Water Company (IWC) administered and distributed water treated from Holland Pond on the US side to the three (3) communities minimal municipal control (Forest, 2010a). With increases in population and water demand, the various municipalities later provided, owned and managed new treatment plants and conduits in their respective communities (Stanstead and Derby Line) through a water systems agreement signed in 1996 whilst IWC still owns and manages the old water infrastructure (Forest, 2006).*

Sources: Adopted (Breen, 2016 p. 35: Baker, 2011 p. 5).

## 4.0: Conclusion

This literature review discussed current challenges that threaten the supply of clean and safe drinking water to communities in rural Canada but occasionally citing examples from rural NL. Using a thematic analytical method, the review identified potential solutions to water systems challenges. The discussions were then focused on regional approaches to drinking water management as a potential solution to water management challenges in rural Canada. The manner in which drinking water systems are managed will have some influence on future development considering its pivotal position in infrastructural planning (Connelly, Markey, & Roseland, 2009; Kennedy, Roseland, Markey, & Connelly, 2008; Breen, 2016). The nature of recent challenges facing the management of water systems couples with the failure of current management models, regional approaches appear to be a better prospective alternative for provincial and municipal investments. There is, however, the need for proponents of regional approaches to look beyond current water management challenges to include historical antecedents and linkages with other forms of development to forestall future disparities (Breen & Markey, 2015).

Recommendations are also hereby made for further research to investigate the feasible procedures and actors required to execute a regional approach in drinking water management as well as enact definite policies and regulations on source water protection (groundwater and surface water). A coordinated and collaborative exertion involving the full participation and engagement of stakeholder-municipalities or communities could turn this vision into strategies, actions, and outcomes in public water supply systems in rural Canada and NL.

**Indemnity:** *The author of this review has made every practicable effort to trace the origin of text and visuals used to duly acknowledge their producers. In case of any errors and omissions, please contact the office of Rural Resilience at Grenfell Campus, MUN. NL.*

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