

## The International Indigenous Policy Journal

Volume 3 Issue 3 *Water and Indigenous Peoples* 

Article 8

September 2012

# Multi-Barrier Protection of Drinking Water Systems in Ontario: A Comparison of First Nation and Non-First Nation Communities

Dan Walters Nipissing University, danw@nipissingu.ca

Nicholas Spence Western University, nspence@uwo.ca

Kayli Kuikman Nipissing University

Budhendra Singh Nipissing University

## **Recommended** Citation

Walters, D., Spence, N., Kuikman, K., Singh, B. (2012). Multi-Barrier Protection of Drinking Water Systems in Ontario: A Comparison of First Nation and Non-First Nation Communities. *The International Indigenous Policy Journal*, 3(3). **DOI:** 10.18584/iipj.2012.3.3.8

## Multi-Barrier Protection of Drinking Water Systems in Ontario: A Comparison of First Nation and Non-First Nation Communities

## Abstract

In some way or another, all levels of government in Canada and First Nations share responsibility to implement multi-barrier protection of drinking water. The goal is to protect water from source to tap to minimize risk so that people have access to adequate and safe drinking water. The federal government has committed to assist First Nations achieve comparable levels of service standards available to non-First Nation communities. However, several recent reports on the status of drinking water services standards in First Nations indicate that people in these communities often experience greater health risks than those living off reserves. Using the federal drinking water risk evaluation guidelines, the capacities of First Nations and non-First Nations in Ontario to implement multi-barrier protection of their drinking water systems are compared. The Risk Level Evaluation Guidelines for Water and Wastewater Treatment in First Nation Communities rank drinking water systems as low, medium, or high risk based on information about source water, system design, system operation, reporting, and operator expertise. The risk evaluation scores for First Nations drinking water systems were obtained from Aboriginal Affairs and Northern Development Canada. A survey based on the federal Risk Level Evaluation Guidelines was sent to non-First Nation communities throughout Ontario with 54 communities responding. The capacity among First Nations was variable throughout the province, whereas all of the municipalities were in the low risk category, even small and northern non-First Nation community water systems. It is clear that the financial and technological capacity issues should be addressed regardless of the legislative and regulatory regime that is established. The current governance and management structure does not appear to be significantly reducing the gap in service standards despite financial investment. Exploring social or other underlying determinants of risk may provide alternative solutions to the ongoing water crisis in many First Nations.

## Keywords

drinking water, capacity building, First Nations, Canada

#### Acknowledgments

This research was funded by the Social Science and Humanities Research Council of Canada. We thank the two anonymous reviewers for their insightful comments and suggestions.

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## Multi-barrier Protection of Drinking Water Systems in Ontario: A Comparison of First Nation and Non-First Nation Communities

In response to increasing pressure on drinking water supplies, many jurisdictions are developing policies and regulations intending to minimize the risk to human health. Recent literature suggests the use of a multibarrier approach – source, distribution, treatment, monitoring, and management – to ensure an adequate and safe drinking water supply. Governance involves the decision-making process – the formal and informal rules of decision making – that are followed (Young, 2002). How do we make decisions? Who decides? Management refers to the choice among contingencies or operational approaches. What principles and information should guide our decisions? These questions are under intense debate as the governance and management of drinking water in First Nations communities are in need of reform.

The federal government has a fiduciary responsibility to provide basic needs to First Nations and has committed to assist First Nations in achieving drinking water service standards similar to those in non-First Nation<sup>1</sup> communities of similar size and circumstance. The governance and management structures of drinking water in First Nations and non-First Nations are different. The federal government and First Nations share responsibility for implementing multi-barrier protection of drinking water, whereas, provincial governments and non-First Nations share multi-barrier protection responsibilities. The aim of this article is to compare the capacity of First Nations and non-First Nation communities in Ontario to implement multi-barrier protection of drinking water system risk factors or capacity to effectively manage sewage.

The article is organized into five sections. First, to establish the context for the comparison of First Nations and non-First Nation drinking water systems, their respective roles and responsibilities for implementing multi-barrier protection are described. While the goal may be the same, the means to achieve this end are very different. Second, we outline the federal Risk Level Evaluation Guidelines for Water and Wastewater Treatment in First Nation Communities (Indian and Northern Affairs Canada [INAC] et al., 2005). This provides a framework and tool for comparing the capacity to implement multi-barrier protection of drinking water systems. The Risk Level Evaluation Guidelines for Water and Wastewater Treatment in First Nation Communities (hereafter referred to as the Risk Evaluation Guidelines) rank drinking water systems as low, medium, or high risk, based on information about source water, system design, system operation, reporting, and operator expertise. Third, the data collection and results of the comparisons of risk are described. Fourth, the implications of the possible transfer of First Nations drinking water systems to provincial regulations and standards are discussed.

## Multi Barrier Protection: Governance and Management

The recent changes to Ontario's drinking water governance and management are in response to the Walkerton Tragedy where seven people died and thousands became ill due to e-coli in the town's drinking water supply. This incident sparked a judicial inquiry led by Justice O'Connor. The Walkerton Reports (O'Connor, 2002a, 2002b) revealed fundamental problems with procedures for minimizing risks to human health. The Walkerton Reports (O'Connor, 2002a, 2002b) did not directly address the First Nations drinking water crisis. Table 1 outlines the new legislation that frames the multi-barrier protection strategy in the province. There are four components to the multi-barrier approach. First, source water protection helps minimize the threat of contaminants entering the water supply. Second, the treatment and distribution of drinking water systems are subject to certain operating standards. Third, monitoring ensures that the water supply meets established standards and is demonstrated through rigorous testing. Fourth, management refers to the ongoing communication about potential threats to drinking water supplies. Table 1 does not include all direct or indirect legislation governing drinking water systems. The Ontario Water Resources Act (1990),

<sup>&</sup>lt;sup>1</sup> For the purpose of this paper "non-First Nations" refers to the municipalities and townships that are responsible for operating water systems and supply community members with drinking water.

Environmental Protection Act (1990), and Environmental Bill of Rights (1993) are also important pieces of legislation. The multi-barrier approach includes the development of source water protection plans, creation of design standards for treatment technology, distribution systems, water quality monitoring, and emergency response preparedness (Hrudey, Hrudey, Huck, Payment, & Gillham, 2002). In Ontario, municipalities or townships are responsible for ensuring they meet the regulatory standards established by the province. The Drinking Water Systems (O.Reg.170/03) regulation (Ontario Regulation, 2002) requires that laboratories notify the Ministry of Environment, local Medical Office of Health, and drinking water system owner or operator of any test results exceeding the provincial standard. The management of municipal and township drinking water systems is funded through fees based on volume or flat rate cost structures. While not yet in force, the Sustainable Water and Sewage Systems Act (2002) will require full cost recovery for drinking water and wastewater services. This helps ensure that municipalities will have the financial resources to hire qualified people to develop long-term planning strategies and run the day-to-day operations of water plants to minimize the risk of human health problems. However, not all communities have equal capacity - financial, institutional, technical, political, and social - to effectively implement this approach (de Loe & Lukovich, 2004). In particular, small communities (less than 5,000) or rural settlements are vulnerable or lack the necessary capacity to effectively manage drinking water supplies (Corkal, Schtzman, & Hilliard, 2004; de Loe & Kreutzwiser, 2005). To support capacity among conservation authorities, the provincial government provided financial assistance (~\$120 million) for the development of source water protection plans. Implementation costs have vet to be addressed. It is uncertain whether the Sustainable Water and Sewage Systems Act (2002) will extend to cover source water protection efforts. There is a strong legal foundation for the protection of drinking water systems in Ontario with the exception of First Nations.

Table 1. Ontario's Multi-Barrier Drinking Water Protection Legislative Framework

Multi-barrier Protection	Legislation
Source water	Clean Water Act
Treatment & Distribution	Safe Drinking Water Act
Monitoring	Safe Drinking Water Act
Management	Clean Water Act Safe Drinking Water Act

First Nations drinking water systems, with the exception of source water protection, are not subject to the legislative and regulatory changes in Ontario. First Nations located within a source water protection region can have a representative on the source water protection committee and participate in the planning process; however, First Nations can only participate in the process if the community passes a by-law or band resolution agreeing to comply with provincial legislation. Many First Nations and Aboriginal organizations oppose this requirement, since the provincial government has failed to support Aboriginal and Treaty Rights. As a consequence, multi-barrier protection of drinking water is primarily a shared responsibility among First Nations and the federal government. There is no federal legislation or regulations that directly deal with drinking water systems. Table 2 outlines the mix of plans, protocols, and guidelines that frame the multi-barrier efforts on reserves. There are numerous guidance materials available to First Nations for developing source water protection plans including Guidance for Safe Drinking Water in Canada: From intake to tap (Health Canada 2001) and Guidance for Providing Safe Drinking Water in Areas of Federal Jurisdiction

(Health Canada 2005). Also, the Protocol for Safe Drinking Water in First Nations Communities (2006), Guidelines for Canadian Drinking Water Quality (Health Canada, 1996), First Nations Water and Wastewater Action Plan (INAC, 2008), and Water and Wastewater Policy and Level of Services Standards (INAC, n.d.) provide the foundation for minimizing health risks in First Nations. There is currently no legislative framework to ensure compliance. The federal government has attempted to address this by introducing Bill S-11 (2010) and Bill S-8 (2012). Bill S-11 (2010), entitled the Safe Drinking Water for First Nations Act, could have required that First Nations' drinking water systems meet provincial and territorial legislative and regulatory standards, but the Bill concluded with the dissolution of parliament in the spring of 2011. There was significant opposition from First Nations and Aboriginal organizations due to the lack of consultation in the development of the legislation. Upon reconvening the federal parliament, the government introduced Bill S-8 (2012), entitled the Safe Drinking Water for First Nations Act, which was nearly identical. Bill S-8 states that the federal government is "committed to working with First Nations to develop proposals for regulations to be made under this Act" ("Bill S-8", 2012, Preamble). The commitment to work with First Nations has less meaning than the commitment to respectful consultation. Bill S-8 (2012), Section 3, includes a nonabrogation or derogate clause; however, this clause is weakened by the phrase "except to the extent necessary to ensure the safety of drinking water on First Nations lands." This could lead to the abrogation of Treaty or Aboriginal Rights (AFN, 2012). Bill S-8 (2012) Section 5(1)(b) includes a provision to "confer on any person or body any legislative, administrative, judicial, or other power that the Governor in Council considers necessary to effectively regulate drinking water systems and wastewater systems." In addition, Bill S-8 fails to address financial and technological capacity issues in First Nations. There is no mention of multi-barrier protection of drinking water supplies.

In lieu of federal legislation, multi-barrier protection of First Nations drinking water is framed by guidelines and policy directives. The responsibility for planning and implementing multi-barrier protection is shared among First Nations, Aboriginal Affairs, and Northern Development Canada (AANDC), Health Canada, Environment Canada, and Public Works and Government Services Canada (Table 2). While First Nations have responsibility at each step of multi-barrier protection, there is a clear fragmentation of responsibility within the federal government. These departments are coordinated through Interdepartmental Committees.

Table 2. Responsibilities for Multi-Darrier Protection of First Nations Drinking Wate	Table 2.	Responsibilities	for Multi-barrie	r Protection	of First Na	ations Drin	king Water
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Multi-barrier Protection	Standards	Shared Responsibilities		
Source water	Guidance Materials on Source Water Protection Plans	AANDC and Environment Canada <sup>1</sup>		
Treatment & Distribution	Protocol for Safe Drinking Water in First Nations Communities	AANDC <sup>1</sup>		
Monitoring	Guidelines for Canadian Drinking Water Quality	Health Canada <sup>1</sup>	• First Nations <sup>2</sup>	
Management	First Nations Water and Wastewater Action Plan Water and Wastewater Policy and Level of Services Standards	AANDC and Health Canada <sup>1</sup>		

<sup>1</sup> Public Works and Government Services Canada provide technical support to departments <sup>2</sup> First Nations Technical Advisory Group provide technical advice to First Nations

First Nation Band Councils are responsible "for ensuring the water systems are planned, designed, constructed, operated, and maintained in accordance with the program and financial conditions of their

funding arrangements" (Commissioner of the Environment and Sustainable Development [CESD], 2005, p. 5). Pursuant to Section 81(1)(1) of the Indian Act (Government of Canada, 1985) Band Council can make bylaws for the purpose of "construction and regulation of the use of public wells, cisterns, reservoirs and other water supplies." However, their capacity or flexibility to plan and design a drinking water treatment plant is limited because of the AANDC formula for determining the appropriate level of service standards for a community. Under this arrangement, the federal government has the dual role of funding and enforcement agent. First Nations must follow reporting and inspection regimes as identified in the Protocol for Safe Drinking Water in First Nations Communities (2006). If AANDC determines that communities are not in compliance with the reporting requirements, funding for projects can be withheld or even third-party control may be implemented if failure to comply continues (Morales, 2006). The funding for community water treatment plants ranges from \$35,000 to \$65,000, depending on the size of the facility (Kamanga, Kahn, McGregor, Sherry, & Thornton, 2001). First Nations are responsible for covering 20 percent of the drinking water system operating costs (CESD, 2005). Communities are expected to raise this through user fees or other community revenue sources. The federal responsibilities to assist First Nations achieve comparable service standards are fragmented among several agencies; however, AANDC and Health Canada are the two main support agencies (Swain, Louttit, & Hrudey, 2006).

The federal government has two key responsibilities with respect to ensuring access to safe drinking water: funding and policy directives. AANDC is a funding agency, providing financial assistance to First Nations through the Capital Funding Program and the Operating and Maintenance Program. The Capital Funding Program covers 100 percent of the design, construction, upgrading, and major repair costs for water projects, whereas the Operating and Maintenance Program provides 80 percent of the day-to-day operation and maintenance costs. The operating and maintenance costs are based on the Gross Funding Requirement for service delivery. First Nations receive this funding through Comprehensive Funding Arrangements (Kamanga et al., 2001). As mentioned, First Nation Band Councils are responsible for the remaining 20 percent of operating and maintenance costs. In some circumstances, First Nations receive 100 percent of the operating and maintenance costs; however, this appears to be decided on a case-by-case basis, without any clear guidelines on how the decision is made. The other key federal responsibility is to make policies that enable First Nations to access safe drinking water. While there is no legislative foundation, there are several policies to guide efforts to protect drinking water on reserves. For example, the level of drinking water service standards that the government will finance is decided through funding formula. The current decision-making process does not allow much flexibility on the part of the community to address drinking water problems.

Health Canada, particularly through environmental health officers, is responsible for monitoring drinking water quality and to advise communities on how to improve it (Health Canada, 2003). However, Health Canada has consistently devolved responsibility of monitoring water quality to First Nations, largely in support of self-governance. If drinking water problems do occur, the Chief and Council are responsible for issuing the appropriate drinking water advisory (i.e., boil water or do not consume). Inadequate capacity to properly monitor drinking water quality within some First Nations raises concerns about the real health risks in many communities. The Procedures for Addressing Water Advisories in First Nations Communities South of 60° (Health Canada, 2007) describe the roles and responsibilities of the Chief, Council, and federal government in working towards the timely removal and prevention of future drinking water advisories. In the event of an unsatisfactory water sample and subsequent water advisory, the Chief and Council must develop and implement an action plan to eliminate the problem, monitor the effectiveness of the corrective measures, update community members on progress, and submit the action plan and other water system operation information to Health Canada and AANDC officials.

Source water protection requires that local capacity to integrate land and water-related activities be developed. Environment Canada, in partnership with AANDC and Health Canada, is developing guidelines and documents to help First Nations develop source water protection plans for the drinking water supply; however, the guidelines are not enforceable and only apply to reserve boundaries. Failure to incorporate watershed boundaries in the source water plans means that water quality and quantity threats beyond the reserve boundary will not be affected. Public Works and Government Services Canada supports the efforts of the other federal departments in the delivery of their programs. These departments have the responsibility of supporting First Nations by enhancing their capacity to provide safe water on reserves. The Ontario First Nations Technical Services Corporation also supports communities in building capacity. While provinces and municipalities are not listed, they are becoming increasingly involved in the governance of First Nations drinking water. We cover this in more detail later in the article.

In summary, the strategy for protecting drinking water in non-First Nations is more robust compared to the strategy in First Nation communities. There is no regulatory framework to ensure standards are being met; First Nations water systems are controlled through policy directives and conditional financing. Only a few First Nations are within the prescribed source water protection areas in the province. The capacity to operate and maintain drinking water systems is strained by the lack of adequate financial resources. The First Nations' Band Councils are accountable to the people in their communities to supply safe water; however, the financing is controlled by the federal government through a funding formula. Non-First Nations are able to charge for services and generate tax revenue, which is more sustainable, whereas, First Nations must rely on conditional federal funding. The responsibility for multi-barrier protection is fragmented among several departments. More regulations will not address the drinking water problems in all First Nations. Even with the development of legislative and regulatory standards, this does not affect the apparent gap in funding. Several recent reports have been critical of the federal government's efforts to ensure safe access to drinking water in First Nations (CESD, 2005; Swain et al., 2006). There does not appear to be an effective strategy for addressing the financial capacity issues on reserves. If the Sustainable Water and Sewage Systems Act (2002) applied to First Nations in Ontario, would the federal government agree to financially support full cost recovery of drinking water systems? We discuss financial and other capacity issues in the conclusion.

## Measuring Risk

Federal programs to enhance First Nations capacity to access safe drinking water tend to target at-risk communities. As a consequence, the government must both "define" and "measure" the risk among the drinking water systems of First Nations. The defining and measuring of risk by the federal government are the focus of this section. Wastewater systems are also the focus of the federal risk evaluation, but not discussed in any detail in this article.

The federal government's definition of risk is outlined in the Risk Level Evaluation Guidelines for Water and Wastewater Treatment in First Nation Communities (INAC et al., 2005). It is one tool the government uses to prioritize capital and maintenance projects and to develop long term plans to minimize health risks. The overall health risk ranking of a drinking water system is framed using five categories: water source, design, operation, reporting, and operators (INAC et al., 2005). Table 3 outlines the scoring rules for each category's numeric score and descriptive ranking.

The assessors spend several days in the community completing the survey on behalf of AANDC. The survey responses are based on interviews, document and report reviews, and other sources. The aim is to measure the risk of the drinking water system based on a risk ranking from one to ten. Using available information from regional representatives of the various departments and agencies involved in water governance, individual water systems are assessed to determine a risk ranking for the categories. The guideline requires assessors to address additional considerations in determining the category risk ranking.

Source water protection is the first line of defence in a multi-barrier approach. A clean source of water helps mitigate health risks and reduces reliance on treatment technology. The water source score is based on quality and quantity measures. The initial source water score (two or five points) is based on whether potable water is taken from surface water, groundwater, or groundwater under direct influence of surface water (GUIDI). In general, groundwater sources with lower recharge rates are considered safer (two points). If it is determined to be hydrologically connected or unknown, the water source is given the same risk score as a surface water

supply (five points) because surface water sources can be more vulnerable to pollution. The remaining items consider future threats. How vulnerable is the source water to contamination? Is there a sufficient amount of water to meet demand? Has source water quality been deteriorating? Does the community have a source water protection plan? The drinking water system design risk scores are based on how the system was built to operate. "If the system was operated and maintained perfectly, can the system theoretically treat the water to required levels? Whether it actually does is evaluated in the Operation risk category" (INAC et al., 2005, p. 10). Starting with an initial score of one, additional points are added based on the ability to meet the Guidelines for Canadian Drinking Water Quality (Health Canada, 1996), provincial building standards, waste management system, system capacity to meet demand, and overall reliability of the technology to treat and distribute safe water. Additionally, a high risk ranking is given if the system cannot meet bacteriological parameters or there is no disinfection treatment. The operation risk scores consider treated drinking water quality, as well as operating and maintenance procedures. Initially starting with one point, additional points are added based on the ability to meet the Guidelines for Canadian Drinking Water Quality (Health Canada, 1996), evidence of operating procedures, emergency response planning, and evidence of maintenance. There are a number of additional considerations. If the water plant fails to meet the Guidelines for Canadian Drinking Water Quality (Health Canada, 1996), the operation and design score should be raised by two points. Moreover, failing to meet bacteria levels raises the overall water system risk to high. If there is no disinfection treatment or the equipment is used incorrectly, the overall system should be ranked high risk. The final two categories focus on the plant operators. The reporting risk score is based on recording keeping and reporting habits of the water plant operator(s). Are drinking water quality monitoring records and reports available? An important consideration is also the relative importance of the missing information. The operator risk score is based on the level of training and experience the operator has with the technology for the community.

Within each category, the points are added to calculate the risk score. The risk scores range between one and ten. A category scoring over ten is given the maximum value of ten. The scores are grouped into one of three descriptive risk rankings: low risk (1-4), medium risk (5-7), and high risk (8-10). The five category totals are weighted and combined to measure the overall risk of the community drinking water system: Water source (10 percent); Design (30 percent); Operation (30 percent); Reporting (10 percent); Operators (20 percent). The weights are based on the relative importance of the category in minimizing potential health risks.

While polluted source water may pose a higher risk, ultimately the system should provide clean drinking water. Therefore, water source is not as important as the design and operation. Reporting is weighted less than operator because a trained operator is more likely to make the adequate reporting. (INAC et al., 2005, p. 2)

## Table 3. Federal Drinking Water Risk Evaluation System

Categories	Criteria	Description	Risk Score
Water Source	Groundwater		2
	Surface water <u>or</u> Groundwater under direct influence of surface water	based on type of source water	5
	Availability of water	Meets needs	0
		Past shortages <u>or</u> within the next 5 to 10 years	1
		Does not meet needs	2
	Vulnerability to contamination	Unlikely	0
		Low	I
		Medium	2
		Multiple sources	3
	Deteriorating or variable water quality	Source water deteriorating rendering treatment ineffective	2
	Source water protection	Ne plan implemented	2
		Implementing a plan not designed for the community's source water	1
		Implementing a plan designed for the community's source water	0
Design	Frequency of failing to meet	Either high frequency or magnitude	1
	quality guidennes	High frequency and magnitude	2
	Building design standards	Does not meet provincial design standards	1
	Multiple treatment processes	Does not have multiple treatment processes	1
	Waste management	No management of treatment process wastes	1
	Capacity	Does the system exceed 75% of its volume or within 5 years of allotted life cycle	1
	Flexibility	System not designed with flexibility to meet future demands	1
	System reliability	Overall system is unreliable including equipment, treatment process, power supply, chemical supplies, and distribution	3

Categories	Criteria	Description	Risk Score
Operation	Starting with Ipoint.		L
	Frequency and magnitude of failure to meet water quality guidelines	High frequency or magnitude	1
		High frequency and magnitude	2
	Operating procedures	No operating manual	3
	proceedies	Operating manual not being use	2
		An unapproved manual but maintenance being performed	l
	Emergency response	No emergency response plan	2
	Ver fication of maintenance	Inadequate maintenance is being performed	l
		Little or no maintenance is apparent	2
		If no record of maintenance	L
Reporting	Adequacy of records and report	Consistent records and reports (100-81%)	1-4
		Inconsistent records and report (80-52%)	5-7
		Improper records and reports (<25%)	8-10
Operator	Training and experience	Fully certified	2
		Certified I level	4
		Certified - 2 levels	6
		Certified - 3 levels	7
		Trained 2 + years	7
		Trained 2 - years	8
		Untrained 5 + years	9
		Untrained 5 - years	10

Table 4 demonstrates the overall drinking water system risk calculation for the Dokis First Nation. The system in the Dokis First Nation, with a population of approximately 200 people, would be classified as a small drinking water system (less than 500 people). There is road access to the community, which is located on the French River. The medium risk ranking of the Dokis' water system is based on the quality of source water, the water system design, and operation. It was reported that there was a source water protection plan for the well; however, no such plan exists. The source water receives a seven because it is unknown if the groundwater wells are GUDI. The medium rank is based on treated water failing to meet chemical and physical water quality parameters. No data on biological parameters were available. The Risk Evaluation Guidelines suggest raising the source by two points or increasing overall risk to high. It is unclear how the design and operation were given a medium risk, but it could possibly be due to the fact that the assessors had insufficient information to answer questions. The reporting and operator categories receive a low risk ranking, indicating that operators are trained to the level of the water treatment system and they are documenting and reporting test results. While keeping trained operators is a problem for some communities, it does not appear to be an issue in the Dokis First Nation. Each First Nation has unique situations and circumstances that may contribute to drinking water risks. We use the Dokis First Nation to illustrate the overall risk calculation scoring and ranking system. As demonstrated in the analysis section of this paper, we cannot conclude that the Dokis Fist Nation is representative of all small scale water systems in First Nations throughout the province. One thing that appears to be consistent among all First Nations is missing data in the risk surveys and lack of community members' involvement in the risk ranking.

Risk Evaluation Categories	Weight (%)	Example Dokis First Nation
Water source	10	$7 \ge 0.1 = 0.7$
Design	30	6 x 0.3 = 1.8
Operations	30	$7 \ge 0.3 = 2.1$
Reporting	10	$1 \ge 0.1 = 0.1$
Operator	20	$2 \ge 0.2 = 0.4$
Overall Risk	Low (1-4) Medium (5-7) High (8-10)	5.1 (medium risk)

Table 4. Drinking Water Risk Rankings Calculation for the Dokis First Nation

The risk categories are added to determine an overall risk ranking for the each water system. Scores range from one to ten, and are categorized as low (1-4), medium (5-7), or high (8-10). The characteristics of each risk ranking are described in Table 5.

Table 5. Federal Evaluation Risk Rankings

Risk Rank	ank Characteristics			
Low	minor deficiencies, meeting GCDWQ for drinking water			
Medium	deficiencies, which individually or combined pose a risk to the quality of water and human health. Do not require immediate action, more easily corrected			
High	major deficiencies posing a high risk to the quality of water and may lead to health and safety or environmental concerns. Deficiencies result in advisories, repetitive non-compliance with guidelines and inadequate water supplies. Regions jointly with First Nations are to undertake immediate corrective action to minimize or eliminate deficiencies.			

Source: INAC et al. 2005; 3-4

"Source water protection mitigates risk and decreases the burden on the treatment facility. Mitigation of risk from barriers from the source to tap is ideal; however, ultimately, water treatment is relied upon to render the water safe for distribution as drinking water" (INAC et al., 2005, p. 5). This statement appears to indicate that the federal government considers drinking water capacity a technological issue. Sixty percent of the community risk score is based on categories that measure the technological capacity to supply safe water. In their studies of drinking water protection, de Loe and Lukovich (2005) and Ivey, de Loe, and Kreutzweizer (2006) identify five dimensions of capacity: financial, institutional, technical, political, and social. We will discuss some of these dimensions of capacity in the conclusion of the article. We use the federal Risk Level Evaluation Guidelines as a framework to compare the capacity to implement multi-barrier protection of drinking water systems in First Nations and municipalities.

## **Data Collection and Analysis**

Through the Access to Information Act the federal risk evaluation surveys of First Nations drinking water systems in Ontario were obtained for 2005 and 2007. At the time of writing more recent data on First Nations risk surveys were unavailable. The database includes risk rankings in five categories: source water, design, operation, reporting, and operators. Within each of the five categories there are several subsections that are used to measure "risk." The overall risk rankings for communities (low, medium, or high) are determined using the federal drinking water risk evaluation guidelines previously discussed. There are 137 First Nation communities in Ontario and 143 First Nation drinking water system risk evaluation surveys (Figure 1). The red dots mark the approximate location of First Nation drinking water systems, whereas, the blue dots represent First Nation drinking water systems inside the provincial source water protection areas. Some communities do not have a drinking water system, whereas, others may have several drinking water systems in various communities within the reserve. Of the water systems, 45 serviced between 500 and 5,000 people and 98 serviced fewer than 500 people. The majority are considered small scale water systems.



Figure 1. Location of First Nations Drinking Water Systems in Relation to Provincial Source Water Protection Areas in Ontario

These data are not available for drinking water systems operated by municipalities or townships. A survey based on the federal risk evaluation guidelines was sent to municipalities and townships throughout Ontario. A total of 54 municipalities and townships throughout the province completed it (Figure 2). The number of people serviced by the drinking water systems varied: 9 serviced less than 500 people; 26 serviced between 500 and 5,000 people; and 20 serviced over 5000 people. Again, the red dots are water systems outside the source water protection regions, and the blue are inside these areas. The municipal and township surveys were completed by staff from their respective communities. The respondents were very knowledgeable of their community water system(s). The survey questions correspond with Table 3 above, which outlines the risk evaluation scoring and ranking procedures.



Figure 2. Municipalities Responding to the Drinking Water Risk Survey in Relation to Provincial Protection Areas in Ontario

The gap between First Nations and non-First Nations is quite evident, as shown in Tables 6 and 7. We discuss these tables and the survey responses in the following sections. Details within the survey responses shed further light on the differences in service standards of First Nations and non-First Nations of similar size and location.

_	Risk Categories	Low	Medium	High
	Source water	16	55	72
	Design	72	22	49
	Operation	60	51	32
	Reporting	65	48	30
	Operator	112	19	12
-	Overall	55	62	26

Table 6. First Nation Communities Drinking Water System Risk Rankings

Table 7. Municipal Drinking Water System Risk Rankings

Risk Categories	Low	Medium	High
Source water	16	34	4
Design	52	2	0
Operation	52	0	2
Reporting	54	0	0
Operator	54	0	0
Overall	54	0	0

## Source Water

The first point of risk prevention is source water protection. Ontario's Clean Water Act and subordinate regulations establish source water protection committees and regions to better integrate water protection and growth management by creating a watershed-based approach. Land use decisions require consultation with other water users. Under the current regulations, municipalities are responsible for the development and implementation of risk management strategies, while conservation authorities are responsible for the coordination of planning efforts across source water protection regions. A local authority is required to assess threats to water quality and quantity through a process that emphasises a science-based approach.

As mentioned earlier, First Nations in parts of Ontario can participate in the source water protection planning process. First Nations located in one of the 19 source water protection regions in the province are entitled to one, two, or three representatives on the source water protection committee, depending on the size of the committee. If there is more than one community, there is still only one seat available on the committee. Other representation (and the number of seats) on the committees includes municipal (five or seven seats), agriculture (two or three seats), industrial (one or two seats), aggregate/oil and gas (two seats), and other (five or seven seats). The source water protection committees have 16 or 22 voting committee members, plus First Nation representation, if applicable. Through a Band Council Resolution, First Nations can request that their drinking water system be included in the source water protection planning process. The 19 source water protection regions were established based on conservation authority boundaries. There are 27 First Nations

inside the source water protection regions, with 15 participating in the process. The remaining 110 First Nations are outside these areas (see Figure 1).

A comparison of the potential risks associated with source water of First Nations and municipalities demonstrates that there is a clear gap in capacity to access safe and adequate drinking water supplies. Figures 3a and 3b illustrate the distribution of low, medium, and high source water risk rankings for First Nations, municipalities, and townships across the province. Only 27 of the First Nations were reported to have a source water protection plan, whereas, 50 municipalities indicated that they had one for the community supply. The City of Waterloo was the only community to report the occasional shortage of water. Only seven survey respondents indicated that their community water supply was highly vulnerable to pollution because of multiple sources of contaminants in the watershed. Only two communities indicated that vulnerability was unlikely; interestingly, both the communities rely on surface water sources for their drinking water. The majority of respondents indicated a minor or low risk of pollution to the community water supply. The four communities with a high water source risk ranking were those without a source water protection plan. There are a large number of municipalities with a medium risk ranking because surface water sources receive an initial score of five.



Figure 3a: First Nation Source Water Risk Rankings in Ontario



Figure 3b: Municipal and Township Source Water Risk Rankings in Ontario

## Design

Recall that the design risk score and ranking are based on whether the community treatment technology could supply clean and adequate potable water, if operated as designed; while the operation category covers whether or not the system does supply adequate and safe drinking water. The design rankings for First Nations and other municipalities are shown in Figures 4a and 4b. Two communities had a water system design risk of medium, both with scores of five (Figure 4b). With respect to the subcategories, it would appear some small and medium size communities tend to experience higher risk in comparison to the larger urban areas. Treated water in the City of Timmins and Alnwick/Haldimand Township did not meet provincial standards; however, this only occurred in Alnwick/Haldimand Township during a power outage or pumping issue that resulted in a temporary boil water advisory. With the exception of the City of London, all other communities without filtration and disinfection were small or medium size systems.

In Ontario, 49 of the 143 drinking water systems were ranked high risk; 63 of them exceeded federal drinking water health parameters. No data were available for 30 drinking water systems. This raises concerns about the adequacy of communities to monitor water quality. In many First Nation communities, the drinking water systems are at capacity and struggle to meet growing demand. It is often reported that having a small population and being in a remote location, as defined by distance from urban areas or lacking in road access, are key factors in providing access to safe water. However, no apparent clustering of First Nations based on size or location in any of the risk categories was found (Figure 4a). Neither of these appears to explain the risk experienced by First Nations in Ontario.

## Operation

The operation risk category evaluates if the treatment technology provides adequate amounts of safe drinking water (Figures 5a & 5b). The water system operation risk rankings are high in two communities, whereas, they are low in the other 52 communities in this category (Figure 5b). Machin, a town located in northwestern Ontario that supplies water to nearly 550 people, received a high risk ranking because the drinking water system failed to meet bacteriology. The Town of Mississippi water system in the town of Mississippi that supplies 5,000 residents received a high risk ranking because it lacked disinfection treatment and failed to meet provincial drinking water standards. Six non-First Nation communities reported not having an emergency response plan; these included a mix of large, medium, and small drinking water systems throughout Ontario.



Figure 4a. First Nations Drinking Water System Design Risk Ranking in Ontario



Figure 4b. Municipal and Township Drinking Water System Design Risk Rankings in Ontario



Figure 5a. First Nation Drinking Water System Operation Risk Rankings in Ontario



Figure 5b. Municipal and Township Drinking Water System Operation Risk Rankings in Ontario

In many First Nations, the service standards to ensure adequate and clean drinking water are not being met. According to the federal Risk Evaluation (Figure 5a), the drinking water systems in 83 First Nations were at medium or high risk, while only 12 were reported to supply a sufficient volume of water to the community. This number probably underestimates the number of drinking water systems that supply a sufficient amount of water because there were 128 responses of no data available.

## Reporting

The reporting requirements for municipal water systems are legislated in the province, but there is no legislative basis for reporting requirements in First Nations. The quality of reporting varies among First Nations (Figure 6a); however, there is evidence that service standard gaps exist. Sixty drinking water systems in First Nations had positive test results for coliform. The frequency ranged from 1 to 168, with an average of 14 per community over the previous two-year period. All municipalities were a low risk in the category of reporting (Figure 6b). The reporting category is linked to the operator risk ranking because a trained operator would ensure that reporting and testing was completed.



Figure 6a. First Nations Drinking Water System Reporting Risk Rankings in Ontario



Figure 6b. Municipal and Township Drinking Water Reporting Risk Rankings

## Operator

The majority of First Nations water systems were run by trained operators and only 12 drinking water systems were at high risk due to operator qualifications (Figure 7a). Again, there are no medium or high risk municipal drinking water systems in the province in the operator category (Figure 7b). The ability to hire and retain highly qualified people to run the drinking water treatment plants does not appear to be an issue. Only one community reported having an operator certified one-level below the treatment plant; however, that person was in the process of receiving the necessary level of certification. The inability to retain trained operators does not appear to be a problem, and it seems that the investment in training has been effective.



Figure 7a. First Nations Drinking Water System Operator Risk Rankings in Ontario



Figure 7b. Municipal and Township Drinking Water System Operator Risk Rankings in Ontario

## Overall

The most revealing comparison is the overall risk rankings for communities. There is much greater variability in the capacity of First Nations to implement multi-barrier protection (Figure 8a). None of the municipalities scored higher than a four out of ten on overall risk. All the municipalities were in the low overall risk ranking category (Figure 8b). It is often reported that small and remote municipalities and townships experience greater risk than the larger urban areas. One of the smaller municipalities in central Ontario commented that they would be in need of financial assistance to upgrade some of the older sections of the distribution system; however, that does not appear to be the case using the federal Risk Evaluation Guidelines.



Figure 8a. First Nation Drinking Water System Overall Risk Rankings in Ontario



Figure 8b. Municipal and Township Drinking Water System Overall Risk Rankings in Ontario

The five categories of risk and the sub-categories demonstrate a clear difference between service standards among many First Nations and other First Nations or non-First Nation communities. These capacity issues should be addressed prior to transfer of First Nations drinking water systems to provincial legislative control.

## Conclusion

The federal government has a constitutional responsibility to ensure that communities of similar circumstances should have equivalent service standards. Although it is often reported that drinking water systems in small and remote communities – First Nation or otherwise – are characteristically at risk, this study would suggest otherwise. There was a mix of small and remote, as well as large, municipalities that responded to the survey; yet, none of the 54 non-First Nation communities scored above low risk. While some non-First Nations were high risk in some categories, the overall risk for all non-First Nations was low. This has implications for First Nations if their water systems are subject to provincial, or any other, legislation and regulatory standards. We discuss the current limitations by examining the technological, financial, institutional, political, and social capacity issues that bear on the First Nations ability to implement multi-barrier protection.

The delivery of adequate and safe drinking water is a complex technical task. Each step in the multi-barrier approach requires highly skilled persons and adequate equipment to ensure people have access to safe drinking water. The ability of municipalities and townships to staff or retain the necessary expertise to plan and manage water systems helps to minimize their overall risk. The technical and financial capacity issues are mutually supportive. Municipalities and townships have greater control over the technical issues by virtue of better financial certainty. This is not to suggest that it is not difficult for small communities to meet the stricter monitoring and reporting standards. The survey provided space for respondents to comment on other issues. Respondents from three small communities benefit from economies of scale, spreading the increase costs among many customers. Provincial grants are available to help support capital expansion and repair; however, the financial strain is felt in many communities.

There is cooperation between the Ontario and federal governments to help address the technological problems in some First Nations. A recent pilot project aims to introduce alternative drinking water systems in some Ontario First Nation communities. A few communities will be selected to help showcase Ontario water treatment technologies. This pilot project does not discuss the long-term financing for operation and maintenance of the technology in the selected communities.

Financial capacity is an ongoing challenge. The Sustainable Water and Sewage Act will ensure that municipalities and townships are receiving full cost recovery for the delivery and collection of drinking water. How would First Nations meet this legislative requirement? The governance of First Nations drinking water is complex. The recently concluded Safe Drinking Water for First Nations Act (2012) would have addressed the current legislative gap in service standards, but it would not have solved the financial shortfall.

Political leadership is critical to success; however, political action appears to ebb and flow from one water crisis to the next. The evacuation of community members from Kashechewan and the housing crisis in Attawapiskat gathered attention from ruling and opposition parties, but both political and public attention soon wanes, until the next crisis is revealed. In the meantime, responsibilities continue to be downloaded upon First Nations without sufficient resources. The Safe Drinking Water for First Nations Act (2012) did little to help mend relationships with First Nations either. There appeared to be little consultation with First Nations about transferring water systems to provincial and territorial legislation and standards.

Social considerations include the level of public awareness and participation in decision-making (de Loe & Kreutzwiser, 2005). First Nations located within the source water protection regions in Ontario have an opportunity to participate in the development of source water protection plans if they agree to be subject to

provincial legislation. The majority of First Nations are located outside the 19 source water protection regions. For those inside these areas, there is an opportunity to work on building relationships with others in the watershed.

Despite the financial and technological investments in First Nations water systems, there are significant differences in service standards among First Nations and non-First Nation communities in Ontario. It suggests that the problem with drinking water in First Nations is possibly more than just a financial or technological problem. Are there other possible underlying determinants of drinking water risk? The current survey methodology fails to incorporate the community members' perceptions of the problem. Doing so may help improve relationships among First Nations and other levels of government in Canada. This comparison study was based on a snapshot of risk. Tracking the temporal and spatial variability among First Nations may help identify other possible determinants of risk. Why do some First Nations have the capacity to implement a multi-barrier approach and others do not?

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