

Boil Water Advisory Mapping Project: An exploration and review of available data

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Project objectives

The original objective of the *Boil Water Advisory Mapping Project* was to gather and systematically review information about boil-water advisories from across Canada in order to indicate where drinking water quality and, thus, public health is at risk. In addition to mapping the geographic distribution of compromised drinking water, the intention had been to also demonstrate what diversity exists in the severity of threats to water safety and the duration of exposure to these threats, anticipating that the analysis would confirm differences by region, urban or rural residence, and particularly distinguish the great extent of health risks faced by many reserve communities, as have been described by First Nations organizations for decades. This analysis would then form the basis for further investigation of health and related effects of water quality issues in the most affected communities, and on women in those communities.

Project objectives were revised when an initial scan of existing projects and available data sources found: 1) a national, web-based map of boil water advisories had already been developed by *Water Chronicles* (as described below), 2) public access to Health Canada data on First Nations water advisories is very limited, which precluded an analysis of the distribution of those advisories and limited the ability to compare First Nations and non-First Nations communities, 3) additional information on First Nations drinking water was soon to be released¹, and 4) quality and consistency issues for provincial and territorial boil water advisory data were apparent. Thus, the objectives were amended to focus on a description of the BWA data and its limitations for the current *Women and Water* research, in order to build a foundation for future work.

Methodology

Provincial and territorial government websites and the Health Canada website were reviewed for the availability of drinking water advisory data, and where data were not found, additional searches were performed using the *Google* search engine. Data were compared for variables reported, timeliness of updates, any quality issues described by administrators, or other issues that arose in review. Data from the online map of water advisories was triangulated with a sample of data from original data sources. As well, an online search was performed for critiques of BWA data, water quality measurement initiatives or research, and key media reports concerning water advisories.

Availability and limitations of water advisory data

There is no universal indicator of household access to safe drinking water in Canada. The Canadian Institute for Health Information has identified the need and stated the intentions of a national collaborative initiative—the Health Indicators Project—to develop a comparable indicator of drinking water quality, as well as an indicator of waterborne disease (CIHI, 2005). Statistics Canada, as part of its Environmental Sustainability Indicators, has monitored freshwater quality primarily for the purpose of assessing risks to aquatic life. However, since 2006, efforts have been under way to develop a measure that assesses the quality of water for human consumption, though to date no results have been published. The quality of both source and treated water will be monitored. Measurement tools will score their quality according to how closely specific parameters of water quality conform to Canadian guidelines, as well as rank source water for treatability according to the complexity of treatment required to meet guidelines (Statistics Canada, 2008a). This information is drawn from data collected by Statistics Canada's

Survey of Drinking Water Plants², which Indian and Northern Affairs Canada also implemented in First Nations communities (Statistics Canada, 2008b). As well, the Federation of Canadian Municipalities, which carry responsibility for the provision of clean water to a large proportion of the Canadian public, compile data on hundreds of variables concerning key quality of life issues in selected Canadian cities; these include wastewater treatment and water consumption, but do not include drinking water quality (FCM, n.d.). Thus, drinking water advisories still represent the best available proxy indicator of the safety of drinking water. However, it is important to consider some limitations of the measure and quality issues for existing public data sets, particularly for comparisons across jurisdictions.

Regulations governing BWAs and public notification of advisories differ considerably between provinces, territories and First Nations reserves. A cross-jurisdictional review of water policy conducted by Ecojustice in 2006 (then called the Sierra Legal Defense Fund) reported improvements in transparency and accountability since 2001, yet still found that five provinces and territories lacked criteria specifying when an advisory should be issued or procedures for notification (Newfoundland-Labrador, Northwest Territories, Nunavut, P.E.I., and the Yukon), seven had no requirements for public reporting (Alberta, Manitoba, New Brunswick, Northwest Territories, Nova Scotia, Nunavut, and Yukon), five lacked public reporting practices, whether annual reports, test results, or online water advisory listings (Alberta, Nova Scotia, New Brunswick, Yukon, Nunavut), and improved public reporting was recommended for three (BC, PEI, Quebec) (Sierra Legal Defense Fund, 2006).

Since 2006, further improvements in reporting have been accomplished, including the addition of online advisory listings for Nova Scotia and New Brunswick, and an online data module provided by Alberta. However, even where public reporting exists, formats vary considerably and do not always include water advisory data, which limits the opportunity for comparison. Eight provinces and territories maintain a public online listing of current water advisories³ and three provide other information, such as test result data⁴. Nunavut and Yukon territories still do not provide public data. Health Canada gathers data on water advisories issued on First Nations reserves, but posts only total counts of advisories, without specifying the community in which they occur, or any additional information. Other public advisory listings provide information on several additional variables--including reasons for advisories, start and end dates, source water information, and type of advisory--although these vary from one jurisdiction to the next, and sometimes even within regions. Advisory listings may also vary in their coverage, due to the failure by some public health units to report events or to rescind them promptly when they have been resolved, as was observed by Ontario officials (Eggertson, 2008). The extent to which regions vary in the coverage and timeliness of BWAs may introduce bias into an analysis of their regional distribution. One national review of BWAs reported that only 5 of 9 Alberta Regional Health Authorities provided information on BWAs. As well, some health regions acknowledge considerable time lags in reporting (e.g. three month lag for the BC Interior Health Region) (Eggertson, 2008). Furthermore, in most jurisdictions, water advisories are only recorded for public or semi-public water supplies (often limited to some minimum number of household connections), and do not address the safety of drinking water obtained from private wells (one exception is the Manitoba advisory listing). Approximately 4 million Canadians obtain water from private wells, which studies have shown to exceed minimal acceptable standards for contamination more often than public supplies (Jones et al., 2005).

It is noteworthy that in some jurisdictions, initiatives which purport to improve information on drinking water appear to have created a more cumbersome format which may pose barriers for the public. For example, an online interface may allow users to look up individual water suppliers for detailed, technical information (e.g. monthly test result reports) and search for a history of adverse water quality events. However, current water advisories for all

suppliers cannot be derived without having to search for information on each of numerous suppliers. Users may also be given a telephone number to contact their water supplier, which places the onus of responsibility for the dissemination of information on individual members of the public. In the case of the Alberta government's website, emergency advisories are explicitly excluded from the site, which is designed to provide only monthly or annual reports, as stated in a disclaimer on submissions (www.environment.alberta.ca). Reduced access to public advisories in Ontario in recent years was noted by a report to the Walkerton Inquiry, the authors stressing the importance of transparency for public trust as well as for the benefits of research (Krewski et al., 2002). Although, arguably, local suppliers offer the best information about water quality issues because they are directly involved in water treatment, and their involvement may improve accountability, recent changes to public notification systems call into question whether the public, as well as researchers and planners, have sufficient access to information on drinking water quality. It is possible that fragmentation of responsibilities and increasing political sensitivity around drinking water safety is compromising the public's access to important public health data. With no uniform system for reporting the status of drinking water, accountability and equity may also suffer.

Water Chronicles, an independent online media organization, monitors information on drinking water quality for the purpose of raising public awareness. Their website (water.ca) posts available data on current boil water advisories on an interactive map of Canada and on maps for each individual province or territory; listings are updated daily. Boil water advisories, "do not consume" orders, Cyanobacteria blooms and water shortages are each mapped separately. Water Chronicles obtains data from available online public listings provided by provincial/territorial governments or, in some cases, from direct updates by their contacts in provincial ministries, or from media advisories, where no public listings are available. Although First Nations reserve data have recently been added to the site, it is unclear how complete these data are and whether the data will be continually updated, with cooperation from Health Canada. The advantage of the website is the consolidated national picture of Canadian drinking water advisories that it provides.

Water advisories are primarily intended to serve as preventative measures; they do not necessarily indicate the occurrence of unsafe drinking water, nor indicate a uniform level of risk. The reasons for an advisory and therefore the associated severity of drinking water risks vary considerably, though different provincial and federal jurisdictions may not consistently distinguish this variability in the terminology they employ. Often, a *boil water advisory* or a *precautionary advisory*, as these terms clearly imply, are terms used when the public has been alerted to take precautionary measures, (e.g. boil the water, at a rolling boil, for one full minute) to protect against a potential threat to health in public drinking water. Such advisories are commonly issued when there are unacceptable levels of disease-causing bacteria, viruses or parasites in the water system anywhere from the source to the tap, when there is an unacceptable level of turbidity (cloudiness caused by fine particles) which promote bacterial growth and hamper disinfection, when there has been an interruption in or discontinuation of treatment, or for reasons of aesthetics or taste. Generally, *boil water orders*, *do not consume orders* or *emergency advisories* are terms used when there is evidence that an outbreak of illness is or may be associated with drinking water. Where boil water advisories have been in effect for a long time, some may be classified as *permanent orders*. Arguably, permanent orders lose relevance as preventative measures, but may imply greater severity of conditions. In rare cases, *do not use orders* may distinguish severe conditions where it may be harmful to come into contact with the water supply, which was the case in the First Nations community of Kashechewan, where residents developed rashes on the skin (Harden & Levalliant, 2008). Therefore, a lack of consistency in terminology may lead to a loss of information regarding severity of some circumstances, when comparisons are made across jurisdictions.

In the absence of nationally enforced standards, differences in quality standards, treatment requirements and regulations for the issuance of drinking water advisories may influence the number of advisories reported within various provincial and federal jurisdictions, or changes in the number of advisories over time. For example, an increase in the number of advisories issued in British Columbia over a span of several years are thought to reflect increased monitoring and application of turbidity guidelines in recent years (Eggertson, 2008). Similarly, although a regulatory framework for First Nations communities is now under development, critics note that reserves have long suffered the consequences of a lack of regulations and legislation regarding drinking water, as INAC and HC policies and guidelines afforded these communities lesser protection than did the more stringent regulatory regimes in place in the provinces (Harden & Levalliant, 2008).

It is noteworthy that reports on the frequency of water advisories count each advisory equally, though they may refer to water systems that range widely in the size of population served (one resort, campground, school, trailer park, or a larger community). Water suppliers or facilities rather than communities generally represent the unit of observation in studies of water advisories, and most communities are served by multiple suppliers. From a public health planning standpoint, it would be useful to have a measure of the size of the population lacking access to potable water. Newfoundland provides the only advisory data set with information on the size of population affected. Large numbers of advisories appear in Newfoundland-Labrador, particularly in proportion to the size of the population. A CBC news report from 2000 stated that approximately 10% of Newfoundland's population may not have safe drinking water (CBC, 2008, Nov.), which has diminished to approximately 8.6% in 2009⁵. As well, Ontario's adverse water quality incidence reports provide information on the number of houses served by the water provider under consideration. The Aboriginal Peoples Survey is another source of data that quantifies the Aboriginal population⁶ affected by unsafe water, as the survey estimates the proportion of residents who report unsafe drinking water at the time of the survey and at any point during the year, which is recorded by community and summarized by province, or urban or rural residence (Statistics Canada, 2006).

Access to archival information on water advisories is very limited, as advisories are most often removed from a listing when they have been resolved. Only Northwest Territories and New Brunswick offer archival data for multiple years, whereas Manitoba, the Interior of BC and Nova Scotia include advisories rescinded within the calendar year, or in the case of Nova Scotia, only those rescinded within the past week. Although the duration of current advisories may be calculated, because they are unresolved events they will not provide an accurate estimation of the rate of resolution of boil water advisories. Based upon 654 drinking water advisories for First Nations reserves during 1995-2007, a report (soon to be released) by the First Nations and Inuit Health Branch of Health Canada found that one fifth of water advisories were resolved within one week, and just over one third were in effect for two weeks or less, whereas one quarter of advisories lasted longer than a year. Their findings also point to the need to account for seasonal variation in drinking water advisories, as significantly more advisories were issued in summer than in winter months (Lydon-Hassen et al., 2009).

Cross-regional and other comparisons (First Nations and non-First Nations, urban and rural) of drinking water safety also need to consider the available evidence on variability in causes of unsafe water supplies. Though the available BWA data often provide some information on reasons for advisories, these are most often limited to short-term, procedural issues or detailed test results. The underlying or 'upstream' causes of advisories are not normally addressed in BWAs. Some common causal factors that contribute to bacteriological contamination include wastewater contamination of drinking water supplies, contamination of surface water from animal waste, or where watersheds are insufficiently protected from industrial waste. As well, Spring runoff contamination is a common

seasonal factor. For example, much of southern Manitoba lies in a flood plain, and spring flooding can lead to the contamination of drinking water supplies for those who rely on private wells supplied by groundwater, which reflects the current situation (April 2009) in the province as it faces large scale flooding. BWAs for Newfoundland-Labrador indicate the influence of underlying economic factors on water quality, as a fairly common reason stated is chlorination having been turned off by operators due to a lack of funds to operate the treatment system. Furthermore, small rural communities and reserves are likely to face compounded challenges of poorer quality water sources, coupled with limited financial, human and technical resources, compared to urban centres. Critics point to a grossly under-resourced infrastructure on reserves, where in fact the need for sophisticated treatment plants is greater than in cities (Peterson H., 2006). INAC officials, themselves, have acknowledged that their estimates for the capital investment plan for water and wastewater systems in 2002 to 2007 fell short by 30 to 50 per cent (Peterson S., 2008).

Other Important Data for Consideration

Other data which hold importance for this research include the cost to consumers of public drinking water and data on the prevalence and incidence of waterborne illness and deaths attributed to contaminated water, to which gender-based analyses and a consideration of the cultural relevance of those analyses should be brought to bear.

Estimates have placed the cost of water to the average Canadian household at approximately \$25 per month (Hrudey, 2008, May), and the unit cost for North American urban residents at 50 cents per one thousand litres—1,000 times less than the cost of bottled water (CBC Marketplace, 2000). Municipalities are poised to increase the price of water to adequately resource treatment infrastructures and maintenance (Hrudey, 2008, May), added costs which women may be least able to afford. Women are disproportionately found among Canadians living in poverty and have been found to sacrifice their food budget and their own nutrition in order to meet the cost of housing and utilities, which are inadequately resourced by social assistance programs (McCracken, 2004). Yet, a national opinion survey has also found that women, parents with young children, and Canadians living in agricultural areas report the greatest willingness to pay more for safer public water (Canadian Water Network, n.d.). The results suggest that despite women generally having lower incomes than men, they place a relatively high value on the safety of drinking water, which may reflect their greater investments in domestic and caregiving roles, as well as other gendered aspects of water's meaning for women.

According to the United Nations, 80% of illness in developing countries is caused by water, but in Canada, there is limited analysis of the burden of such illness or its rate of occurrence. There is even less analysis of gender influences on waterborne illness or of its gender distinct effects. However, Health Canada's National Notifiable Disease Registry provides data on several waterborne illnesses, which are sex-disaggregated. In 2004, the PHAC reported 571 cases of cryptosporidiosis, including 304 cases in males and 263 in females. In the same year, there were 4,046 cases of *Giardiasis*, including 2273 in males and 1752 in females⁷ (PHAC, 2006). Overall, Health Canada estimates that approximately 90 deaths and 90,000 illnesses each year are caused by contaminated drinking water (Sierra Legal Defense, 2006). According to one review of Canadian waterborne disease outbreaks, the highest rate of waterborne illness has been reported in BC, where most municipalities rely on surface water which undergoes chemical treatment, but no filtration (Krewski et al, 2002). A new multi-year study led by the National Collaborating Centre for Public Health is enumerating past cases of waterborne illnesses (including illness related to exposure to chemical and radiological agents in drinking water) in Canada to identify risk factors contributing to ill health, with the goal of linking the evaluation of water system safety to known public health outcomes (NCCEH, 2008, April). The

importance of linking illness and water quality data may increase as the number of immunosuppressed individuals increase in Canada (e.g. due to HIV/AIDS or population undergoing cancer treatment).

Summary & Conclusions

Canadian water advisory data lack coverage, timeliness and consistency, making it difficult to draw fair comparisons across regions or between First Nations and non-First Nations populations. Furthermore, most jurisdictions lack information on the duration of water advisories or archival data necessary for the calculation of rates of resolution, and nearly all jurisdictions lack information on the size or, in the case of federal data for First Nations reserves, even on the location of a population at risk. Thus, the 'person place and time' variables upon which epidemiological methods rely are not addressed by water advisory data and limit its utility for public health planning. Flawed as it is, in the absence of a better indicator of the safety of public water, water advisories remain a quick and convenient measure. Water Chronicles provides an online mapping tool for Canadian boil water advisories, though it necessarily reflects the same data limitations of its original sources. In an increasingly politicized context, this independently produced resource meets a growing gap for information, particularly as we see a trend toward decentralized information on drinking water quality, and reduced access and transparency of public information. In conclusion, this review of current Boil Water Advisory data indicates that the Canadian public and researchers lack comprehensive information on the safety of drinking water necessary to assess equity in this area of study.

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¹ The First Nations and Inuit Health Branch of Health Canada would soon release a report on First Nations drinking water advisories; a poster presentation based on the findings was shared with us and is referenced below. Secondly, at the time of publication, *Water Chronicles* was in the processes of adding First Nations reserve data to its online map of Canadian water advisories [www.water.ca].

² Includes approximately 2,600 facilities, licensed and regulated by provincial or territorial agencies; excludes systems that serve communities with less than 300 people and other regulated systems that service schools, camp grounds, commercial establishments, or provincial parks.

³ Public water advisory listings:

- British Columbia: BC recently reorganized their website, removing a central portal to their water advisories. Advisories are now accessed through the websites of individual health authorities.
 - Northern Health Authority - <http://www.healthspace.ca/nha>
 - Interior Health Authority - <http://www.interiorhealth.ca/health-and-safety.aspx?id=536&terms=boil>
 - Vancouver Island Health Authority - http://www.viha.ca/mho/environment/water_quality/boil_water/
 - Vancouver Coastal Health Authority - <http://www.vch.ca/environmental/drinking/>
 - Fraser - <http://www.fraserhealth.ca/HEALTHTOPICS/ENVIRONMENTALHEALTH/Pages/WaterTurbidity.aspx>
- Manitoba: <http://www.gov.mb.ca/waterstewardship/odw/public-info/boil-water/index.html>
- New Brunswick: http://www.gnb.ca/0053/public_health/alerts_advisories-e.asp
- Newfoundland & Labrador: <http://www.env.gov.nl.ca/env/env/waterres/cwws/microbiological/boilwateradvisories.asp>
- Northwest Territories: http://www.maca.gov.nt.ca/operations/water/WaterQ_Main_MenuSQL.asp
- Nova Scotia: <http://www.gov.ns.ca/nse/water/boiladvisory.asp>
- Quebec: <http://www.mddep.gouv.qc.ca/eau/potable/avisebullition/index.htm>
- Saskatchewan: <http://www.saskh2o.ca/>
- First Nations (Health Canada): http://www.hc-sc.gc.ca/fniah-spnia/promotion/water-eau/advis-avis_concern-eng.php

⁴ Other online water data/reports:

- Alberta: http://www.albertawater.com/index.php?option=com_content&view=article&id=72
- Ontario: <http://www.ene.gov.on.ca/envision/adverse/adversewater.htm>
- Prince Edward Island: <http://www.gov.pe.ca/envengfor/index.php3?number=1012573&lang=E>

⁵ Calculations performed by Prairie Women's Health Centre of Excellence, based upon 2006 population figures associated with Newfoundland-Labrador communities for which advisories were posted as of April 27, 2009.

⁶ For the purpose of the Aboriginal Peoples Survey (a post-censal survey), Aboriginal are individuals whose response to the Census question indicated that they: had Aboriginal origins and/or identified as North American Indian, Métis and/or Inuit, and/or had treaty or registered Indian status and/or had Indian Band membership.

⁷ Presumably, several cases were not assigned by sex.