OUR GROUNDWATER

Our Future

From Data to Innovation

Ottawa | February 2016

ACTION CANADA
BUILDING LEADERSHIP FOR CANADA'S FUTURE

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Theme for the year

Canada has a proud history of invention. New ideas in science, technology, education, government, public and private enterprise have informed the last 150 years. Drawing on lessons from these past creative disruptions, what policies does Canada need to support future economic or societal innovations?

Disclaimer

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Acknowledgements

This report was made possible by the dedication and support of Action Canada, its staff and board, and its community. Our deepest gratitude goes to Jim Mitchell, our Task Force Advisor, for his patience, teaching, and generous spirit. We wish to recognise Janet Smith and Malcolm Rowe for their advice and direction, as well as the numerous experts in groundwater science and policy whose knowledge informed our recommendations and challenged our assumptions. Finally, we are grateful to Cathy Beehan, Action Canada's CEO, for her leadership over the 2015-2016 fellowship year.

Executive Summary

Canada is a country that perceives itself as water rich, yet one quarter of Canadian municipalities experienced water shortages between 1994 and 1999.[1] In communities that depend on groundwater, the figure is even higher. In many parts of Canada, citizens, utilities and industries all compete for a portion of the country's finite groundwater resources.

Despite the critical importance of groundwater to the lives and prosperity of Canadians, few understand how much is hidden below the ground. The lack of data on the size and renewal rate of vital aquifers hinders innovation and the development of smart public policy related to how groundwater is managed in Canada.[2]

Groundwater extractions are not consistently recorded, and provinces and territories lack standardized reporting models that could facilitate better cross-jurisdictional comparison.

This report calls for the expanded collection of data on existing groundwater resources; for provincial and territorial governments to each empower a centralized body to oversee groundwater; and for greater groundwater policy and planning integration across all levels of government. Crucially, it is recommended that the groundwater data collected be made publicly available in order to foster both public and private sector innovation.

Introduction

Thirty-five million Canadians rely on surface and groundwater for residential and industrial uses. One third of the residents in Ontario, everyone in PEI and 80% of rural residents nationally depend on groundwater for their daily personal use.[2] Without continued, sustainable access to groundwater sources, the viability of these communities is threatened. The ability to power industry, grow crops and supply water necessary for drinking, cooking and cleaning is dependent on groundwater.

To ensure the availability of water sources for the future, Canada must ensure that the supply and demand for water are held in balance. This is no sure thing: population growth, climate change and industrial demands are putting increasing stress on Canada's water resources.[2] Canada's federal, provincial, territorial and municipal governments need a modern, 21st century approach to water policy, starting with access to accurate and timely data on water availability, water usage and replenishment rates. More specifically, they need this information for groundwaxter, which, by virtue of being underground and out of sight, has often been neglected in water policy. This is a critical oversight, especially in light of Canadians' current water usage patterns.

Canada's water consumption increased 25% over the 20 years leading up to 2005.[1] Per capita, Canadian residential water use is more than double that of Europeans.[2,4] Compounding this challenge is the expansion of new types of energy production, such as hydraulic fracturing (fracking) for natural gas, which requires vast amounts of water. In British Columbia, more than 8 billion litres of water were used for fracking in 2014, an amount the Oil and Gas Commission projects to increase until 2019.[3,4]

What is Groundwater?

Groundwater is found between particles of soil and in cracks and openings in underground rocks. Although groundwater exists almost everywhere, the quantity of water in the ground varies with the soil and rock conditions as well as the local weather. Areas where the amount of underground water is suitable to tapping with a well are called aquifers. Groundwater circulates as part of the hydrological cycle. When it rains, some rainwater infiltrates the ground and becomes groundwater. Over time, groundwater evaporates, flows to connect with surface water such as lakes and rivers, or is pumped out of the ground for human use. Groundwater is often discussed in contrast to surface water, also key to the hydrological cycle, which is the water found above ground in lakes, rivers and streams.

In Canada, very little data is recorded on groundwater supply, or its depletion, creating significant uncertainty for those who rely upon these water sources for their livelihood. To ensure the availability of groundwater to Canadian citizens and industries in the future, federal, provincial and territorial governments need to address the lack of data on groundwater supply (i.e., total quantity available by region across aquifers) and demand (e.g., number of wells, usage rates). With robust data, Canadian governments will be able to develop groundwater public policy that considers predictable supply of water to citizens and industry.

Dry Groundwater Wells in Canada[5]

From 1999 to 2003, the Canadian prairies experienced a drought similar in intensity to the famous "Dust Bowl" droughts of the 1930s. Many wells ran dry. Without them, farmers were forced to abandon their land and tens of thousands of jobs were lost. The cost to the Canadian economy was $5.8 billion. In fact, six of the ten costliest natural disasters in Canadian history have been droughts.

CASE STUDY:

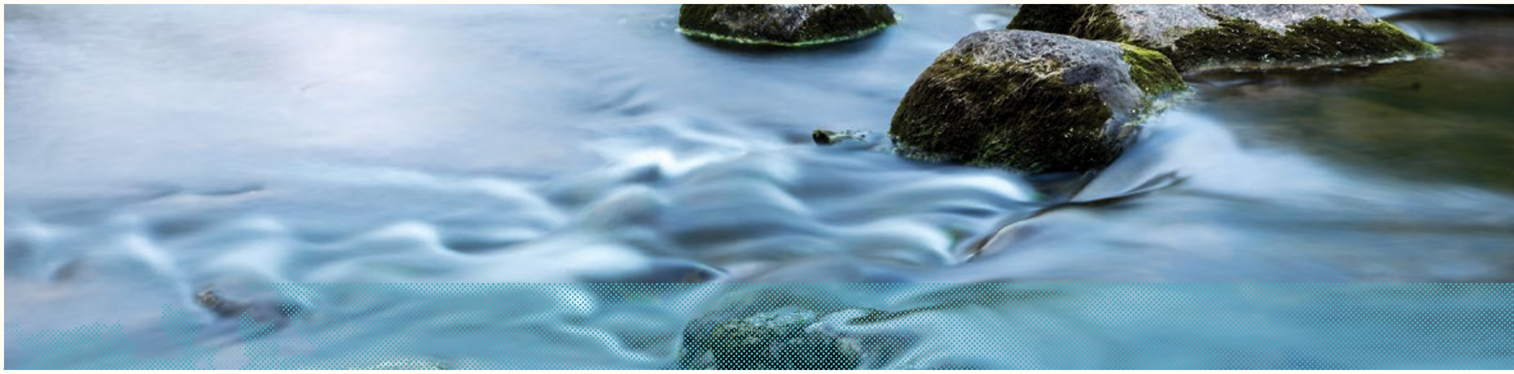
Data Drives Innovation – Acid Rain[6]

The acidification of lakes and rivers due to industrial production in North America emerged as an environmental and public health issue in the 1960s and 70s. This posed a particular problem in Eastern Canada as the Canadian Shield was identified as very sensitive to acidification. The cause of acid rain, however, was due to pollution by heavy industry on both sides of the border.

In 1991, both countries signed the Canada–US Air Quality Agreement to address trans-boundary air pollution in an effort to reduce acid rain. The agreement committed both countries to setting a cap on emissions, as well as increasing the monitoring and tracking of air pollution and progress towards reductions. The agreement has proven to be a success - Canada has reduced its emissions by 58% since 1990 and the United States achieved a 79% reduction. The reduction was due in part to innovations in industry.

For example, in response to regulation and monitoring, new coal energy technology drastically reduced sulphur dioxide emissions. New companies and opportunities emerged once governments were able to measure and regulate emissions.

In Canada, the Canadian National Air Pollution Surveillance program coordinates collection of air quality data from provincial, territorial and regional air quality monitoring networks across the country. As well, electric power generating facilities are required to have continuous emission monitoring systems (CEMS) technology and to report their air pollution emissions annually as part of the National Pollutant Release Inventory. The aggressive expansion of data collection and scientific monitoring under the Agreement has been crucial to both countries making progress under the Air Quality Agreement.



Current State of Groundwater Policy in Canada

Groundwater policy varies across provinces and territories but pockets of excellence have emerged as regulatory policies and practices are updated. However, large gaps remain; effective decision-making requires adequate evidence, and Canada lags behind other countries in its collection and monitoring of groundwater data.[2] The lack of robust data on groundwater resources currently limits the ability of Canadian governments to answer simple questions, such as 'how much groundwater can be sustainably extracted?' Despite best efforts to date, at the macro level, Canadian governments have a limited understanding of the quantity of groundwater consumed annually, and the rate at which groundwater is being replenished.

Concern over groundwater policy (or the lack thereof) is not new. The Canadian Geoscience Council (now the Canadian Federation of Earth Sciences) (1993), the Council of Canadian Academies (2009) and the Canadian Municipal Water Consortium (2014) have all called for greater collaboration among levels of government, highlighting the lack of reliable data as an obstacle to modern water policy and enforcement.[2,7,8] The Canadian Framework for Collaboration on Groundwater (2003) recommended a national groundwater monitoring network. Thirteen years later the ability to collect data and monitor groundwater resources remains limited.[9]

To address the question of groundwater supply, the Groundwater Geoscience Program has begun mapping 30 of Canada's largest aquifers.[10] The mapping of these vital aquifers will provide important insight into Canada's ability to meet its future groundwater needs. However, underground mapping is a time consuming and costly endeavour, and it is anticipated that this project will not be completed until 2025.

In terms of groundwater demand, there is a patchwork of policies in place across the provinces and territories, with each jurisdiction requiring different levels of reporting from groundwater users. Canada has no unified system across the country that allows for a comprehensive understanding of demand.

A State Runs Dry - California's Groundwater Depletion[11]

A 2015 study released by the California Department of Water Resources showed that land in California's central valley agricultural region sank more than a foot in just eight months as residents and farmers pumped more and more groundwater amid a record drought. Groundwater levels reached record lows, up to 100 feet lower than previous records.
NASA completed the study by comparing satellite images of the Earth's surface over time. The collapsing aquifers beneath the surface have permanently reduced water capacity, limiting potential for future replenishment.

Jurisdictional Challenges and Complications

The collection and coordination of data on groundwater supply and demand is inconsistent. Jurisdictional complexity and the geographic distribution of groundwater frustrate efforts to collect and share data effectively.

As a natural resource, groundwater is generally considered the purview of provincial and territorial governments, per the Canadian constitution. To varying degrees, each province and territory maps its groundwater resources, reviews and grants permits for use, and monitors the viability of watersheds. Issuing permits for groundwater usage includes regulating well drilling and operation, typically with provisions on pumping rates, quantity, duration, and purpose of use.[2]

There is, however, also a federal role. The federal government holds jurisdiction over federal lands and international boundary waters, including any groundwater found on First Nations reserves or aquifers shared by the United States. Federal water laws have an impact on groundwater by enabling the collection and inventorying of data; the protection of fish habitat; the control of potential pollutants; and by requiring environmental assessments on projects of, or funded by, the federal government.[2]

The issue of multi-jurisdictional responsibility for groundwater has resulted in fragmented regulatory frameworks for groundwater. Challenges arise because water is crucial in multiple domains, from industry to environment to drinking water. Jurisdictional overlaps abound. For example, the granting of a groundwater license (provincial and territorial jurisdiction) may negatively impact fish habitats (a federal responsibility).[2]

Adding to the complexity is the role of municipalities. While provinces and territories are primarily responsible for groundwater regulations, the impact of these regulations usually falls on local governments. Municipalities own water utilities and make land-use decisions that can impact an entire watershed.[8]

Fragmented Water Policy - British Columbia[12]

Today in British Columbia, groundwater use by the energy sector does not fall under the Ministry of Environment, but is managed by the BC Oil and Gas Commission, and is therefore subject to different standards than other industries. Varying standards across users for the same resource hinders the ability of the provincial government to develop effective policy, and sets the stage for potential conflict over water allocation.

Unified Groundwater Policy - Saskatchewan's Water Security Agency[13]

In 2012, the Government of Saskatchewan created the Water Security Agency, a Crown corporation mandated to protect and manage the quality and sustainability of all water in Saskatchewan. The Agency oversees the monitoring of the Province's dams, surface and groundwater, and wastewater services and is responsible for the allocation and forecasting of water use. The Agency monitors more than 70 wells and reports on aquifers in the province. It also works closely with the Prairie Provinces Water Board, which ensures equitable sharing of water resources between Prairie provinces and protects surface and groundwater quality and quantities.

Groundwater Data Initiatives

Groundwater licensing, monitoring and related data publication varies by province and territory. While Ontario has clear requirements for industry and residents with respect to access to groundwater and reporting its use, British Columbia has historically had little to no requirements for reporting usage.[12] Publication of these data – including critical pieces of information such as allocation rates and usage – is limited at best.

Province	License required for accessing groundwater?	Requirements for license holders to do ongoing monitoring?	Groundwater data published online?	Requirements for long-term groundwater planning for municipalities?
Alberta[14]	Yes, but not domestic use	No, but can be conditional	Well drilling only	Non-binding targets
British Columbia[15]	Yes, but not domestic use. Starting 2016	No	Well drilling only	No, but encouraged in Regional Growth Strategies
Nova Scotia[16]	Yes if over 23,000 L/day	No, but can be conditional	Well drilling only	No
Ontario[17]	Yes, but not domestic use	Yes. Daily use	Well drilling only. Usage data available upon request	Municipalities required to complete a Master Servicing Plan
Saskatchewan[18]	Yes, but not domestic use	Yes	Well drilling, and community use	No

TABLE 1 Sample of groundwater policy across Canadian provinces, 2015

There are significant differences in data collection requirements across jurisdictions. Provinces and territories vary in the data they require to be reported for ongoing use. The permitting processes – who needs a license, duration of the license, the criteria for granting a license – also vary. As a result, current data are fragmented and inconsistent between governments, representing a lost opportunity to properly manage a valuable natural resource.

Efforts to compile data across provinces and territories have been incomplete. Environment Canada's Municipal Water and Wastewater Survey (MWWS) collected data on groundwater extraction but had a response rate below 50% due to the survey's voluntary nature.[2] Despite being the best source for municipal groundwater usage, the MWWS was cancelled in 2012.[2,19]

Enabling Opportunities for Innovation

Public, timely and accurate groundwater data will foster both private and public sector innovation. With better data, policy makers and private sector innovators would spend less time trying to understand the problem – ‘how much is being used and how quickly is it being replenished?’ - and more time making informed decisions to solve it. Whether it is growing demand from industry for groundwater, or the threats posed by climate change, now is the time to be thinking long-term about Canada’s groundwater and using accurate information to support decision-making.

By committing to comprehensively tracking and publishing groundwater data, provincial and territorial governments will be better equipped to set informed, sustainable targets for water consumption, collaborate with local governments in making policy decisions, foster innovative ways to better understand Canada’s water resources and reduce end-user consumption.

Public Sector Innovation: Unlocked by Groundwater Data

Integrating data into city planning: Municipalities could incorporate groundwater usage and availability forecasts into community planning decisions, such as land use.[8] For example, the decision to pursue water-intensive industries or recreational development (e.g., golf courses) in a community would be informed by the local aquifer’s capacity to sustain the increased demand without excessive depletion.

Managing water scarcity risk: Provincial and territorial governments could assess the potential impact of industrial growth on existing groundwater license holders. The forecasted demand, combined with the duration of existing groundwater licenses, would provide valuable insight into the potential water scarcity risks across communities in Canada, and help avoid conflicts between municipalities and industries that are increasingly consuming groundwater.[2]

Water resiliency at a federal level: If provincial and territorial governments begin to consistently collect and make groundwater data public, the federal government would be in a stronger position to manage the groundwater that is under its own jurisdiction. Comprehensive provincial and territorial groundwater data could lead to the creation of a national database, one that combines provincial and territorial data with data collected by the federal government, to foster an informed understanding of where groundwater is under stress in Canada and what federal policies are required to address this.[2,19]

A National Leader - Oak Ridges Moraine[20]

Formed in 2001, the Oak Ridges Moraine Hydrogeology Program (ORM Program) in Southern Ontario is a national leader in groundwater data collection, interpretation and sharing. Among the strengths of the ORM Program is that it allows for knowledge-based decisions regarding groundwater use within its catchment. The City of Toronto, the regions of York, Peel and Durham and nine local conservation authorities collectively fund and benefit from the ORM Program. They use it to inform land use policy and decision-making and increase the efficiency of regional groundwater understanding, thereby improving water security.

The ORM Program started with provincially collected groundwater data from the Ontario Ministry of Environment and Climate Change's Water Well Information System (WWIS).

Over the first decade of operation the ORM Program added temporal, geological and some usage data to the system. Municipal, provincial, federal and private sector data were collected to enhance the growing groundwater database. Critically, records are digitized, geologically referenced and available online.

Private Sector Innovation: Opportunities for Business to Leverage Groundwater Data

Water distribution in Canada is uneven, with large demands on groundwater being better tolerated in some regions than others. For industries with water-intensive operations, such as nuclear energy, oil and gas, manufacturing, farming or mining, it is critical to be close to a stable water source. Companies can use groundwater data - or through the use of less restrictive requirements, government can encourage industry - to set up operations in water abundant areas blessed with quicker replenishment rates.

The low cost of water in Canada stifles the financial incentive for conservation or innovation in the development and use of efficient water technologies. Appropriate pricing through groundwater licensing - informed by accurate data on supply and demand - can encourage industrial and public users of water to find solutions that minimize costs and consumption.

There have already been improvements in some areas. In the oil and gas business restrictive water policies and pricing have fostered innovation, leading to increased water recycling during extraction. As another example, companies making water infrastructure investments can use technology to better detect leaks in pipes or weak points in infrastructure, thereby avoiding costly repairs and business disruptions through data-driven maintenance and repair scheduling. Governments can also use data to set pricing to match the real cost of infrastructure planning and maintenance.[8]

Data Drives Innovation – WaterSmart Program[21]

WaterSmart Software uses water data to provide real time analytics for commercial water infrastructure, helping municipalities and utilities run more efficient systems and plan for future infrastructure upgrades, as well as providing end user consumption data through smart meter technology. Through the simple detection of a leaky pipe or a major burst, WaterSmart gives municipalities the ability to better plan maintenance and prevent major repairs, avoiding costs and public disruptions. Consumers are given data about their individual usage and average neighbourhood usage in an attempt to encourage conservation and reduced consumption. Municipalities can also take this technology a step further by offering incentives through price reductions for meeting usage targets.

Recommendations

To avoid mismanaging groundwater supplies into crisis, Canada must improve its approach to groundwater management. The goal is the creation of modern regulatory frameworks in each province and territory that can effectively oversee the changing supply and demand for groundwater. The comprehensive collection and publication of groundwater data can then be used to inform the planning, management and conservation of Canada's groundwater resources. The accessibility of groundwater data is key: making it public fosters opportunities for policy and private sector innovation that no government can predict.

Based on the experience of other jurisdictions dealing with groundwater shortages and a review of existing provincial and territorial policies, there are clear measures the provinces and territories can take to collect and manage groundwater data in a comprehensive, timely and responsible manner. These steps must be matched by a commitment to make these data publicly available and easily accessible.

1. **Consolidate water management policies:** All water users should be regulated by a single provincial or territorial body (ministry or agency). Such a body would reduce the overlap that currently exists where ministries and sectors have vested, yet competing, interests. A single ministry or other such body, such as Saskatchewan's Water Security Agency, can provide regulatory clarity for groundwater users while properly overseeing the resource.

2. **Aquifer mapping and monitoring:** Once created, provincial and territorial groundwater management bodies should be required to map vital aquifers and regularly publish public reports on groundwater levels. Municipalities do not have the human or financial resources to undertake comprehensive monitoring or measurement of aquifers.

3. **License holders required to collect usage data:** All industries or municipalities that have licenses for groundwater use should, at a minimum, be required to meter and report their groundwater usage annually. Licenses should, where necessary, include a requirement for more frequent usage monitoring and reporting, particularly in cases where aquifer mapping shows that groundwater sources are particularly vulnerable to depletion.

4. **Groundwater database:** Each province and territory should maintain a public database that provides comprehensive information on well drilling, license allocations, groundwater usage and water table levels. Data should be published at least annually and in a publicly accessible format to facilitate comparison with historical observations. Data should be accompanied by an explanation of what constitutes a sustainable groundwater level. The provinces and territories should use standardized and comparable data formats to facilitate collaboration and understanding, especially for trans-boundary aquifers.

5. **Flexibility and resiliency in groundwater licensing:** In lieu of universal fees and 30-year terms for licenses - currently the standard duration of a license in many provinces and territories - the creation of a fee schedule and varying duration of licenses should be established. This would enable better management of aquifers, proper recovery of costs and allow regulators to re-assess groundwater sustainability more regularly.

Conclusion

Water resource management is challenging and costly for all levels of government, but even more challenging are the social, environmental and monetary costs associated with mismanagement. Experts at University of California Davis estimate that the 2015 California drought will cost their economy $2.7 billion USD in agricultural losses alone.[22] Canada is not in a state of emergency, but water shortages are more common than most realize and water demand is growing. It is time for a collaborative approach to data collection, informing policy and enabling innovative solutions to an ever-more pressing issue.

A decision to take proactive measures to better regulate, license, conserve and protect groundwater resources will help to ensure that Canadians will have access to sufficient water to meet their personal and economic needs. The collection and analysis of data on groundwater quantities and usage will enable better planning and management by governments and communities.

The resulting knowledge will also open the door for future public and private innovation. The technology and tools to manage groundwater in the 21st century exist – we just need the will to adopt and implement them.

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