Operating a public drinking water system with industrial high water user demand:

Exploring the drinking water system in Old Perlican, NL

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A community case-study report for the *Exploring Solutions for Sustainable Rural Drinking Water* Systems Project

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List of acronyms

BWA	Boil water advisory/boil order
CFIA	Canadian Food Inspection Agency
DBP	Disinfectant by-product
DOEC	Department of Environment and Conservation
DOHCS	Department of Health and Community Services
DWQI	Drinking Water Quality Index
GS	Service NL/Government Services
HAA	Haloacetic acids
ICSP	Integrated Community Sustainability Plan
LI	Langelier Index
MBSAP	Multi- Barrier Strategic Action Plan
MIGA	Municipal and Intergovernmental Affairs
MNL	Municipalities Newfoundland and Labrador
MUN	Memorial University of Newfoundland
NL	Newfoundland and Labrador
OETC	Operator Education, Training, and Certification
PMA	Professional Municipal Administrators of NL
PSAB	Public Sector Accounting Board
TCA	Tangible Capital Assets
THM	Trihalomethanes

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Introduction

Project overview

In rural Newfoundland and Labrador (NL), watersheds provide drinking water supplies, while also supporting other resources and activities that form our culture, identity, and economy. Healthy drinking water supplies are dependent on healthy watersheds as well as on supporting water policies, practices, and infrastructure. The *Exploring Solutions for Sustainable Rural Drinking Water Systems* study, led by Dr. Kelly Vodden, aims to identify the types of risks and challenges influencing drinking water quality and availability in rural areas, with a particular emphasis on communities of 1,000 residents or less in NL. Factors for success and possible solutions are also being examined. This project is in partnership with Memorial University of Newfoundland (MUN), Municipalities Newfoundland and Labrador (MNL) and the Professional Municipal Administrators of NL (PMA).

This interdisciplinary research addresses knowledge gaps related to drinking water systems in NL by providing a current and comprehensive picture of drinking water issues in small communities from a multitude of angles. This has been accomplished by drawing from current and past research and existing sources at federal, provincial and municipal levels, as well as research from other jurisdictions. Dialogue with stakeholders has also been a key method for understanding the issues and solutions for drinking water systems in rural NL.

One component of the project is the completion of case studies; at least one for each of the six MNL regions[1]. The objective of this case study research is to profile key issues, challenges and solutions related to public drinking water systems in rural NL. The method of inquiry consists of semi-structured key informant interviews using an interview guide and the review of key documents. In February 2014, the five key informant interviews were conducted in the Town of Old Perlican. Participants included: two municipal staff representatives, one resident, one business owner, and one local representative. Four of the five interview participants agreed to be audio-recorded. The methodology is further described in Appendix A and the interview guide is located in Appendix B.

This report is an investigation into the water system in the Town of Old Perlican, including: the source water, infrastructure, governance and public perception this system. Old Perlican is the case study area for the Avalon Peninsula Region of Newfoundland, as defined by MNL.

[1] To see all MNL regional boundaries please visit the project website: http://nlwater.ruralresilience.ca/?page_id=17

Community description

The Town of Old Perlican is located near the tip of the Bay de Verde Peninsula, connected to Avalon Peninsula, approximately 60 km north of Carbonear (Old Perlican, 2014a). The 2011 population of 661 people, and combined with their active participation in the fishery and several other services located within the town, Old Perlican acts as a service centre for the smaller communities at the head of Trinity and Conception Bays (Ibid.). The presence of migratory European fishing in Old Perlican dates back to the 1500s, and in 1729 a Justice of the Peace was appointed in the community, however, the municipality was only incorporated in 1971 (Ibid).

Local crab and shrimp processing facilities employ close to 500 workers at peak production, along with harvesting of ground fish such as lump, mackerel and capelin, because of which Old Perlican was somewhat insulated from the economic effects of the Northern Cod moratorium in 1992 (Old Perlican, 2014a). The town also acts as a smaller regional service centre based on amenities such as: the Dr. A. A. Wilkinson Memorial Health Centre, which offers acute care with a modern laboratory and x-ray facilities, Baccalieu Collegiate High School and the volunteer fire department that serves Old Perlican and several other communities in the area (Ibid). Old Perlican also has a vibrant business community as well as an active local heritage committee promoting the community's historical connection with the fishery, which serves in drawing tourism in the area.

Currently 90 percent of the residents in Old Perlican have access to the municipally supplied water (Old Perican, 2014b). The remaining residents have their own private wells.

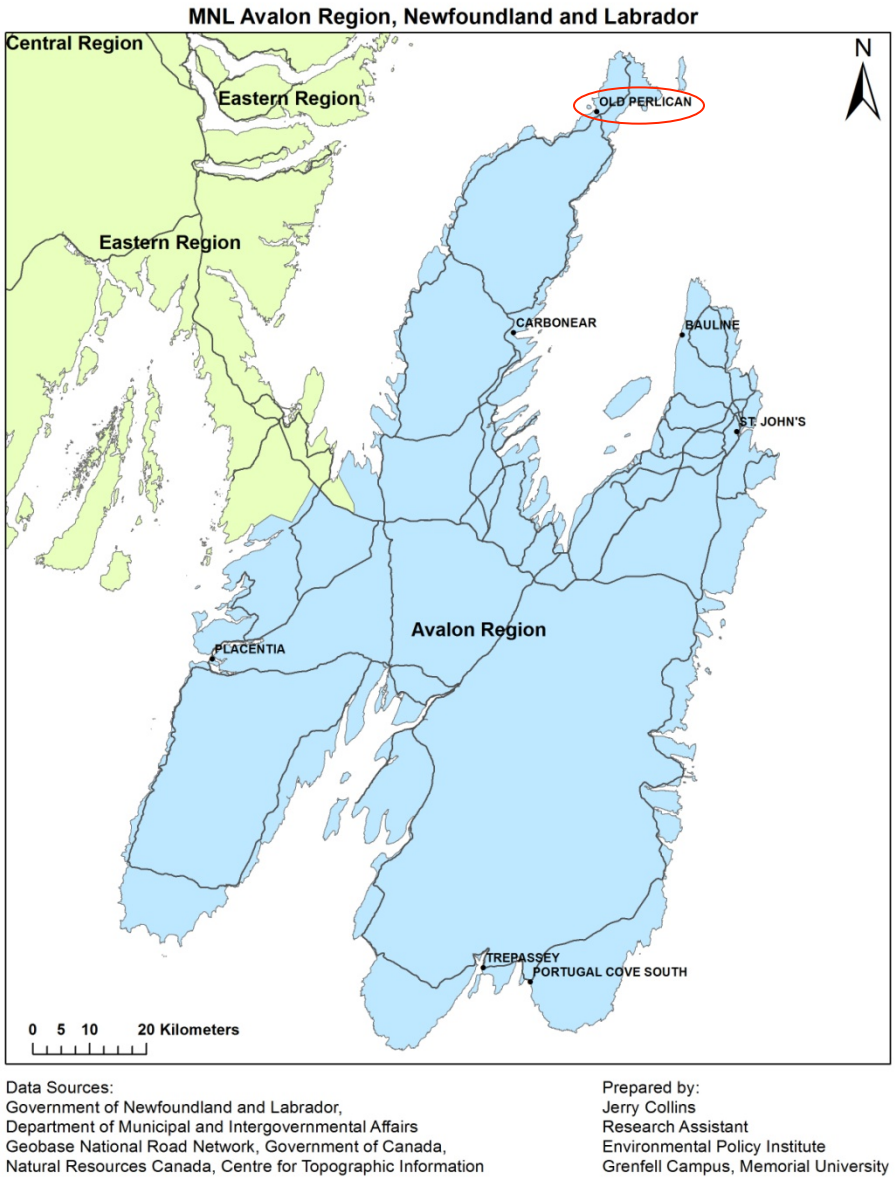

Figure1. MNL Avalon Region, Newfoundland and Labrador and location of Old Perlican

Community water system

Source water supply

Old Perlican has two surface water supplies: Bell Pond, which is used for resident consumption and Cooks Cove Pond, which is used primarily for commercial water use, but is available as a backup water supply for residential use if required (Old Perlican, 2014c). Bell Pond was developed as the municipal water source in the early 1970s, when Old Perlican was incorporated and Cooks Cove Pond was developed 11 years ago to accommodate industrial high water users, namely one of fish processors located in the community.

Infrastructure

Despite having two different water sources, the municipal drinking water system in Old Perlican functions as an integrated whole. The system is for the most part gravity fed, with the exception of a booster pump at Long's Hill to supply residents of that particular area (Old Perlican, 2014b). Bell Pond has been the main residential water supply for over 40 years and much of the in-ground infrastructure, particularly the service lines, is the same age and in poor condition. A new water treatment plant and main line was installed 11 years ago, but other than replacement lines the rest of system is outdated. Currently, approximately 95% of households are connected to the municipal drinking water, with the remainder of residents on private wells.

Local governance

Old Perlican is governed by the Town Council, which consists of seven elected volunteers: a Mayor, Deputy Mayor and five councillors. Council meetings are scheduled on a bi-monthly basis.

The current standing committees of Council are:

- Ambulance
- Recreation
- Finance
- Crown Lands
- Special Events
- Public Works
- Emergency Planning
- Town Beautification

In addition to these committees, the town also has representatives working with the Fire Department and Heritage Committee. Committee meetings are called at the notification of each committee chair or mayor (Old Perlican 2014c). The Public Works Committee, which assists in oversight of the drinking water system, meets every second Monday. (Ibid.).

The town has three employees who collectively manage water operations: the foreman and the water/heavy equipment operator, who are full time staff and one part time general maintenance worker.

Finally, Council have two main planning documents: *The Old Perlican Municipal Plan 2009*, which was developed by a certified Municipal Planner under the *Urban and Rural Planning Act* and an Integrated Community Sustainability Plan (ICSP). The *Municipal Plan* addresses future strategic planning related to marking boundaries for the protected water source, however, as stated in the plan "land use designations set out on the Future Land Use maps are general only and, except in the case of roads or other physical barriers, are not intended to define exact limits (Old Perlican, 2009: 8)". Thus, there is a degree of flexibility with respect to the future boundaries of the protected source water area. One goal stated in the ICSP is the improvement of the municipal water system through overall improvements to the soda ash system and infrastructure more generally (Old Perlican, n.d.), Council is notably concerned about the levels of disinfectant by-products in the water. Subsequent local water governance in Old Perlican will be discussed further in the proceeding section.

Figure 2. Town of Old Perlican

Research findings

The following four sections outline issues in Old Perlican related to:

- Source water quality and quantity
- Infrastructure and operations
- Policy and governance
- Public perception, awareness and demand

Source water quality and quantity

Interviewee responses on source water quality ranged, particularly the municipally supplied water delivered to the tap, although there is some consensus that chlorination has a negative effect on the taste and smell. Those working for the town and in business indicate that the water quality is very good, which is also confirmed in the Drinking Water Quality Index (DWQI) rating through the Water Resources Portal. The surface water sources are described as having good quality water, but as they are surface water sources they are affected by seasonal weather changes, such as increased rain and run-off as well as ice on the pond which causes the water to "turn over" drawing sediment and mud from the bottom of the ponds. These seasonal fluctuations cause increased discolouration in the water, which in turn make it less aesthetically appealing to drink.

Overall, in recent years, interviewees have described water quantity as being good. Bell Pond is fed by a series of smaller ponds and is described as being an ample source in meeting residential demands. However, water volume has been an ongoing issue over the past decade between the municipality and high water industry users (i.e. fish plants). The main impetus behind developing Cooks Cove Pond as a source water supply was to use this pond for industrial high water users. Prior to Cooks Cove coming on line, interviewees stated the combination of in ground infrastructure and decline in source water levels, the municipality was unable to keep up with the total user demands. When Cooks Cove Pond was developed the town also installed a new water plant and larger main line to keep up with water demands. Currently, both residents and the industrial high water users draw from Bell Pond, but in times of peak demand- such as when the fishery opens, the fish plants start drawing from Cooks Cove Pond. As will be discussed further, accommodating the volume demands of the town's industrial high water users requires continued communication between the both the town and the fish plants (Quinlan's and Quin'Sea.).

Key informant perspectives

Actually the quality of drinking water in Old Perlican is very good. As for domestic use I don't hear of many challenges, at least where we are with the small domestic use we use. As for quantity we use extreme amounts of water. We are a shellfish producer, shrimp processing uses a significant amount of water. Well I guess shrimp alone uses 100 gallons a minute. We peak out at maybe 1800-1900 gallons a minute when processing both shrimp and crab or shrimp and one other species. - Business operator

Key informant perspectives

Like I said, if you get a lot of rain or a lot of snow and you get a lot of runoff, the rain will change the color of the water, something like that. That's even the same with the well water. If you get a heap of rain that changes the color of the water. The water runs on the ground. But after a few days that all settles down again. – Resident

There is room for improvement. Some of the improvement we cannot do because of the minerals in the water. Magnesium, we cannot do anything with that. Generally, it is good. Appearance, the aesthetics, we cannot do anything about that. As of now the water is a little brown due to runoff in the pond. We cannot do anything with that. – Water operator

Boil water advisory (BWA)

A boil water advisory (BWA) is issued when water samples are found to have higher than accepted amounts of e-coli or total coliforms (bacteria) detected or when there are deficiencies in disinfection or the distribution infrastructure in general (DOEC, 2013). BWAs can be issued by the municipality or provincial drinking water officials, however, only the provincial government may lift the BWA. Two consecutive clean samples taken by Environmental Health Officers, or the Environmental Technician- both of whom work under Service NL (GS) - must occur at least a week apart before the BWA is lifted.

There has been one recorded BWA, dated 6 March 2010 on the DWQI summary for Old Perlican on the Water Resource Portal (DOEC, 2014). The reason stated for this is explained as "inadequately treated water was introduced into the system due to fireflows, flushing operations, minor power outage or other pressure loss (Ibid.)".

Key informant perspectives

Well I've had one boil order since I've been here [six years]*, and we've put ourselves on that. And the one we did have was because we were changing the equipment so there wouldn't be any chlorine going into the water, so we put ourselves on a boil order. – Water operator*

Drinking Water Quality Index (DWQI)

Old Perlican was ranked as "very good" in September 2012 and September 2013, with a notation under each of those dates stating that perceived water quality may be lower because that the aesthetics parameters pH and manganese (2012 only) were exceeded. However, on all other test dates prior to September 2012- as well as the January 2013 test- the water has not been assigned a DWQI rating from the DOEC because of the high levels of HAAs measured in their water supply (DOEC, 2014).

Physical parameters and major ions

The DOEC Water Resource Portal provides results for physical parameters and major ions in source water and tap water, based on the listed maximum acceptable concentrations in the *Guidelines for Canadian Drinking Water Quality* (DOEC, 2013; Table 1.).

Table 1. List of physical parameters and ions tested in drinking water by DOEC

Physical parameters	*Ions*
- Alkalinity	- Boron
- Colour	- Bromide
- Conductivity	- Calcium
- Hardness	- Chloride
- pH	- Fluoride
- TDS	- Potassium
- TSS	- Sodium
- Turbidity	- Sulfate

Nine sample dates are displayed for both source water and tap water. Source water results indicate that pH[2] was exceeded on every test date and colour exceeded for the last five test dates, with the last test date on 10 September 2013. Tap water tests show pH is out of the acceptable range for all test dates, and colour is exceeded on four dates, with the last date also 10 September 2013 (DOEC 2014).

Nutrients and metals

Similarly to physical parameters and ions, DOEC display results for nutrients and metals in source and tap water through the Water Resource Portal (DOEC, 2013; Table 2.) These results are also in accordance with the listed maximum acceptable concentrations in the *Guidelines for Canadian Drinking Water Quality*.

Table 2. List of nutrients and metals tested in drinking water by DOEC

Nutrients	*Metals*
- Ammonia	- Zinc
- Dissolved Organic Carbon	- Aluminum
- Nitrate(ite)	- Antimony
- Total phosphorous	- Arsenic
- Kjeldahl nitrogen	- Barium
	- Cadmium
	- Chromium
	- Copper
	- Iron
	- Lead
	- Magnesium
	- Manganese
	- Mercury
	- Nickel
	- Selenium
	- Uranium

[2] Tests indicate pH is too acidic, i.e. 6.5 and below on pH scale

Results for the above parameter were tested for both source water and tap water on eight separate sample dates (DOEC 2014). Results for the source water show no exceedances and the water was last tested on 10 September 2013. The tap water test indicates that Manganese exceeded the recommended guidelines on two dates, 25 September 2012 and 29 January 2013, with last test date on 10 September 2013 (DOEC 2014).

Chlorination disinfection by-products (DBPs)

The presence of DBPs, that is, the chemical by-product that forms when chlorine interacts with organic matter, has been an increasing concern across the province- with the double number of communities currently exceeding the acceptable levels compared to the year 2000 (White, 2012). The *Guidelines for Canadian Drinking Water Quality* set the maximum levels at 80 µg/L for HAAs and 100 µg/L for THMs (Health Canada, 2012). Reports published on the provincial DOEC Water Resources Portal indicate that Old Perlican has tested higher than Health Canada recommended levels for Haloacetic acids (HAA) compounds from fall 2008 to winter 2012 and fall 2012 to spring 2013 (DOEC 2014). DOEC reports indicate that Old Perlican has been in the acceptable for Trihalomethanes (THMs) over all test dates shown, with the last test date in summer 2013 (DOEC, 2014).

Key informant perspectives

Well these HAA's and THM's are the by- products. The cost of chlorine is almost the cost of doing business. If you want safe water then you have to pay for the chemicals. – Water operator

Langelier Index (LI)

The Langelier Index indicates the degree of saturation of calcium carbonate in water. A negative reading indicates that water will have a tendency to be corrosive in the distribution system; a positive reading means water will tend to deposit calcium carbonate in the distribution system; and a LI near zero means that the water will be neither corrosive nor calcium forming (DOEC, 2014b). The result from the DOEC testing indicate that the LI in Old Perlican ranges from -3.74 to -7.92, which suggests that this could be having a potentially effect on the waterlines.

Infrastructure and operations

Existing infrastructure

Drinking water infrastructure is made up of fixed capital assets for public use or and includes water treatment, storage, and distribution systems (Gov. of NL 2005; Government of Canada 2006). As stated above, Old Perlican's water system services a population of less than 1000 and thus is considered small by provincial standards (Gov. of NL, 2014a). The town operates from a surface water supply, which is the case in 63% of public water sources in NL (Ibid.).

The town water supply was developed in the early 1970s. There was a new water plant installed approximately 11 years ago, at which time a new main line serving the community

was also installed. The main line is composed of ductile iron, which ranges from six inch diameter and larger. The services lines are largely copper, and given their age (40 years+) a lot of the leaks occurring in the town system are the result of the copper flaring, weakening the ends of the pipes and causing them to fail. Prior the installation of the new plant and main line 11 years ago, the water system was stated by one interviewee as far too small to adequately service the needs of the town. The current system infrastructure is described as well suited to current water demands in Old Perlican in terms of pipe diameter. As stated previously, Cooks Cove Pond also came on line around the same period to serve as the main water source for the fish plant operations in town. The fish plants and residents (along with other non-high water users) draw from Bell Pond outside of the fishing season. The system is set up such that the fish plants can be switched on and off each source water pond.

The water is gravity fed into the main line and the only pumps in the system are: a booster pump at Longs Hill (Old Perlican, 2014b) and an injector pump to pump the chlorine into the water, which is located at the plant. Several forms of disinfection exist in NL, including chloramines, ozone, mixed oxidants, and ultraviolet (UV) light (DOEC, 2014c). Old Perlican uses chlorination–the most prevalent disinfection method in NL–in the form of chlorine gas (i.e. sodium hypochlorite). There is a back-up generator at the water plant to ensure that chlorine is pumped into the line in case of power outages. The water plant is equipped with a basic water screen, but this only filters out larger debris from the system. Additionally water drawn from Bell Pond is stored in a 66 000 gallon holding tank, prior to be treated with chlorine. Both water sources are treated with chlorine prior to entering the main drinking water supply, however the fish plants also have their own chlorination system and they must comply with the standards and protocols set by the Canadian Food Inspection Agency (CFIA) with respect to their treatment of water.

There are two full time employees: the town foreman and the water/heavy equipment operator, who are both certified as a level 1 operator through the DOEC's Operator Education, Training, and Certification (OETC). There is also one part time general maintenance worker, and collectively these three people look after the town water system. Having three employees responsible for water operations is described by interviewees as a huge asset because it ensures that the knowledge of the system is not limited to only one person. This makes it much easier for employees to schedule vacation time without comprising water operations, in addition to more long term planning considerations (e.g. retirement, staff turnover, etc.). Additionally, they have physical record of their data infrastructure in the form of as-builts and other maps, which provide record of the changes that have taken place over the history of the system.

The chlorine residuals are tested daily at three locations: the water plant, middle of the town, and end of the line. On average the water operator spends two hours a day checking chlorine residuals and regular maintenance, but this time varies depending on service line emergencies, specifically leak repairs, which occur frequently (~25-30/year). Additional time is required during regular seasonal maintenance, such as flushing the lines, or in responding to residents' complaints, which often involves flushing lines at dead ends.

Challenges

Although the water system in Old Perlican is functioning to provide residents with adequate drinking water, there are several important challenges that the system faces. The following is a short summary of infrastructure challenges in the Old Perlican water system, based on key informant interviews:

- **Demand issues by high water users**

One of the critical challenges facing Old Perlican is meeting the volume demands of high water using industries in the town. Despite recent (<12 years) infrastructure upgrades to the water system, one fish plant operator states that he is concerned as to whether the town will be able to meet the fish plant's water requirements, which are industry standard for seafood processing. The plant's water volume is increasing recently as the business increases its production. This informant suggests there is a systemic problem within small rural communities in this province because while they have been downloaded the responsibility of managing water systems on to themselves, it is becoming increasingly difficult to ensure that the financial and human resources are there to deal with developing a water supply that can handle extremely high water industry users. Ultimately, as this interviewee suggests, the fish plant plays a huge role supporting the town's municipal drinking water system. According to this informant, the town needs to be communicative and open with their water decisions with respect to dealing with businesses with extremely high water demands such as fish processors.

Key informant perspectives

Well again that seems to be, the government started this program a long time ago, ten or twelve years ago or fifteen years ago where they're trying to turn over all the water systems to the municipalities. The municipality in my estimation are too ill equipped to maintain a system to the degree they need to give a good water supply to the town in terms of volume. Quality in some areas is a problem, but again in some areas it's not. Where you are getting your water, what it's like, what the runoff in those areas are like, and the general location. For the most part it's an expensive proposition to maintain water systems, a town like this where we have such a high industrial use of it, I mean we alone are in the 2,000 gallon a minute use of it, it falls back on businesses like ours to ensure the town has the money to do it, and their means to get it is through taxes.- Business operator

- **Water lines: dead ends, leaks and corrosion**

The main concerns with respect to waterlines in Old Perlican are dead ends, leaks and corrosion. The water operator suggests that these issues are to a great extent unavoidable when dealing with a municipal drinking water system, particularly when houses are situated alongside small lanes, which are ultimately responsible for dead ends.

Dead ends arise because of the layout of the houses within the community, particularly in houses that are down a lane way, a considerable distance from the main line and where the homeowners in question are low water users. The only solution for this is to regularly flush the line at this connection. One interviewee suggested that a having two fish plants in

the town was very beneficial to the water lines because they are regularly having high volumes of water move through them, effectively flushing them out.

One interviewee stated that leaks were the town's biggest problem in terms of the amount of time the employees are involved in line repair and replacement. Leaks are described as an inevitable consequence of having a system that is over 40 years old, especially in the presence of acidic water as suggested by the LI for Old Perlican's water. Curb stops and locations where there are joins in the water line are particularly vulnerable to leaks, particularly in service lines that are largely composed of eroding copper. Leak detection is by far the most expensive aspect of repairing leaks, and greater leak detection tools would be invaluable to the community.

Finally, on a related note to aging infrastructure and leaks, Old Perlican also has an issue with corroding pipes. This is attributed to chronic low LI readings and the town has made attempts at dealing with this issue by adding soda ash to the water.

Key informant interviews

We're up to 25 leaks this summer, we've done six this past month [i.e. January]. Aging infrastructure, that's the problem. – Water operator

- **Water tank**

The main issue with the water storage tank at the Bell Pond water plant is that water stored in the tank is currently not chlorinated and when the water remains stagnant, the tank it is susceptible to algae growth. While the water has yet to be chlorinated prior to being piped through the town, the algae growth can cause further discolouration of the water. One informant suggests that the solution to this issue would be as straight forward as putting a small amount of chlorine in the holding tank, which would prevent algae growth

Addressing infrastructure challenges

It was expressed in key informant interviews that to make necessary infrastructure improvements – including those improvements to the Bell Pond plant, the main line and the development of Cooks Cove Pond – the town will need to continually readdress their infrastructure in order to keep up with the fish plants water demand. According to one fish plant operator, their taxation rates have increased in recent years in order for the town to meet their water volume needs. It is suggested that this will be achieved through a process of the town working with the provincial government on an upgrade on the Cooks Cove Pond water system. However, as stated by another interviewee, Old Perlican has not applied for or received Capital Works funding through the department of Municipal and Intergovernmental Affairs (MIGA) in the last five years. The same respondent suggested that the town needed greater support in their application process from MIGA, particularly in reducing the amount of time municipalities have to spend in completing their applications. Thus, currently, the process of applying for support in this upgrade is not yet underway. Additionally, the fish plant operator noted that if they encountered any low

volume issues with Cook's Cove Pond the town provides them with a small feed out of Bell Pond as well.

In terms of making general improvements to their water system, the staff is making continued efforts at flushing the lines and replacing sections of damaged pipes as frequently and effectively as possible. Scheduling regular flushing is ideal, but such an activity often gets demoted in priority should an emergency occur and employees are required to divert their attention to more immediate issues. However, as one interviewee stated, it is acknowledged among the staff in charge of water operations that preventative care measures such as these are important in enhancing the longevity and reducing damage to in-ground infrastructure into the future.

The issue of dead ends in the municipal system is a bit more challenging to deal with, aside from the need to regularly flushing the lines, because of the layout of houses in communities. One potential solution offered by an interviewee was branch circuits- that is, when two water lines meet, providing better circulation of water compared to water leading to a dead end. An optimal water system design would utilize branch circuits and eliminate dead ends altogether, but it was noted that this is not always a practical scenario.

Figure 3. Bell Pond Water Plant, Old Perlican (Old Perlican, 2014b)

Policy and governance

Ensuring the safety of drinking water in Canada is a responsibility shared between federal, provincial, territorial, and municipal governments (Health Canada, 2012a). The following section details the roles and responsibilities that each tier of government plays in the governance of drinking water.

Federal

In Canada, the responsibility for ensuring the safety of drinking water supplies is shared by the various levels of government. The principal responsibility of ensuring the safety of drinking water generally rests with the provinces and territories, while municipalities usually ensure the day-to-day operations of treatment facilities and distribution systems. Federally, Health Canada works in collaboration with the provinces and territories, through the Federal-Provincial-Territorial Committee on Drinking Water, to develop the Guidelines for Canadian Drinking Water Quality (GCDWQ) The GCDWQ are published by Health Canada and used by all Canadian jurisdictions (provinces, territories and the federal government) as a basis to establish their own enforceable requirements for drinking water quality.

The federal government does not directly influence the regular operation of the drinking water system in Old Perlican beyond the role that the *Guidelines for Canadian Drinking Water Quality* plays in provincial and municipal policy and practice.

Provincial

The provincial government is responsible for ensuring public access to safe drinking water based on the provisions of four main legislative acts: the *Municipalities Act* (1999), the *Municipal Affairs Act* (1995), the *Environmental Protection Act* (2002), and the *Water Resources Act* (2002). As stated, where these acts apply to drinking water, the province of NL follows the *Guidelines for Canadian Drinking Water Quality*. There are a total of 478 public water sources across the province where this service is provided via four provincial departments that share responsibility in managing these public supplies through the Multi-Barrier Strategic Action Plan (MBSAP) (DOEC, 2014c). The MBSAP consists of three levels of governance that are outlined in the 2013 *Drinking Water Safety in Newfoundland and Labrador Annual Report* (Table 3). The four government departments most directly responsible for drinking water in NL are: The Department of Environment and Conservation, Department of Health and Community Services (DOHCS), Municipal and Intergovernmental Affairs (MIGA) and Service NL (or Government Services- GS). These departments' specific roles and responsibilities in implementing MBSAP are also described in detail in the 2013 *Drinking Water Safety in Newfoundland and Labrador Annual Report* (Ibid.; Table 4).

Table 3. Multi-Barrier Strategic Action Plan - Three levels of governance

Level 1	- Source water protection - Drinking water treatment - Drinking water distribution
Level 2	- Monitoring - Data management and reporting - Inspection and enforcement - Operator education, training, and certification - Corrective measures
Level 3	- Legislative and policy frameworks - Public involvement and awareness - Guidelines, standards, and objectives - Research and Development

(DOEC, 2014c)

Figure 4. Town of Old Perlican (Old Perlican, 2014d)

Table 4. Roles and responsibilities of provincial departments managing drinking water in NL

Department of Environment and Conservation- *Water Resources Management Division*	- Acts as the lead department - Regulates development activities within protected public water supplies - Samples and reports on chemical and physical drinking water quality parameters in public water supplies from source to tap - Administers OETC program - Hosts Annual Clean and Safe Drinking Water Workshop
Department of Health and Community Services (DOHCS)	- Responsible for NL Public Health Laboratory and regional drinking water testing locations where municipal and private water supplies are tested for bacteriological indicators *E. coli* and total coliform bacteria - Conducts drinking water safety initiatives and review guidelines related to water which to enhance health and prevent disease
Municipal and Intergovernmental Affairs (MIGA)	- Provides financial support to communities for the provision of drinking water infrastructure - Involved in NL Drinking Water Safety Initiative and installation of Potable Water Dispensing Units
Service NL (or Government Services- GS)	- Samples and reports bacteriological water quality parameters in public water supplies from source to tap - Environmental Health Officers contact municipality/LSD immediately if sample tests indicate *E. coli* and/or total coliform bacteria or if chlorine residual is inadequate to implement BWA

(Adapted from Will, 2014)

Provincial public reporting

DOEC releases several public reports relating to drinking water quality (DOEC, 2014c; Table 5).

Table 5. DOEC public drinking water quality reporting

Seasonal Community Drinking Water Quality Reports	-	An interpreted report of seasonal drinking water monitoring Indicates parameters that exceed the *Guidelines for Canadian Drinking Water Quality* Provided to all communities with a public water supply
Exceedance Report:	-	A report delivered via fax or email to communities immediately after water quality laboratory results exceed the *Guidelines for Canadian Drinking Water Quality*
Annual Drinking Water Safety in NL Report:	-	Provincial report released annually Describes the province's activities under the MBSAP
Drinking Water Quality web documents	-	The Water Resource Management Division's website contains a regularly updated online tool with information on drinking water quality See: *http://www.env.gov.nl.ca/env/waterres/whatsnew/index.html*

(Adapted from Will, 2014)

Municipal

The Town of Old Perlican is governed by the *Municipalities Act* (1999). The town operates a public water supply system and property owners who receive this service pay an annual water tax, as described ins.130 and 131 of the Act (Ibid.). This tax is currently a fixed amount determined by council and is paid annually. In 2013, the combined water and sewer rate per home was $260.00 per year this has remained static for a number of years. It is suggested by one interviewee that the water rates do cover general water operators, not including the cost of specific equipment failure. High water users and institutional users are charged different rate from residents. The high school, hospital and private care home pay $260.00 per year + four mills[3] assessed value. High water users pay $ 1.50/1000 gallons (Old Perlican, 2014e), an increase of 50% over the previous industrial rate as of 2012. One plant reports paying charges of over $100,000 yearly for more than 200 million gallons of water. The 2012 town budget included water system maintenance/operation costs of $144,000 (Mercer 2012).

[3] Mills= 0.001, thus a property assessed at $100 000, taxed at 4 mills would pay the following: ($100 000 * 4)/1000 = $400 in taxes.

The municipality does not have a formal water management plan, but there are various regulatory procedures in place to ensure the effective management of the water system as a whole while remaining responsive to dynamic community concerns. For instance, the town operates under the policy that new developments should be built in a serviceable area. However, given that some priority owners have large pieces of property or property outside of a serviceable area comes up for sale, overall, the town council assesses new users' requests on a case by case basis.

One noteworthy policy change affecting municipalities, as stated by an interviewee, was related to the reporting of Tangible Capital Assets (TCA). Starting in 2008, municipalities across Canada were required to account for their TCA in annual financial reporting, with the order from the Public Sector Accounting Board (PSAB)- an independent body with the authority to set accounting standards for the public sector (MIGA, 2014). TCA in the case of water infrastructure includes: dams and diversion structures, pipelines, reservoirs, tanks, wells, pumps, mechanical and electrical equipment, buildings, electric power and emergency equipment (CICA, 2007). This requires that municipalities pay closer attention to the value of infrastructure materials over the course of these materials' useful life than was done previously.

As described above, water operations are performed by the foreman, water/heavy equipment operator and the general maintenance worker. This includes: keeping daily log books of residuals and any other maintenance performed and tracking water quality reports. The log book is also used to record any public complaints made regarding the water system. The municipality is also responsible for testing chlorine residuals at various points along the entire extent of the water line, which is performed on a daily basis.

The majority (85%) of public surface water supplies in the province are designated as "protected" under the *Water Resources Act* (2002). Municipalities are responsible for submitting an "Application for Protection of a Water Supply Area" to the Water Resources Management Division of DOEC in order to achieve this designation. In addition to the visible signage, this designation offers protection from development, mandated surveillance by the municipality, and periodic inspections by a DOEC representative (DOEC, 2013b). Both Bell Pond and Cooks Cove Pond have protected status and there are notices and signs around the water supply ponds stating these as protected water sources. Recreational use on these ponds is prohibited, and while interviewees suggest that there is large portion of the public that will abide by these rules, the town would have tremendous difficulty in preventing some people trout fishing on these ponds or riding over them in their skidoos in the winter.

Key informant interviews

Positive aspects of publicly supplied water… It's readily available and you get comfort as I indicated earlier that the town is responsible for the municipal water supply and they have protocols in place to ensure that they are meeting government regulations as it relates for water supply to municipalities to the town. – Business operator

Federal, provincial, municipal relationships

There is little regular interaction between federal and municipal representatives on issues of local water supply governance. Thus, the focus here is on relationships between provincial and municipal governments, as expressed in the participant interviews.

Interview participants indicate that there is adequate working relationship amongst the various provincial departments responsible for drinking water, which includes DOEC, GS, MIGA and, by extension CHS- but municipal representatives have effectively no direct contact with CHS. As stated, Old Perlican receives DOEC water quality reports, as well as regular visits from GS when they do their water testing. There was also an incident in the past two years where the town needed enforcement assistance from DOEC because a contractor was dredging in the water supply and was not listening to Council's request that he discontinue. However, other than the reporting done by DOEC and bacteriological testing by GS and the occasional water-related 'emergency' there is very little in the way of interaction between provincial government players and the Town of Old Perlican.

Public perception, awareness, demand and practice

Perception

Water quality and quantity

Town representatives indicate that residents are quite polarized in their opinions of drinking water quality, with some believing that the water is very good, particularly in comparison with other rural communities while the others maintain that the municipal drinking water is not fit for human consumption. In the participant interviews, residents' primary concern when it comes to the quality of water is the discolouration and the chlorine taste. Additionally, one resident made the comparison to his well water, suggesting that it appeared something was wrong with municipally supplied drinking water based on its cloudy appearance and unpleasant chlorine taste and well.

The town representatives suggested that while the water may have a distinctive chlorine taste and smell, which some interviewees suggested was actually very minimal, the water is completely safe and is far better quality than that of many rural communities' drinking water in NL. The majority of interviewees suggested that residents' perceptions that the water is unsafe cannot be validated with the evidence collected by the town or that presented in the DOEC reporting. There is an issue with chlorine as being thought of as unsafe- unrelated to the presence of DBPs, which HAAs have been high at times in Old Perlican- is largely driven by aesthetics and a larger ethos that ingesting any amount of chemical, such as chlorine, is damaging for one's health.

As stated throughout this report, other than complaints from the fish plants, there have been very little, if any, complaints regarding water quantity since the upgrades to the overall system 11 years ago.

Key informant perspective

It is pretty poor. It's supposed to be good and safe to drink but the quality is not good as far as we're concerned. It smells when it comes out of the tap, it smells like chlorine. – Resident

To use the proper words [resident's think] *it's "not fit to drink".* – Water operator

Some people get a taste of chlorine. Generally, it should be okay. It's not like well water. It's going to be a different because of chlorinated water. Some people get the smell of bog. We're getting water out of a pond, from time to time you are going to get that. – Water operator

I don't know if it's a belief but I think the biggest issue is chlorination. Nobody wants to drink, with more health conscience individuals, people are more conscience over your health, a lot of people rightly or wrongly have the perception in your mind that chlorinated water is not good, chlorinated levels are too high, and that kind of thing. – Business owner

Government

Despite some residents' negative perceptions regarding the quality of the municipally supplied water there does seem to be a good level of trust between residents and the town in relation to the management of the drinking water system. One resident suggested that he is confident that town employees are doing their jobs as required by provincial standards, however, he personally does not drink the water because of the chlorination it has undergone. Interviewees indicate that in general it appears that residents are satisfied with the timelines in which the town responds to complaints and residents concerns regarding leaks, discolouration in water due to stagnation at the dead end, etc.

Representatives of the town state that they need to do a greater deal of outreach with members of the general public, particularly to educate residents around some of the misinformation they have regarding drinking water safety. This is especially relevant because, as will be discussed in the next sections on public awareness and practice, it is evident that residents tend to associate clear water (e.g. water coming from well and spring sources), as clean water. On the other hand, cloudy water is viewed as unclean and unsafe, which from a bacteriological perspective is not necessarily the case. The town is currently in the process of determining how to best engage the public, because it is evident from past experiences that public town meetings are not very effective. As a general practice, emergencies, such as BWA and other urgent messages are communicated to the public via posters, radio, the town website and social media (Facebook and Twitter).

Additionally, given the taxation arrangement between the high water users and the town, in particular the fish plants, it is felt by one plant operator that the town needs to be engaged with the plant in accommodating their growing demand for piped water. If for some reason the town, and more specifically the current level of infrastructure, cannot meet this supply, then the fish plants could no longer be able to operate in Old Perlican. This would have a devastating effect on the current tax contributions towards the municipal drinking water system as a whole.

Key informant perspective

Well I've been talking to town, the fella who looks after it. They do everything for the water and they're supposed to test it. They go around to different spots and different places and into the home they get water, don't they? In different spots they have it tested. And according to government regulations it's safe to drink, it's supposed to be right. – Resident

Well I guess it's an ongoing concern to us with the water supply that we have and we do have conversations and continue to have conversations with the municipality on, not as much for us the quality because we do not have a quality issue with the water but the volume issue with the water and the durability of the system they have in place to ensure that they supply us with amounts of water that allow us to conduct our business. Because without the amounts of water that we require- we're out of business. – Business operator

Threats

Other than the threat posed by the fish processers no longer being able to operate in Old Perlican and the subsequent negative impacts this would have on both the local economy and the municipal water system, there was little addressed in terms of threats to the source water ponds and the town's water infrastructure. There is only minimal development within a 50 foot proximity of the Bell Pond water supply, and this development is limited to seasonal and summer cabins.

Interviewees suggest that while there are signs posted indicating that the source water ponds are protected water supplies, it would be an impossible task to prevent all recreational use on these ponds. In the winter months especially, it was noted in one interview, that someone will almost inevitably go across the water supply in their skidoo. The only other risk indicated was that one resident suggested that ecological risks are perhaps the thing most threatening to the water supply, namely beavers in the watershed and the seabirds landing on the ponds. Another ecological related issue addressed was the potential impact of climate change, such as warming water temperatures could lead to increased microbial growth. However, based on responses across the key informant interviews, the severity of these actual and potential ecological threats is limited, as they do not seem to be currently impacting water operations in a significant way.

Awareness

It is evident, based on key informant interviews here as well as broader scientific and policy-based sources, that residents' perception of water quality is driven more so by aesthetic concerns than it is driven by the publically available research (e.g. reporting by DOEC and to a lesser extent GS). Furthermore, some residents demonstrate a general distrust of chlorine and chlorination as a water treatment method in terms of the potential harm it can cause, without much acknowledgement of why chlorine is used so broadly in treatment systems across the province, and the country. This issue is particularly troubling in terms of resident safety, because as a water disinfectant, chlorine kills and prevents the growth of potentially lethal microorganisms- which themselves are colourless and

odourless. Thus, it is dangerous to assume that clear, odourless water- such as that coming from a spring or a well, is safe drinking water. However, this is the association made by some residents.

Key informant perspectives

As far as we are concerned, it is unsafe. But it is always inspected and it's supposed to be safe by government regulation. But if you put a glass of water up to your face, you know it's not good...[the water] *it's coming from a pond. So if it came straight from the pond it would be alright, but it goes through the system.* - Resident

[The water] *is chlorinated, so there is less bacteria in it. The fellas that drink out of dug wells, they don't know what they're drinking.* – Water operator

Residential demand and practice

As stated previously, approximately 95% of households in Old Perlican are serviced with municipal drinking water. The remainder of residents are on private wells. As a general rule, weather a residence is utilizing the piped water or not, if water is connected to a residence, then the homeowner in question pays municipal water taxes, regardless if they still have access to and/or use a private well. There is also a spring source located near the Lion's Club, from which residents of Old Perlican, as well as those from outside of the community, collect their drinking water. Additionally, people get water from friends and family, who, in turn, get their water from a well.

It was stated in participant interviews that many residents, including members of the Old Perlican town staff, have developed a preference for bottled water over the taste of the chlorinated municipally supplied water. In addition, some people noted that it was common practice for people to use the municipally supplied water for cooking and other household activities, but that many residents would choose another source of water for drinking.

Key informant perspectives

They use either an artesian well, they have a place outside where people can [get] public water. And Foodland has a public water supply, and they have an artesian well, so the water would be purified. I don't know what it's called, but you boil your water and you bring in your water there and you get it. But it's people from Bay de Verde, everywhere that get water from the Lion's Club. And when the weather is alright over here it's fine, but when it's winter it's harder to get to it. – Resident

I find the water in Old Perlican, it tastes a bit different because I don't live in that community, I'm comparing it to my own community now. And I have an artesian well. So I do see a difference in the water, I don't really know what it is, the taste that I get that I don't like as well as my own but that might just be me. But I know people in Old Perlican that come over here for drinking water, I have a sister who comes over here and I don't know what it is with the water in Old Perlican. They use it for cooking and boiling the kettle and stuff like that but not to drink. – Local representative

I think not unlike any other town in rural Newfoundland it's the I guess use or consumption of bottled water that has come about, people are paying more attention to water they're drinking and nobody now seems to want to drink surface or pond water that is normally provided in most towns these days. – Business operator

Industrial, commercial and institutional demand

In addition to the fish plants, there are a number of other businesses and institutions operating in the town, including: a funeral home, country inn, drugstore, two gas station/convenience stores, one large supermarket, automotive garage, variety store, a marine supply store, cabinet makers, hair salons, accounting and insurance businesses, a fast food takeout (attached to the gas station), licensed liquor store, contracting and trucking business, in addition to seniors' retirement home, a hospital, a regional high school and a Harbour Authority building (Old Perlican, 2014a). Other than the fish plants there are no other high water users in the community.

As stated throughout this report, the fish plants have a major impact on the municipal water system as a whole, so much so that they have their own source water pond developed, Cooks Cove Pond, as a part of the municipal system. While the fish plants place additional stress on the municipal drinking water system, they also contribute significantly to the cost of operating the system through metered water taxes. Operationally, it was stated by one interviewee that the fish plant is beneficial to the entire system as well because given their extremely high rates of water use; they are effectively flushing out the system on a regular basis.

Conclusion

The Town of Old Perlican have a number of key assets at their disposal in terms of managing and developing their water system in the future. Currently, they employ three staff members to operate their drinking water system, which utilizes two source water ponds of good water quality and ample supply. Furthermore, with fairly recent upgrades in 2003, they were not only able to bring an additional source water supply onto the system, but also expand the capacity of the in ground water delivery infrastructure while modernizing their former water plant (at Bell Pond) and building a new plant at Cooks Cove Pond.

In addition to their residential tax base, they benefit tremendously from the revenue generated from institutional buildings, but especially two industrial high water users located in the community. As stated throughout this report, as extremely high water users, the fish plants contribute a great deal to the community, not only as local sources of employment but also to a great extent with their tax contributions to the municipal drinking water system. This provides both an excellent opportunity for Council and town management in operating a functioning water system, but also a challenge in meeting the evolving demands of these high water users.

In terms of improving on the system currently in place, the system needs to be upgraded based on the knowledge the town now has through conversation with the fish plant management. Through these conversations the town had a better understanding of the current volumes that are needed to run the fish plants, based on these businesses' need to upgrade and remain economically competitive. This does present a potential challenge in terms of funding these upgrades, but the town, in addition to using the tax revenue generated from the fish plants, will need to look to funding from MIGA and any other potential sources.

Additionally, other infrastructure challenges that they need to address include replacing old and eroded copper service lines, however, this appears to be occurring on an as-needed basis in terms of repairing resulting leaks. Moving forward, town management has suggested that they will be investigating a new safety feature-emergency call for the purpose of checking in on operators in the field, as a backup to the current informal check in process. Management would also like to engage further with the public around water safety and 'managing' residents' negative perceptions of the municipally supplied water through public awareness building around these issues. It was suggested too that future planning efforts around the drinking water system will feature a greater focus on climate change and managing the effects of climate change in rural communities such as Old Perlican.

Main Suggestions by key informants moving into the future:

- DOEC OETC training should increase the number of courses they offer and ensure that in addition to online training modules, that regional classes, with 'hands-on' exercises are continued in the future.
- Municipalities and municipal leadership need training and focus in two critical areas: i) Public engagement, public awareness building and group facilitation training exercises would be key for municipalities to better respond to local residents about critical public service issues such as drinking water safety and watershed protection, and ii) municipalities need to develop clear strategies in collaboration with high-water using industries and industry groups to more effectively lobby the appropriate funding agencies for the resources to develop their communities to facilitate both residents and industrial high-water users demands in their communities.
- Further research regarding water filtration alternatives should be made available to municipalities

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Appendices

Appendix A. Case study methodology

Case study Methodology

Objective

In depth profile of key issues, challenges and solutions related to public drinking water systems in rural NL.

Methods

- Semi structured key informant interviews (an interview guide will be used):

  *Note depending on size and human resources in the community the below informants may not be available

  - Water Operator (at least 1)
  - Town administrator (at least 1)
  - Mayor/Council/LSD Committee rep (at least 1)
  - Business owner/heavy users (~2-3)
    - Include businesses that sell bottled water
  - Environmental or watershed groups (if they present) (at least 1)
  - Health office for community/region
  - Environmental Officer who tests water for that town
  - Residents
    - Best done in a focus group format (possibly by attending another meeting)
    - Seniors groups, family resource centres, youth groups, community groups, etc.
- Review of documents
  - Project's administrator/operator survey results
  - DOEC data on community/drinking water supplies
  - Development regulations and by laws related to water
  - Any studies done on drinking water/infrastructure
  - Any other pertinent drinking water related documents
  - Media articles (preliminary database on basecamp)
- At least 3 days' worth of interviews done with 1-3 trips
- At least 1 trip reporting back to the town and requesting feedback at a town council meeting/town hall meeting

Requirement of Case Study Community

- Community of 1000 or less
- At least one per MNL region
- On a public drinking water supply (mix of groundwater, source water and PWDU)

- Willing to be part of study (most likely a town that answered the admin survey)

Possible Topics

- LSDs and Municipalities
- PWDU
- Community trying something new and working (alternatives/solutions)
- Impact of industry/tourism/high water user
- Regional water operators
- Drought issues
- Chronic/long term BWAs
    - How do towns with long term BWAs cope?
- Compliance with BWAs
- Aboriginal communities- Labrador issues→ training for operators, access to water workshops, capacity, infrastructure, sampling
- Roadside springs
- Metering
- Aging infrastructure
- High DBP's
- Chlorination issues
- Real time water quality monitoring
- DWQI/Langlier index
- Use of bottled water/safety of bottles water
- Bacteriological outbreak
- Resident perceptions

Community Contact

*May vary, for example Theresa will require permission from the Nunatsiavut

- Initial informal contact.
- Formal letter of request to Mayor and Council/LSD committee
- Follow up to confirm participation and identification of key contact in community
- Discussion with key contact re methods, available documents, and arranging field visits
- Circulation of report drafts to the town contact and arrangements for feed back visit

Final Reports for Each Case Study

- Each case study community will have an overall community case study outlining the state of the drinking water system, as well as individual topic based reports that are specifically related to drinking water issues or innovations in the community. What will be included in these reports will vary depending on the community and topics identified, however some basic requirements are described below.

- The overall community reports should include:
    - 15-30 pages (1.5 spacing)
    - Title page, table of contents
    - Introduction of community and their water system
        - Source water supply (GW/SW)
        - Types of infrastructure
        - Human resources (e.g. water operator)
    - Summary of findings according to research components (from both the background review and the interviews)
        - Source Water
        - Infrastructure
        - Policy/Governance
        - Public Perception, Awareness and Demand
    - Conclusions and Future Directions
    - References
- Community summary document
    - 3-5 pages
    - Headings:
        - Introduction
        - Source Water
        - Infrastructure
        - Policy/Governance
        - Public Perception, Awareness and Demand
        - Conclusions and Future Directions
    - Minimum 1 image per page
    - Formatting instructions to come
- The topic based reports should include:
    - 3-5 pages
    - Introduction of topic and significance to drinking water
    - Description of issue/innovation in the community
    - Description of the issue/innovation in the province wide context
        - If an innovation applicability of using the innovation in other parts of the province
        - If an innovation- has this been used in other parts of Canada/the world? Give examples.
        - If an issue- what has other places in Canada/the world done about this?
    - Conclusions
    - Recommendations for future research
    - References

Conducting Key Informant Interviews

1. When contacting key informant interviews start with an e-mail or phone call. If you do not hear back from the possible interviewee within a week then make a follow up phone call. We suggest making 3 attempts in total to contact the potential interviewees.
2. Arrive on time and prepared for your interview. Make sure you have:
    a. 2 copies of the interview consent form (1 copy for you, 1 copy to be left with interviewee, make sure you and all interviewees sign both copies)
    b. Tape recorder fully charged- always ask and get on the consent form that this is ok
    c. Pen and paper
    d. Copy of the interview guide
3. Before you begin the interview make sure you have the consent form signed and you have asked if you can record the interview, if not take notes to the best of your ability.
4. When the interview is over thank them for their time and ask them if they would like a copy of the case study.
5. Make sure to get your interviewees contact information so that you can follow up with them later when outputs of the project are available. Confirm how they would like to be communicated with in the future.

Appendix B. Interview guide

Rural Drinking Water Project Interview Guide

*It is likely there will be overlap between the questions, be conscious of linking questions together and following up on comments.

*Should prepare questions in addition to the ones below specific to the case study community. These questions should be derived from the administrator/operator survey results and background research.

Section A:
Background Information on Respondent

1. What town do you live in?
    - How long have you lived in your town?
2. What is your profession? What is your role in your community that relates to drinking water?
    - Are you a paid part time/full time position? A volunteer? A user?
3. How long have you been working/associated [with the subject town]?
4. Are you involved in any other organizations in your town not covered above?

Section B:
General Drinking Water Information
***To be collected from all participants**

1. How would you describe the quality and quantity of your local drinking water?

    - Are you content with the drinking water quality in your community?
    - Do you like the taste/appearance?
    - Has your opinion on the drinking water quality changed overtime?

2. In your opinion what is the general resident's perception of the drinking water quality in your community?

    - In your opinion, are there any (widely held) misconceptions?

3. Do you think your town's drinking water is safe?

    - Are there any factors that you think may be affecting the safety or quality of drinking water in your community?

4. Have you ever felt that the water system/source in your community as being vulnerable/facing particular threats? (If the respondent struggles with this--e.g. presence of disinfectant bi-products, point or non-point pollution, physical obstructions in water source, aging or inadequate infrastructure...*for a complete list see pgs. 12-24 DPSIR document)*

    *NB- *It is key here to have a good working knowledge of those risks/threats for community in question based on the community profile at the Water Resources Portal**

    - Under what circumstances did these threats emerge? (e.g. after a particular evident, access to a new information, speaking with a public official etc.)
    - To what extent do any threats apply to you individually as opposed to a risk for the entire community?

5. How do you determine whether your current water system is safe, or conversely under threat? I.e. What sources of information (people, government, scientific lit..) would you regularly use in determining the safety and quality of your water system/source?

    - Has government been helpful in identifying threats within your water system/water source?

6. Have your perceptions towards the risks associated with water quality changed over time? If yes, how so?

7. What are the positive aspects of the publicly supplied water in your town?

8. Name any negative impacts of the public drinking water on your town? (impacts can be economic, social, environmental etc)

9. What other sources of drinking water do people in your town use other than the publically supplied drinking water (e.g. spring water, bottled water)?

10. What have been the challenges your community has faced in the past regarding drinking water?

    - Does the number of Boil Water Advisories in your community concern you?

11. What would you consider the emerging or more recent challenges for your community's drinking water supply?

12. What kind of development/land use is there in the vicinity of your community's water suppl(y/ies)?

    - In the greater watershed/catchment?

13. Is your water source designated as a protected public water supply area?

    - Are there any activities that are prohibited in or around your water supply?

    - If so, do you think these prohibited activities are appropriate?

        - Are they enforced? Are they violated?

    - Are there any activities that should be prohibited in your town's drinking water source that pose a risk to human health?

14. Have there been problems with the water supply and/or delivery system(s)? Including source water, the pump house, treatment/ filtration or distribution systems?

    - Have they been addressed/resolved? If so, how? If not, why?

    - Is this problem(s) a reoccurring problem?

15. Are you aware of any research that has been done on the local water supply?

- Has there been an evaluation of the sustainability/capacity of the water supply? Hydrological surveys? Other studies?

16. Do changes in weather ever impact your town's drinking water supply?

    - If so, in what ways?

    - Is there a plan to mitigate these impacts? Are there adaptation strategies in place?

    - Describe any changes in water quality/availability that occurs seasonally and/or after extreme weather events.

17. In what ways do you think being "rural" affects your community's drinking water quality and supply?

Section C:
Role Specific Questions

Water Operator
Water System, Maintenance and Operations

1. What is the local source of drinking water?
    - Is it the only one? Is there a back-up supply?
2. If your town is designated as a protected public water supply area:
    - Why did your town choose to designate as a protected public water supply area?
    - How is the water supply managed/protected?
    - Do you think source protection measures are adequate?
    - Has the council tried any new methods of reducing violations of the town's rules/regulations?
3. How long ago was your town's public water supply (source) developed? Can you tell me anything about the historical development of the drinking water suppl(y/ies) locally?
4. How would you describe the level and quality of water infrastructure in your community?
    - Type of infrastructure
    - Scale appropriate for design capacity?
    - What year was it installed? Have upgrades been made since installation?
5. Do you have water treatment?
    - How long have these systems been in place? Is everything currently working?
    - What kind of treatment system do you use?
    - Are you happy with it?
    - Is there sufficient disinfecting agent available? Has the disinfecting agent expired?
6. Do you have water filtration do you use?

- How long have these systems been in place? Is everything currently working?
- What kind of filtration is used?
- Are you happy with it?

7. How is drinking water currently delivered in the community? Do all residents have piped services?
    - What proportion of your community households rely on private wells?
8. Are there any high risk public facilities supplied by the public drinking water system?
    - Daycare facility?
    - Hospital?
    - Seniors home, long-term facility?
    - School (K-12)?
9. Are there any high water users using the public supply?
    - Fish plants, other industry?
    - Does this impact the quality or quantity of the drinking water?
10. Is there a designated workshop area for drinking water system operation and maintenance?
    - Are there appropriate tools in the workshop to perform basic maintenance?
    - Are there operating and maintenance manuals for the treatment equipment, pumps, etc. readily available?
    - Do you have spare parts, consumables, maintenance kits, etc?
11. How often do you check for chlorine residual?
12. Do you have a regular system cleaning program?
13. How many (if any) emergency repairs have been required completed in the last 2 years?
    - Is any emergency repair kit readily available to keep the system operational in an emergency situation (such as back-up pumps?)

14. Are there any re-occurring operational problems?

15. Do you have a cross-connections control program (Connection to prevent back-siphoning and/or backpressure into the town water mains)?

16. Do you have the resources to prepare and maintain up-to-date water treatment system/plant and distribution systems documentation such as As-Built drawings, Process diagrams, Operations Manuals, Log Books, Lab Results, etc?

    - Could you easily locate As-Builts for:

        - Water Treatment System/Plant
        - Distribution System
        - Water Storage Tank

17. Do you feel the water treatment facility, water source area, and/or water storage tank have adequate security to prevent unauthorized entry?

18. How is the municipality currently track potential threats to source water (e.g. point pollution, physical obstructions within the watershed, levels of DBPs, cabin development, flooding etc.), if at all?

    - Would you be interested in mapping these things to assist in strategic planning and development in the future?

19. What other innovative strategies have you used in attempt to address your water challenges (e.g. the Regional Water Operator)?

    - In the case of the Regional Water Operator, how did this come about? Please describe.

        - What were/are the benefits? Drawbacks?
        - How was this funded?

    - What are the future plans in terms of regional strategies to manage water infrastructure/source water?

Certification and Training

1. What is your level of water operating training/certification?

    - Years of experience?

2. What are your typical hours of work as operator?
    - How many hours are spent on work/maintenance related to the water treatment system/plant and distribution system, etc?
3. Are you happy with your compensation?
4. Is there only one water operator in your town?
    - Does anyone replace you while on vacation, training or sick?
    - Does this person have the same training as you?
5. Were your trained with the Operator Education, Training and Certification (OETC) Program provided by the DOEC (Department of Environment and Conservation)? If not, proceed to question 8.
    - What were the benefits of this program?
6. Are there any limitations with operator training in NL?
    - Travel costs?
    - No replacement while on training?
    - Other?
7. Do you have any suggestions on how the province can improve the OETC program?
    - Can you suggest any alternative ways of delivering training sessions?

Complaints and Reporting

8. Do you keep record of your daily activities (flows, chlorine residuals, maintenance activities, etc)?
9. Do you receive complaints about the drinking water either directly from residents or from the town office?
    - What types of complaints?
    - How often?
    - What is the range of response times to these complaints?
10. Have there been Boil Water Advisories issued in the past 2 years?
    - What protocols are there for notification about a boil water advisory when it is communicated from government services/DOEC to your town?

- What protocols are there for notification at the town level for communicating the advisory to residents?

11. Have you been in contact about water quality issues over the last 12 months with the Department of Environment and Conservation, Municipal Affairs or Government Services?

    - What spurred the contact?

Town Administrator/Staff / Councillor

System

1. What is the local source of drinking water? Is it the only one? Is there a back-up supply?

2. How long ago was this supply developed? Can you tell me anything about the historical development of the drinking water suppl(y/ies) locally?

3. How is drinking water currently delivered in the community?

    - Do all residents have piped services?

    - What proportion of community households rely on well and septic systems?

4. How would you describe the level and quality of water infrastructure in your community?
    - Type of infrastructure
    - Scale appropriate for design capacity?
    - What year was it installed? Have upgrades been made since installation?

5. Heading into the future, how do you see the drinking water system developing?
    - Expansion? (Drivers?)
    - Taking on new systems?
    - Replacement? New Approaches?
6. Do you have any comment on private wells in the area?
7. Within your area can you think of any examples of innovative or unique technology?
    - E.g., Point of entry treatment, mobile treatment units

8. Are there any public facilities supplied by the town water system? For example:
    - Daycare facility
    - Hospital
    - Seniors home
    - School (K-12)
9. Are there any high water users using the public water supply?
    - Fish plants, other industry?
    - Does this impact the quality or quantity of water?

Management/Financials/Policies

10. If your water source is a designated protected public water supply area:
    - Why did your town choose to designate as a protected public water supply area?
    - How is your water supply managed/protected
    - Do you think source protection measures are adequate?
    - Has the council/town tried any new methods of reducing violations of the town's rules/regulations?
11. Do the household water tax rates cover water operation and maintenance expenses in your town?
12. Is either of the following available for the current water system(s)?
    - Inventory/As-Builts/GIS mapping
    - Infrastructure assessment/evaluation
    - Planning document/SOPS
13. Do you have the resources to prepare and maintain up-to-date water treatment system/plant documentation such as As-Built drawings, Process diagrams, Operations Manuals, Log Books, Lab Results, etc?
14. Do you feel that the current water infrastructure is planned and managed sustainably?
    - If no, is this a future goal?

- Have you made progress toward sustainable infrastructure goals? Is sustainable infrastructure included in your ICSP(Integrated Community Sustainability Plan) or capital works plan?

15. Have you requested and/or received capital works funding in the last 5 years for a drinking water related project(s)?
    - For what?
    - Was it received?
16. Have you requested and/or received operation and maintenance assistance related to your water treatment system/plant and/or distribution system in the last 5 years?
    - What was requested?
    - Was it received?
17. Do infrastructure funding programs allow for consideration of local context?
    - If yes, how? If no, what challenges does this present? How do you deal with these?
18. Are there any programs, policies, or standards you consider to be critical or influential when it comes to household/drinking water infrastructure?
    - Foundational
    - Last 5 years
    - Last 10?
    - Last 20?
19. Is there a town/regional/provincial water management plan?
    - Is infrastructure included in this?
20. Do you have the ability within the current regulatory framework to accommodate unique local elements/challenges?
    - If yes, how? If no, what challenges does this present? How do you deal with these?
21. Is there a difference between what is mandated and what occurs on the ground in the provincial policies/regulations?

22. Does your town have difficulty with the availability of qualified water operators?
    - How many replacements have you hired in the last 5 years
23. Has your town ever considered a regional water operator?
    - If so, why?
24. Does your office receive complaints about the drinking water?
    - What types of complaints?
    - How often?
    - What is the range of response times to these complaints?
    - Are these complaints recorded/logged?
25. Have there been Boil Water Advisories issued in the past 2 years?
    - What protocols are there for notification about a boil water advisory when it is communicated from government services/DOEC to your town?
    - What protocols are there for notification at the town level for communicating the advisory to residents?
26. Does you town have an emergency response plan and is drinking water considered in this plan? Please explain.
    - Has this been updated in the last 5 years?

Jurisdiction and Integration

27. Could you please describe the jurisdiction/level of authority you have?
28. Are there other agencies whose jurisdiction overlaps/overrides/conflicts with yours?
    - Do you work with these agencies? If yes, how?
    - Conflicts? Challenges? Please explain.

29. Are there recognized connections between household/drinking water infrastructure and other aspects of water management: water stewardship, source water protection, conservation, regional development?

30. Do you see an obvious link between household/drinking water infrastructure and regional planning and development?

    - If yes, please describe how state of infrastructure influences development (or vice versa).

    - If no – discuss.

31. How is the municipality currently track potential threats to source water (e.g. point pollution, physical obstructions within the watershed, levels of DBPs, cabin development, flooding etc.), if at all?

    - Would you be interested in mapping these things to assist in strategic planning and development in the future?

32. What other innovative strategies have you used in attempt to address your water challenges (e.g. the Regional Water Operator)?

    - In the case of the Regional Water Operator, how did this come about? Please describe.

        - What were/are the benefits? Drawbacks?

        - How was this funded?

    - What are the future plans in terms of regional strategies to manage water infrastructure/source water?

33. Describe your relationship with provincial and federal government departments/agencies, NGOs or private industry regarding drinking water quality? Has the relationship changed over time?

    - Are there any challenges that need to be overcome to ensure effective collaboration/a better relationship? Please explain.

Business Owner

1. Are there any regulations/policies/laws you have to adhere by related to water?
    - Who imposes these policies: federal/provincial/municipal government?
    - Who enforces these policies?
    - Do you feel these policies are appropriate?
2. Is your business ever impacted by the drinking water quality in your town?
    - Please explain.
3. If in food service/food and drink retailer, do you provide patrons with water products other than publicly supplied drinking water? Why or why not?
4. If a food/drink retailer who sells bottled water, is bottled water a common purchase in your town?
5. How would you describe your business' level of water use in your community? (Higher than average, average etc...). Please explain.
6. Describe any attempts within your business and/or with community partners to promote the protection/better management of drinking water.

Environmental and/or Watershed Group

1. What is the mandate of your organization?
    - Are there any mandates specific to drinking water?
    - Do you have any drinking water related programs/educational opportunities?
2. Describe your relationship with provincial and federal government departments/agencies, other NGOs or private industry regarding drinking water quality?
    - Has the relationship changed over time?
3. Is your water source designated as a protected public water supply area?
    - Why did your town choose to designate as a protected public water supply area?
    - How is the water supply managed/protected?
    - Do you think source protection measures are adequate?
    - Has the council tried any new methods of reducing violations of the town's rules/regulations?
4. Have you partnered with any groups/organizations regarding water-quality management?

Environmental Health Officer

Ask intro/general questions as much as they pertain to a regional jurisdiction

1. Please briefly describe your mandate as an Environmental Health Officer.
    - What communities do you serve?
2. How much interaction do you have with the municipalities in "your region"?
    - Who, at the municipal level, do you interact with the most?
    - Describe the level of interaction your field staff have with water operators/staff in municipalities.
3. What is the greatest health risks associated with the water quality in (subject town)?
    - Are measures being implemented to reduce these risks?
    - What can be done to reduce these risks?
    - Where does your department stand with DBPs and other 'chemical and physical' parameters as far as the potential health risk they represent from a municipal perspective?
4. At what point do you intervene with respect to drinking water safety?
    - Do you monitor the Drinking Water Quality Reports issued by DOEC?
    - Do towns ever approach you to help interpret these reports?
    - To what degree do you help municipalities mitigate their specific environmental health risks/concerns?
5. Describe your relationship with other provincial and federal government departments/agencies, NGOs or private industry regarding drinking water quality? Has the relationship changed over time?

General Resident

1. Are you aware of any laws/policies surrounding your source water supply?

- Do you think these laws/policies are adequate/appropriate?

2. As a resident, do you have faith in your government (local, provincial, federal) to provide your town with clean and safe drinking water? Why or why not?

Section D:

Closing Questions for All Respondents

1. How would you like to see the water system in your town develop heading into the future?
    - Future opportunities? Concerns?
    - Links to sustainable development? Climate change?
2. Do you have any other recommendations on how the Department of Environment and Conservation, Water Resources Management Division and/or Department of Municipal Affairs and/or NL Services and/or Department of Health and Community Services can improve their drinking water policies or funding programs?
3. Is there anything else you would like to add? Documents you would like to suggest?
4. Is there anything I can provide back in terms of information that you would be interested in? Get contact information, if not already recorded.