

BURIED TREASURE

Groundwater Permitting and Pricing in Canada



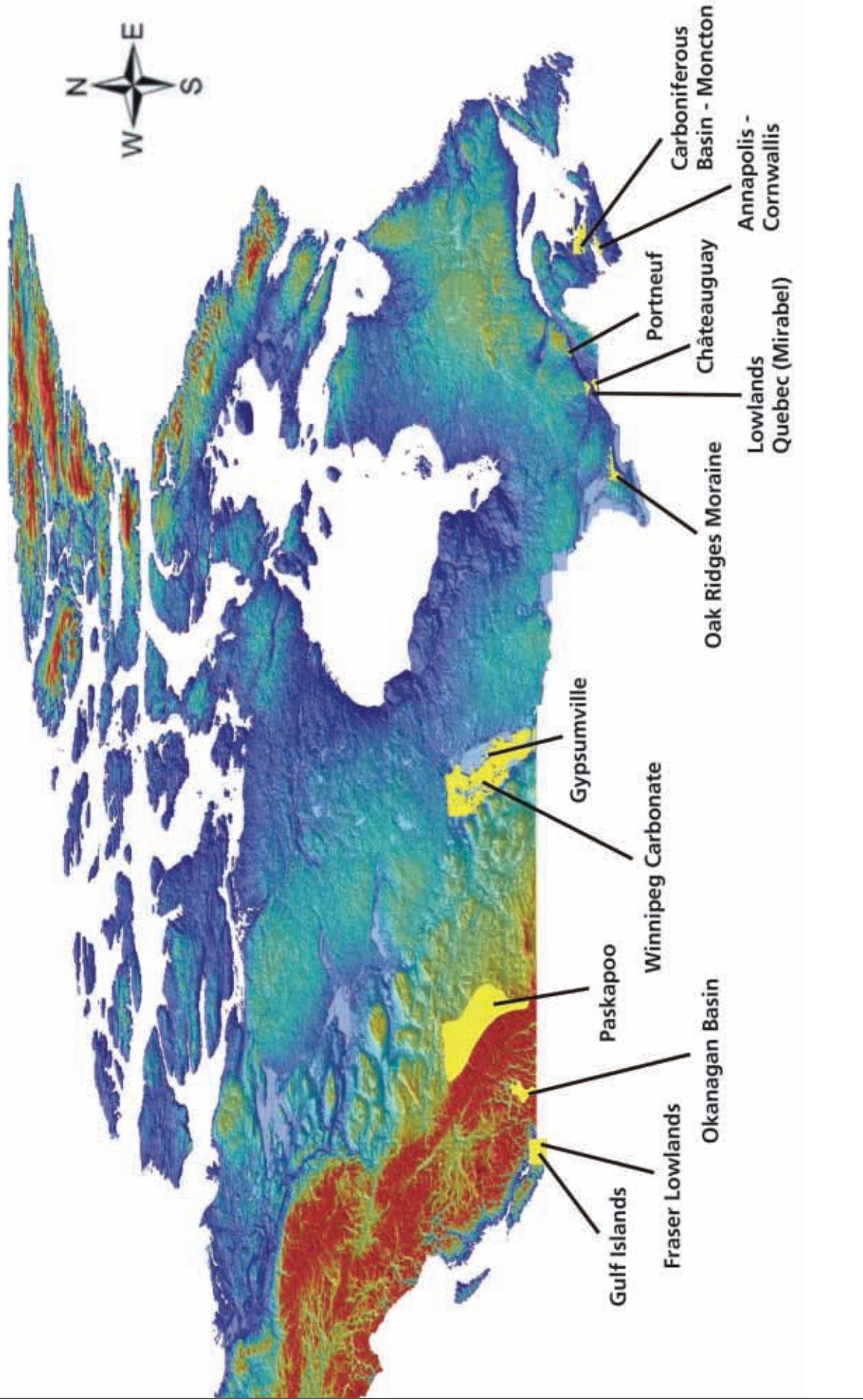
by Linda Nowlan
for The Walter and Duncan Gordon Foundation

with Case Studies by Geological Survey of Canada,
West Coast Environmental Law, and Sierra Legal Defence Fund

March 2005



LOCATION OF REGIONAL AQUIFERS
ASSESSED BY GEOLOGICAL SURVEY OF CANADA



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- Alfonso Rivera is the Chief Hydrogeologist, Geological Survey of Canada, Natural Resources Canada.
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The opinions expressed in this report are those of the author and do not necessarily reflect the views

of any of the reviewers or of the Walter and Duncan Gordon Foundation.

Any errors or omissions are the responsibility of the author.

METHODOLOGY

The author and project supervisor decided on the Terms of Reference (TOR) after receiving comments on a draft TOR from the Advisory Committee. The author did a literature scan, and the research assistant did a legislative scan. Using a regulatory template prepared by the author and modified by the research assistant, the research assistant contacted regulators in each jurisdiction except BC, Ontario, NWT, and Nunavut and completed the template based on telephone interviews. The author covered the other jurisdictions.

The author and project supervisor also designed three case studies, located authors, and commissioned and reviewed the studies. The Advisory Committee, regulators, and other reviewers were sent a draft report for comment and review.

Introduction

“The oil and gas reservoirs in this country are better understood than the groundwater reservoirs, as you all know.” — Karen Brown, 2004, Assistant Deputy Minister, Environment Canada¹

GROUNDWATER – BURIED TREASURE?

The importance of groundwater is not restricted to the quantities in which it is used, or to the steady growth in its use, but also to the particular people it serves and the areas where it is used. The close relationship between groundwater and surface water, for example the fact that a decline in groundwater will reduce surface flows, is not universally understood or appreciated.² Moreover, the importance of groundwater protection is not adequately taken into account in water management.

There is a need for greater public awareness of the value of groundwater and an understanding of how it is regulated. This report was written to help fill this need. The primary focus is on provincial and territorial permitting and licensing requirements for groundwater, and how these requirements address the environmental consequences of withdrawals.

The scope of this report is to:

1. compare existing provincial regulatory policies on groundwater quantity,
2. describe how allocation and permitting/licensing decisions are made in each province and territory, and
3. describe how pricing of groundwater extraction, if it exists at all, is done in each province and territory.

Regulations for allocation and pricing vary widely across the country, and no reference material comparing provincial and territorial regulations now exists. This report aims to fill this information gap; it is not a critique of existing practices.³

The report is organized into five chapters and three case studies. The chapters cover groundwater science, groundwater allocation law, a comparison of provincial and territorial groundwater permitting requirements, a comparison of public participation opportunities in groundwater permitting, and a comparison of groundwater pricing requirements. Executive summaries of the three case studies that were commissioned for this report, “How Well Do

We Understand Groundwater in Canada? A Science Case Study,” by Alfonso Rivera of Natural Resources Canada; “Groundwater Use in Canada,” by Susan Rutherford, West Coast Environmental Law; and “Groundwater Pricing Policies in Canada,” by Randy Christensen and Simone Magwood, Sierra Legal Defence Fund, can be found at the end of chapters 1, 2, and 5 respectively. (The full version of each case study is available on the website BuriedTreasureCanada.ca, and on each author’s own website.)

FRESHWATER IN CANADA

With about one-half of one percent of the world’s population, Canada has a disproportionate global share of water. But groundwater is just one part of the country’s vast water resources, which include millions of lakes and hundreds of rivers. In fact, the surface area and number of lakes in North America far exceed those of any other continent. Canada alone has at least three million lakes and, in some regions, there are as many as 30 lakes for every 100 sq. km.⁴

But poor distribution, wasteful use, and new stresses are three factors that contradict this apparent water wealth.

First, while Canada holds twenty percent of the world’s fresh water, much of it is non-renewable or fossil waters held in lakes, underground aquifers, and glaciers. Adjusting for these factors, Canadians can lay claim to seven percent of the world’s fresh renewable water. Most of water drains north toward the Arctic Ocean and away from the heavily populated centres. In fact, 60% of Canada’s water flows north, while 84% of the population lives in the southern part of the country, within 300 kilometres of the US border.⁵

Second, Canadians are profligate water users, being among the highest consumers of water in the world in terms of per capita use, a recent Statistics Canada study notes.⁶ Among member countries of the Organization for Economic Cooperation and Development (OECD),⁷ Canada ranks second highest in terms of per capita water consumption after the US, and is 65% above the OECD average.

Canadians use double and even more than European citizens with comparable standards of living.

Third, many forces cause stress on Canada’s water supplies. Climate change is the most serious threat. The same 2003 Statistics Canada study reports that climate change threatens Canada’s fresh water resources as glaciers are rapidly diminishing, receding in some places to rates not seen for as many as 10 millennia. Since 1850, some 1,300 glaciers have lost between 25% and 75% of their mass, with most of this reduction occurring in the last 50 years. Along the eastern slope of the Rocky Mountains, glacier cover is receding rapidly, and total cover is now close to its lowest extent in 10,000 years. The full impact of climate change is unknown, but changes to water recharge patterns and depletion of groundwater supplies in shallow unconfined aquifers are potential results.⁸

Canadians rely on groundwater in both obvious and hidden ways. About a third of the total population uses groundwater for drinking water, and a far larger proportion of rural residents, about 80%, depend on underground water as a drinking source. As well, industry, mining, oil and gas, manufacturing, and agriculture are considerable users.

But Canadians take groundwater, like other water resources, for granted, and this complacency is misguided because of imperfect knowledge of:

- the full extent of the resource,
- groundwater use patterns and trends across the country,
- the price, if any, charged for its extraction and use,
- the different ways it is managed across jurisdictional boundaries,
- whether the laws and policies are grounded in the principles of hydrology and hydrogeology, or whether they flout those principles, and
- the complete environmental impacts of groundwater extraction.

Further, there are no readily available figures showing how dependent freshwater species are on

groundwater resources, nor how to calculate how much groundwater can be pumped out of a spring before affecting the river to which it is linked.

Globally groundwater is being exploited at ever-increasing rates and regulators are forced to make tough choices between competing users.

A *Federal Water Policy* was introduced in 1987 that recognized the federal role in groundwater management and pledged to take more action to manage this resource. However, the federal government has taken little direct action to improve groundwater management. Regulators did join forces to address national level groundwater issues in 2000, producing the *Canadian Framework for Collaboration on Groundwater* in 2003, a Geological Survey of Canada document developed in collaboration with the provinces which focused on groundwater supply.⁹

OVERVIEW OF TRENDS

Lack of knowledge about the hidden resource of groundwater poses management challenges, as across Canada examples of groundwater stress emerge.

In parts of Alberta, water demands are exceeding supply: the land suited to irrigation is about twice the area that can be served with the water currently available.¹⁰ Although in 1991 the Alberta government capped the amount of water allocated for irrigation purposes in the South Saskatchewan River Basin, subsequent computer simulations demonstrated that the region's overall demand for water in some cases already exceeded the water supply.¹¹

Legislation was passed recently to enable the construction of a pipeline for interbasin transfer of treated water to supply the Lacombe/Ponoka area of Alberta with water, since the local groundwater resources were no longer able to meet the needs of a growing population.¹² This law demonstrates the need to relate land-use planning to water-supply planning, especially in water-short areas that rely on groundwater. This area of central Alberta is a groundwater "hot spot," as are areas in northeast Alberta where there is demand for groundwater for steam for thermal recovery of bitumen.¹³

In BC, observation wells are indicating water level declines. The data show that groundwater levels are not declining across the province as a whole, but rather in local areas where groundwater withdrawal and urban development has been intensive, such as the Lower Mainland, the Okanagan, the southeast coast of Vancouver Island, and the Gulf Islands.¹⁴ Approximately eight percent of the 300 British Columbia aquifers that had been classified as of 1999 were found to be at risk due to heavy use.¹⁵

Stress is also evident in the actions of the three provinces that have issued moratoriums for all or some of their groundwater permits. Ontario's year-long province-wide moratorium on water takings was lifted on December 14, 2004. PEI's moratorium, which applies to new irrigation wells only, will be lifted when a hydrogeological assessment is completed. Manitoba has prohibited the issuance of new groundwater permits in six of the thirteen sub-basins in the Assiniboine Delta Aquifer as the calculated sustainable yield has been reached on these sub-basins.

Municipalities dependent on groundwater, notably those in southern Ontario, the southern Prairies, and the interior of British Columbia, experience more frequent water shortages than those relying on surface water. In 1999, about 26% of Canadian municipalities with groundwater distribution systems reported problems with water availability within the previous five years.¹⁶

There is anecdotal evidence that the water table in Whitehorse, Yukon, is dropping,¹⁷ and even in the Northwest Territories where groundwater use is relatively insignificant for people, its environmental role is key. Scenic areas like the Nahanni National Park Reserve have many seasonal streams, and the contribution of groundwater to stream flows there is unknown.¹⁸

In 2004 a scientific study by the US Geological Survey (USGS) showed that for the first time groundwater pumping had reversed the direction of flow away from Lake Michigan, one of the Great Lakes that represents the largest concentration of unfrozen fresh surface water in the western hemisphere.¹⁹ Groundwater pumping is affecting an

entire water basin, one of the largest in the world and one that lies at the centre of Canada's two most populous provinces, Ontario and Quebec.

Looking further south, excessive pumping has created "an environmental catastrophe known to only a few scientists, a handful of water management experts, and those unfortunate enough to have suffered the direct consequences."²⁰ Though Canada does not face the same supply problems as the US

southwest due to a much smaller population and greater water resources, because Canada's water laws are similar to those in the US, and only minimal attention has so far been paid to the environmental impacts of groundwater pumping, there is cause for concern. Despite Canada being a comparatively water-rich country, groundwater "hot spots" are starting to emerge.

1

Groundwater Science in Canada

Groundwater is subsurface water or water stored in pores, cracks, and crevices in the earth.

Groundwater is a source of water for wells and springs, and is often a significant source for lakes and rivers.

An aquifer is an underground geological formation or group of formations that contain potentially exploitable water. If left untouched aquifers will be replenished, but if the rate of withdrawal exceeds the rate of natural recharge, the volume of water stored in the aquifer will be reduced and, possibly over time, even entirely depleted.

Ground and surface waters are different but connected forms of water moving through the stages of the hydrologic cycle. The two scientific disciplines of hydrogeology, the study of groundwater, and hydrology, the study of surface water, are closely related. Groundwater is an integral part of hydrological study, and knowledge of its occurrence and flow characteristics is central to basin or watershed management. The close relationships between groundwater and surface water deserve further study.

However, even though surface water and groundwater are inextricably connected as two forms of a single resource, they have different characteristics, which may be why the regulation of groundwater and surface water has evolved along separate tracks. Some of the characteristics that account for the different approaches are based in hydrology, hydrogeology, and the physical nature of the two resources; others are based on people's perceptions.

- The primary distinguishing characteristic is that groundwater is tied to the land and lies beneath it, while surface water moves visibly across the landscape in rivers, streams, and lake systems. The tie to the land is one reason why private ownership of groundwater under the rule of capture evolved, while surface water under the common law was never capable of private ownership.
- The pace of the movement is another distinguishing feature. Movement of groundwater is measured in decades, centuries, or even millennia, while surface water flows at much faster rates. Recharge rates of aquifers are generally

slow, from millimetres to centimetres per year. These features make the calculation of sustainable extraction rates more complex for groundwater than for surface water.

- The storage area of groundwater resources is usually larger than for surface waters. Though Canada has no comparable aquifer to the immense Ogallala Aquifer, which is over half a million square kilometres and stretches from Nebraska to Texas, it does have numerous large aquifers which cross provincial and international boundaries. These aquifers pose cross-jurisdictional management challenges.
- Measuring groundwater requires a longer time and more effort than measuring surface water. It can be harder to evaluate the state of the resource as test wells must be observed for a number of years before trends emerge, while flow samples provide immediate feedback on the water quantity in a river. Determining the impact of groundwater extraction on a drainage basin or watershed takes time.
- Developing the resource also involves different approaches. It is far easier and cheaper to drill a well than to construct a canal, dam, or reservoir.
- While groundwater levels can be affected by reductions in precipitation which reduces recharge, they may be less susceptible to seasonal fluctuations, such as those caused by evaporation from surface waters.
- The quality of groundwater is often, but not always, higher than surface water, as most geological formations protect it from polluting influences. However, once contamination of groundwater does occur, it persists and is more difficult and costly to treat than polluted surface water.

All these characteristics help explain why the law has treated ground and surface water separately rather than as interconnected parts of the same system. Allocation decisions need to account for these conditions, as well as consider groundwater, surface water, and land as inter-related factors for the purposes of environmental management.²¹

ENVIRONMENTAL IMPACTS OF GROUNDWATER EXTRACTION

The environmental consequences of over-abstraction of groundwater may not be as immediately obvious as other environmental problems, yet they can be numerous and profound.

Water shortage is one obvious consequence of excessive taking of water. In the extreme, streams disappear and wells run dry. This happened in the summer of 2000, when Spencer Creek in south-western Ontario “disappeared” temporarily because of excessive takings in the local watershed. The Ministry of the Environment then restricted groundwater takings and the creek reappeared.²²

“Subsidence” may also result from groundwater extraction. Land subsidence is a term used to denote the consolidation of soils due to different processes. In hydrogeology, land subsidence is related to groundwater overexploitation. It is the gradual compaction of soil layers due to an increase of effective stresses (grains of soils) and a decrease of interstitial water (water pressures) in a porous-medium aquifer due to excessive pumping. When the effective stresses increase, the aquifer is compacted and the land surface subsides.

There are no instances of land subsidence due to groundwater overexploitation in Canada. Most regional aquifers in Canada are bedrock aquifers, but this phenomenon could happen in porous-medium aquifers, such as multilayered aquifer systems including clay-rich tills, sometimes referred to as aquitards. If such aquifers are connected to porous-medium aquifers, and if excessive pumping occurs, land subsidence could occur.

Subsidence due to excessive groundwater extraction is a major problem elsewhere. Mexico City is suffering from this, and American examples are collected in the book *Water Follies*. In California’s Central Valley, land subsidence was caused by extremely high rates of extraction by deep-well turbines which far exceeded the recharge rate. Although an engineered and costly solution of importing water through a canal helped to restore the water tables, about 90% of the subsidence constituted a loss of groundwater storage capacity that will never be regained.²³

Overwithdrawals can also harm wetlands, which are closely connected to groundwater systems.²⁴ The impact of excessive withdrawals on fish and especially on wildlife is not completely known, but habitat will be affected by changes in water availability.

Saline intrusion is another possible consequence of excessive withdrawals, although this problem is limited in Canada. In one case in PEI, saltwater intrusion was likely caused by pumping from an aquaculture operation, affecting water quality in a

single domestic well. That problem has since been rectified. BC's Gulf Islands and Winnipeg have also had saline intrusion into fresh groundwater.²⁵

Before groundwater extraction approvals are issued, governments often require hydrogeological studies to determine the potential environmental impacts and propose ways to minimize those impacts. The timing of this type of research and analysis is important. To minimize environmental impacts, the study should be required *before* the approval is granted.

Case Study

How Well Do We Understand Groundwater in Canada?

A Science Case Study

BY ALFONSO RIVERA, GEOLOGICAL SURVEY OF CANADA

This case study constitutes a summary of a lengthier study. The longer version is available for download on the website of BuriedTreasureCanada.ca and the Natural Resources Canada website: <http://gwp.nrcan.gc.ca/>.

INTRODUCTION

These are the fundamental issues that frame this science case study:

- How much groundwater does Canada have?
- Which are the major regional aquifers in Canada, and what is the state of groundwater development in these regional aquifers?
- What is the volume of groundwater stored?
- What are the recharge rates of regional aquifers?
- What are the groundwater fluxes of regional aquifers?
- What is the average residence time of groundwater in regional aquifers?
- How is groundwater exploited in Canada?
- What is our understanding of the interactions between groundwater, surface water, and aquatic ecosystems?
- How sustainable is current use of the groundwater resources of Canada?

Although this case study cannot yet answer all these questions, it provides a starting point for identifying gaps in the available information about this resource — a starting point that is necessary for management decisions. Water management which does not include groundwater will be incomplete.

The study presents an overview and a synthesis on the status as of 2004 of the knowledge of groundwater quantity in Canada based on the regional aquifers assessments of the Earth Sciences Sector (Geological Survey of Canada and Geomatics Canada) of Natural Resources Canada, carried out in cooperation with the provinces over the last ten years.²⁶ It is a summary of the state of scientific

knowledge about the groundwater sources (aquifers) of the country, and it focuses on characteristics of the regional-scale aquifers: aquifer location and extension, groundwater exploration, exploitation, recharge, storage, and sustainability. It also looks at interactions and the effects of groundwater overexploitation. A recent groundwater case in the US is presented as an example of how excessive pumping has reduced the amount of groundwater that enters Lake Michigan.

This study also explores the consequences of limited knowledge and examines how governments in Canada are adding to our base of knowledge and understanding about this resource. It shows that Canada does not yet have complete knowledge of its groundwater resources. Some trends, however, may already be depicted, partially showing the status of the groundwater resources, their dynamics within the hydrologic cycle, and the effects of their use.

How much groundwater does Canada have? What is the volume of groundwater stored?

Based on current knowledge, we are still unable to answer these two questions at the scale of the country. While data and information on surface water are sufficient in Canada, data and information on groundwater remain scarce.

The groundwater resources of Canada may be larger than all surface waters (rivers, lakes) combined. They supply 82% of the country's rural population, 43% of agriculture, and 14% of industry needs. In many regions, they are the main support of ecosystems. They are less prone to contamination and more protected against climate changes (droughts), yet their nature, extent, sustainability, and vulnerability are virtually unknown on a national scale.

Which are the major regional aquifers in Canada?

This analysis is supported by twelve regional-scale studies. The map on the inside front cover of this report shows the location and names of the regional aquifers whose assessment is either completed or ongoing.

Some provinces have made serious efforts to inventory their aquifers (e.g., British Columbia) or are currently planning inventories (e.g., Alberta, Quebec), but it is impossible to know how many aquifers exist in all of Canada as there has never been a comprehensive national inventory done. There are various complexities for carrying on such an endeavour, including the location, the nature (geological frameworks), and the sizes of the aquifers.

The Geological Survey of Canada selected 30 regional-scale aquifers to be assessed and inventoried. The selection of those aquifers was done on a priority basis and in consultation with provincial governments. The priority criteria included among others:

- socio-economic impact (e.g., the aquifer is an important source of freshwater supply for human use, agriculture, and/or industry);
- geographical situation (e.g., transboundary aquifers, federal lands);
- environmental features (potential interactions with rivers, lakes, and wetlands or ecosystems); and
- technical-scientific aspects.

Twelve of these regional aquifer assessments have now been completed or are ongoing. Some conclusions in this study are drawn from completed regional projects, as well as from basic knowledge of the geology and hydrogeology of Canada.

What are the recharge rates of regional aquifers? What are the groundwater fluxes of regional aquifers? What is the average residence time of groundwater in regional aquifers?

This section addresses the science used to characterize aquifers and understand groundwater behaviour. The full case study discusses state-of-the-art practices for groundwater assessments in greater detail. Many practices have become standard in modern quantitative hydrogeology, and this summary touches on three of the most relevant issues in understanding aquifer dynamics: groundwater recharge, groundwater flux, and aquifer characterization.

Recharge rates in the regional assessments range from 45 to 500 millimetres of recharge per year, accounting for 4% to 35% of the precipitation in the corresponding region. Definitive conclusions cannot (and should not) be drawn from these numbers alone, for recharge rates are not a direct measure of either aquifer renewal times or of aquifer exploitation. Aquifer recharge is only one of the parameters to be considered in the more comprehensive equation of sustainable yield of an aquifer, along with other elements such as geological framework, aquifer storage, discharge, hydraulic connections with surface water bodies, resident times, water levels, evapotranspiration, etc. (See full case study for a more detailed presentation of recharge rates.)

As aquifers are depleted, recharge estimates have become essential in determining appropriate levels of groundwater withdrawal. More recently, estimating recharge has become even more important in three specific areas of research:

1. Contaminant transport as aquifer management expands from cleanup of existing contamination to aquifer protection by delineation of areas of high recharge (vulnerability), that is, groundwater quality assessments.
2. The assessment of sustainable yield at the scale of regional aquifer, that is, groundwater quantity.
3. Climate change, as changes in temperature and precipitation may act to modify the timing for recharge to aquifers.

Most of the regional aquifers in Canada are located in “fractured media.” Thus they are characterized as “fractured aquifers,” the nature and behaviour of which are very different from unconsolidated porous aquifers. A myriad of methodologies and techniques abound for the characterization of porous media at all scales. The same is not true for fractured aquifers, particularly at the regional scale. Given the lack of specific methodologies, it is a common practice for the assessment of fractured aquifers to use the same approach as for porous media in determining the residence time of water in the aquifer.

This poses many problems related to the uncertainties of the assessments. Aquifer remediation (groundwater pollution), aquifer connectivity (groundwater flow), aquifer vulnerability, and well-capture zones (groundwater protection) are areas of highest uncertainties.

The current, most common techniques to map and assess fractured aquifers are:

- geological characterization,
- hydraulic testing,
- chemical characterization, and
- geophysical methods (surface and borehole).

In addition, the difficulties in the assessments are enhanced by the **upscaling** and the **heterogeneity** of fractured aquifers.

Because the zones of impact of groundwater development (e.g., interactions with surface water, wetlands) may be larger in fractured aquifers, it is often strongly recommended that an interdisciplinary approach with multiple lines of evidence be used. This is not a common or regulated practice in Canada; only a few research groups apply this approach. All of this contributes to limiting our ability to fully characterize the recharge, fluxes, and residence times of aquifers in Canada.

How is groundwater exploited in Canada?

Most of the regional aquifers so far inventoried by the Geological Survey of Canada (GSC) have been found to be exploited at shallow depths, to a maximum of 200 metres and mostly between depths of 20 metres to 100 metres. There are many possible reasons why this has occurred. First, freshwater is abundant at shallow depths. It is also cheaper to build and maintain, and it is quicker to develop and use. The water at shallower levels is generally of good quality, and there are fears that deeper groundwater might be of lower quality. There are also indications of decreasing permeability with increasing depth, which makes the water more difficult to access. (Groundwater use in Canada is the subject of another case study in this report, found at the end of chapter 2.)

What is our understanding of the interactions between groundwater, surface water, and aquatic ecosystems?

For some time the scientific community has recognized that within the water cycle there are continuous dynamic interactions between surface water bodies (e.g., rivers, lakes, wetlands) and groundwater (aquifers which happen at various spatial and temporal scales).

It is clear that, independent of their very different natures and scales, surface water and groundwater should be considered and treated in an integrated way. However, very few scientists, let alone water managers, take this holistic approach; generally, surface water resources are studied and managed without consideration of groundwater. In Canada for instance, most of the water investments are done to assess and develop surface water resources, but very little is done to similarly understand groundwater. In large part, this is due to the persistent gaps in knowledge about the interactions between surface water and groundwater.

The physical processes and mathematics needed to assess GW/SW interactions are known and are relatively well established. Basic knowledge of hydraulics, hydrological process, and geology may be coupled with equations describing groundwater flow (i.e., Darcy's law) to assess those interactions.

However, even though the basic theoretical knowledge exists, the interactions between groundwater and surface water are complex and the application of the theory is not straightforward. To understand these interactions in relation to climate, landforms, geology, hydrology, and biotic factors, a sound hydrogeological framework is needed. The lack of such a framework represents the main knowledge gap in Canada.

The case in Wisconsin

Elsewhere, studies demonstrate the links between surface water, groundwater, and aquatic ecosystems. For example, the Great Lakes are surface water bodies that influence and are influenced by groundwater. The case study by the US Geological Survey and Wisconsin Geological and Natural History Survey examines groundwater flow in and adjacent to the Lake Michigan Basin in southeastern Wisconsin in an area centred on Waukesha, Wisconsin (<http://wi.water.usgs.gov/glpf/index.htm>).

This is an interesting case study for Canada given that both countries share the same basin. The effects seen in the south could well be observed in the north if the same pumping conditions existed.

The analysis of the water budget, GW/SW interactions, and the conclusions from this case study are based on a numerical three-dimensional model built by the US Geological Survey. The most important findings are the following:

- The groundwater divide is not the same as the Great Lakes watershed divide (i.e., the sub-continental divide). While it serves as the divide for shallow flow, the deep aquifer divide is distant from it.
- The groundwater divide moves in response to pumping.
- Pumping has reduced the amount of groundwater that enters Lake Michigan.
- Groundwater flow below the sub-continental divide has shifted.

In summary, before pumping began, groundwater flow lines were directed everywhere toward Lake Michigan. Today deep flow is reversed and moves from the lake toward pumping centres. However, most of the flow that moves toward wells from beyond the lake shore does not originate as lake water, but rather is derived from water already stored in deep rocks below the shale. In this sense, the wells are withdrawing groundwater that originated hundreds if not thousands of years ago as precipitation over land entered the flow system as recharge and migrated eastward over long flow paths to be stored below the lake.

Even though Lake Michigan itself is a very minor source of pumped water in southeastern Wisconsin, pumping has reduced the amount of groundwater that enters the lake. This is a clear example of the effects of groundwater overexploitation and the dynamic interactions between surface water bodies and groundwater stored in aquifers. Furthermore, this case shows that without baseline knowledge of those interactions and the lack of regulations, anthropogenic effects might completely modify a natural system, even more than natural conditions would (e.g., climate change), as demonstrated by the “sudden” changes in the volume and direction of flow of groundwater stored without changes for thousands of years under the lake’s basin.

This is the first time that there has been a publicly documented case of the impact of a number of separate water takings on an entire basin. The example is relevant for Canada as there are increasingly large withdrawals of groundwater from the Great Lakes Basin on the Canadian side of the border, especially in the Greater Toronto area. Although there have been no cases of such overexploitation on the Canadian side to date, it is possible that this situation could occur. This example raises a warning flag.

How sustainable is current use of groundwater resources in Canada?

While there is no complete knowledge from coast to coast, some trends can be drawn from the assessments of the GSC regional aquifers.

Although certain local conditions dictate otherwise, in general there is not a steady drop and depletion of groundwater levels in Canada, nor is there evidence of decreasing volumes (e.g., groundwater storage in aquifers) or declining supplies. Most of the regional aquifers in Canada are in pre-development conditions: that is, they are in hydrodynamic equilibrium (recharge equals discharge). The illustration on the inside back cover shows records of groundwater levels of six of the regional aquifers studied by the GSC and provincial partners. The figures shown are for the Carboniferous aquifer with 3 years of record, (2001-2004); the Annapolis aquifer with 40 years of record (1966-2002); the Portneuf aquifer with 8 years of record (1996-2003); the Gulf Islands aquifer with 31 years of record (1973-2004); the Gypsumville aquifer with 3 years of record (1998-2001); and the Mirabel aquifer with 19 years of record (1974-1993). In general, groundwater-level observations do not show any major deviation from natural cyclic conditions (i.e., recharge and discharge). Some show a slight downward trend, which may not be significant.

Two of the regional aquifer studies included an evaluation of their sustainable yield. The Mirabel aquifer system estimated that the current pumping (about 18 mm³/y, or nineteen percent of recharge) was sustainable, and that even doubling that amount would have no adverse effects on the system.²⁷ The Carboniferous Basin study estimated that the sustainable yield would be five percent of the recharge by precipitation.²⁸

None of the twelve regional-scale assessments revealed declines in groundwater levels. In general, Canadian regional aquifers cannot be compared to regional aquifers in the US, many of which are either fully developed or overdeveloped (i.e., discharge is greater than recharge), such as the Ogallala in the High Plains or the San Joaquin Valley in California.

An important decline of groundwater level has been documented in only one aquifer in Canada (which was not part of the GSC regional aquifer assessments). In the Estevan Valley aquifer in southern Saskatchewan, the water level in the aquifer was locally lowered by more than 45 metres (and by nearly 20 metres as much as 20 kilometres away) by a field of pumps extracting water for electricity generation. However, this drop is a local decline. Pumping was halted in 1994. While the pumping was originally thought to be well within the sustainable yield of the aquifer, further studies suggest the water level in the aquifer will take up to 20 years to fully recover.²⁹ There could be other instances of overexploited aquifers in Canada, perhaps at local scales, but the current information as synthesized by the GSC has not identified any.

As for water quality, there are instances of groundwater contamination in Canada. Most are at the local level from point sources such as livestock effluents, mining, other industries, and waste disposal sites, and a few are at the regional level from diffused contamination (i.e., non-point sources such as agriculture). Groundwater is vulnerable to natural and human impacts. Modern urban development, agricultural practices, and land use are the main causes of groundwater quality problems in Canada.

Clearing up some terminology: exploration, exploitation, development, and sustainability of aquifers

During the GSC assessments, it was observed that there is confusion in the terminology as it is used in the practice of hydrogeology in the characterization of regional-scale aquifers. A brief description of the most common terms is provided below.

Aquifer **exploration** is followed by aquifer **development**, which precedes the production of groundwater for supply purposes. Exploration consists of selecting and testing an aquifer, whereas development refers to preparing it for **exploitation**. It is said that an aquifer is in **pre-development** conditions when it has not been exploited (pumped) or has been exploited only minimally, and it is in hydrodynamic equilibrium with nature (recharge equals discharge). **Overexploitation**, on the other hand, is a condition of an aquifer which has been pumped beyond a certain yield, and it may no longer be sustainable at the human scale.

Sustainability refers to the long-term use of groundwater without causing adverse effects, such as land subsidence, saltwater intrusion, or deterioration of water quality. However, there is no official definition of sustainable development for groundwater resources in Canada as compared, for example, with countries in the European Union (EU). The methodologies currently emerging in the EU for sustainable development relative to water are based on the concept of integrated river basin management. Under this perspective, the achievement of sustainable groundwater development is done through the balance of recharge inputs to aquifer storage (the groundwater resource) against discharge outputs for economic, environmental, and human (social) benefits.³⁰

A tentative definition of sustainability that could be applied to groundwater resources in Canada was recently proposed by the GSC.³¹ Keeping in mind the regional-scale scope for the assessment of aquifers, they proposed that the volume of groundwater that can be extracted from a groundwater system (one or more aquifers hydraulically interconnected) be such that it does not cause adverse effects to humans and the environment. One or more of these effects could be:

- Groundwater overexploitation (withdrawals exceed recharge)
- Long-term harm to ecosystems (decrease in, or obliteration of, groundwater-fed streams, ponds, or lakes)
- Saltwater intrusion
- Changes in groundwater quality
- Land subsidence due to compaction of aquitards (i.e., beds of lower permeability in the stratigraphic sequence that contain water but do not readily yield water to pumping wells)
- Decrease of water table with increasing pumping costs
- Changes in land drainage patterns

Some or all of these effects may be used as indicators for groundwater *availability* and for *managing* the resource. The proposed definition acknowledges, however, that the sustainability of groundwater resources is an evolving issue and should be performed in phases. The elements for such an analysis at regional scales are:

- perform a detailed quantitative assessment of the aquifer system;
- design and operate a groundwater monitoring system; and
- build, calibrate, and periodically revise numerical models of the aquifer system.

It was proposed that optimal groundwater development conditions could be based on the concept of sustainable safe yield (SSY) of an aquifer system, both as function of space and time, accounting for aquifer storage, recharge, discharge, and withdrawals (pumping and/or feeding ecosystems).

The evolving concept of sustainability presents a challenge to hydrogeologists to translate complex socio-economic and political questions into technical questions that can be quantified systematically. Hydrogeologists can contribute to sustainable water resource management by presenting the longer-term implications of groundwater development as an integral part of their aquifer assessments. The GSC also recommended that sustainability of groundwater resources be accompanied, or be an integral part of, water management practices at the municipal and/or provincial level.

SUMMARY: THE CONSEQUENCES OF LIMITED KNOWLEDGE

Knowledge and information are the backbone of any water management scenario. Thus the question should be raised: how can we appropriately manage water resources in the absence of knowledge?

These are some of the most prominent facts in relation to groundwater in Canada:

- There is insufficient information on government-wide water programs and results to support policy development. This is even more obvious in relation to groundwater resources.
- The lack of understanding of the groundwater resource (quantity and quality) could result in bad management practices, overexploitation, and quality deterioration.
- The amount of groundwater stored in Canadian aquifers and their sustainable yield and role in ecosystem functioning are virtually unknown.

And the most relevant groundwater knowledge gaps in Canada are these:

- Groundwater supply and use (rate of pumping, lack of groundwater meters)
- Dynamics of GW/SW interactions
- Recharge rates of aquifers
- Methods for estimating baseflow under the influence of fractured aquifers
- Intrinsic vulnerability of regional aquifers
- Characterization of fractured-rock aquifers
- Long-term data and sustained monitoring of groundwater levels and groundwater quality

The best practices for water takings vary from region to region and from country to country. There is no example of a single country, or a unique model, that can be applied in a standardized manner. It is difficult to apply the best practices because of the lack of sufficient knowledge, data, and information, especially when proposed water takings will have combined effects on surface water bodies, groundwater flow systems, and ecosystems.

A recent comprehensive study on best practices for assessing water taking proposals in Ontario³² evaluated the best scientific practices for assessing the impact of water takings on an aquifer, including the protection of ecosystems and the environment. This study evaluated interactions between surface water, groundwater, and aquatic and terrestrial habitats and compared best practices with other jurisdictions in Canada and other countries. It also reviewed the literature to determine the applicability of methods and the choice of those that are necessary in Ontario, and suggested the need to consider water takings both at the scale of the watershed and the specific site.

The study found that there were myriad methods for evaluating the effects of water takings on the water resources, but very few to measure the impact on ecosystems. It was believed that the existing methods to assess water resources could easily be adapted to the characterization of hydraulic functions in ecosystems, though there was no discussion on how to do it.

A very important element not evaluated in the study is how water takings could affect groundwater quality. Groundwater systems may vary depending on the type of aquifer (porous, fractured), the interactions with surface water, climatic conditions, etc. However, one common factor for managing all groundwater systems is that the total amount of water entering, leaving, and being stored in the system must be conserved. That is, the water budget must be balanced in the long term.

Human activities such as groundwater withdrawals and irrigation change the natural flow patterns, and these changes must be accounted for in the calculation of the water budget. Because any water that is used must come from somewhere, human activities affect the amount and rate of movement of water in the system, entering the system, and leaving the system.

Groundwater systems (aquifers) may interact with surface water bodies (streams, lakes, reservoirs, wetlands, and estuaries) and, in some cases where groundwater pumping rates exceed a certain threshold, the quality of the surface water can affect the quality of the groundwater (as surface water is drawn into the groundwater). Thus, groundwater developments (withdrawals) may affect groundwater quality.

As development of land and water resources intensifies, it is increasingly apparent that development of either groundwater or surface water affects the other type of water.

The key to managing these issues is a continued collection of data, water monitoring and modelling; these activities should help alleviate the knowledge gaps. Water modelling in particular should

be done by integrating groundwater and surface water. Coupled GW/SW models already exist although research is ongoing. The inclusion of the two habitats is far from being a standard practice in hydrogeology and water management.

Main conclusions and recommendations

On the one hand, trends on the state of groundwater in Canada, as learned from the GSC regional-scale aquifer assessments, are largely positive (e.g., no overexploitation and steady-state conditions). But on the other hand, the lack of detailed data and information severely hinder the application of best water management practices, in particular practices for water takings and interactions between surface water, groundwater, and aquatic and terrestrial habitats. The limited current knowledge is the main obstacle to improving groundwater regulation.

Challenges for improved groundwater management include the need to develop better combined GW/SW models and regional-scale indicators of groundwater conditions. In addition to both water resources, aquatic and terrestrial habitats should be examined when dealing with the sustainable use of groundwater as water takings increase. Groundwater storage evolution (flow and dynamic storage of aquifers) is one of the most important issues to address.

In summary, the results of the twelve completed or ongoing regional-scale aquifer assessments carried out by the GSC and its provincial partners in the last ten years have not shown any examples of overexploitation. (The only known example of overexploitation, in the Estevan Valley aquifer in Saskatchewan, was not a GSC regional aquifer assessment.) These regional aquifers are important indicators of the trends and conditions of groundwater resources in Canada, their availability, sustainability, and vulnerability. But they represent only a sample of the aquifers and cannot portray a full picture.

The regional aquifer assessments will continue with collaboration between federal and provincial governments; however, it is not likely that a comprehensive national inventory of all the groundwater resources of Canada will be produced in the foreseeable future. Some provinces may advance faster and with more complete assessments and inventory of groundwater at the provincial level, whereas others will lag behind, not because of lack of will, but perhaps because of lack of funding and expertise. It has become clear that due to financial restrictions, the requirement for multidisciplinary expertise, and the interjurisdictional nature of groundwater, no single agency or department in Canada is capable of such an endeavour and commitment. The GSC should continue to provide strong, effective, and sustained leadership in this area. The GSC assessments and inventory are a good but modest start.

Canada cannot be compared to the US where a large number of regional aquifers are overdeveloped, as in Canada most aquifers are in pre-development conditions. However there are lessons to be learned from our southern neighbour. Knowledge of the identification, assessment, and inventory of the groundwater resources of Canada is a prerequisite to avoid catastrophes of the same nature as those in the US. We should take advantage of the pre-development conditions that seem to prevail in Canada to assess our aquifers before it is too late.

2

Groundwater Allocation Law in Canada

Water allocation is the process used to decide how water should be shared between industrial, agricultural, municipal, and domestic uses. Ideally, allocation will also reserve water to sustain the environment.

The chapter discusses the historical distinction between the regulatory systems for surface water and groundwater, a distinction no longer relevant in modern integrated management laws which recognize that surface water and groundwater are interconnected in one hydrological cycle.

Provincial statutes and regulations have significantly modified the common law systems of riparian rights and prior allocation, and regulators now base allocation decisions on statutory rules. This chapter briefly outlines the different provincial legal frameworks underpinning allocation decision-making before the detailed discussion of different aspects of permitting in chapters 3, 4, and 5.

Though jurisdiction over groundwater is primarily provincial, the federal and municipal governments play a regulatory role. Aboriginal water rights are also growing in importance. International legal and

policy commitments influence the content of national law as well. These topics are also raised in this chapter.

HISTORY OF GROUNDWATER LAW – THE “UNKNOWABLE RESOURCE”

The law of groundwater allocation in Canada developed initially from English common law. Archaic legal concepts separated groundwater and surface water management due to judges' incomplete understanding of the hydrologic cycle. Courts in England applied different theories to conflicts involving surface water from those involving groundwater.

The English common law first developed the concept of “riparian rights” for surface water. The word riparian means “related to the banks of a river”; it comes from the Latin word *ripa* meaning “bank of a river.” Riparian rights are the legal rights of owners of land bordering on a river or other body of surface water. Riparian rights are not ownership rights, but rights of access to the water for domestic uses, such as for drinking, bathing, or irrigation. The rights are not absolute. A landowner exercising

riparian rights must not impair the rights of downstream users, either by fouling the water quality or by overly diminishing its quantity.

Riparian rights grew out of easily observable features of surface water which lent themselves to regulation. As water moved over many parcels of land, any interference with its flow or quality was readily apparent, so rules for sharing the water among those whose land it passed over and prohibiting interference were easy to develop. These features are not shared by groundwater. Historically, it was impossible to see subterranean water resources and so impossible to detect if they were moving, still, running out, or unimpaired.

Groundwater was a relatively unknown quantity in the early 1800s when water rights disputes arose. Judges distinguished between groundwater flowing in defined underground channels, to which the riparian rights theory was applicable, and other unknown forms of underground water. For all these other sources of groundwater, the rule of absolute capture prevailed. This rule allows landowners the unfettered right to extract groundwater from under their land regardless of any injury they may cause their neighbours. The rule was based on the proposition that everything that lies beneath the land belongs to the landowner.

The distinction is erroneous because only rarely will groundwater flow in defined channels and act like streams. Also no one could discern which underground water sources fit the category of an underground stream.

Why did the law treat these two classes of water differently? From today's vantage point and with the benefit of contemporary knowledge of hydrogeology, this distinction seems strange. But to judges who first heard disputes involving underground water, the matter was far from clear. Surface water that flowed above ground was visible, crossed land that was privately owned but was clearly not part of the land, and flowed in observable patterns. The activities that interfered with its flow were obvious. In contrast, groundwater could hardly be subject to the same rules as it "moved through the hidden veins of the earth," was "mysterious," and "unknow-

able."³³ The English common law rules that formed part of the law of Canada and the US treated groundwater as a foreign substance.

Ignorance about the nature of groundwater is particularly evident in a famous American case in 1904 in which the Texas Supreme Court ruled that a landowner, W.A. East, was not entitled to damages from a railroad whose drilling of wells for its steam locomotives had caused his well to go dry.³⁴ The court said the railroad had a right to pump as much groundwater as it chose without liability, as the origin, movement, and course of groundwater was "so secret, occult, and concealed" that any legal rules governing groundwater "would be involved in hopeless uncertainty, and would, therefore, be practically impossible." The other public policy reason for disallowing the claim was that attempting to apportion groundwater would discourage development.

This decision has been roundly criticized and has led to charges that Texas groundwater law is the "law of the biggest pump." Though there are recent signs of change, Texas is the only state to still maintain the rule of capture. The Texas Supreme Court has commented that "what was so secret [and] occult to us in 1904 - the movement of groundwater - was no longer so"³⁵ and held that unregulated groundwater pumping was unacceptable, but left it to the legislature to create the rules.

This characterization of groundwater as mysterious and unknowable and the separate development of the law of groundwater and the law of surface water continued well into the second half of the 20th century. Provincial licensing provisions used for surface water were extended to groundwater in Ontario only in 1961, and to the Prairie Provinces in the 1970s.³⁶

Water law doctrines

A welter of different legal doctrines about water exist in Canada, which have now mostly been superseded by statutory rules:³⁷

- riparian rights, still used to some extent in Ontario and the Maritimes;
- prior allocation, where a licensee acquires rights to water from the date of the licence

application (a system also known as FITFIR or “first-in-time, first in right”) used in BC, Alberta, Saskatchewan, and Manitoba;³⁸

- Civil Code used in Quebec; and
- the authority management approach used in Yukon, Nunavut, and Northwest Territories.³⁹

The common law systems share the same central defects: they do not promote the optimum use of water, and are too rigid to adapt to changing societal priorities. Riparian rights favour riparian landowners, prior appropriation favours senior water right holders, and neither allocates water according to those uses society deems most important.

Neither system encourages conservation or recognizes public values like ecological functioning, neither provides a means to compel a transfer from a lower priority use to a higher use, and neither allows new users access to water rights if there is no riparian land or extra water capacity left. The features of these rules that made them desirable in earlier times – to encourage settlement and to promote economic and agricultural development – no longer prevail.

Surface water licences issued under common law rules still operate in some parts of Canada. Two examples are large irrigation licences in Alberta⁴⁰ and older municipalities, industries, and hydroelectric operators who had licences before 1961 when the

Ontario Water Resources Act was passed and which “are now treated as if they hold vested rights that are beyond the reach of the permit system.”⁴¹ These licences remain unaffected by statutory changes as most statutory systems grandfather pre-existing licences.⁴²

Historical large volume licences with priority over other uses can contribute to water shortages and exacerbate conflicts over water allocation in arid regions such as southern Alberta where competition for scarce water resources is increasing.⁴³

Jurisdiction over water

The number of jurisdictions involved in the regulation of water complicates water rights in Canada. Water is primarily regulated at the provincial or territorial level, though the federal government, Aboriginal governments, and municipalities also exercise control over different aspects of water.

The Constitution of Canada⁴⁴ distributes powers between the federal and provincial governments to make laws and to own and manage property. Water is not specifically mentioned as a specific head of legislative or proprietary power for either of these levels of government. The Constitution also gives shared responsibilities to both the federal and provincial governments over certain subjects such as interprovincial water issues, agriculture, and health.

Notable Recent Groundwater Cases I – Riparian Rights Trump Groundwater Use Rights

In a drawn-out battle pitting citizen conservationists against a giant multinational, a judge ruled in favour of a citizens’ group that Nestle’s water withdrawals from Michigan’s Sanctuary Springs were unlawful.

In his 68-page judgment delivered in 2003, Judge Root found that: “In cases where there is a groundwater use that is from a water source underground that is shown to have a hydrological connection to a surface water body to which riparian rights attach, the groundwater use is of inferior legal standing than the riparian rights. In such cases, as here, if the groundwater use is off-tract and/or out of the relevant watershed, that use cannot reduce the natural flow to the riparian body...Groundwater withdrawals that run afoul of either of the above standards are unlawful, not in the criminal sense, but as a matter of civil property law.”

Michigan Citizens v. Nestle Waters North America Inc, at <http://www.envlaw.com/decisions/MCWC%20decision.pdf>

Provincial role in water management

Key legislative powers give provinces the primary role in water management. These powers include:

- the power to make laws concerning property and civil rights, which includes regulation of the use of property, and land use;
- the jurisdiction to regulate “local works and undertakings”;
- proprietary powers over Crown land, as the *Constitution Act* generally provides for provincial ownership of all public lands (including water);
- the ownership of natural resources;
- jurisdiction over municipalities;
- matters of a “merely local or private nature”; and
- natural resources, forestry, and electrical energy.

Links to each provincial agency are contained on the central Environment Canada website.⁴⁵

Water rights are obtained by licence or permit in most provinces. In all the provinces except BC, groundwater and surface water are part of the same licensing regime. The provincial role in permitting or licensing (the terms are used interchangeably in this report) is discussed in detail in subsequent chapters.

It is important to note that provincial water statutes may not have accounted for Aboriginal rights to water, and some First Nations believe that they have existing and superior rights to water.⁴⁶ Federal water interests, such as fisheries and navigation, must also be accounted for, and may limit the broad sweep of the provincial ownership and control provisions.

Territorial role in water management

Like the municipalities, the three northern territories, Nunavut, Yukon, and Northwest Territories (NWT), do not have independent constitutional status. The *Constitution Act* gives the federal Parliament the power to legislate with respect to any territory in Canada which is not part of any province. The three territories were created through federal statute and given limited legislative jurisdiction, similar to the legislative powers of the provinces.

Indian and Northern Affairs Canada (INAC) is responsible for the all legislation and policy relating to water management in NWT and Nunavut. The most significant water licences are issued by water licensing boards but must be approved by the Minister of Indian Affairs and Northern Development before they take effect.

The four boards responsible for administering water rights through licences in different areas of NWT are the:

- Northwest Territories Water Board for the Inuvialuit Settlement Region;
- Gwich'in Land and Water Board for the Gwich'in Settlement Area;
- Mackenzie Valley Land and Water Board for the Unsettled Claim Areas in NWT, Transboundary Projects with the Gwich'in Land and Water Board and the Sahtu Land and Water Board; and
- Sahtu Land and Water Board for the Sahtu Settlement Area.⁴⁷

The Nunavut Final Agreement establishes a number of co-management boards, including the Nunavut Water Board created in 1993.⁴⁸ The 1996 *Royal Commission on Aboriginal Peoples* identified the Nunavut board as a useful precedent for Aboriginal involvement in other regions of Canada.⁴⁹ In addition to issuing water licences, this board helps develop land use plans and environmental assessments pertaining to water. Inuit rights to water use, management, and administration have been integrated into the joint management regime.

The Yukon Water Board is an independent administrative tribunal that issues water use licences for both surface water and groundwater for a variety of undertakings such as placer and quartz mining, municipal use, power, and conservation.⁵⁰

Federal role in water management

The federal role exists because of the federal government's legislative and proprietary powers. The strategic and environmental importance of water resources bolsters the rationale for federal involvement.

The main constitutional powers of the federal government related to water are specific legislative powers over:

- sea coast and inland fisheries;
- navigation and shipping;
- international or interprovincial “works and undertakings” — which the courts have interpreted to cover pipelines;
- federal works and undertakings;
- canals, harbours, rivers, and lake improvements; and
- Indians and lands reserved for Indians.

Two other broad powers have been interpreted to give Parliament wide powers over the environment. The first is the “POGG” power which stands for “peace, order, and good government” of Canada, and which has been used to justify federal laws regulating matters of national importance. The second is the criminal law power, important for environmental protection as it can be used to prohibit an activity, it carries a penal sanction, and it may be used to protect public safety or health.

The federal government also has the power to negotiate treaties, but implementation of treaties is more complex. The federal government has the constitutional authority to implement “Empire” treaties, which are those treaties concluded by the British Empire on Canada’s behalf before Canada assumed full control over its international relations in 1931. The federal government also still has the power to implement subsequent treaties, but only if the subject matter of the treaty falls within federal jurisdiction; otherwise it must rely on the provinces for implementation. This is significant in the context of water because the 1909 *International Boundary Waters Treaty* is an Empire treaty, so may be implemented by the federal government even if the legislation would otherwise infringe on provincial legislative authority. The federal government has to be much more aware of provincial powers for any other water treaty it now concludes in light of the changed constitutional environment since 1931.

As a property owner, the federal government also has control over water, but there is no central federal water law, despite the existence of the comprehensive-sounding *Canada Water Act* which authorizes agreements with the provinces for the designation of water quality management areas, and for the delineation of flood plains and hazardous shorelines to control flooding and erosion.⁵¹ Examples of federal-provincial agreements on groundwater include the hydrometric and water quality agreements between Environment Canada and PEI which includes long-term monitoring of both groundwater and surface water quantity and quality.

Other key federal water laws are the *Fisheries Act*, which prohibits damage to fish habitat and the deposit of deleterious substances in fish-bearing waters, and the *Navigable Waters Protection Act*, which prohibits any “work” that is built or placed in, on, over, under, through, or across any navigable water unless the work, the site, and the plans have been approved by the Minister of Fisheries and Oceans. The *Indian Act* is the chief federal law regulating the activities of Indians and it has limited provisions regarding the types of water bylaws that bands can pass on reserve land.⁵²

Currently, the federal role in groundwater relates to three specific areas: research, national programs, and international affairs. Many federal departments have a role in groundwater policy: the key departments are Environment Canada, Natural Resources Canada, and Agriculture and Agri-Food Canada (including the Prairie Farm Rehabilitation Administration), while Heritage Canada, Fisheries and Oceans Canada, National Defence, Transport Canada, Parks Canada, and Indian and Northern Affairs Canada are supporting players. Natural Resources Canada is the federal lead for groundwater quantity, while Environment Canada is the lead on groundwater quality⁵³ as well as for freshwater. The latter maintains a freshwater website⁵⁴ and also sponsors research collaborations on water issues of national importance, such as the report *Threats to Water Availability in Canada*.⁵⁵

Diminished Federal Role in Water Management?

In the 1987 *Federal Water Policy* the federal government pledged to develop a better understanding of groundwater:

“Only modest attention has been paid to groundwater resources on a national scale because the nation’s surface water supplies are so large. Yet, one-quarter of all Canadians depend on groundwater for domestic use. It is known, too, that groundwater sources sustain the value of wetlands, streams, lakes, and other surface waters when surface runoff is light or nil. Any contamination associated with groundwater, some of which occurs naturally, can, therefore, spread to surface waters and vice versa.

“The federal government is committed to the preservation and enhancement of the groundwater resource for the beneficial uses of present and future generations.

“To meet this commitment, the federal government will:

- develop, with provincial governments and other interested parties, appropriate strategies, national guidelines and activities for groundwater assessment and protection;
- conduct research and undertake technological development and demonstration projects in response to groundwater problems;
- develop exemplary groundwater management practices involving federal lands, responsibilities, facilities, and federally funded projects;
- develop measures to achieve appropriate groundwater quality in transboundary waters; and
- provide information and advice on groundwater issues of federal and national interest.”⁵⁶

One of the experts who conducted the inquiry which provided the basis for the 1987 policy has expressed the opinion that the entire policy remains unimplemented due to the elimination of the Inland Waters Directorate of Environment Canada and a perception that there has been a declining priority for water at Environment Canada.⁵⁷

In 2001, a report from the Commissioner of the Environment and Sustainable Development regarding the Great Lakes and St. Lawrence River Basin referred to the 1987 policy statements about groundwater and said that despite the federal government’s commitment to improving its understanding of groundwater aquifers, “It has gained little understanding of groundwater in the basin since then. Its knowledge has remained fragmented and incomplete.”⁵⁸

Actions to implement the *Federal Water Policy* have involved many federal partners and taken many different forms.⁵⁹ A key factor to consider is that the federal government shares jurisdiction with the provinces over water.

There have been many calls for the federal government to take a stronger role in fresh water management, given its jurisdictional powers and its central coordination role.⁶⁰ The federal government agreed at the 2002 World Summit on Sustainable Development to complete an integrated water resource management plan by 2005.

Local government role in water management

Local governments supply water to local users on a central system (e.g., industrial or domestic users within a municipality). Local governments do not issue permits for water takings or allocations. In fact local governments require a permit from the province for water takings to supply their own systems. However, local governments need to be involved in decision-making about water-taking permits, or at least be provided with the knowledge of other levels of government about water resources, as water supply and land use decisions are closely tied.

Land development may be restricted by the availability of groundwater. In BC, though there has been no example to date of denial of a new subdivision on the basis of water quantity concerns, subdivisions have been scaled down to meet these concerns, for example, substituting 200 houses for 350.⁶¹ In the key groundwater recharge area of the Oak Ridges Moraine in southern Ontario, the provincial government introduced new development controls after a lengthy controversy.⁶² Debate over the existence and scale of subdivision development on the Moraine continues.

The links between drought, sprawl development, and groundwater depletion are also receiving more attention. Paved development can impair the landscape's ability to recharge aquifers and surface waters as paved-over land sends billions of gallons of water into streams and rivers as polluted runoff, rather than allowing it to seep into the soil to replenish groundwater.⁶³

Further, municipalities are not efficient water users.⁶⁴ Reducing municipal demands on groundwater sources could be achieved through greater water efficiency and conservation measures, and increased attention to two of the major factors that influence water consumption: the cost of water and residential density.⁶⁵

Since 1994 Ontario has required municipal investments in water efficiency and sewage system optimization in order to be eligible to apply for provincial capital grants. Specifically, the Municipal Assistance Program (1994) required municipalities to have a program in place to properly maintain

their existing system and to examine water efficiency and system optimization as an integral component of their proposed capital projects. These requirements were carried forward into subsequent funding programs such as the Provincial Water Protection Fund (1996), which earmarked funds consistent with the principles of full exploration of system optimization and economic efficiency program allocation, calling for environmental studies to encourage conservation, protect the water resource, and defer the need for capital works.

If experience in the US is any guide to what may happen in the future in Canada, municipal competition with agricultural users for water will increase.⁶⁶ This is starting to happen in the rapidly urbanizing Okanagan, also BC's chief productive agricultural area, where water resources are already heavily allocated. The Canadian Water Resources Association estimates that at present per capita usage rates, they will be fully allocated in less than 25 years. A similar situation prevails in southern Ontario.⁶⁷

Integrated management will involve all levels of government. The extent of municipal influence on environmental protection is receiving more recognition, and as water laws emphasize source protection and environmental protection laws take a more holistic approach, this influence is likely to increase even more.⁶⁸

Aboriginal water rights and Aboriginal role in water management

European settlement deprived Aboriginal peoples of their water rights by changing the quality, quantity, and flow of rivers and lakes in Canada, resulting in damage to habitat and boat routes, flooding of traditional land and forced relocation, and loss of control over a vital resource.⁶⁹

Both surface water and groundwater rights are key parts of the settlement of land claims and the establishment of co-management regimes for natural resources. As economic development is a significant component of contemporary Canadian Aboriginal rights, the availability of sufficient quantities of water for agriculture, fishing, hydroelectric development, transportation, tourism, and other industrial uses is a central concern. Water rights are also need-

ed to preserve traditional ways of life such as hunting, fishing, and trapping.

The literature on Aboriginal or customary water rights is surprisingly sparse. The sole text on the topic is from 1988.⁷⁰ Aboriginal rights have evolved considerably since that date, due to Supreme Court of Canada rulings on the nature and extent of Aboriginal title and Aboriginal rights, and also due to land claims and treaty settlements in the Canadian North and other regions of the country.

Aboriginal rights to water can arise from a number of possible legal sources.⁷¹ Though there has been no specific judicial consideration of an Aboriginal right to the use of water, it is reasonable to assume the existence of such a right. “[A]boriginal rights lie in the practices, customs, and traditions integral to the distinctive cultures of Aboriginal peoples.”⁷² The courts have upheld sustenance rights and traditional practices of hunting, fishing, and trapping, and as “it is difficult to imagine a sustenance right more basic than the right to the use of water,” an Aboriginal right to water likely exists.⁷³

Though the state of Aboriginal law in Canada is evolving rapidly, courts have not often been called upon to consider Aboriginal water rights. However, based on the growing importance of freshwater resources and the extensive jurisprudence on this topic from the US, it is likely that these issues will come before the courts in the near future.

Applicability of US jurisprudence to Canadian Aboriginal water rights

The American jurisprudence on the Aboriginal right to water is extensive compared to that in Canada. The major case in the US is *Winters* 1906, which established the *Winters Doctrine* and the principles of Indian reserved water rights. The US Supreme Court held that a reserve right of a sufficient amount of water necessary to fulfill the purposes of the Indian reservation was implied in the creation of reservations of land. A reserve right to water is a right created by federal law, senior to all future users, and cannot be lost by non-use. The right is created as of the date the reservation was established.⁷⁴

In reaching this decision, the court reasoned:

The Indians had a command of the lands and the waters—command of all their beneficial use, whether kept for hunting, “and stock,” or turned to agriculture and the art of civilization. Did they give up all this? Did they reduce the area of their occupation and give up their water which made it valuable or adequate?

Whether *Winters* rights extend to groundwater underneath a reservation has not yet been settled.⁷⁵

The water rights at issue in the *Winters* case were from the Milk River, a transboundary river that originates in Montana and then flows into Alberta before returning to Montana. It provides an interesting contrast in how water rights are addressed on both sides of the Canada-US border. On the American side, the Aboriginal peoples enjoy the reserved right to water established by *Winters*, but there is no mention of Aboriginal water rights in the Alberta *Water Act* of 1999. One water law expert reviewing this situation argued that “by ignoring the issue in the Bill [the draft Water Act], the province is losing an opportunity to invite a settlement of claims according to an equitable set of principles. The experience in the United States suggests that if we fail to settle these issues now, they will surely become more bitter and, in the result, will undermine the security of the very rights that the province is trying to protect and assure.”⁷⁶

Many authors have commented on the likelihood of the *Winters* case and the associated body of law being equally applicable in Canada.⁷⁷ No Canadian court has yet considered the major US Indian water rights cases.

Contemporary Aboriginal role in water management

It is premature to predict the future Aboriginal role in groundwater or surface water management. However, looking at the first modern treaty between an Aboriginal group and the provincial and federal governments gives some clues about possible roles. The 2000 *Nisga'a Final Agreement*, in relation to water, provides that:

- The province retains full ownership and regulatory authority over water.
- Existing water licences remain in place.

- The Nisga'a have a water allocation equal to one percent of the annual average flow from the Nass Valley watershed for their domestic, industrial, and agricultural needs.
- The Nisga'a also have a reservation for the purpose of conducting studies to determine the suitability of streams for hydropower purposes. Any hydro development will be subject to provincial approval and regulation.⁷⁸

The treaty does not specifically address groundwater.

At least two significant lawsuits regarding Aboriginal water rights in Canada are in progress. In the first, the Haida Nation launched an Aboriginal title claim to all of Haida Gwaii (the Queen Charlotte Islands), in 2002. The Haida are seeking an order quashing all licences, leases, permits, and tenures that are incompatible with Aboriginal title and the exercise of Aboriginal rights. The lawsuit also seeks an accounting of all profits, taxes, stumpage dues, royalties, and other benefits acquired by the province, Canada, and third parties and are further seeking damages and compensation for what the lawsuit alleges is the government's unlawful conduct.⁷⁹

In the second suit, the Chippewas of Nawash Unceded First Nation, the Walpole Island First Nation (Bkejwanong), and the Saugeen First Nation are pursuing an Aboriginal title claim to parts of the lakebed

of Lake Huron and Georgian Bay. In September 2004, the governments of Canada and Ontario were unsuccessful in their second attempt to quash this claim. They had argued that the title claim to parts of the Great Lakes was incompatible with their Crown sovereignty over the same waters.⁸⁰ In Ontario, a number of First Nations communities have been issued permits to take water for their water supply, but the precise application of the *Ontario Water Resources Act* to groundwater on First Nations Reserves has not yet been finally determined.

Some First Nations have developed water bottling projects on their reserves. The Iroquois Nation in Akwesasne, Ontario, created Iroquois Water Ltd. to market spring water; it exports more than 90% of its product to the US.⁸¹

International law and policy context for groundwater

Water is at the forefront of international policy dialogues on sustainable development. While interest initially focused primarily on surface water, more attention is now devoted to groundwater, especially given its pivotal role in supplying drinking water and irrigation in many developing countries.

Water was one of the focal points of the 2002 Johannesburg World Summit on Sustainable Development.

Notable Recent Groundwater Cases II – Court Orders Coca-Cola to Stop Using Groundwater in India

In December 2003 the Kerala High Court directed an Indian branch plant of Coca-Cola to find alternative sources of water for its bottling plant and stop its harmful groundwater extraction. The decision followed massive local protests – a thousand local families protested for 608 days, claiming that the plant was killing their coconut palms and rice paddies. The judge said, "Groundwater is a national wealth and it belongs to the entire society. It is a nectar, sustaining life on earth. Without water, the earth would be a desert. At present, there is no law governing the control or use of groundwater." He ruled that Coca-Cola's extraction of the groundwater was illegal. The company had no right to extract that much water and the government was bound to prevent it. In February 2004 the Kerala state government followed up on the court decision, ordering Coca-Cola to stop using groundwater at its local plant until monsoon rains started in June, a decision that Coke officials described as "unwarranted and unjustifiable."

Perumatty Grama Panchayat v. State of Kerala. 2004 (1) KLT 731, available online at <http://www.elaw.org/resources/text.asp?id=2551>.

The United Nations (UN) adopted a water goal as one of the eight Millennium Development Goals. Goal 7 on environmental sustainability includes the target: “To halve, by 2015, the proportion of people without sustainable access to safe drinking water.” This target covers both surface water and groundwater, as the United Nations Environment Programme (UNEP) estimates that over two billion people around the world rely on groundwater for drinking water.

Water has also become a hot topic of discussion in the human rights arena. Though it may seem logical that the right to water is an implicit part of other internationally agreed rights, such as the rights to food, health, and life itself, this human right has only recently been elaborated by the UN.⁸²

Many international organizations, such as the World Bank,⁸³ the UN Food and Agriculture Organization,⁸⁴ UNESCO,⁸⁵ UNDP,⁸⁶ UNEP,⁸⁷ and the Global Environment Facility⁸⁸ are tackling groundwater. The three World Water Forums, most recently the Third Forum in Kyoto, Japan, in 2003, have also focused on groundwater.⁸⁹

National rules are influenced by international law. Freshwater treaties tend to focus on transboundary rivers. The international legal system has been slower to address shared groundwater resources, paralleling the slower evolution of groundwater laws in national legal systems.

The International Law Commission appointed a Special Rapporteur to investigate the issue of confined transboundary groundwaters. His preliminary report on the topic was tabled in 2003.⁹⁰ Rules governing the use, allocation, conservation, and overall management of groundwater across borders are still unclear.⁹¹ More legal work will no doubt ensue, as almost all countries other than islands are hydrogeologically linked to their neighbours. Canada is no exception.

Though the focus of the International Joint Commission (IJC) has been on shared surface waters, it has by necessity examined groundwater as an integral part of its mission. Its 2000 report, *Protection of the Waters of the Great Lakes*, highlights groundwater as an important component of the Great Lakes Basin, and points out that while nei-

ther country fully understands the extent of groundwater resources, Canada lags behind the US in data collection and monitoring. The IJC itself does not always take an integrated approach: major studies such as its International Lake Ontario–St. Lawrence River Study Board are not examining the linkages between groundwater and surface water.⁹²

The protection of groundwater is also an important part of the current negotiations surrounding *Annex 2001* to the *Great Lakes Charter*.⁹³ Ontario’s rejection to date of the proposed *Annex*, which would have enshrined vague “resource improvement standards” and possibly allowed greater rates of extraction and diversion from the lakes, was based in part on the lack of clarity in transboundary water resource rules.⁹⁴

The IJC continues to urge both governments to take more action on improving their groundwater knowledge, most recently in its 2004 review of recommendations made in its 2000 report:

The Commission observes that the *Boundary Waters Treaty* is silent regarding groundwater. However, apart from the fact that sometimes groundwater and surface water flows may be indistinguishable, the IJC can and has considered groundwater flows under References issued pursuant to Article IX of the treaty and can consider impacts on groundwater flows when deciding whether to approve applications for projects with transboundary effects pursuant to Articles III, IV and VIII of the treaty. The Great Lakes Charter and Annex 2001 both define “waters of the Great Lakes Basin” as including tributary groundwater that is within the Charter boundary. As such, it appears that any water management regime that is developed as a result of the Annex 2001 process will be applied to both groundwater and surface water withdrawals within the Charter boundaries. The Commission cautions that because of the relatively poor state of scientific knowledge concerning the quality, quantity and flow of groundwater, that any regime should be flexible enough to accommodate improvements in that knowledge.⁹⁵

Case Study

Groundwater Use in Canada – Case Study Summary

BY SUSAN RUTHERFORD, WEST COAST ENVIRONMENTAL LAW

This case study constitutes a summary of a lengthier study. The longer version is available for download on the website of BuriedTreasureCanada.ca and on the website of West Coast Environmental Law, at <http://www.wcel.org>.

INTRODUCTION

This case study focuses on groundwater use in Canada. It explores patterns of groundwater use across the country and notes some of the significant gaps in the data. It also briefly reviews and evaluates use trends in the bottled water industry and the regulatory schemes applicable to that industry in each of the provinces and territories.⁹⁶

In the end, this study underlines groundwater's integral role in the everyday lives of Canadians. Groundwater is used in all kinds of industries, it flows in our public water systems, and it has a growing commercial importance. This study shows that Canada does not yet have a complete set of data for fully understanding how we use groundwater, and therefore lacks an essential building block for regulations to control groundwater use and protect sustainability.

AVAILABLE DATA AND GAPS

We gathered data from federal, provincial/territorial, and local government sources, and from industry and non-government researchers, where available. The quality and availability of data were uneven. Use data in Canada more often tracks *water* use than *groundwater* use, and it is even more difficult to find data that track groundwater takings by detailed categories of use, as opposed to aggregated use categories. The most recent Canadian water-use data date from 1999, another limit on fully understanding groundwater use across the country.

We identified the following specific data gaps:

- Several jurisdictions (Ontario, Quebec, Nova Scotia, Yukon, NWT, and Nunavut) did not have use data readily available. In some cases (Ontario and Quebec), we were able to obtain data from private sources (Gartner Lee and Quebec Water Bottlers' Association respectively). Ontario's new-water taking regulation that passed in 2004 will require mandatory reporting on groundwater use, however.

Table 1: Groundwater use in Canadaⁱ

Province/ Territory	Population reliant on groundwater (number) [1996 data]	Population reliant on groundwater (%) [1996 data]	Groundwater use as % of total water use in province [Current data]
BC	1,105,803	28.5%	10% ⁱⁱ
AB	641,350	23.1%	3% ⁱⁱⁱ
SK	435,941	42.8%	n/a
MB	342,601	30.2%	n/a
ON	3,166,662	28.5%	2.5% ^{iv}
QC	2,013,340	27.7%	n/a
NB	501,075	66.5%	n/a
NS	426,433	45.8%	n/a
PEI ^v	136,188	7 out of 9 (77.78%)	n/a
NL	189,921	33.9%	n/a
YK	15,294	47.9% ^{vi}	75.4% total licensed water use ^{vii}
NWT	18,971	28.1%	n/a
SUM	8,993,579	30.3%	n/a

Notes:

i. The left two columns of data are reproduced from Statistics Canada, "Freshwater Resources," in *Human Activity and the Environment: Annual Statistics 2003*, at p. 25. In compiling and estimating these data, Statistics Canada extrapolated from Municipal Use Database (MUD) 1996 data and assumed that the population not covered by the MUD, 1996 is rural and that 90% of this population is groundwater reliant (except in PEI, where 100% of the population is known to be groundwater reliant). Data in the right-hand column are derived from sources which are noted in each case.

ii. See <http://wlapwww.gov.bc.ca/wat/gws/gissues.html>. These data are from 1981, and no updated data are available, though the ministry advises that the percentage use by various sectors may not have changed significantly.

iii. See <http://www3.gov.ab.ca/env/resedu/edu/focuson/groundwater.pdf>. Since Alberta has figures only on allocations, not on use, it is possible that the 3% figure is an estimate of use.

iv. Canadian Bottled Water Association. See http://www.cbwa-bottledwater.org/en/Leave_Behind.htm.

v. Reporting for PEI is incomplete. Currently there are 13 municipal water systems in PEI, all of which are completely reliant on groundwater.

vi. An article on the website Taiga.net reported that more than 99% of Yukoners depend on groundwater for their water supply at least a portion of the time. See <http://www.taiga.net/yourYukon/col222.html>.

vii. Yukon 1999 State of the Environment Report, combined with personal communication with Kevin Rumsey of Yukon Water Resources Branch, Changing Water Resources Department.

- There is a general shortage of data on actual use of groundwater. Most jurisdictions had some data available on volumes of groundwater allocations (under a permit or licensing regime), but few jurisdictions had readily available data to confirm the actual volume of use. Only Manitoba and Alberta were able to provide some actual use data.⁹⁷ Saskatchewan, in addition to an allocation database, has data on actual groundwater withdrawals. Protection of commercially sensitive information was sometimes given as a reason for withholding actual use data.⁹⁸ It is questionable whether using “commercial competitiveness” is a valid policy reason to block public access to information on how much groundwater is being used.
- Unevenness in data collection and categorization of use among jurisdictions made comparisons from one jurisdiction to another cumbersome. Also, most jurisdictions have organized their use data into very general categories, rather than implementing a finer resolution or categorization scheme. This makes it difficult to ascertain which particular uses are the most prominent.
- There is a shortage of data placing provincial groundwater use in the context of national use of water and groundwater.
- Trend data for non-municipal use of groundwater are either not available or not readily available.

INTERPRETING THE DATA

Level of dependence on groundwater

On a national scale, the degree of Canadians’ dependence on groundwater is significant: some “8.9 million people, or 30.3% of the population, rely on groundwater for domestic use. Approximately two-thirds of these users live in rural areas.”⁹⁹

Table 1 compares the provinces and territories on the basis of two measures of dependence on groundwater resources: the number and proportion of the jurisdiction’s population that is dependent on groundwater for their drinking water supply, and the proportionate share of the jurisdiction’s overall use of water that is met by groundwater resources.

Aggregated provincial data such as those in Table 1 mask regional dependencies within provinces, which can be significant. For example, in BC, the Gulf Islands communities (located between the Mainland and Vancouver Island) are almost completely dependent on groundwater for their drinking water and other freshwater needs.

Other measures of reliance

One of the measures of reliance on groundwater is the reliance of municipal water systems on groundwater supplies. Table 2 shows numbers of municipal systems and populations dependent on groundwater sources. The data are drawn from MUD 1999.

The greatest dependencies in Table 2 are marked in bold. For example, Yukon has the highest percentage of its municipalities reporting reliance on groundwater, with four out of four, or 100%. With 142 municipal systems reliant on groundwater, Quebec has the greatest number of municipal systems reliant on groundwater. Ontario, however, has the largest population (1,280,183) dependent on groundwater. Note that Quebec, which has a population of 574,864 dependent on groundwater exclusively, has a significant additional population of 41,892 dependent on *combined* groundwater/surface water sources.

Table 2: Municipal use of groundwater (municipalities with populations >1000 only)ⁱ

Province/ Territory	No. of municipalities where source is GW or combined GW/SW and proportion of total in province	Population whose municipal water source is GW only and proportion of total Canadian population whose municipal source is GW
BC	63 out of 144 (43.75%)	382,202 (13.68%) ⁱⁱ
AB	36 out of 125 (28.80%)	121,739 (4.36%)
SK	43 out of 68 (63.24%)	111,699 (4.00%)
MB	21 out of 48 (43.75%)	53,893 (1.93%) ⁱⁱ
ON	113 out of 267 (42.32%)	1,280,183 (45.82%)
QC	142 out of 405 (23.05%)	574,864 (20.57%) ⁱⁱ
NB	40 out of 74 (54.05%)	144,520 (5.17%)
NS	13 out of 38 (34.21%)	35,635 (1.28%)
PEI ⁱⁱⁱ	13 out of 13 (100%)	50,476 (1.81%)
NL	19 out of 86 (22.09%)	29,972 (1.07%)
YK	4 out of 4 (100%)	8,861 (0.32%)
NWT	0 out of 17 (0%)	0 (0%)
SUM	492 out of 1285	2,794,044 (100.01% – rounded %)

Notes:

i. Data from MUD 1999.

ii. BC reports an additional population of 1,202 whose systems have combined GW/SW sources; Manitoba an additional population of 1,485 whose systems have combined GW/SW sources; and Quebec an additional population of 41,892, whose systems have combined GW/SW sources.

iii. Data from PEI (not MUD) and is incomplete.

There is a need, however, to be somewhat cautious interpreting MUD data used in Table 2. The fact that the data capture only municipalities with populations greater than 1,000 is a serious limitation, especially for determining groundwater use. This excludes rural and small town residents, who are significant in number. Moreover, because so many rural and small town residents use private or community wells, the omission of these populations means that the overall provincial picture of groundwater use is incomplete.

By comparison, Statistics Canada with its data in the two left columns of Table 1 attempts to overcome the population limitation of the MUD data by projecting figures for rural Canadians reliant on groundwater, based on an assumption that 90% of rural populations are groundwater-reliant. (The assumption made seems reasonable, though perhaps a bit high,¹⁰⁰ for all jurisdictions except for perhaps NWT, where due to permafrost, surface water may be preferred over private wells.) Note the significant difference that bringing in the rural populations (and making assumptions about their use) makes to the “bottom line” picture of Canadians’ everyday dependence on groundwater: 8.9 million people instead of 2.8 million!

Trends in average daily flow – municipal use 1983–1999

Table 3 sets out data for total Canadian average daily municipal water flow of all water systems, groundwater sourced systems, and combined GW/SW systems, for the years 1983 to 1999, at five- or six-year intervals. For each average flow figure, the correlating municipal population that relies on the source has been set out below it, where data were available. (The 1983 and 1989 MUD data do not provide a breakdown of population by water source.) Thus, the first column is the average daily flow from all municipal water systems, and the total population reliant on them; the second column is the average daily flow from groundwater sourced systems, and the population reliant on those systems; and the third column is the average daily flow from combined GW/SW systems, and the population reliant on those systems.

Table 3: Canadian municipal population and average daily flow 1983-1999ⁱ

Year	ADF (all sources) (m ³ /day) municipal. population	ADF (groundwater) (m ³ /day) municipal. population	ADF (combined) (m ³ /day) municipal. population
1983	12,418,647	1,722,728	698,868
	20,486,207	n/a	n/a
1989	13,854,381 (up)	1,804,788 (up)	1,233,471 (up)
	22,504,394 (up)	n/a	n/a
1994	13,825,442 (down)	1,098,054 (down)	819,117 (down)
	23,913,874 (up)	2,078,011	1,400,447
1999	14,828,932 (up)	1,480,515 (up)	29,697 (down)
	25,365,259 (up)	2,794,044 (up)	44,579 (down)

Notes:

i. Data from MUD 1983–1999.

It is difficult to detect any hard and fast trends arising from these data in Table 3. Between 1989 and 1999 there appears to a positive correlation between increases in municipal population and increases in municipal use of water and groundwater. However, looking at the longer period of 1983 to 1999, despite an overall *increase* of approximately five million people in all systems during that period, the use of groundwater *decreased* (the population reliant on groundwater is unavailable for 1983). This negative correlation is also apparent in the period 1989 to 1994 for overall water use.

Table 4 sets out average daily flow figures for groundwater and combined source systems, for each province over the period 1983 to 1999, at five- to six-year intervals.

Table 4: Total average municipal daily flow, groundwater/combined sources (m³/day)ⁱ

Province	1983	1989	1994	1999	Trend since 1983
BC	309,056	343,745	296,258	274,794	-
AB	127,043	149,476	73,382	78,720	-
SK	272,392	285,626	133,444	47,066	-
MB	38,665	47,833	22,010	21,611	-
ON	1,091,681	1,383,690	658,178	567,013	-
QC	329,901	549,121	543,979	354,732	+
NB	128,880	139,725	101,117	93,994	-
NS	65,348	74,791	29,726	19,308	-
PEI ⁱⁱ	32,408	35,903	19,281	24,932	-
NL	11,001	27,349	22,298	19,715	+
YK	15,221	1,000	17,498	8,327	-
NWT	0	0	0	0	Same
TOTAL	2,421,596	3,038,259	1,917,171	1,510,212	-

Notes:

i. Data from MUD 1983–1999.

ii. The results for PEI are somewhat misleading because the number of municipalities participating in the MUD studies varied considerably (e.g., whereas 19 municipalities reported their use in 1983, only 9 participated in the 1999 study). Currently there are 13 municipal water systems in the province, all of which are completely reliant on groundwater.

These data reveal that Ontario, Quebec, and British Columbia are the biggest users of municipal groundwater, and that municipal groundwater/combined source use peaked in or around 1989, but has been in an overall downward trend since that peak. (However, Alberta and PEI are now both again moving up.) Looking at long-term absolute values, all provinces now use less groundwater/combined sources than they did in 1983, with the exception of Quebec and Newfoundland and Labrador. These trends are interesting when compared to the trend in overall municipal water use, which peaked in 1989, declined in 1994 but is once again on the rise and has exceeded the 1989 level (as evident in Table 3).

Groundwater use – beyond municipal water systems

Despite the importance of municipal water systems, they are neither the only users of groundwater, nor necessarily the biggest. Rural populations most often have private wells, which are usually not licensed. Larger industrial and commercial operations tend to drill their own wells. In most but not all jurisdictions, wells (or other operations) that withdraw a high volume of water require a permit. (See the discussion of the regulatory system governing bottled water later in this case study.) Wells are also often subject to construction, maintenance, and decommissioning standards.

Table 5 compares volumes and shares of municipal use of groundwater and overall use of groundwater by province and territory. Unfortunately, data for non-municipal takings were not available in most jurisdictions, and where they were, the rates of measure varied. Under such circumstances, it

was difficult to draw any useful comparisons or conclusions on the meaning of the data. The different measurements here and in other sections highlight the problem of comparing different provincial systems due to lack of consistency in measurement.

Table 5: Municipal and other groundwater takings

Province/ Territory	Total municipal withdrawal of GW in m ³ /day in m ³ /day ⁱ	% of total municipal GW use in Canada	Total provincial/territorial withdrawal of GW (rate measures vary)	% of total Canadian withdrawal of GW (all GW uses)
BC	274,148 ⁱⁱ	18.52%	n/a	25% ⁱⁱⁱ
AB	78,720	5.32%	184,303,000 m ³ /year (allocated) ^{iv}	n/a
SK	47,066	3.18%	1,542,327 dam ³ /year (allocated) ^v	n/a
MB	21,186 ⁱⁱ	1.43%	80,664 dam ³ /year (allocated) ^{vi}	n/a
ON	567,013	38.30%	n/a	n/a
QC	326,106 ⁱⁱ	22.03%	n/a	n/a
NB	93,994	6.35%	322,301,12 m ³ /day (allocated) known GW source only ^{vii}	n/a
NS	19,308	1.30%	n/a	n/a
PEI	24,932	1.68%	n/a	n/a
NL	19,715	1.33%	n/a	n/a
YK	8,327	0.56%	n/a	n/a
NWT	0	0%	n/a	n/a
SUM	1,480,515^{viii}	100%	n/a	n/a

Notes:

i. Data from MUD 1999.

ii. BC municipalities withdraw an additional 646 m³/day from combined GW/surface sources; Manitoba municipalities an additional 425 m³/day from combined GW/surface sources; and Quebec municipalities an additional 28,626 m³/day from combined GW/surface sources.

iii. See <http://wlapwww.gov.bc.ca/wat/gws/gissues.html>. These data are from 1981, and no updated data are available, though the ministry advises that the percentage use by various sectors may not have changed significantly.

iv. Alberta Environment, "Water Allocation in Alberta." Note that Alberta Environment has also published figures demonstrating the difference between allocated use and actual use. For water use for oil injection, data that show that while 169 million m³ was allocated from surface water and groundwater for injection purposes in 2001, the actual volume diverted was 47.5 million m³. Of this, 37.1 million m³ was from non-saline (fresh) sources made up of 26.9 million m³ of surface water, and 10.2 million m³ of groundwater. See http://www.waterforlife.gov.ab.ca/docs/geowa_report.pdf.

v. (N.B. 1 dam³ = 1 cubic decametre = 1 million litres) Data compiled from a raw data set provided by Don Anderson, Saskatchewan Watershed Authority, 2004. The data set is based on 3,095 active projects in Saskatchewan. Of these, 617 are at the application stage, 151 are approved for construction, and 2,327 are approved for operation and have been licensed.

vi. Of the total, Manitoba reported the following allocated and actual annual volumes by sector: irrigation (28,848 dam³ allocated, actual N/A); industrial (18,054 dam³ allocated; 9,130 dam³ actual); municipal (13,854 dam³ allocated, 5254 dam³ actual); other (13,769 dam³ allocated, actual N/A); agricultural (5,750 dam³ allocated, 2,059 dam³ actual). While actual use data is incomplete, Manitoba water managers are confident that aggregated licensed amounts for each category exceed the actual amounts used across each sector. Information supplied by Water Licensing Branch, Manitoba Water Stewardship.

vii. Estimated volume, compiled from data provided by Nelda Craig, Manager, New Brunswick Water Sciences Section, Science and Reporting Branch, Environment and Local Government.

viii. The total average daily flow of ground-sourced municipal water of 1,480,515 m³/day represents just 9.98% of the total average daily flow of all municipal water of 14,828,932 m³/day (calculated from MUD, 1999).

Groundwater use patterns and trends

Data that might reveal trends over time in non-municipal use of groundwater is either not available or not readily available. Trend information on water use in Canada that has been published to date relates to trends in water use more generally and, unfortunately, does not usually distinguish or isolate trends in groundwater use.

Table 6 organizes information into five different categories of groundwater use. This organization presents a compromise for managing the unevenness in the data and finding some common basis for comparison. For BC, establishing five categories was a stretch, since BC's data are normally presented referring to four categories of use. In contrast, Saskatchewan's data are normally presented in fourteen categories, so these were pooled as logically as possible into the five established categories. The largest allocations are indicated in bold type; more detailed breakdowns are captured in the notes.

If jurisdictions gathered their data using a standardized template of use categories, and at a high level of resolution such as Saskatchewan's, comparisons between jurisdictions would be easier.

Table 6: Groundwater allocation-by-use category (based on permit allocation unless noted as an estimated value)

Province/ Territory	Industrial	Agricultural	Municipal	Commercial & Institutional	Other
BC ⁱ (est)	55%	20%	25%		
AB ⁱⁱ	34.5%	16.9%	26.3%	14.1%	8.24%
SK ⁱⁱⁱ	52.42%	3.09%	43.01%	0.88%	0.60%
MB ^{iv}	22%	44%	17%		17%
ON ^v	35.1%	27.3%	23.9%	5.6%	8.2%
QC ^{vi}	29.5%	16%	54%	0.08%	
NB (est) ^{vii}	26.66%		73.22%	0.12%	
NS ^{viii}	n/a	n/a	n/a	n/a	n/a
PEI (est) ^{ix}	Some	Some	#1 use		
NL (est) ^x			#1 GW use	#2 GW use	
YK (est) ^{xi}	no	no	#1 and only real use	no	no
NWT	n/a	n/a	n/a	n/a	n/a
NUN	n/a	n/a	n/a	n/a	n/a

Notes:

i. Data source: "Ground Water Issues in British Columbia," Ministry of Water, Land and Air Protection, see <http://wlapwww.gov.bc.ca/wat/gws/gissues.html>. These data are from 1981, and no updated data are available, though the ministry advises that the percentage use by various sectors may not have changed significantly. Also BC State of Environment report (2001). "Industry" includes BC's categories of Industry, Manufacturing, Mining, and Aquaculture (together at 55%); "Municipal includes Municipal (18%) and Domestic (7%).

- ii. Data source: Alberta Environment, "Water Allocation in Alberta," 2001. "Industry" includes Alberta's categories of Industrial (8.0%), Injection (26.4%), and Drilling (developing oil/gas wells) (0.1%); "Agriculture" , includes Agriculture (16.5%) and Irrigation (0.4%); "Commercial and Institutional" includes Commercial (12.7%) and Commercial Cooling (1.4%); and "Other" includes Fish Management (5.1%), Recreation (2.7%), Other Purpose (0.3%), Water Management (0.1%) and Wildlife Management (0.00%). Note that Alberta's category of "Commercial" includes uses of gardening, golf courses, parks, aggregate washing, construction, bottling (water, etc.) , snow/ice making, hauling water, other (abattoirs, dust control, bridge/vegetable washing, etc.), which might be classed as "municipal" or "industrial" in other jurisdictions.
- iii. Data compiled from a raw data set provided by Saskatchewan Watershed Authority, 2004. "Industry" includes Saskatchewan's categories of Drainage (4.26%), Other-Aquaculture (1.43%), Industrial-Aquaculture (0.20%), Industrial-Cavern Washing (4.61%), Industrial-Cooling Water (10.11%), Industrial-Mineral Recovery (4.27%), Industrial-Oil Recovery (Steam flood) (3.68%), Industrial-Oil Recovery (Waterflood) (18.06%), and Industrial-Process Water (5.80%); "Agriculture" includes Irrigation-Agriculture (1.13%) and Industrial-Intensive livestock (1.96%); "Municipal" includes Domestic (0.04%), Municipal (0.92%), Municipal-community (0.22%), Municipal-recreational (0.65%), Municipal-rural distribution (0.06%), Municipal-tankload (2.4%), Municipal-urban distribution (38.72%); "Commercial and Institutional" includes Irrigation-commercial facility (0.05%), Municipal-institutional (0.21%), Municipal-commercial facility (0.54%), and Industrial-bottled water (0.08%); "Other" includes Irrigation-park (0.46%), Multipurpose-recreation (0.02%), Other-recreation (0.08%), and Other (0.04%).
- iv. Data source: Manitoba Water Stewardship Department, Water Licensing Branch. "Agricultural" includes Manitoba's category of Agricultural (7%) and Irrigation (37%); "Municipal" includes Municipal (17%) and Domestic (0%); and "Other" include such uses as recreational (water slides), space heating/cooling, firefighting, flood control and habitat.
- v. Data source: G. Lee, "Good and Acceptable Practices for Assessing Water Taking Proposals – Ontario Ministry of the Environment and Energy." (Draft for Discussion, July 2002). "Industrial" includes Ontario's categories of Industrial (11.2%), Dewatering (21.7%), and Construction (2.2%); "Municipal" includes Water supply (23.9%); "Commercial and Institutional" includes Commercial (5.4%) and Institutional (0.2%); and "Other" includes Recreation (0.1%), Remediation (1.7%), and Miscellaneous (6.4%).
- vi. Data source: Quebec Water Bottlers' Association, http://www.aeeq.org/saviez-vous_en.html. "Industrial" includes Quebec's categories of Aquaculture (25.3%) and Other industrial (6.5%); "Agricultural" includes Livestock and irrigation (16%); "Municipal" includes Domestic (54%); and "Commercial and Institutional" includes Commercial (0.08%).
- vii. Estimated information was compiled from raw aggregated water use data provided by N. Craig, Manager, New Brunswick Water Sciences Section, Science and Reporting Branch, Environment and Local Government. Estimates are based on known allocations, where groundwater was indicated to be the exclusive source. "Industrial" includes New Brunswick categories of Aquaculture (23%) and Food Processing (1.36%); "Municipal" includes Domestic Well (46.23%) and Municipal (26.99%); and "Commercial" includes Bottled (0.12%).
- viii. At the time of writing, the electronic database normally employed to generate summary data was in the process of being updated. Data should be available upon request in 2005.
- ix. Personal communication with George Somers, Water Management, PEI Department of Fisheries, Aquaculture and Environment. Groundwater was noted as the sole source of potable water and municipal use was estimated to be the number-one use of groundwater. Food processing was estimated to be the largest industrial user, with aquaculture also using groundwater to a limited extent.
- x. Pers. comm. with Dr. Abdel-Razek, Government of Newfoundland and Labrador, Department of Environment and Conservation. Dr. Abdel-Razek estimated that municipal use was the number-one use of groundwater, with commercial use being the number-two user (mainly water bottling and aquaculture).
- xi. Data source: Yukon 1999 State of the Environment Report, combined with personal communication with Kevin Rumsey of Yukon Water Resources Branch, Changing Water Resources Department.

COMMON ALLOCATED USES ACROSS CANADA

It is clear from reviewing Table 6 and the accompanying notes that the largest volume of groundwater allocated is for industrial purposes, with municipal allocations second and agricultural allocations third. Specific industrial uses vary significantly from province to province, with some overlaps. Some of the heavier industrial users of groundwater include¹⁰¹ the manufacturing sector (paper and allied products, food and primary metals manufacturing are the leaders), thermal power generation, mining, and aquaculture.¹⁰²

Municipal systems service not only residential users but also many city-dwelling commercial and industrial operations. (It has been estimated that only one percent of the municipally supplied treated water in Canada is used for human consumption.¹⁰³) Some of the many uses of water in municipal systems for industrial, commercial, and institutional use include: "...pulp and paper production, industrial processing, heating, ventilation and air conditioning for buildings, restaurants – for cooking and washing, hotels – for washing bedding, flushing toilets, etc, schools universities and hospitals – for cooking, washing and bathroom uses."¹⁰⁴

Industry sectors that rely on public municipal systems for water tend to be those dominated by smaller establishments, such as the beverage industry which requires potable water, rather than industry sectors dominated by larger establishments, which tend to be self-supplied.¹⁰⁵

Groundwater is commonly used in agriculture, especially for crop irrigation and washing, and for watering of livestock. Watering livestock is such a common use in Alberta that Schedule 2 to Alberta's Groundwater Evaluation Guideline to submitting an application for a water licence actually provides a "guide" for calculating the quantities of water needed for raising beef, hogs, chickens, and turkeys.¹⁰⁶

Finally, another common use of groundwater across the country is water bottling. Saskatchewan, Manitoba, Quebec, New Brunswick, and Newfoundland and Labrador all specifically track allocations for bottled water operations. Though water bottling is not a high-volume use, unlike some other uses it is 100% consumptive – a factor to be considered when evaluating use and impacts. Water bottling must also be viewed relative to the size of the aquifer and its recharge.

THE BOTTLED WATER INDUSTRY

Both production and consumption of bottled water have increased in recent years in Canada. Statistics Canada has reported that net supply of bottled water increased from 527 kilolitres in 1995 to 850 kilolitres in 2000 (more than 61% increase in production), and apparent consumption per capita increased from 18.0 litres to 27.6 litres per capita.¹⁰⁷ In Ontario, consumption of bottled water rose 45% between 1999 and 2002.¹⁰⁸

REGULATION OF BOTTLED WATER OPERATIONS

Bottled water operations are regulated at both the federal and provincial levels. At the federal level, bottled water is regulated as a food product. At the provincial level, regulation potentially entails purview and licensing of water withdrawals, and protections against pollution and contamination.

While most jurisdictions have laws that regulate water takings, including groundwater takings, usually via a permit system,¹⁰⁹ a few (Ontario, Quebec, and Newfoundland and Labrador) have over the past couple of years taken steps to regulate the water bottling industry as a distinct use of groundwater.

Ontario's approach has been the most targeted, actually imposing a moratorium on new water bottling operations within the southern part of the province. The moratorium regulation, which was lifted in December 2004, applied not only to water bottling but also other takings that remove water from a watershed. The moratorium prohibited the issuance of new or expanding permits to take water for the following purposes:

- beverage manufacturing, including the manufacturing or production of bottled water or water in other containers;
- fruit or vegetable canning or pickling;
- ready-mix concrete manufacturing;
- aggregate processing where the aggregate and the water taken are incorporated into a product in the form of a slurry; and
- manufacturing or production of products where more than a total of 50,000 litres of the water that is taken, is or will be incorporated into a product on any day in the normal course of manufacturing or producing the product.

The one-year moratorium provided time to review Ontario's water supplies and draft new rules for water taking to help better protect the province's water resources.

In Quebec and Newfoundland and Labrador, the governments have attempted to inject both sustainability and community-impact considerations into their regulatory frameworks. Newfoundland and Labrador has regulated bottled water since 1988 by a policy for allocation of water use. However, this allocation tool was reinforced by the introduction of the provincial *Water Resources Act*. In addition, Newfoundland and Labrador requires a permit for construction of non-domestic wells for all non-domestic uses.

CONCLUSION

Groundwater use in Canada is significant and extensive in both its scope and its complexity. Across the country, we rely on clean, fresh, groundwater in the most essential way – for drinking water and other daily needs. We have also extensively incorporated this resource into our industrial, agricultural, and commercial endeavours. In some industries, such as the oil injection industry, we rely further on non-fresh or saline aquifers to meet the need for water.

The impacts, potential and real, from the use of groundwater are many and varied: potentially depleting the resource, contaminating it (sometimes to the point of requiring extensive remediation), mixing saline into fresh supplies, and effecting other related ecological or human systems, such as nearby streams and fish habitat or other human users of the resource. Given these hazards, we need to plan and manage groundwater use carefully, carry out other related research such as mapping, and learn more about the resource's interactions with other elements of the water cycle.

Yet we still lack knowledge about our use of groundwater. The data are not complete, and the gaps in the data interfere with our ability to get a full picture of what is going on across the country, and sometimes even to interpret what is happening with groundwater use within the various jurisdictions. Canadians need to devote more resources to data collection and standardize the ways that data are collected so that the information can become more accessible and useful. Because groundwater data provide an essential building block for regulation of the resource for sustainability, efforts to increase the data set on groundwater use in Canada will support regulatory efforts regarding sustainability.

3

Provincial Groundwater Permitting Requirements

Not only do the groundwater resources of each province and territory vary, so do their permitting processes.

This chapter discusses general features of water laws that govern groundwater allocation, including integrated water resources management, overall water strategies, public ownership of water and the purposes of water laws. The features of these laws related to groundwater allocation are then compared, focusing on key variables. Specific details of groundwater licensing systems are examined (often part of an overall water licensing scheme), including the definition of groundwater, what is controlled, and the criteria for issuing a licence. Included is a comparison of thresholds and exemptions, prohibitions, length, cancellation and amend-

ment, transfers, priority of uses and reporting requirements. Implementation, enforcement, and compliance are briefly discussed. The chapter moves on to describe how provincial governments monitor groundwater use, and finishes with a section on provincial laws other than water laws that affect groundwater allocation.

Table 7 below demonstrates the extent of groundwater permitting in each province and territory. The name of the main law and regulation is included. The date that the legal system included groundwater is also incorporated, where available, to show how recent most groundwater permitting systems in Canada are.

Table 7: Groundwater Permitting Overview

Jurisdiction	No. of wells	Total no. GW permits	No. of permits issued annually	GW licensing law	Date licensing applied	Regulation
BC	100,000+ estimate only, submission of well records not currently mandatory	n/a: in BC licensing does not currently apply to groundwater	n/a	<i>Water Act</i> could be extended for licensing groundwater. The necessary regulations do not currently exist.	No requirement for license	<i>Ground Water Protection Regulation, 2004</i> , focuses on well construction standards and GW quality protection.
AB	500,000 total wells. Approx, 5,000 new wells drilled each year	Not available; numbers kept by regional offices	Not available	<i>Water Act</i>	1962	<i>Water (Ministerial) Regulation</i>
SK	Not available	Approx. 3,600	Approx. 300	<i>Ground Water Conservation Act</i>	1959	<i>Ground Water Regulations</i>
MB	Not available	533 licences as of August, 2004	Varies	<i>Water Rights Act</i>	1972	<i>Water Rights Regulation</i>
ON	500,000 approx.	2,800		<i>Water Resources Act</i>	1961	<i>Water Transfer and Taking Regulation</i>
QC	n/a	More than 600 catchments >75m ³ day	MENV gets approx 6,000 well reports/yr	<i>Environmental Quality Act</i>	2004	<i>Groundwater Catchment Regulation</i>
NB	Estimated at 3,000 new wells each year	Approval (not permit) required to construct and operate wells above threshold	Not available	<i>Clean Water Act, Clean Environment Act</i>	Not available	<i>Environmental Impact Assessment Regulation, Water Quality Regulation</i>
NL	17,000+	Not available	About 10	<i>Water Resources Act</i>	Water Use authorization: May 1988 to May 2002. Water Use Licence: May 2002 to present	<i>Water Resources Act</i>
NS	97,000 total wells approx.; estimated 3,000 new wells each year	Approx 100, only includes withdrawals >23,000 L/day. Withdrawals <23,000 L/day do not require permits	Less than 10	<i>Environment Act</i>	1973	<i>Activities Designation Regulations</i>
PEI	Approx. 21,000	500–800	Approx. 30	<i>Environmental Protection Act</i>	Not available	<i>Water Well Regulations</i>
YK	Not available	Approx 5	Variable	<i>Waters Act</i>	Not available	<i>Waters Regulation</i>
NWT	Not available	Not available	Not available	<i>Northwest Territories Water Act, Mackenzie Valley Resource Management Act.</i>	Not available	<i>Northwest Territories Waters Regulations</i>
NUN	Not available	Not available	Not available	<i>Nunavut Waters and Nunavut Surface Rights Tribunal Act</i>	Not available	<i>Nunavut Water Board By-Laws</i>

GENERAL FEATURES OF GROUNDWATER ALLOCATION LAWS

Water laws replace or add to the common law rules which would otherwise govern water management. Regulations dictate who is entitled to a groundwater use right, such as a permit or licence, how to allocate water between competing water users, and when to remove or curtail those rights.

Some features of water laws, discussed below, include the integration of water management in a holistic law and administrative structure, formation of an overall water strategy, the assertion of public ownership, and a statement of the purpose of the law or regulation.

Integrated water management – law and administration

Integration of water resources management (IWRM) has become a catch phrase used in international and national policy discussions. In 2002, at the World Summit on Sustainable Development in Johannesburg, countries pledged to “develop integrated water resource management and water efficiency plans by 2005, with support to developing countries.”¹¹⁰

Further, it has been reported that “groundwater is often managed separately from:

- A: surface water though it is part of the overall hydrological cycle, both in quantity and quality,
- B: urban wastewater though it simultaneously represents an additional resource and a potential pollution threat to groundwater, and
- C: land management though aquifers are threatened by pollution from urbanization, industrial development, agricultural activity, and mining enterprises.

An IWRM approach to managing groundwater means balancing the exploitation of the resource (in terms of quantity, quality, and relevant links to other natural resources) with the increasing demand for water for broad economic development and livelihoods. The balancing should take into consideration efficiency, equity, and the long-term sustainability in terms of maintaining both quality and quantity at desired levels.”¹¹¹

While many provinces are moving toward a more integrated approach to water management, often jurisdiction over water is divided between several different ministries, and numerous laws govern its use.

Of all the provinces, Saskatchewan and New Brunswick have the greatest number of statutes involved in groundwater allocation. At the other end of the spectrum, Newfoundland and Labrador’s *Water Resources Act*¹¹² provides a comprehensive scheme for the management and control of water resources in one law; its initial allocation policy has been in place since 1988.¹¹³ Manitoba’s draft *Water Protection Act* deals with quantity and quality in a single statute, but does not replace the numerous other provincial water-related statutes, as originally contemplated.¹¹⁴

Administrative control of groundwater is also divided in most provinces. Usually the lead role is with the Ministry of Environment, but many other ministries are also involved. For example, in BC, the management of water falls under the mandates of several ministries: Water, Land and Air Protection; Sustainable Resource Management (through the Crown corporation Land and Water British Columbia Inc.); Agriculture and Food; Energy and Mines; Health Services; Forests; and Community, Women’s and Aboriginal Services. Manitoba has created a new Department of Water Stewardship, and Saskatchewan has created a separate Watershed Authority that works in conjunction with other ministries.

Overall strategy for water management

Increased environmental awareness and the shadow of the groundwater contamination tragedy that caused seven deaths and thousands of illnesses in Walkerton, Ontario, in May 2000 have focused provincial governments’ attention on water management. Many provinces have undertaken comprehensive reviews of their water legislation and produced broad strategies, such as Alberta’s Water for Life, Quebec’s Water Policy, and Ontario’s source protection planning.

A key issue with all comprehensive strategies is dedicating appropriate resources to implementation. In jurisdictions that plan to use source

protection or water management plans, funding and timing need to be addressed. In Ontario, the Implementation Committee on Source Water Protection was formed to advise the government on how to tackle these issues.¹¹⁵

Public ownership

Governments assert ownership rights to supplant the common law doctrine that said a landowner owns all the resources under the land, including groundwater.¹¹⁶ Ownership of the water is necessary to control its allocation, to set terms and conditions on its exploitation, and to allow its diversion and use contrary to the common law of riparian rights. Governments may more freely regulate the social, economic, and environmental aspects of water when public ownership of water is unequivocal.¹¹⁷

Eight out of ten provinces and all three territories state outright that the Crown controls the property right in the water.¹¹⁸ Ontario and PEI are the exceptions.¹¹⁹ Governments assert ownership of the water to grant water rights to others and to charge royalties or rent for the use of water. Ontario's new proposals employ a regulatory charge rather than a royalty for water taking. Unlike royalties, regulatory charges do not imply ownership.

Purpose of law

Most water laws or regulations contain objectives or purposes statements that link water management to environmental or sustainability objectives. They do not include "efficiency" as an objective. For example, the NWT law lists "conservation, development and utilization of waters in a manner that will provide the optimum benefit for all Canadians in general and, in particular, for the residents of any part of the Northwest Territories for which the Board is authorized to issue licences."¹²⁰ The purposes sections of Alberta's *Water Act* and the draft Manitoba *Water Protection Act* also emphasize environmental protection.¹²¹

Ontario's water-taking regulation was billed as the first ecosystem-based allocation regulation when it was introduced in 1999. Its introductory section

stated: "The purpose of this Regulation is to provide for the conservation, protection and wise use and management of Ontario's waters, because Ontario's water resources are essential to the long-term environmental, social and economic well-being of Ontario." This purpose has been repeated in the new amended regulation.¹²²

Specific reference to allocation and/or groundwater is rare in the purposes section of a general water law, and may instead be located in a regulation, as in Quebec's groundwater catchment regulation which states:

The object of this Regulation is to

- (1) promote the protection of groundwater intended for human consumption; and
- (2) govern groundwater catchment in order to prevent the catchment of that water by an owner or operator from causing abusive nuisance to its neighbours, in particular by lowering the phreatic water level or by reducing the artesian pressure, to prevent the drawing of water in excessive amounts considering its availability, and to minimize the negative impacts from the catchment on watercourses and bodies of water, on the persons entitled to use them and on the ecosystems associated with those watercourses and bodies of water.

KEY VARIABLES IN GROUNDWATER ALLOCATION PERMITTING LAWS

The most striking variables to emerge from the comparison of the provincial permitting requirements concern the following:

- Existence of groundwater permitting system
- Source protection plans
- Water management plans
- Environmental impacts of groundwater withdrawals
- Public participation opportunities and constraints (considered in chapter 4)
- Use of economic instruments to manage groundwater (considered in chapter 5)

Existence of groundwater permitting system

BC remains the sole jurisdiction in Canada that has no general licensing requirement for groundwater extraction above a defined threshold level. The BC *Water Act* contains licensing provisions which could apply to all or designated areas of BC, but they will apply only if and when cabinet makes such a designation. In 2004, a *Groundwater Protection Regulation* was introduced, but it does not mandate licensing, instead focusing on standards for well construction and groundwater quality protection. New Brunswick also does not require permitting but does require approvals to construct and operate groundwater wells having a daily capacity of 50 cubic metres or greater per day.

Source protection plans

To protect groundwater drinking water sources, a source protection plan may set water-taking limits.

The first recommendation from Justice O'Connor in the Walkerton Inquiry report on protection of drinking water sources was that "Drinking water sources should be protected by developing watershed-based source protection plans. Source protection plans should be required for all watersheds in Ontario." Since Walkerton, most provinces have reviewed the critical importance of source protection in a multi-barrier system for clean drinking water, and revised their laws to reflect this emphasis.

Justice O'Connor further found that the plans should:

- address the management and protection of groundwater sources,

- include the identification of all significant water withdrawal including municipal intakes, and
- be based on water budgets, which compare the water flow into an area with the cumulative annual flow out of that area.

Water allocations should then be calculated so they do not exceed the amount of water available according to the water budget in a particular source protection plan.¹²³

Justice O'Connor's call to link the issuance of groundwater permits to source protection plans was echoed by Ontario's *White Paper on Source Protection Planning*,¹²⁴ the government-appointed Source Protection Advisory Committee's Report,¹²⁵ and the Technical Experts Committee and Implementation Committee reports.¹²⁶

No jurisdiction in Canada has yet fully adopted source protection plans, though six provinces have laws which authorize or require the preparation of these plans. Source protection plans may be, but are not always, the same as drinking water management plans.

The legislative scheme varies in the six provinces that have source protection legislation or policies:¹²⁷

- Ontario introduced new draft legislation in 2004, consistent with the Walkerton recommendations. The proposed content of an assessment report for a source protection plan will require the preparation of a water budget and a quantification of the existing and anticipated amounts taken from a watershed for both permitted as well as unpermitted uses.

Water Budget

The movement of water within the hydrologic cycle can be described through a water budget or water balance. It is a tool that when used properly allows the user to determine the source and quantity of water flowing through a system. From a groundwater perspective the key components of a water budget are infiltration, contribution to baseflow, deeper groundwater flow outside the study area, and groundwater taking. Water budgets improve understanding of how much ground and surface water is available to support local communities, the interactions between ground and surface waters, and how quickly water gets replenished once water is removed from an aquifer, stream, river, or lake.

- In BC, there are three types of plans:
 1. Drinking Water Protection (DWP) Plan, which the Minister of Health may order for municipal drinking water sources in designated plan development areas.¹²⁸
 2. Water Management Plan to protect the water resource (surface or ground), which may be prepared together with a DWP plan.¹²⁹
 3. Source assessment and assessment response plan, which the Drinking Water Officer may order under the *Drinking Water Protection Act* for protecting the community watershed or community well capture zone area.¹³⁰ This could include well protection plans developed by the water purveyor. If the focus of the assessment response plan is the water source, it is essentially a source protection plan.

The first two plans require ministerial designation and cabinet approval. The DWP plan and assessment response plan are focused on quality protection. The water management plan can address quality or quantity. If ground water quantity is the issue in a water management plan, then specific regulations may be developed for drilling authorization or groundwater licensing, if required.

- In New Brunswick, the *Clean Water Act* allows cabinet to designate all or any portion of a watershed, aquifer, or groundwater recharge area that is used as a source of water for a public water supply system as a protected area. For groundwater, the *Wellfield Protected Area Designation Order* focuses on protecting water quality and guarding against contamination, but may also limit allocation.¹³¹ The *Wellfield Regulation* defines permitted and prohibited uses of the land within three concentric zones around the water source.¹³² The *Wellfield Protected Area Designation Order* now has nineteen municipal aquifers designated and protected. All surface water source supplies are protected under the *Watershed Protected Area Designation Order* (including a phase one 75 metre no development buffer from the water body and a phase two restrict-

ed land uses for the each watershed). This includes 30 watersheds.

- In Quebec, the *Groundwater Catchment Regulation*¹³³ establishes protection areas around wells or springs serving more than twenty persons, with a flow rate of more than 75 litres/day. Activities likely to contaminate groundwater are prohibited within 30 metres of the well or spring.
- Nova Scotia has introduced a Municipal Source Water Protection Plan requirement for drinking water source areas. In order for a municipality or utility to meet the conditions of its approval to operate, a completed Source Water Protection Plan must be submitted to Nova Scotia Environment and Labour (NSEL) by September 2005.¹³⁴ In addition, Nova Scotia's *Environment Act* authorizes the designation of protected water areas, and at least twelve regulations have been passed which designate or regulate water bodies as protected areas.¹³⁵
- In PEI, under new regulations that came into force on January 1, 2005, all municipal water utilities must submit well field protection plans to the province for approval by January 2006. (The plans do not need to be fully implemented by this date; however an implementation schedule must accompany the submission of the plan.)¹³⁶

Water management plans

Water management plans are closely related to source protection. Provinces that do not have specific source protection planning requirements may have more general water management planning provisions.

- Alberta's *Water Act* states the minister must develop a water management framework based on water management planning areas and plans.¹³⁷ Two of the purposes of such plans are to manage groundwater and to prohibit further allocations.¹³⁸ Currently, there is only one approved water management plan for the South Saskatchewan River Basin Management Plan, but it does not deal with groundwater.

- BC's *Water Act* authorizes the creation of water management planning areas, which must be developed with public consultation. One potential groundwater management plan is under consideration for the Township of Langley, a major municipality in the Lower Mainland. The water management plan can address quantity or quality for surface water and groundwater. If groundwater quantity is the issue, there are provisions in the *Water Act* to develop specific regulations on drilling authorizations or groundwater licensing, if required.
- In Saskatchewan, a planning model for watershed and aquifer management plans has been introduced.¹³⁹ The Yorkton Aquifer is one of the priority areas for developing an aquifer management plan, one of the ten major aquifers identified in the province.¹⁴⁰
- Manitoba's draft *Water Protection Act* also requires the preparation of watershed management plans.¹⁴¹

Environmental impacts of groundwater withdrawals

Water laws have grown out of the need for rules for consumptive uses. As environmental impacts of water withdrawals have become more evident over the years, and as knowledge of hydrogeology has grown, laws have evolved. A number of tools can regulate the environmental impacts of groundwater withdrawals.

A common way for regulators to address the environmental impacts of groundwater withdrawals is

through the criteria for issuing a groundwater licence or permit. These criteria may include:

- consideration of cumulative impacts and protection of the natural ecosystem during licensing decisions,
- conservation requirements, and
- instream or environmental flow protection.

Each of these topics is discussed below (see section "Criteria for issuing groundwater permits").

Most jurisdictions also have regulations for wells, primarily designed to guard water quality by protecting the zones around wells, but also to control and sometimes limit the rate of extraction and to conserve groundwater, for example by obligating well owners to stop or control artesian flows.¹⁴³

Most jurisdictions also have licensing, registration, or other technical requirements for well drillers, a topic not addressed by this report.

Other more indirect methods of minimizing negative impacts of groundwater withdrawals include:

- wetland legislation,¹⁴⁴
- drought policies,¹⁴⁵ and
- restrictions on water exports.¹⁴⁶

GROUNDWATER LICENSING SYSTEMS

The provincial and territorial systems of groundwater licensing or permitting share certain characteristics, and differ in others.

Arizona's Groundwater Management Code

Arid Arizona has been wrestling with water supply and groundwater preservation for the last few decades. Its 1980 *Groundwater Management Code* is highly regarded for bringing together state and local governments, applying planning management techniques, and reducing overdrafting, though its complicated conservation standards have caused many legal battles in the litigious US. The *Code* sets three levels of management standards. Phoenix and Tucson, the state's biggest cities, representing about 80% of Arizona's population, are covered by the highest level of standard and are designated as Active Management Areas. Arizona has also struggled to find the balance between historical and new water rights, and between conservation and development.¹⁴²

Definition of groundwater

Provinces and territories define groundwater in different ways:

- In Newfoundland and Labrador, groundwater is “all water that exists beneath the land surface in the zone of saturation and includes springs.”
- In BC, it is “water below the surface of the ground.”
- In Nunavut, waters generally means “inland waters, whether in a liquid or solid state, on or below the surface of land.”
- PEI defines groundwater as “water within the earth that supplies wells and springs.”
- In Nova Scotia groundwater means “all water naturally occurring under the surface of the province.”

Some provinces do not distinguish between types of water. For example, Manitoba’s definition of water includes “all water on or below the surface of the ground.”¹⁴⁷

What is controlled?

Water use licences may specify the rate, quantity, duration, and time of use. A licence or permit will also commonly state the purpose for which the water will be used.

Conditions on licences are routine. In Saskatchewan, licences have a standard condition requiring the applicant to mitigate any problem which occurs between existing users. Monitoring conditions may also be a part of a water licence. For example, Manitoba Water Licensing includes reporting requirements on water usage as a condition of each licence.

Criteria for issuing groundwater permits

The criteria for issuing a groundwater permit vary from province to province, as the following examples reveal.

Ontario’s criteria for issuing a water-taking permit were already more detailed than other provinces, before 2004 amendments to the regulation refined

Wisconsin’s New Groundwater Law – Strict Well Controls

About three-quarters of Wisconsin’s population rely on groundwater for daily use. The state has a vast groundwater resource that is being rapidly exploited: more than 17,000 new wells are drilled every year, adding to the estimated existing 800,000 private residential wells and the more than 11,000 high-capacity wells. Huge increases in water use, about 33% over the past fifteen years, are showing up in declining water tables in many urban areas; for example, the water table has dropped by 450 feet around Milwaukee and Waukesha.

Compounding the problems, the dropping water table in some places is releasing naturally occurring radium and arsenic into drinking water. A new law is designed to remedy these problems.

Wisconsin’s 2004 *Groundwater Protection Act* requires advance notice to the state of any proposed new well. It directs staff to review the environmental consequences of proposed high-capacity wells (those where all wells from a single property pump more than 100,000 gallons a day or 70 gallons a minute) if the well:

- is within 1,200 feet of any surface water identified as an “outstanding resource water” (like a pristine lake), or an “exceptional resource water” (like a wild river), or a trout stream;
- has a water loss of more than 95% of the water withdrawn (like a beverage bottler);
- may significantly affect a spring that has a minimum flow of one cubic foot per second for a least 80% of the time.¹⁴⁸

them.¹⁴⁹ The new regulation calls for consideration of a number of matters when issuing a permit, including protection of the natural functions of the ecosystem, water availability, water use (including the impact or potential impact of the water on water balance and sustainable aquifer yield), and other issues including the interests of anyone else who has an interest in the water taking.

Other sections of Ontario's regulation allow an application to be refused if the proposed water taking is in a high-use watershed as shown on the Average Annual Flow Map, and if the water taking is for certain defined uses such as water bottling and aggregate processing unless certain conditions are met. Ontario's obligations under the *Great Lakes Charter* must also be considered when issuing a permit.

In Alberta, a licence can be refused if the minister believes that the proposed transaction is not in the public interest.¹⁵⁰ Also, regulators *must* consider whatever restrictions or guidance an approved water management plan provides, and *may* consider any existing, potential, or cumulative effects on the aquatic environment; hydraulic, hydrological, and hydrogeological effects; and effects on household users, other licensees, and traditional agriculture users that may result from the diversion of water. Regulators may also consider effects on public safety, the suitability of the land for irrigated agriculture, and any other relevant matters such as any applicable water guideline, water conservation objective, and water management plan.¹⁵¹ Alberta's criteria for issuing groundwater permits for oilfield injection and for coalbed methane are contained in guidelines.¹⁵²

Under the *Water Quality Regulation* of the *Clean Environment Act*, all waterworks in New Brunswick using more than 50 cubic metres of water daily require a permit to operate except in the case of a domestic well not connected to a distribution system. These groundwater sources must conduct a Water Supply Source Assessment, according to guidelines published to assist both the public and private sectors in the construction or modification of municipal and other large-scale water supply

sources. The primary objective of these guidelines is to promote the proper testing and construction of water supply sources so that they will give a long-term yield of adequate quality water. In doing this, information on groundwater will be collected, and the impacts on existing water sources assessed.¹⁵³

Nova Scotia's criteria are found in the *Guide to Groundwater Withdrawal Approvals*, and include the submission of a hydrogeological study that clearly evaluates the potential effects of the proposed withdrawal on existing groundwater users and the environment.¹⁵⁴ The criteria often include environmental considerations.

Cumulative impacts and protection of the ecosystem

Some provinces consider the cumulative impacts of groundwater withdrawals on a basin-wide basis. For example, the previous version of the Ontario *Water Taking and Transfer Regulation*¹⁵⁵ specified that the director had to consider the protection of the natural functions of the ecosystem; however applicants for groundwater licences were required by policy rather than regulation to consider the impacts of their proposed taking on other users and to obtain a hydrogeological report.¹⁵⁶ The Ontario Environmental Appeal Board said in the past that the Ministry of the Environment failed to routinely require the assessment of cumulative effects when a permit to take water was granted. Ontario's new water-taking regulation deals with these issues.¹⁵⁷

In Manitoba, the Groundwater Management Section has conducted aquifer sustainability studies on a number of aquifers. Applicants are required to submit project-specific technical reports prepared by licensed hydrogeologists.¹⁵⁸

In Alberta the *Groundwater Evaluation Guideline* was published in 2003 to assist with the goal of reducing impacts of oilfield injection on other water users and the environment. The *Guideline* requires a technical report supporting the application to demonstrate that impacts will be minimal.¹⁵⁹

In PEI the Drinking Water Management Section looks at the relevant watershed as a whole in making licensing decisions. The maximum used in practice is 50% of the available recharge for the area subject to the application. The total proportion of the recharge is assessed for the purposes of evaluating each application. This maximum is currently being reviewed. With the exception of a few heavily developed watersheds, water use does not come close to the 50% limit. Adherence to the maximum ensures there will be adequate groundwater to account for seasonal variation and protection of stream flows.¹⁶⁰

In Nova Scotia the *Guide to Groundwater Withdrawal Approvals* was published in 2004.¹⁶¹ Hydrogeological reports must be completed to evaluate the potential effects of proposed withdrawals on existing groundwater users and the environment. The *Approval Procedure Regulations* describe information requirements and the review process involved in assessing water withdrawal approvals.¹⁶²

Newfoundland and Labrador's law entitles the minister to determine the rate at which groundwater is to be withdrawn from a well in order to minimize the risk of lowering the water table, and maintain a balance between recharge and discharge rates of an aquifer (among other things).¹⁶³

For the provinces that do not routinely consider the environmental impacts of groundwater withdrawals, a commonly cited reason is lack of staff and competing priorities.¹⁶⁴

Conservation requirements

Water laws in Canada historically have not placed a premium on conservation. Governments have a number of policy options for water conservation: controls on wells, conservation plans,¹⁶⁵ or statutory powers to establish conservation objectives.¹⁶⁶ Often the powers to achieve conservation objectives are scattered throughout the relevant act and associated regulations.

For example, in Manitoba, although the *Water Rights Act* does not specifically refer to conservation, it provides that the minister "may reserve any

unlicensed water" to conduct surveys to determine how the water may be used to the greatest advantage of the province, or for a purposes the minister determines will be of the greatest advantage.¹⁶⁷ The *Ground Water and Water Well Act* provides that the minister has discretion to direct that a survey of groundwater resources be undertaken or that a study of the conservation, development, and use of groundwater be taken.¹⁶⁸

In Yukon, conditions can be placed on licences, but in practice, there are no conservation requirements included in the terms and conditions of licences. The schedules refer to licences for conservation, and there is one example of a conservation licence issued to Ducks Unlimited, but it has never been implemented.¹⁶⁹

Under its new *Water Taking and Transfer Regulation*, Ontario requires water conservation be considered when reviewing permit applications: specifically, whether water conservation in accordance with best water management practices for the relevant sector is being implemented or is proposed to be implemented. For all existing takings, permit holders will be encouraged to adopt water conservation best practices. Additional requirements may be placed if the water taking:

- is in a high- or medium-use watershed,
- is in a watershed or parts of a watershed with low water conditions,
- triggers the *Great Lakes Charter*, and/or
- is a large municipal residential supply.

A potential way to tie water permits to conservation was recently proposed by a number of conservation groups in Ontario:

Municipalities should be required to develop and implement water conservation plans, which in general should include metering for users of municipally supplied water. Municipalities should not be issued any new water-taking permits until a water conservation plan is in place.¹⁷⁰

Instream or environmental flow protection

Surface and groundwater law in most states developed along tracks that appeared to be parallel

but would eventually collide. The collision eventually occurred when groundwater pumping, through the capture process, began to reduce the flow in lakes, rivers, and streams.¹⁷¹

Groundwater allocation has important links to instream or environmental flows as aquifers provide base flow for surface water sources. Reserving groundwater supplies can help maintain these flows. A surge of interest in how to incorporate this concept into law has lately arisen. As the case study on groundwater science in this report demonstrates, few scientific methods exist to measure the impact of groundwater withdrawals on ecosystems.

Instream flows are usually defined as the stream flows needed to protect and preserve instream resources and values, such as fish, wildlife, and recreation.¹⁷² The term “instream flow” is used in many American state laws, such as Washington State. The concept has been adopted in national laws in Australia and South Africa, and the Australian term “environmental flow assessment,” considered to be more inclusive of economic and social factors, is gaining wider acceptance. An environmental flow is defined in a recent IUCN (World Conservation Union) publication as the water regime provided within a river, wetland, or coastal zone to maintain ecosystems and their benefits where there are competing water uses and where flows are regulated.¹⁷³ The consequence of setting instream or environmental flows is preventing a licensed user from withdrawing water if the water in a river flow drops below the requirements to protect aquatic health.

The role of groundwater in environmental flows is not well understood. There is currently no standard approach to setting the stream flow threshold, either in Ontario or elsewhere.¹⁷⁴ Provincial governments are looking at how to establish healthy water systems that protect environmental or instream flows, including steps to protect aquifers that contribute to these flows. Here are some examples:

- In Alberta, the *Water Act* allows the government to apply for a water licence to maintain a rate of flow for the purpose of implementing a water conservation objective. There are also

regulations specifying minimum instream flows for rivers, such as the South Saskatchewan Basin Water Allocation Regulation, which allows conditions to be placed on licences limiting the amount of water that may be diverted and used for the Waterton, Belly, and St. Mary Rivers.¹⁷⁵

- In addition to licence conditions, Alberta’s regulators have the statutory authority to order holdbacks of up to ten percent of a water allocation attached to a licence when a transfer is approved.¹⁷⁶
- Manitoba’s draft *Water Protection Act* has a number of provisions to protect instream flow needs.¹⁷⁷ Currently water managers in Manitoba use standard conditions in water licences requiring licensees to comply with all instructions and specifications that may be issued by Fisheries and Oceans Canada which is specifically meant to satisfy the requirement of instream flow needs.¹⁷⁸
- In PEI, the current groundwater allocation policy, limiting groundwater extraction to 50% of the available recharge, is designed primarily for protection of baseflow. (There is also a separate formal process for assessing the impact of surface water withdrawals.) PEI is currently assessing the adequacy of its approach and may develop a new threshold if necessary.
- Since 2003 the Ontario Ministry of the Environment has partnered with Conservation Ontario to test new methods for setting minimum stream flows to protect natural functions of the ecosystem in three watersheds, a project designed to address the need for a standardized approach to setting threshold flows for surface waters in Ontario.

Exemptions

Except in BC where groundwater is not subject to permitting requirements, domestic use is exempted from licensing requirements. However, the definitions of domestic use vary.

Saskatchewan requires a licence for all use of groundwater but exempts persons “owning or occupying the land to use any quantity of groundwater that he

or she may require for domestic purposes on the land.”¹⁷⁹ In light of the fact the definition of domestic use includes the watering of livestock and spraying of crops, 5,000 cubic metres per year is the maximum, by policy, on a domestic project, provided it fits within the definition. In practice the cut-off for a livestock operation is 300 cattle; if a landowner has more, he or she must obtain a water licence.¹⁸⁰

Newfoundland and Labrador exempts “natural persons” with riparian rights “owning or lawfully occupying land adjoining a river, stream, pond, lake, or other body of water,” who may “use a quantity of that water as he or she requires for domestic purposes without appreciable alteration in its quantity or quality.”¹⁸¹

In Ontario a water-taking permit is not required by anyone for domestic or farm purposes, defined to mean ordinary household purposes or the watering of livestock, poultry, home gardens or lawns, but does not include watering or irrigating crops grown for sale or for firefighting.¹⁸²

In Alberta exemptions from the requirement to obtain a groundwater licence exist for:

- owners or occupiers of land under which groundwater exists for household purposes, defined as “the use of a maximum of 1,250 cubic metres of water per year per household for the purposes of human consumption, sanitation, fire prevention and watering animals, gardens, lawns and trees;”¹⁸³
- groundwater diversions made by manual pump;
- diversions of saline groundwater;
- the diversion of water for the purposes of pesticide application;
- the temporary diversion of water for use related to the drilling of an oil or gas well in the Green Area;
- up to 5,000 cubic metres of use upon instruction from the local Forestry Office;¹⁸⁴ and
- traditional agriculture users who owned or occupied land with any water source, including groundwater, on January 1, 1999. (These users

may continue to use up to 6,250 cubic metres per year to raise animals or apply pesticides to crops without an approval, licence, or registration.¹⁸⁵ However, they will have no priority rights unless they become approved, licensed, or registered.)

In Nunavut, a licence is not required for any unlicensed use of waters that is authorized by the regulations, including the use of waters for a domestic purpose, for extinguishing a fire, for controlling or preventing a flood on an emergency basis, or for the use of waters in a national park.¹⁸⁶

In NWT, exemptions exist for using water for household requirements, watering domestic animals, and irrigating a household garden. As well, instream users, defined as people using waters to earn income or for subsistence purposes, are exempt from the requirement to have a licence. Exemptions also exist for using water to extinguish a fire and to control or prevent a flood or on an emergency basis.¹⁸⁷ Finally, no licence is required for using water that has no potential for significant adverse environmental effects, would not interfere with existing rights of other water uses, and satisfies the criteria set out with respect to a number of different types of undertakings in Schedules IV to VIII.¹⁸⁸

In PEI no well supplying a single residence for domestic water use would ever be pumped at a rate of more than four litres per second, and thus by default domestic wells are exempt from permitting provisions. Any well providing essentially domestic supply to a central system would require a permit.

Quantity exemptions

Most provinces do not require a licence or permit to be obtained until a certain threshold amount of water will be used. The threshold varies substantially, as shown in Table 8.

The thresholds in the territories are based on defined categories set out in schedules to the regulations. There are licensing criteria for industrial undertakings, mining and milling undertakings, municipal undertakings, power undertakings, and for agricultural,

Table 8: Quantity exemptions for water licensing

Jurisdiction	Quantity exemption
BC	No GW permits
AB	Traditional agricultural uses (6,250 cubic metres/year); domestic uses (1,250 cubic metres/year); camp water supplies up to 1,250 cubic metres/year.
SK	Less than 5,000 cubic metres/year domestic uses.
MB	Less than 25,000 litres/day for agricultural and irrigation purposes.
ON	Less than 50,000 litres/day. ⁱ
QC	Less than 75 cubic metres/day.
NB	Less than 50 cubic metres/day.
NS	Less than 23,000 litres/day. ⁱⁱ
PEI	Less than 4 litres per second. ⁱⁱⁱ
NL	No quantitative threshold for any non-domestic use.
YK	All threshold amounts are listed in schedules IV-VIII to the regulation. Less than 100 m ³ per day generally exempt.
NUN	All threshold amounts are listed in schedules to the regulation. Less than 100 m ³ per day generally exempt.
NWT	All threshold amounts are listed in schedules to the regulation. Less than 100 m ³ per day generally exempt.

Notes:

i. There is also a discretionary authority to require a permit for water takings of less than 50,000 litres per day where the taking of water interferes with any public or private interest in any water.

ii. Division I of the *Activities Designation Regulations*, NS Reg 47/95, s 5(1)(a)

iii. *Water Well Regulations*, PEI Reg EC188/90, s 6 (1).

conservation, recreational, and miscellaneous undertakings. Licences are not required when water use is less than 100 m³ per day for industrial, mining and milling, and agricultural, conservation, recreational, and miscellaneous undertakings less than 50 m³ per day for municipal undertakings.¹⁸⁹

Prohibitions on issuing licences

Provinces may use moratoriums to restrict groundwater extraction when conditions dictate.

Ontario imposed a year-long moratorium on the issuance of new and expanded water-taking permits, which expired in December 2004, due to evidence that permits to take water did not fully consider the effects of the water taking on the whole watershed, and to have time to review Ontario's

groundwater supplies and draft new rules for water taking.¹⁹⁰ The moratorium applied in southern Ontario and in the five northern Ontario watersheds covered by a Conservation Authority. Municipal use and agricultural use permits were not covered.

Manitoba Water Licensing has reported that six of the thirteen sub-basins on the Assiniboine Delta Aquifer are at their assumed sustainable yield and are therefore fully allocated and no additional licences can be issued with respect to these sub-basins. As a result there are 71 applications in those six sub-basins which are waitlisted. Other situations include applications being denied when proposed wells are too close to existing domestic wells, and applications to dewater quarries or gravel pits

frequently cause controversy resulting in an extensive permitting and assessment process. These situations are more common closer to Winnipeg in the ex-urban fringe where population densities are relatively large and expanding.

PEI also has a moratorium on issuing permits for new irrigation wells. As a result, all existing irrigation permits were recalled and then reissued with new metering and reporting conditions added. The reason for the moratorium was not a lack of water,

Table 9: Length of groundwater permits

Jurisdiction	Length of permit
BC	No permits issued for groundwater
AB	Variable: 1, 2, 10, or 25 years depending on purpose; also historic licences in perpetuity ⁱ
SK	Variable, from 5 years to in perpetuity ⁱⁱ
MB	Up to 20 years ⁱⁱⁱ
ON	Varies, 2-10 years depending on purpose and environmental conditions ^{iv}
QC	10 years ^v
NB	Approvals are issued in perpetuity
NS	Not to exceed 10 years ^{vi}
PEI	Usually open-ended, exploration permits 1 year ^{vii}
NL	5–10 years depending on the source of the water
YK	Up to 25 years ^{viii}
NWT	Maximum licence term is 25 years ^{ix}
NUN	Maximum licence term is 25 years

Notes:

i. The *Water (Ministerial) Regulation's* makes the length of permit as that stated in any water management plan, order of the minister, or water guideline. In the absence of those documents, the length must be 10 years or less, unless it is for a municipal, agricultural, irrigation, or implementing a water conservation objective purpose, in which case the length will be for 25 years or less. In either case, the Director can determine a licence should be for longer than 10 or 25 years respectively. Subsection 12(4) lists the considerations to be made in determining the appropriate length. Temporary diversion licences must be for a period of one year or less. Coal bed methane licences are first issued for only two years.

ii. Normally for industrial process, permits are for five-year terms; municipal are open-ended. Saskatchewan has been moving toward more term licences, but in the past, licences were issued in perpetuity.

iii. The minister has the discretion to allow a licence to be issued for up to 20 years, and to allow a licence to construct water works (e.g., a dam) to be issued in perpetuity. In practice, the following number of years are given to different licence types: irrigation, 20; livestock, 10; municipal, 20; industrial, at least 10; other, at least 10.

iv. A common expiry date is 10 years for a groundwater-taking permit.

v. The *Groundwater Catchment Regulation* states that the "valid term of authorizations" for catchment projects in section 31 (those under 75 cubic metres, bottling licences, and those over 75 cubic metres if not for drinking water supply) is 10 years. Previous catchments, however, have no limit on length.

vi. The *Approval Procedures Regulations* stipulate that approvals can be granted for a maximum of 10 years. The majority of groundwater withdrawal approvals are issued for a 10-year period; however, shorter durations are sometimes used, depending on site-specific circumstances.

vii. In practice, the extraction permits have open-ended terms, given the expense associated with constructing wells and the relative lack of competition for groundwater in PEI. Groundwater exploration permits last one year.

viii. The Yukon *Waters Act* gives the Board discretion to set the length of licence terms up to 25 years. The actual length given varies and is a subjective determination based on the type of operation. Generally, the Board will issue licences for the period applied for, but if a proposed use involves a project with a long-term forecast, plans which include the length of time projected would need to be submitted with the application.

ix. *Northwest Territories Water Act* RSC c 39, s 4, , s 14(1).

but rather because the dry summer of 2001 was followed by large number of applications for irrigation permits. If all permits had been given at that time, there could have been a doubling or tripling of their number. In order to ensure an adequate water supply to cover the large number of permit applications, the moratorium was implemented to provide time to conduct hydrogeological assessments. This study is ongoing.¹⁹¹

Length of permit

The length of groundwater permits varies from province to province, as shown in Table 9.

Cancellation and amendment

Closely tied to the issue of permit length is the power to cancel or amend the terms of the licence. Balancing security of water rights with the ability to adjust to changing conditions is a challenge for groundwater regulation. In drought conditions or if all the water has been allocated, adjusting the water available to licence holders through administrative procedures will be difficult and raises the issue of compensation for licence changes.

The rules usually provide for amendment and cancellation for cause. Newfoundland and Labrador's provision is typical: it entitles the minister to refuse to issue, cancel, alter, or suspend a licence where there is noncompliance, nonuse of rights, the applicant made a false or misleading statement, fees or compensation are unpaid, in the case of fraud, non-compliance with an order, if the licence is issued in error, or if there has been a cancellation or termination of ownership of the licence holder's land.¹⁹²

In Manitoba, the minister has the power to cancel or restrict existing licences if a new application is for a higher priority use in an area where all the water available for use or diversion has already been allocated to other licensees. In that case compensation will be payable.¹⁹³ Similar powers exist in Saskatchewan.¹⁹⁴ These powers are, however, rarely used.

Manitoba Water Licensing presents an example of reallocation in a case of overallocation. The Winkler Aquifer 60 miles southwest of Winnipeg was being

overpumped and had reached its assumed sustainable maximum yield. Domestic wells, a town, a Hutterite colony, some industrial licensees, and several rural municipalities were all relying on groundwater from the aquifer. The overpumping was also a concern because of the saline water at the bottom of the aquifer. The different stakeholder groups were represented on an aquifer management board, which negotiated a solution: most of the licensees were issued allocations from a treated surface water source (e.g., the Red River), in place of their groundwater allocation.

Transfer of rights

Provincial laws may contain transfer provisions, such as in BC, which allows "transfers of appurtenance."¹⁹⁵

Creating limited market rights is another method of encouraging transfers. The ability to transfer water rights provides flexibility for systems that may be overallocated, and avoids the stringency of the older water law systems such as "first in time, first in right." Untransferable water rights essentially freeze historical patterns of use and are intolerably rigid.¹⁹⁶

Creating a market can also stimulate conservation. If water rights holders can sell the unused portion of their rights, they have an incentive to reduce their own use and practise better conservation. On the other hand, water markets and transfer of water rights are controversial and give rise to charges of "water for sale," and commodification of water. They spark fears about the potential privatization of this valuable resource.

Alberta has allowed transfers through a market scheme. The water-stressed area chosen for the first transfer program is in the province's prime agricultural land, the South Saskatchewan Basin. Either an approved water management plan or cabinet approval is required before a transfer will be considered.¹⁹⁷ The province is clear that "what is being transferred is the right to divert a volume of water from a source of water supply under a certain priority - there is no physical transfer of water from the land. A transfer of all allocation of water under

Table 10: Rules of priority for water use

Jurisdiction	Priority of uses
BC	No groundwater licensing.
AB	First-in-time, first-in-right principle, otherwise no priority is given to any of the listed uses in s.11 of the <i>Water Act Regulation</i> . For normal applications, priority numbers are assigned according to the date and time the complete applications are received. Licensees and traditional agriculture users have priority among themselves in accordance with the priority numbers assigned.
SK	No priority system. It had one under the <i>Water Rights Act</i> (repealed in 1984).
MB	Priority to the first to apply for a licence, and where two applications have the same date, the priority is decided by s. 9 of the <i>Water Rights Act</i> . Although “domestic purposes” are technically exempted, they are listed as the first priority. Priority is listed as 1) domestic purposes, 2) municipal purposes, 3) agricultural purposes, 4) industrial purposes, 5) irrigation purposes, and 6) other purposes. The priorities only take effect when two licence proponents apply on the same date to use the same aquifer. This rarely occurs and the first-in-time system is employed almost exclusively.
ON	Water use priorities are outlined in <i>Permit to Take Water: Guidelines and Procedures Manual</i> OMOE (1999, 10): “The taking of water for domestic, farm purposes and fire protection are considered the most important uses, generally followed by takings for municipal water supply, then the taking of water for industrial, commercial and irrigation purposes.”
QC	No prioritization. Only volume thresholds are considered.
NB	No specific priorities for use, though domestic use is favoured in practice.
NS	Groundwater allocations are on a first-come, first-served basis with priority given to drinking water applications. Priority is also given to existing withdrawal approvals over new applications.
PEI	No prioritization scheme under the act or regulations. A water policy drafted several years ago laid out priority to be given to different types of uses, but this was never formally implemented. In practice, the general priority is domestic use, followed by commercial and industrial uses, and finally irrigation. Overall, however, there is a lack of competition for groundwater in PEI which normally prevents prioritization of uses from becoming an issue.
NL	The <i>Water Resources Act</i> provides that in the case of concurrent applications for the same water source, priority shall be given in the following order: 1) domestic purposes, 2) municipal purposes, 3) agricultural purposes, 4) commercial, institutional, and industrial purposes, 5) water and thermal power generation purposes, 6) other purposes prescribed by regulation. The minister may alter priority with permission from the Lieutenant Governor in Council if the body of water in question is more suited to a particular purpose. Further, unlike most schemes, there is no priority merely for applying before someone else for the same body of water. The minister may also cancel a pre-existing licence if an applicant applies for use on the same water with a higher priority use, but the applicant is then obligated to compensate the rightholder who loses or has altered his or her licence. S. 17, however, trumps all priorities by entitling the Lieutenant Governor in Council to determine the highest priority as a proposal of the Newfoundland and Labrador Hydro-Electric Corporation to generate thermal power.
YK	First in time
NWT	First in time
NUN	First in time

a licence is voluntary, with a willing seller and willing buyer.”¹⁹⁸ It is also at pains to explain that any transfers will be closely monitored, and that due to public concern transfers cannot be made of the rights related to household purposes and traditional agriculture uses. As of February 1, 2005, a total of three licence transfers had been authorized. (The province approved one additional transfer, but this was from one party to itself for a different diversion in a different location rather than a transfer between two different parties.)¹⁹⁹

Priority of uses

In eight of the thirteen jurisdictions surveyed, licensing systems establish rules of priority for water use, either based on criteria such as the date the licence was obtained (“first in time” or prior allocation), or on set categories that the government has determined are in the public interest. (See Table 10.) Some provinces establish priorities to guide decisions if applications are submitted concurrently, though simultaneous receipt of more than one licence application is exceedingly rare. Most provinces and territories recognize essential human needs, usually called “domestic uses,” as the highest of priorities.

Reporting actual versus permitted use

Actual use figures for groundwater permits are not widely collected or disclosed. Until the end of 2004, five jurisdictions – Yukon, Manitoba, PEI, Newfoundland and Labrador, and Saskatchewan – required reporting on actual use,²⁰⁰ but in practice, as the case study on groundwater use in chapter 2 shows, only two provinces, Manitoba and Alberta, provided actual use data for this report, and Alberta’s data are incomplete.

Some provinces require actual use reporting as a licensing condition. In Nova Scotia the terms and conditions of water withdrawal approvals require records of actual groundwater use to be maintained, which must be submitted to the department upon request. In Manitoba, licences contain a condition requiring annual water use to be reported no later than February 1 of the following year. Licences also contain a condition requiring meters to be installed to monitor discharge.

After criticism from the Auditor General of Ontario and others about the lack of actual use data,²⁰¹ Ontario amended its regulations. The province now requires mandatory reporting of water use under its amended *Water Taking and Transfer Regulation*. Annual reporting of water takings by all permit holders will occur in three phases, starting with municipal drinking water systems, major industrial dischargers, and moratorium-type uses that remove water from the watershed, who all must report by 2006. All other uses will be phased in to report by 2008 at the latest. The new regulation requires every person to whom a permit has been issued to collect and record data on the volume of water taken daily. The data collected must be measured by a flow meter or calculated using a method acceptable to the ministry. On or before March 31 in every year, permit holders must submit to the ministry the data collected and recorded under the previous year.²⁰²

The US is able to report that fresh groundwater withdrawals during 2000 were fourteen percent more than during 1985.²⁰³ The US Geological Survey first conducted the water-use compilations for 1950 and has published them every five years since. No comparable country-wide data compilations exist for Canada.

To fully understand the amount of water withdrawn from a watershed, not only should all licensed users be required to report their use data, it is also important to record the unlicensed withdrawals as those may be considerable, especially those related to agriculture and domestic use if there is a large number of wells in an area. One way to collect this comprehensive data is to have all groundwater uses subject to reporting requirements, but not necessarily licensing, in designated sensitive areas.²⁰⁴ Staff resources would be required to process and manage these data.

Implementation, enforcement, and compliance

Although many provinces’ schemes provide extensive investigation, inspection, contravention, and penalty provisions, in practice they are infrequently used. Typically, regulators have the power to suspend or cancel a licence if there is non-performance or if the director finds there is a serious

breach of any licence term or condition. In the case of non-performance, the licensee would usually have an opportunity to clarify the status of the operation first. For minor offences, regulators usually seek voluntary compliance before proceeding to the enforcement response. Penalties can also be monetary, levied through administrative penalties.

Indicators to measure protection and monitoring of groundwater may also be necessary. A framework law and a water policy will not protect the resource if, in practice, few regulations or guidelines have been issued, the budget allocation for groundwater monitoring and assessment for projects is minimal, there are few qualified staff, and initiation of watershed planning is left to concerned communities with funds they must personally raise.

Implementation can be measured through indicators such as:

- implementing regulations and guidelines for project reviews, development approvals, licensing processes, and reclamation rules;
- providing substantial and long-term government budget allocations for science and monitoring;
- providing adequate and long-term budgets for permit, licence, and environmental impact assessment reviews by department personnel to assess the adequacy of information on groundwater and potential impacts; and
- requiring research on groundwater impacts before projects are approved or completed.

Monitoring and assessment of water use

Part of the renewed interest in cooperative groundwater management across all jurisdictions in Canada was demonstrated in a 2003 federal-provincial groundwater monitoring workshop.²⁰⁵ This workshop reported that Canada does not compare well to other countries in terms of monitoring groundwater. Canada has an estimated 1,500 to 2,000 observation wells across the country compared to 42,000 in the US and 15,000 in Mexico. The majority of monitoring wells are west of Ontario.

At least three federal departments are involved in groundwater monitoring: Natural Resources Canada

(through the Geological Survey of Canada or GSC), Agriculture and Agri-Food Canada, and Environment Canada (EC) (through the National Water Research Institute). EC installs monitoring wells to assess groundwater contamination and GW/SW interactions. The GSC installs monitoring wells as an element of regional-scale assessments and then turns them over to the province where the assessment takes place. (This process is described in more detail in the full version of the science case study, the summary of which is included in this report after chapter 1.)

As with other aspects of groundwater management, provincial programs to monitor surface and groundwater and quantity vary.

In BC since 1960, 350 observation wells have been established, with 163 active today. Some observation wells have close to 50 years of record. Reporting of eighteen key observation wells is done in the Snow Survey Bulletin. Access to month-end data is on the ministry website.²⁰⁶

In Alberta there was a reduction in the number of groundwater monitoring wells in the early 1990s due to budget cuts. The department is trying to improve monitoring, and there are approximately 200 deep wells and 100 shallow wells in the quality monitoring well network which are monitored especially for long-term changes.

Two networks operate in Saskatchewan. The first is the Saskatchewan Research Council, which began in 1964 with 54 wells and three surface water stations, and which measures natural groundwater level variations in known environments not affected by humans and related to climate. The second is the Saskatchewan Watershed Authority started in 1994 with 18 wells. It measures groundwater levels in stressed systems.

Manitoba currently has 600 monitoring wells, rain gauges, and soil moisture monitoring stations, forming one of the largest networks of water-level monitoring wells in Canada. Parts of the network were established over 40 years ago. Current licences for groundwater stipulate the requirement for a flow-measuring device, and all users are required to submit water-use records. These data are necessary for

allocation, planning, and management. However, enforcement of this requirement is limited, as is enforcement of other forms of noncompliance. The lack of enforcement becomes most problematic in periods of water shortage.²⁰⁷

In Ontario, the Ministry of the Environment (MOE) works in partnership with 38 conservation authorities and ten municipalities to monitor 360 monitoring wells which track well levels and water quality. There is no central database for all programs in Ontario: the MOE monitors water quality, and different industries such as the aggregate and water bottling industries monitor for compliance.

The Ministère de l'environnement in Quebec began monitoring groundwater in selected locations in the 1960s and began a watershed inventory program in the 1970s. Monitoring frequency was sparse and for only short periods of time in some cases. The number of observation wells peaked at about 200, but monitoring ceased in 1984 when the majority of wells were handed over to local authorities.

In New Brunswick, the Sciences and Reporting Branch of the Department of the Environment and Local Government prepares a monthly summary of the state of water levels in the province based on precipitation and stream flow data. These provide information on how much rain and snow fell (precipitation), the volume of water flowing in rivers and streams (stream flow), and water levels in selected wells used to keep track of groundwater. The information in each report is compared to long-term averages.²⁰⁸ The province has 61 hydrometric stations (measuring water levels and river flows) which are monitored on a daily basis by the hydrology centre for flood and flow forecasting as well as water resource reporting. The Department of the Environment and Local Government also receives data from sixteen climate stations within the province, and eleven stations along the border, which are monitored and archived on a daily basis to keep track of temperature and precipitation for water resource reporting.

The New Brunswick groundwater monitoring network increased this past year to a total of six stations with new wells. New wells are ready and

equipment has been purchased for four additional stations. These stations have been included within the existing hydrometric network, which is maintained by Environment Canada. New Brunswick has also participated in a cooperative snow survey since the early 1970s. The survey starts annually near the end of January with four to five more surveys conducted throughout the snow season. Snow measurements are taken in the Saint John River Basin throughout Maine, Quebec, and New Brunswick. (There have been no snow surveys in other parts of the province since the early 1980s following funding cuts by the federal government.) The snow survey report is produced in both hard copy and electronic format, and the snow survey maps are also posted on the Department of Public Safety River Watch website.

The Nova Scotia Department of Environment and Labour is the lead department in the province, though its mandate does not specifically mention groundwater monitoring, which has been carried out since 1965.²⁰⁹ Nova Scotia's groundwater monitoring network monitors groundwater levels with a telemetric system that currently includes eleven active wells. Ten more wells are expected to be added in 2005. Water chemistry is periodically tested in all the wells.

In PEI the department of Fisheries, Aquaculture and Environment oversees groundwater and monitors thirteen long-term monitoring wells. Where monitoring and reporting of water withdrawals is required, this is specified in the Certificate of Approval or Environmental Management Plan for the undertaking. Except for larger water withdrawal projects, there is little need or incidence of monitoring or enforcement in PEI. Irrigation permits, however, now require meters to be installed and water usage reported. Further, after the moratorium commenced, all existing irrigation permits were recalled and reissued with the meter and reporting requirements added.²¹⁰

In Newfoundland and Labrador, the terms and conditions on licences are strict and place the responsibility for monitoring on the licensees. There are usually over twenty terms and conditions per licence.²¹¹

OTHER LAWS

Though this report focuses primarily on water quantity laws and regulations, other laws also regulate groundwater extraction. Laws for provincial environmental assessment, municipal land use and development, special management areas, utilities, oil and gas, and mining fall into this category. While a full examination of these laws is outside the scope of this report, some general comments can be made.

Environmental assessment laws

The federal government and all the provinces and territories have environmental assessment (EA) laws. Major projects and activities covered by these laws may have groundwater impacts, and so the anticipated environmental effects of substantial groundwater extractions would be assessed under these laws.

Depending on the nature of the project – a new mine, industrial plant, forest development plan – different levels of assessment will be applied ranging from a preliminary screening to a full-scale review by an independent panel of experts. Public participation is a key component of EA laws, and in the absence of other requirements, EA may be the sole method for gauging the potential impacts of a proposal for large takings, and the only avenue for public input. In BC where groundwater remains unlicensed, the BC *Environmental Assessment Act* fulfills this function. In Alberta the overhauled *Water Act* is integrated to some extent with the province's main environmental protection and assessment law.²¹² New Brunswick also integrates major water licensing decisions with its environmental impact review process.²¹³

Municipal laws

Municipal land use laws can also affect groundwater extraction and allocation in a number of ways. Here are just a few illustrations:

- Setting overarching goals for land use as in the provincial policy statement issued under Ontario's *Planning Act*.²¹⁴ "The quality and quantity of groundwater and surface water and the function of sensitive groundwater

recharge/discharge areas, aquifers and headwaters will be protected or enhanced."

- Using official plan policies to, for example, identify areas where a water-taking activity would conflict with the character of the surrounding community.
- Restricting development by designating select groundwater areas as environmentally sensitive.
- Zoning bylaws to prohibit certain land uses such as water bottling operations.
- Restricting the amount of impervious surface that can be built to allow for greater groundwater recharge, as in BC's *Local Government Act*.²¹⁵
- Using tools for integrated stormwater planning, with the objective of putting "as much water back into the ground to support aquifers and streams while protecting and enhancing riparian habitat.... Municipalities can achieve source control by using a variety of tools, from OCP policies to zoning and subdivision servicing requirements."²¹⁶

The role of local governments in groundwater management can be hampered or eased by the degree to which they have a voice in groundwater decisions. Provincial regulators are required to give notice of water-taking permits to municipalities in Quebec and affected municipal governments and conservation authorities in Ontario must be notified of permit applications posted on the Environmental Registry for comment under the new *Water Taking and Transfer Regulation*.

In Ontario in particular, there has been tension between municipal land use regulation and provincial groundwater permitting, most recently resolved in favour of the local level of control in two decisions. In both cases, even though environment officials had already issued water-taking permits, the local council was authorized to reject the expansion of a water bottling plant and prohibit water taking by official plan designations.²¹⁷

Special management areas laws

Some provinces have passed laws with special groundwater requirements for designated areas.

In Ontario the *Oak Ridges Moraine Conservation Act* requires protecting the ecological and hydrological integrity of the Oak Ridges Moraine Area through a conservation plan. The Oak Ridges Moraine Plan contains many groundwater specific requirements, including mandatory wellhead protection for municipal wells and policies to protect groundwater areas that have been mapped as intrinsically susceptible to contamination. The enforceable requirements for groundwater protection equal or exceed other jurisdictions in Canada and elsewhere. Also in Ontario, the *Niagara Escarpment Planning and Development Act* has as one of its objectives maintaining and enhancing the quality and character of natural streams and water supplies.²¹⁸

Ontario has the unique feature of 26 conservation authorities created by the *Conservation Authorities Act*, whose mandate is to manage their respective watersheds.²¹⁹ Each authority is a group of municipalities that share a watershed. Conservation authorities operate in watersheds in which 90% of the provincial population reside.²²⁰ The Association of Conservation Authorities has piloted a number of projects related to watershed management and has published a guide entitled *Watershed Management in Ontario: Lessons Learned and Best Practices*.

In Alberta, the South Saskatchewan River Basin (SSRB) requires special consideration for water allocations in its regulation. However, phase two of the *South Saskatchewan Basin Management Plan*, which seeks to find a balance between water consumption and environmental protection, does not deal with groundwater. A future phase of the plan could address groundwater due to the linkages between surface and groundwater. “However, at this time the groundwater resource in the SSRB is not well understood, and it is believed there are sufficient issues concerning surface water to justify focusing on it alone in phase two.”²²¹

In the NWT the *Mackenzie Valley Resource Management Act* tasks a resource management board to “regulate the use of land and waters and the deposit of waste so as to provide for the conservation, development, and utilization of land and

water resources in a manner that will provide the optimum benefit to the residents of the settlement area and of the Mackenzie Valley and to all Canadians.”²²²

Utilities laws

Utilities that supply water to the public are also regulated. Drinking water providers must follow health standards. Laws that take a holistic approach to water management require the health and environmental impacts of a water project to be considered simultaneously.²²³

Provinces have detailed standards and laws in place for drinking water protection, which may affect groundwater extraction:

- Quebec’s *Groundwater Catchment Regulation* requires catchment projects that will supply drinking water to include a hydrogeological study establishing the impact of the project on the environment, users, and public health.
- Water suppliers in BC need to obtain a similar type of report in support of their application for a Certificate of Public Convenience and Necessity under the *Utilities Act*. For community drinking water wells, a construction permit is also required for works, and an operating permit is required annually to operate the well and system.
- In PEI the *Water and Sewer Act*²²⁴ governs the water licensing scheme for public utilities but does not replace the requirements under the *Water Wells Regulation* for obtaining a groundwater extraction permit. The establishment of a water supply system requires approval under section 13 of the *Environmental Protection Act*, and source protection (i.e., well field protection) is required for municipal water supplies under the new regulations.
- In Ontario the statutory requirements related to approvals of drinking water systems are found in the new *Safe Drinking Water Act*.²²⁵

Oil and gas laws

Wells are often drilled in conjunction with oil and gas development.²²⁶ Groundwater is affected by water injected underground into conventional wells

to increase pressure and carry with it some of the remaining oil.

In Alberta enhanced recovery allocation represents 26.4% of groundwater allocations. The fact that over one-quarter of all groundwater allocations are for a use that removes water from the active hydrologic cycle is significant. The volumes of groundwater used for this purpose at a specific location can be quite large, and are of concern to the rural population. There are many domestic and agricultural users who are not registered, but each one would probably use a relatively small amount compared to a company taking water for enhanced recovery. Rural residents are concerned that licences for oil-field injection are removing water that may be needed for agriculture – a particular concern in times of drought, as aquifers may be recharging slowly and the water table declining.

Due to controversy over this type of use – it removes water from the active water cycle – the

Alberta government appointed an Advisory Committee on Water Use Practice and Policy whose final report recommended a series of changes which could include regulatory changes to groundwater to protect Alberta's non-saline waters.²²⁷

Mining laws

Mining also has the potential to affect groundwater. Mining laws that restrict harmful impacts on water resources are an important piece of the regulatory backdrop. Most concerns relate to the potential for contamination, but groundwater quantity can also be affected if, for example, a mine's water use lowers water. Similarly, sand and gravel workings can lower the water table locally, and this is a concern where there are extensive workings in an area. A full discussion of laws regulating mining and sand and gravel is beyond the scope of this report.²²⁸

4

Public Participation Opportunities in Groundwater Permitting

This chapter continues the comparison of provincial groundwater regulatory systems. It compares the various provincial opportunities for access to information, public participation in decision-making, and access to justice for groundwater quantity decisions.

BACKGROUND ON ENVIRONMENTAL DEMOCRACY

Water is so central to people's daily lives that its management cannot be reduced to simple technical formulas. Public understanding, awareness, and participation in water-use decisions are essential to ensuring those decisions are sound. Yet only seven of the thirteen jurisdictions surveyed make all groundwater records fully accessible to the public (Manitoba, Nova Scotia, PEI, Newfoundland and Labrador, Yukon, NWT, and Nunavut), and even fewer have conflict resolution systems that give all affected people the right to be heard.

"Environmental democracy" can be a key to better environmental decisions. When all those affected by the outcome of environmental decisions, including resource users, community members, and conserva-

tionists are involved in decision-making, in addition to government and industrial sector representatives, they tend to support the decisions and help implement them, and the joint solutions that are discovered last longer.

The three components of environmental democracy are:

- access to information,
- public participation in decision-making, and
- access to justice.

These three interlinked concepts have formal legal status in a 1998 regional treaty adopted by many European states under the auspices of the UN Economic Commission for Europe: the *Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters*, also known as the *Aarhus Convention* after the Danish city of Aarhus at which it was adopted.

As the conference website asserts:

The *Aarhus Convention* is a new kind of environmental agreement. It links environmental

rights and human rights. It acknowledges that we owe an obligation to future generations. It establishes that sustainable development can be achieved only through the involvement of all stakeholders. It links government accountability and environmental protection. It focuses on interactions between the public and public authorities in a democratic context and it is forging a new process for public participation in the negotiation and implementation of international agreements.²²⁹

The Government of Canada has not ratified this convention on the grounds that the present array of laws in Canada is substantially equivalent to the treaty's requirements.

Environmental democracy has been directly linked to water management on many occasions. One of the four Dublin Principles on Water (adopted at an international conference and again named after the city in which the conference was held) states that, "(ii) Water development and management should be based on a participatory approach, involving users, planners, and policymakers at all levels."²³⁰ At each of the World Water Forums held in recent years, the parties reaffirmed the centrality of user participation.²³¹

As the World Bank notes specifically in relation to groundwater, "regulatory interventions (such as water rights or permits) and economic tools (such as abstraction tariffs and tradable water rights) become more effective if they are not only encoded in water law but implemented with a high degree of user participation."²³²

How do the Canadian provinces and territories live up to these environmental democracy principles in relation to groundwater decision-making? As with other aspects of groundwater management, practice across the country varies.

ACCESS TO INFORMATION

Information about groundwater resources

Access to information about groundwater resources and groundwater laws is key to ensuring effective public participation. Yet incomplete information

about this resource is a defect noted by many commentators.²³³

The report from the Walkerton Inquiry illustrated Ontario's problems with data on the extent of current draws on aquifers and watersheds. Dr. Ken Howard testified that "in Ontario unfortunately, we don't manage water, the degree of management extends simply to issuing permits to take water, and to me issuing permits to take water is a little bit like writing cheques on my bank account when I don't know how much is going out to pay...other bills."²³⁴

Most jurisdictions map aquifers and wellhead protection areas and make the maps publicly available. Two examples are BC's aquifer classification system and New Brunswick's wellfield protected area designated orders. Since 1998 the Ontario Ministry of the Environment (MOE) has provided grants to municipalities and conservation authorities to map their groundwater resources. When studies are completed, a summary of findings and key maps from each are posted on the MOE website.²³⁵

Some provinces also make monitoring data available. PEI's website contains a comprehensive table of data noting continuous monitoring of the water table elevations for the province. There are twelve observation wells across the province that are maintained by the Water Management Division of the Department of Environment, Energy and Forestry.²³⁶

Information about the legal requirements to extract groundwater

Most jurisdictions have information programs about the groundwater licensing process itself, such as New Brunswick's *Understanding the Law: A Guide to New Brunswick's Wellfield Protection Area Designation Order*, and Nova Scotia's *Guide to Groundwater Withdrawal Approvals*.

Accessible information about groundwater use is another important function that government agencies perform. Alberta collects and consolidates its information on water licences and presents it in easy-to-understand forms, broken down by "specified purpose," though there are no records for the amount of groundwater water used for domestic purposes or unregistered agricultural use.²³⁷ The

figures that Alberta reports represent the gross allocations for each category, not the actual usage. The majority of these allocations do not consume their full allocation and have return flows or do not use their entire allocation. Therefore, these figures represent only an approximation of who the relative users of water in Alberta might be.²³⁸

Comprehensive databases of water information

Without a database of reliable water-taking information, there is significant risk that many water-taking permits will be granted and land use planning decisions made without adequate knowledge of the availability of water resources.²³⁹

Not only should data on water withdrawals and use be collected and submitted to the authorities, they should also be publicly available. Most provinces have freedom of information laws which apply to groundwater records, and some provinces also maintain a specific database or registry devoted to water records. However, no province or territory in Canada has a central province-wide, user-friendly database, accessible by the general public which consolidates all data on water extractions, water quality, and quantity indicators.²⁴⁰

A complete database would include, at a minimum:

- well-drilling records,
- notices of applications for permits,
- copies of the licences or permits, and
- actual use records.

Provinces score well on the first three criteria, but not the fourth.

All provinces except BC require well records to be kept. BC maintains an incomplete database of well records as these records are submitted voluntarily and no licence is required for groundwater extraction.²⁴¹ The new *Groundwater Protection Regulation* plans to make submission of some types of well records mandatory when phase 2 comes into effect in 2005 (although regulations for this have not been developed yet). BC has well logs accessible from the Internet and is also one of the few provinces that publishes information on

aquifers on the Web.²⁴² However, all groundwater information in the ministry's possession is made public.

The databases maintained by Newfoundland and Labrador and Alberta are the most comprehensive. Newfoundland and Labrador's public Registry of Water Rights requires every water right holder to register that right.²⁴³

Alberta fully discloses everything in the possession of the department, subject to certain confidentiality exceptions, and requires the department to house the information at a location specified by the regulations. No location is established by the regulations.²⁴⁴ For the approvals and licences already issued, the public has online access, but as the reports submitted with applications are too large to file online with the rest of the application, interested people need to file a request in writing for permission to view these technical reports. The Alberta Groundwater Information System contains a hyperlink to the telusgeomatics site which has all the water well drillers reports.²⁴⁵

Yukon has a public register maintained by the Yukon Water Board. The section's files are not in the registry and people occasionally come to the office and request pieces of information from different files. Access to information requests are rarely received.²⁴⁶

Nova Scotia's Environmental Registry maintains copies of approvals, terms, and conditions, but it does not have the public notice and comment procedures found in Ontario's registry. The province also maintains a working database of well and groundwater records, which is not up to date, resulting in issuing permits without true knowledge of the amount of water being extracted.²⁴⁷ The *Well Construction Regulations* require that certified well contractors submit well logs to the province. This requirement has been in place since 1965. The well logs are used to maintain an up-to-date well logs database which was recently upgraded and released in January 2005. The database currently includes records for approximately 97,000 wells that were constructed between 1940 and 2004. Nova Scotia also maintains a database of

groundwater allocation records, which is currently being updated and should be available in the spring of 2005.

Quebec's *Système d'information hydrogéologique* (SIH) contains water records.²⁴⁸

Ontario's information disclosure at first glance appears more complete than other provinces, as notices of proposed water takings are posted on the Environmental Registry. But as the Canadian Environmental Law Association points out, the registry is not a database and shows much less water taking than the actual amount being withdrawn, especially since municipal water takers, the largest overall user in terms of volume of water, do not have to post their permit applications on the registry for comment.²⁴⁹ The Environmental Commissioner of Ontario reviewed the provincial water-taking permit system in 2001 and found numerous deficiencies, concluding that public accountability and transparency were threatened because of these inaccuracies and omissions.²⁵⁰ Mandatory reporting of water use in Ontario under the new water-taking regulation is designed to address this problem. Following are features of other provincial public information systems:

- In Saskatchewan all Watershed Authority offices have access to a database, but there is no public registry type of access.²⁵¹
- In Manitoba there is no legislated requirement for a public database or registry, but in practice people may request and gain access to reasonable amounts of information on a "need to know" basis.
- In PEI until 2004 there was no mechanism to access information, and information was given only to current landowners. There is now a Freedom of Information statute which entitles the section to release to the public well construction details. It is still unclear whether pumping test information is to be released upon request.²⁵²

(See also the discussion in the section on reporting on actual versus permitted use in chapter 3.)

PUBLIC PARTICIPATION IN DECISION-MAKING

Notification and participation opportunities

Participation procedures for permit decisions apply to both surface and groundwater, except in BC where groundwater is unlicensed.

Many provinces require environmental assessment of projects with significant groundwater impacts, and procedures invariably allow public participation. BC, Alberta, New Brunswick, and PEI are in this category. The federal government also requires assessments: a project will require a comprehensive study under the *Canadian Environmental Assessment Act* for extraction of 200,000 m³/year or more of groundwater.²⁵³ When projects meet both federal and provincial thresholds they will be subject to a joint assessment.

Even if a formal environmental assessment process is not triggered, many provinces and territories require permit applicants to notify the public of their application and to conduct public consultation. For example, in Saskatchewan the Watershed Authority requires the applicant to advertise the project. Usually all large projects are advertised, especially if the application is controversial such as for intensive livestock operations.²⁵⁴

The *Approvals Procedure Regulations* in Nova Scotia, which specify how water withdrawal and other approvals are processed, allow public consultation to be required as part of the approval review.²⁵⁵

In Alberta, for applications for water licences, any "person who is directly affected by the application or proposed amendments" may submit a written statement of concern to the director.²⁵⁶ In the case of a contentious project, the province has the option to ask the applicant to host a public meeting where the applicant can explain the nature of the project and application and where the public can express their concerns.

This is a key issue in Alberta, as long-term commitments are being fast-tracked for coal mines and tar sands without awaiting the results of groundwater studies. In one example, the Energy and Utilities Board (EUB) directed that groundwater studies be undertaken in two recent expansions of coal-fired power

plants. For the second of the two projects, the EUB, responding to public intervenors and their experts:

- determined that insufficient data existed on the impacts of the project on groundwater;
- directed that research be undertaken by the applicant on groundwater, including regional cumulative impacts, and verification of the modelling approach;
- directed the applicant to cooperate with stakeholders to address groundwater concerns;
- directed the applicant to address need for a watershed management plan with other stakeholders;
- recommended that Alberta Environment in the process of considering ground water licence should:
 - impose requirements for suitable timing and reporting to establish baseline conditions *prior* to introducing any stresses on the groundwater flow system associated with the expansion,
 - communicate the results of the tests to the EUB and the public,
 - reinstate the requirement that the applicant undertake complete geochemical analysis of waste facility to monitoring and groundwater sampling for dissolved metals, and
 - review implications of coal-ash disposal in the mine site.²⁵⁷

Public participation can improve groundwater allocation decisions. The Lake Wabamun Enhancement and Protection Association was successful in getting the Environmental Appeal Board to recommend (in turn approved by minister) an increased allocation for water loss from mining to the calculation for requirement by the operator to return water to the lake.

In addition to the mandatory notice of municipalities and conservation, Ontario's new *Water Taking and Transfer Regulation* empowers the ministry to require the applicant to notify or consult with anyone else who has an interest in the proposed water taking, provide information on the interests of and responses of those notified or consulted, and provide the ministry with information on the efforts

that the applicant has made to resolve any concerns raised.

Ontario's *Environmental Bill of Rights* guarantees a certain level of citizen involvement in environmental decision-making. "Class I Prescribed Instruments" must be publicly posted on the electronic registry for a minimum of 30 days to allow the public to respond and comment. Regulators must indicate how they have taken the public input into consideration in their eventual decision.²⁵⁸ All applications for permits to take water are Class I instruments except:

- short-term (less than a year) increases in the volume of water takings for irrigation of agricultural crops,
- water takings for a period of less than one year, normally for pumping an aquifer to conduct yield tests, dewatering for construction, for hydrostatic testing of pipelines, all in the ministry's opinion, "generally environmentally insignificant,"
- emergencies,
- where the environmentally significant aspects of the proposal have already been considered in a process of public participation substantially equivalent to that under the EBR, such as an environmental assessment,
- where there has already been a tribunal or similar hearing about the proposal, or
- where there will be an insignificant effect on the environment, such as company name change, requests to change the reporting requirements, or revocation of permits/activities that are no longer in operation.

Though Ontario's Environmental Bill of Rights and Environmental Registry gives the public more extensive opportunities to participate than in many other parts of Canada, its flaws in relation to water-taking permits have been catalogued in detail.²⁵⁹ The Auditor General of Ontario has repeated many of these criticisms in its 2004 report.²⁶⁰

In Manitoba, any person may object to the proposed licences if an applicant has been ordered to publish notice of the application. This will happen

when “by reason of the scope and nature of the use, diversion or control of water or the construction, establishment, operation or maintenance of works or water control works proposed in an application for a licence and their possible impact on other persons,” the minister considers it necessary, and a hearing must be held to deal with these objections.²⁶¹ In practice, however, these provisions are not widely used.

In Quebec, any person adversely affected by pumping may invoke section 1 of the regulations and complain to the ministry.²⁶²

Northern water boards have procedures similar to those of the Nunavut Water Board (NWB). A licence administrator advertises the application for a water licence in a local newspaper and sends the application directly to federal and territorial government departments, hamlet councils, hunters and trappers’ organizations, regional Inuit organizations, regional wildlife organizations, etc. If the public raises no significant concerns by the end of the fifteen-day deadline, the NWB may decide that the project proceeds without a public hearing. However, the NWB will not issue a licence if the environmental screening has not been completed and if no land use permit has been issued by the competent authority (Government of Canada for Crown lands and the regional Inuit organization for Inuit-owned lands). Should there be significant concern, or should the NWB feel that it is in the best interests of the public, the application could be subject to a public hearing.

As there is no groundwater licensing in BC, there are few ways for the public to be involved in groundwater decisions, other than the opportunity to become involved in water management plans which are allowed under the new parts of the *Water Act*. The consultation requirements are designed to achieve a balanced plan addressing the concerns of all users, such as conservation groups, farmers, local governments, developers, homeowners, etc. One plan is currently being contemplated; it is not known how many plans will eventually be prepared. There are also opportunities for public participation if the

Environmental Assessment Act is triggered by the groundwater project or proposal.

Participation on advisory committees

Another avenue for public participation on water policy is becoming more popular: the use of multi-sectoral advisory committees. Several provinces have created such committees related to water, giving representative members of the public a formal voice into water policy, such as the Advisory Committee to the Saskatchewan Watershed Authority; the Alberta Water Council, the New Brunswick Land and Water Advisory Committee, and the proposed Water Council in Manitoba’s draft *Water Protection Act*.²⁶³

On occasion, provinces also appoint committees to provide recommendations on more specialized issues, such as BC’s Ground Water Advisory Board, and Ontario’s Implementation Committee on Source Water Protection and Technical Experts Committee on Watershed-based Source Protection Planning. Government may select members of these committees, or a sector organization such as a provincial environmental network or industry association may be asked to put forward several names, so the government can select one.

Table 11 summarizes the various requirements and rights pertaining to groundwater licensing in the 13 provincial and territorial jurisdictions.

ACCESS TO JUSTICE

Access to justice means that citizens whose information or participation rights have been breached can “have access to a review procedure before a court of law and/or another independent and impartial body established by law, to challenge the substantive and procedural legality of any decision, act or omission,” to use the language of the *Aarhus Convention*.

Administrative appeals

Many provinces have an administrative agency which hears appeals of licences or permits. Ontario has an Environmental Review Tribunal, BC and Alberta have Environmental Appeal Boards, and Quebec has the Tribunal Administratif du

Table 11: Environmental democracy – groundwater permits

Jurisdiction	Reporting requirements by location, source, and purpose of extraction	Notification requirements for permit applicants	Participation opportunities in permit decision-making process	Appeal right in permit decisions	Public database of permit information
BC	n/a	n/a	No, except when EA procedures apply	n/a	n/a. Well records submitted to government are public but submission has been voluntary to date. Registry exists for surface water licences.
AB	Yes, <i>Water (Ministerial) Regulation s 63 64</i>	Yes, 50(1)(d) of the WA, WR (s 13(1))	Yes, s 109(1) WA	Yes, sections 114-117	No, but Part 4 of the WR (ss 15–17) “Access to Information” makes provision for full disclosure.
SK	Yes, ss 31, 34, 35 of the GWR	Yes, SWAA requires the corporation (s 52) to require the proponent to advertise the project by posting it.	Yes	Limited. Only a drainage approval may be appealed to the Water Appeal Board; appeal of approval or licence can be made to the courts.	No
MB	Yes, s 8 of the WRR requires every licence holder to keep records of water use on a form approved by the minister.	Discretionary; s 6(3) of the WRA requires a notice of an application be published if the minister directs, but provision rarely used.	No, except where EA procedures apply to the project.	Yes, s 24 of the WRA allows any person affected by an order or decision to appeal.	No
ON	Yes, annual water use reports must be submitted every year to MOE (phased in by 2008) (Reg 387/04). Well contractor to complete a record for every new well constructed and submit it to the owner and the MOE (Reg 903, OWRA).	Mandatory notice to municipalities and conservation authorities; also can require applicants to consult with others who may have an interest and report back to ministry.	Yes, EBR requires notice of application for certain types of permit to be posted.	Yes	Not currently available.
QC	Yes, s 20 of the GWCR	No	No, but any person adversely affected by pumping may invoke s 1 of the GWCR and complain to the MENV.	Yes	Yes

—Continued

Jurisdiction	Reporting requirements by location, source, and purpose of extraction	Notification requirements for permit applicants	Participation opportunities in permit decision-making process	Appeal right in permit decisions	Public database of permit information
NB	n/a	n/a	No participation in general groundwater approvals; EA requirements have participation procedures.	Yes, s 39 of the CWA establishes an appeal “for a person whose application has been refused or licence has been suspended or cancelled.”	Yes, ss 36 and 37 of the CWA.
NS	Yes, water use records must be kept as a condition of approval.	n/a	Yes, under the <i>Approvals Procedure Regulations</i> the minister or administrator may require public consultation.	Yes, Environment Act, s 137-40 part XIV.	Yes, on environmental registry.
PEI	Yes, WWR requires a well contractor to complete a construction report and submit it to the owner and the department.	No, except when EA requirements apply.	No, except when EA requirements apply.	No	No
NL	Yes, s 31(2) (3) of the WRA. Annual water-use reports must be submitted every year as a licence condition.	Yes, s 14 WRA	Yes, s 14 (3) WRA	Yes, WRA s 86(4)	Yes, ss 13 and 86 WRA
YT	Yes, s 14(1) of the WR	Yes, s 21(1) of the act	Yes, ss 21(1) of the act	Yes	Yes, s 23(1) of the WA
NWT	Yes, s 15 (1) of the act	Yes, s 23 of the act	Discretionary, s 21 of the act	Yes, s 28 of the act	Yes, s 14 of the reg; s 25 of the act
NUN	Discretionary	Yes, s 55 of the act	Discretionary, s 52 of the act	Yes, s 81 of the act	Yes, s 78 of the act

Quebec.²⁶⁴ In the North, water boards make licence decisions and hold public hearings when necessary. In Manitoba, any person affected by an order or decision to appeal within 30 days to the Municipal Board, and the decision of the board is final.²⁶⁵

Only Ontario residents can apply to the Environmental Review Tribunal for leave to appeal a permit. The test for granting leave is a demonstration of significant environmental harm or an unreasonable decision by the Director. Similar tests exist in other administrative appeal boards.

Tribunals, such as Ontario’s, usually have discretion to decide if an applicant has the legal standing necessary to pursue the appeal. This gives regulators great power to exclude potential appellants.

In Alberta, once a decision has been made authorizing or refusing a water licence, it can be appealed. A notice of appeal initiates the appeal to the Environmental Appeal Board.²⁶⁶ If the EAB determines that the party submitting the notice of appeal is not “directly affected” by the decision of the Director, the notice of appeal may be rejected.

Some decisions cannot be appealed (e.g., temporary licences, some amendments, orders of the minister). The EAB makes recommendations to the minister. The EAB may initiate mediation to resolve the notice of appeal, or may hold a formal hearing.

In Alberta, regulators narrowly apply the definition of “directly affected.” In one recent case the Southern Alberta Environmental Group was denied standing to appeal an amendment to a surface

water licence on the ground that their “policy concerns” were too generalized.²⁶⁷

Where giving notice of a licence application is discretionary, governments may choose to waive notice. A group or individual can file a concern, but there is no guarantee that the issues raised will be considered or that consultation will occur. There is no access to experts for review of the applications, including access to hydrologists. In some cases

Restriction on Appeal Rights for Water-Taking Permits in Ontario

Third-party appeals to the Ontario Environmental Review Tribunal are allowed by leave only. In a case before Ontario’s Environmental Review Tribunal, citizens were granted leave to appeal a Permit To Take Water (PTTW). The leave to appeal was granted on the basis that:

1. Each of the appellants has an interest in the director’s decision; and
2. It was unreasonable to grant a PTTW when no sub-watershed groundwater study had been done and many wells and springs in the local areas have gone dry.

As a result, the tribunal was of the opinion that there was a real chance that the environment could sustain significant harm if a PTTW was granted.

But rather than let the appeal stand, the province submitted an application for judicial review of the ERT decision in Ontario Divisional Court. The government attempted to block the appeal of an earlier environment ministry decision to reissue a water-taking permit to Aquafarms 93. The company was granted permission to take three million litres of groundwater per day near Feversham, south of Georgian Bay between Collingwood and Owen Sound, but nine local residents won the right to appeal the decision under the provincial Environmental Bill of Rights.

Under the provincial Environmental Bill of Rights, members of the public are entitled to challenge water-taking permits by getting permission to appeal from the Environmental Review Tribunal. This legal move by the province essentially was “to try to get some clarity around the application of the rules of leaves to appeal.”

Some of the parties have settled with Aquafarms 93 under an agreement that sets up a community steering committee to oversee a better study on the effects of Aquafarms 93’s water taking. Other parties are continuing. A factor in the decision by the parties to settle was that the existing court challenge meant that the residents would have to win twice – at the ERT and also in the court in order to achieve success. By the time the ERT hearing and judicial review will have been heard the permit under appeal will have expired and Aquafarms 93 is expected to be operating under a new permit. Citizens will be back to square one seeking leave to appeal the permit to the ERT again. The MOE will not withdraw the court challenge until either all parties settle or Aquafarms 93 wins the hearing. *Davidson, Smith, Brewster, Weiner, Zinn v. MOE* ERT Case no. 03-203/204/205/206/207

groundwater protection will only be pursued if the public identifies the issue.

It is important to note the role that administrative tribunals, other than an environmental appeal board, may have in relation to groundwater. For example, in Alberta, the Energy and Utilities Board (EUB) plays the pivotal role in approval of projects which have an impact on groundwater and surface water, including coal-fired power plants and associated mines, tar sands, and oil and gas wells, including use of water for enhanced recovery. The Natural Resource Conservation Board (NRCB) has a similar function in relation to intensive livestock operations.

Appeals to the courts

Some provinces provide for appeals directly to courts. In Yukon, an appeal lies on a question of law or jurisdiction to the Supreme Court, on leave being obtained from that court. The appeal provision has not been used.²⁶⁸

Judicial review of these administrative agency decisions is also possible. In Newfoundland and Labrador, the law entitles anyone who believes their rights would be prejudiced by the granting of a licence to file an objection with reasons and the minister will determine if the objection warrants a hearing.²⁷⁰ A person who is "aggrieved by a deci-

Citizen Perseverance – the Artemesia Case

Artemesia Waters Ltd., a large water bottling company, was foiled in its attempt to build a water storage plant on agricultural land in Artemesia Township (now the municipality of Grey Highlands), south of Owen Sound, Ontario. Residents opposed the plant due to concerns about the impacts of the proposed groundwater taking of almost 500,000 litres of water per day on a wetland and a fish stream.

The complicated legal saga started in 1999 when the MOE issued the water-taking permit. Citizen challenges to that decision were defeated by the Environmental Appeal Board (now renamed the Environmental Review Tribunal).

But the residents did not give up. The local official plan and zoning bylaw did not allow the land to be used for commercial water taking, storage, or loading, and the municipal governments refused to make amendments sought by Artemesia, who successfully appealed these refusals to the Ontario Municipal Board.

Still residents persevered. The Grey Association for Better Planning sought judicial review of the Municipal Board's finding in favour of the company and argued that the board had failed to consider water taking as a land use in making its decision. The court agreed, stating: "In deciding that the taking of water was not a use of land and in confining the subsequent hearing to issues relating to the storage and loading of water, the board was refusing to consider an essential, if not the most essential, aspect of the appeal before it."

The court ordered the Ontario Municipal Board to carry out a new hearing that would look at the taking of groundwater as a land use. Artemesia then sought and obtained leave to appeal, but after the municipality joined the residents in their quest to stop the bottling plant, Artemesia capitulated and abandoned the appeal the day before it was set for hearing. The result? "Even where an MOE permit exists, a municipality may still apply official plan policies and zoning bylaws to deny amendments required to permit commercial water taking."²⁶⁹

sion or an order” may appeal in writing, and the minister must give a decision within 30 days in writing. A further appeal to Trial Division exists for a person aggrieved by a decision or order of the minister respecting the terms and conditions of a licence, an amendment, and the cancellation of a licence, but only on a question of law or mixed fact and law. Lastly, the matter may go to the Court of Appeal on a matter of law raised in the appeal.

Some provinces have minimal appeal rights:

- In PEI no appeal right is granted by statute. In practice, issues surrounding the terms of a permit will be negotiated with the section directly. When the PEI section makes a licensing decision, it is based purely on the science, with no formal requirements for public participation. Larger projects, however, trigger the environmental assessment provision and must go through an environmental impact assessment. The section, on such projects, becomes a com-

ponent of that process by requiring permits to match up with the resulting environmental assessment requirements.²⁷¹ In addition, it must be stipulated that a well owner is liable for any harm caused to other groundwater users.²⁷²

While this allows recourse for individuals adversely affected by pumping activity, it would require actual harm (not potential harm) to be demonstrated first.

- In BC no appeal rights exist for groundwater extraction since groundwater permits/licences are not required.
- Saskatchewan’s participation rights changed when the SWAA came into force in 2002, and greatly reduced the number of decisions that could be appealed. Now only a drainage approval may be appealed to the Water Appeal Board; however, a person can appeal approval or licence decisions to the courts.

5

Groundwater Pricing Requirements

The longer we ignore or distort groundwater's value, the more overused, degraded, and misallocated the resource becomes. Without price signals or other indicators of value to help guide policy, we tend to devote too little attention and funding for resource management and protection of groundwater.²⁷³

Literature on water pricing in general is more abundant than on groundwater pricing in particular. Due to this lack of detailed consideration, the introductory section of this chapter discusses generic water-pricing information as background. The case study at the end of this chapter shows which provinces and territories use groundwater pricing.

As command and control, the traditional form of environmental regulation, has fallen out of favour in Canada, regulators recurrently ponder how to make more use of economic instruments. Market forces can increase the likelihood of achieving objectives when they are used in tandem with regulation or when they are mutually reinforcing. Their use may bring certain advantages including increased flexibility that allows for innovation and lower social costs in meeting regulatory requirements.

Yet though Canadian governments endorse the idea of market power to safeguard the environment, Canada trails other countries in tax- and fee-based measures designed to change behaviour.²⁷⁴ The OECD has repeatedly censured Canada for failing to put economic instruments into practice to manage water, most recently in its 2004 environmental performance review of Canada, saying "user fees still cover only part of the cost of delivering water services, while fee structures generally do not encourage conservation."²⁷⁵

Trends noted by the OECD in the following excerpts from the 2001 report are still evident today:

- "Ideally, water pricing should cover both the (fixed and variable) cost of supplying water, the environmental costs of its extraction, and the associated rent. In Canada, however, water pricing is under-utilised as an instrument. In fact, despite some moves in that direction over the recent period, the pricing structure for water supplies is far from an 'economic' approach with full-cost recovery and charges based on consumption.

- “That water prices are low in Canada compared with other OECD countries is not surprising, as water is plentiful. However, they are far from covering even infrastructure costs.
- “The clear trend observed in most OECD countries away from flat-fee pricing for households consumption is much less pronounced in Canada. In fact, only 56 percent of the households were metered in 1996.
- “In any case, having the rate structure decrease with the quantity consumed – valid for 14 percent of households in 1996 – should be immediately suppressed.
- “Flat-rate tariffs are also widespread for industries, a rare feature in the OECD; metering would probably be cost-effective in all such cases.
- “In sum, there is a paradox in Canadian attitudes to water management. On the one hand, prohibition of bulk water removal underlines the high value put on water; on the other hand, there is a strong reluctance to recognize this value by allowing proper pricing that would enhance water conservation and allocative efficiency, and cover the cost of infrastructure.”²⁷⁶

Though widely praised for their ability to reduce use and consumption, policy changes like water metering and full-cost charging structures are still rare. Alberta, the sole province that allows the sale of water licences through a transfer scheme, has only introduced this plan in one area, the South Saskatchewan Basin, and the Basin Management Plan does not apply to groundwater. As the case study on pricing laws and policies at the end of this chapter demonstrates, only six of the thirteen provinces and territories charge for groundwater extraction. Newfoundland and Labrador has all the legal authority it requires to introduce charges but has not yet made use of these tools. Ontario is poised to introduce new charges.

The underuse of economic instruments in relation to water is not due to lack of study: witness recent studies by the federal government, provincial task forces, the CCME, and research institutes such as the Polis project and the Canada West Founda-

tion.²⁷⁷ Nor can failure to implement full pricing and water markets be blamed on a lack of experience from other jurisdictions. Many countries use market tools for groundwater as well as surface water management and conservation. Fees for extraction are commonly used in the US, Europe, Japan, and Australia. Trading in water rights is well established in arid zones around the world.²⁷⁸ Closer to home, in Bend, Oregon, the Deschutes Resources Conservancy operates the innovative Deschutes Water Exchange Groundwater Mitigation Bank.²⁷⁹

BENEFITS OF WATER PRICING

The merits of introducing a charge for a water permit are its potential:

- to improve the efficiency of water allocation,
- to improve water quality,
- to increase government revenues, and
- to improve the government’s knowledge base regarding water use.

Evidence abounds of the positive impact of appropriate charges for water. Increasing conservation is one immediate benefit. One of the key factors explaining high residential consumption rates is the lack of financial incentive to Canadian households to use less water. In 1999, water use was 70% higher when consumers faced flat monthly rates rather than volume-based rates.²⁸⁰ About 57% of Canada’s municipal population had water meters in 1999, showing a gradual increase since 1991.²⁸¹

Well thought out pricing policies can help municipalities avoid expensive new infrastructure costs. The town of Port Elgin, Ontario (pop. 6,500) avoided a \$5.5 million expansion of its water treatment plant by installing 2,400 residential water meters in 1991 at a cost of \$550,000. This reduced summer water use by 50%, all use for 1993 by 25%, and water flow by 30%. The town also saved \$12,000 in sewage treatment operating costs.²⁸²

DRAWBACKS OF WATER PRICING

One major drawback of a charge is its obvious impact on raising water users’ costs.²⁸³ This

apparent drawback is also its major strength: it can provide a clear signal to the users about the real cost of their water use, if indeed it reflects costs over and above those for administration. This incentive is what provides the impetus for the behavioural changes required, be they lower consumption or water conservation. Domestic users must be protected from an inability to access clean water due to financial constraints.

Another drawback is the uncertainty of whether pricing groundwater takings will have the desired effect of encouraging major industrial users who can readily pay the fees as an operational cost to reduce their use of groundwater.

VALUE OF GROUNDWATER

Historically, groundwater has been priced well below its value and, as a consequence, misallocat-

ed. In many states and localities, no charge is imposed for water withdrawn, and the consumer, whether a public water supply entity, an individual, or a firm regards the cost as being confined to the energy used for pumping and the amortization of well construction and the costs of the treatment and distribution system. As a result, depletion and pollution continue largely because it is not recognized that groundwater has a high or long-term value.

The states that do have explicit policies to limit groundwater depletion typically simply prohibit additional groundwater uses and do little to regulate current groundwater uses to extend aquifer life. There is unfortunately too little attention given to regulating existing groundwater uses to lengthen aquifer life, let alone any explicit quantitative evaluation of the trade-off between cur-

Full-Cost Pricing

An interesting distinction on the concept of "full cost" can be drawn between the Ontario law²⁸⁴ and the EU's *Water Framework Directive* which applies to both surface water and groundwater.²⁸⁵

Ontario defines full cost for this purpose as "The full cost of providing the water services [including] the source protection costs, operating costs, financing costs, renewal and replacement costs, and improvement costs associated with extracting, treating, or distributing water to the public and such other costs as may be specified by regulation."

The EU goes further in its definition, requiring member states to take account of the principle of recovery of the costs of water services, including environmental and resource costs, the polluter pays principle, and following an economic analysis which:

shall contain enough information in sufficient detail (taking account of the costs associated with collection of the relevant data) in order to:

- (a) make the relevant calculations necessary for taking into account under Article 9 the principle of recovery of the costs of water services, taking account of long-term forecasts of supply and demand for water in the river basin district and, where necessary:
 - estimates of the volume, prices and costs associated with water services, and
 - estimates of relevant investment including forecasts of such investments;
- (b) make judgments about the most cost-effective combination of measures in respect of water uses to be included in the programme of measures under Article 11 based on estimates of the potential costs of such measures.

Most people agree to full-cost accounting and full-cost recovery. This is distinct from full-cost pricing.

rent and future groundwater use. Consequently, groundwater valuation has historically played almost no role in state groundwater allocation policies. Groundwater policies in most states could be strengthened by acknowledging groundwater's future value.²⁸⁶

This analysis by the US Committee on Valuing Ground Water applies equally to Canada. The myth of water abundance that contributes to careless overuse and waste also results in undervaluation of groundwater.

Here are some examples of how groundwater translates into dollars:

- An Environment Canada valuation study found that if Caledon, Ontario, were to lose the use of all of its groundwater, it would cost residents up to \$33 million in consumer surplus per year to replace it with the next best alternative water source.²⁸⁷
- A study of the economic value of groundwater in the Assiniboine delta aquifer of Manitoba, located in a predominantly agricultural region, estimated the total economic worth of the aquifer water at between \$85 million and \$460 million using the economic efficiency perspective, and between \$795 million and \$4,000 million using the regional development perspective.²⁸⁸

Ontario now has full-cost pricing for the ground and surface water that municipalities provide, though the municipalities themselves do not have to pay the province for their extraction.

On December 23, 2004, the Ontario Minister of the Environment announced that the government intends to introduce administrative fees for a permit to take water applications starting April 1, 2005. The fees will cover the cost of processing, evaluating, and issuing the permit.²⁸⁹ All applicants for a permit to take water will pay from \$750 for new applications and renewals that are straightforward to \$3,000 for applications that involve assessing and reviewing detailed hydrogeological information. Private individual wells and water takings that require less than 50,000 litres a day will not require a permit.

Opposition to water-pricing proposals is coming from the Bottled Water Association which does not want to be singled out to bear the brunt of paying for costs of administration, as their share of the actual use of water in Ontario in 2002 was 0.2% of all water taking permits.²⁹⁰ The Association of Municipalities of Ontario counters their arguments by pointing out that water bottling operations are concentrated in areas with plentiful spring water sources, usually rural areas unserved by good road networks, and that like the aggregate industry, water bottlers should pay the costs of road maintenance.

In Manitoba, the provincial review on water use and allocation also revealed general support for the water use charges authorized by provincial legislation. Fees are used for two purposes: to prevent overuse and for cost recovery. The *Water Rights Regulation* sets annual fee rates, based on volume, for industrial users whose licences have been renewed since 1988. The review concluded that these fees should stay and be expanded to recover costs for water use for all users based on a "fair" equation.²⁹¹

But these market solutions are not a panacea. They are not very useful at dealing with non-quantifiable resources, such as in-stream systems, or ecosystem benefits, both of which may be impacted by groundwater extraction, despite the large body of literature on how to account for ecosystem benefits, including a methodology paper showing how to do this specifically for Canada,²⁹² and the slow but growing interest by the courts in accounting for ecosystem benefits.²⁹³

Pricing for water is also controversial. Citizens object to the commodification of this essential elixir and to the privatization of water supply infrastructure. Others believe that the private sector can deliver water supply and distribution services more efficiently than governments. This report is not the place to resolve that debate. However, a good place to end this discussion is with the opening statement of the Preamble of the EU Water Framework Directive: "Water is not a commercial product like any other but, rather, a heritage which must be protected, defended and treated as such."

Case Study

Groundwater Pricing Policies in Canada

BY RANDY CHRISTENSEN AND SIMONE MAGWOOD

This case study constitutes a summary of a lengthier study. The longer version is available for download on the website of BuriedTreasureCanada.ca and on the website of Sierra Legal Defence Fund at www.sierralegal.org.

INTRODUCTION

Presented here is the first-ever comparative study of groundwater pricing policy in Canada. The study was prepared through a review of acts, regulations, and policies related to groundwater management in each jurisdiction (ten provinces and three territories).

Consideration extends to four broad categories: whether the public owns the groundwater resources, what price is charged for groundwater, cost recovery provisions, and if there are metering requirements.

Pricing, ownership, and export of water have been the subject of heated debate in Canada. At the same time, water regulation is a topic that will be unfamiliar to many readers. In the hope of giving context to the findings, information is provided after the findings regarding the “costs” of groundwater, policy options, and international comparisons.

SUMMARY OF RESULTS

Ownership of groundwater

Virtually all provinces and territories (with the exception of Ontario and PEI) vest ownership of all water in the public (or Crown). This excerpt from the *Manitoba Water Act* exemplifies the provision in most provinces: It states:

Except as otherwise provided in this Act, all property in, and all rights to use, diversion or control of, all water in the province, insofar as the legislative jurisdiction of the Legislature extends thereto, are vested in the Crown in right of Manitoba.²⁹⁴

Where ownership of water is vested in the public, individuals may obtain water rights, which are lesser rights than ownership.

The vesting of groundwater ownership in the public is important for two reasons. First, it is commonly but erroneously believed that land ownership includes an unlimited right to exploit any

groundwater resources beneath that land. The legislative assertion of public ownership of groundwater extinguishes any unfettered right that landowners may have to extract groundwater.

Second, public ownership of groundwater strengthens arguments in favour of imposing water use charges or royalties. Simply stated, the public deserves to be paid for use of public resources, which can be accomplished through water use charges, just as fees and royalties are commonly charged for private use of other public resources such as forests or oil and gas deposits.

Groundwater extraction fees

Six of the thirteen provinces and territories charge for groundwater extraction: Manitoba, Saskatchewan, Nova Scotia, Yukon, Northwest Territories, and Nunavut.

The *Water Resources Act* of Newfoundland and Labrador includes provisions for royalties and water use charges, but as of yet no regulations have been created to implement pricing. Alberta, Ontario, and Quebec do not currently charge for groundwater (or surface water) extraction, but are examining and planning for this possibility in the near future.

Where fees are collected, prices range from \$0.01–\$143.77 per million litres. To put a million litres of water in perspective, it's estimated that the average per capita use of water in Greater Vancouver is about 580 litres per day, meaning that one average user would require 4.7 years to use a million litres of water. Alternatively, an Olympic-sized swimming pool holds about 2.5 million litres of water (1 million litres is approximately 40% of the pool) meaning the cost of filling the swimming pool would range from \$0.03 to \$359.

Of the jurisdictions with pricing in place three have groundwater use above the national average (Saskatchewan, Nova Scotia, and Yukon). Manitoba is at the average and Northwest Territories and Nunavut are below the average.

These findings require some qualification:

- In the jurisdictions where pricing is in place, not all users pay extraction fees. Generally, only industrial or commercial users pay fees, and usually only when water usage reaches a relatively high level.
- These findings are only applicable to primary groundwater extraction. For example, a municipality may obtain groundwater for free, but charge residents for its delivery and infrastructure costs. Or, rural residents who drill private wells to provide themselves with drinking water have to pay the cost of drilling, but generally do not pay a fee for water extraction. Cost policies at the municipal or water system level are beyond the scope of the comparisons in this case study.
- In Northwest Territories, Nunavut, and Yukon, large-scale groundwater use is relatively rare. In those places, the findings reflect charges primarily intended for surface water use, but that would apply to groundwater extraction, should it occur.

(Pricing, use, and quantity categorization for each jurisdiction is set out in the Table 13 at the end of this case study.)

Administrative fees and cost-recovery provisions

All provinces charge administrative fees for licence applications or in relation to well drilling, except BC, which does not require licences. Such fees are a means of ensuring that water users pay for water management, at least in part. In many cases, however, fees collected are simply placed in general revenues. A preferable approach is to specifically collect and allocate licensing and water

use fees to the cost of water management. In British Columbia, water rental fees (from surface water use) are used to offset the costs of Land and Water BC, the responsible agency.

No jurisdiction specifically requires users to pay environmental costs related to groundwater extraction, but most have provisions in their statutes or regulations allowing groundwater use to be regulated on the basis of environmental concerns (through decisions on licence applications or the power to make orders). In other words, there is some regulatory power to avoid or minimize environmental costs, but pricing is not one of the strategies used. Further, even in those jurisdictions where environmental factors are considered in the decision-making process, many groundwater users will be exempt from those provisions because most regulations apply only to large users (such as industry or municipalities).

Research also shows that no jurisdiction charges for *in situ* use of groundwater through its water management framework. That is, there are no charges implied for the use of groundwater without extraction, such as pollutant disposal through an underground injection well.

Metering requirements

Metering is required in five jurisdictions (Manitoba, Saskatchewan, Nova Scotia, PEI, and Newfoundland and Labrador) where groundwater extraction occurs pursuant to a licence. Water use measuring is generally imposed as a condition of licences in NWT and Yukon as well.

Metering serves dual purposes. First, it ensures that water use charges are accurately calculated. Second, it functions as a conservation management tool. Without usage verification such as metering, it is difficult, if not impossible, to ensure the long-term sustainability of groundwater extraction.

THE MANY COSTS OF GROUNDWATER USE

When groundwater is used, a number of types of costs may be incurred due to that activity. These costs, broadly speaking, include the opportunity cost of the groundwater, private costs borne by the water user, infrastructure and administrative costs (that may or may not be borne by the user), and external costs (environmental, social) borne by someone other than the water user. A description of each of these costs is set out in Table 12.

Currently, water users tend to pay their private costs of withdrawal (pumping, on-site storage, etc.), and a small share of the infrastructure and administration costs. However, in all provinces and territories, users of groundwater pay little or no share of the opportunity cost of water, and the social and environmental costs are also external (i.e., they are borne by other users, the public generally, or the environment).

PRICING OPTIONS

In Canada, water pricing is normally seen at the municipal or water system level, and those pricing structures could be applied to groundwater use. Traditionally, where pricing is implemented it seeks to quantify and recover (at least in part) the costs of capture, treatment, and conveyance. Generally rates fall into two general categories: flat- and volume-based rates.

Consumers who pay a flat rate are charged a fixed amount in each billing period, regardless of the volume of water used. Flat-rate pricing structures provide little incentive to reduce water use by individual customers. Instead, municipalities may try to control water demands through legal and administrative measures such as lawn watering restrictions (although poor enforcement often limits the success of these measures).

Table 12: Costs associated with groundwater use

Type of cost	Description
Opportunity costs	Opportunity cost is sometimes defined as the cost in terms of foregone alternatives. Groundwater extraction by a user may have the result of precluding use by another concurrent user, or precluding use by future generations. Groundwater extraction can also diminish surface water sources (see Environmental Costs).
Infrastructure and administrative costs	<p>Costs associated with the establishment, exploitation, and abandonment of groundwater sources and groundwater management. These can include:</p> <ul style="list-style-type: none"> • Well drilling: locating and properly constructing a well • Well abandonment: taking measures to prevent water contamination and accidents at abandoned wells • Water treatment: treating groundwater sources intended for human consumption <p>Administrative costs may include costs associated with metering, billing, and record-keeping; calculating rates each year; and securing customer compliance with water billings. May also include administrative expenses for environmental testing and oversight as well as the prevention or resolution of disputes between users.</p>
Social costs	Refers to adverse impacts on human beings, their property, and welfare related to groundwater use. Such costs could include the mining or overdraft of aquifers, which may diminish future water use or current use by other users. Many environmental costs (see below) could also be considered social costs.
Environmental costs	<p>The costs of environmental degradation engendered by groundwater use:</p> <p>Habitat loss: Groundwater provides base flow to many watersheds and overuse can adversely affect critical habitats such as wetlands and fish-bearing streams.</p> <p>Saline intrusion: Overpumping aquifers near salt water may cause intrusion of salt water. It is a very difficult (or impossible) process to reverse.</p> <p>Land subsidence: Overpumping of groundwater may cause land subsidence. Subsidence often prevents aquifer recharge.</p>

If a volume-based rate is charged, the consumer's water bill varies with the amount of water used. Various rate structures exist, including a *constant charge* (individual unit prices remain constant regardless of the amount used), *declining block rates* (individual unit prices decrease in cost as more units are consumed), and *increasing block rates* (individual unit prices increase as more units are consumed). All these options require water meters to be installed to measure consumption, and all have different impacts on patterns of consumption. Additionally, some jurisdictions have experimented with *seasonal rates*, which charge a higher fee when water is traditionally scarce.

It should be kept in mind that in the municipal context, when one or another of these rate structures are used, the money collected often does not pay for the water itself but only for the service of bringing it to the consumer's tap, for treating the water so that it is potable, and for removing consumer waste through the sewer system. The findings presented in the previous section reflect the price of the water itself.

WATER PRICING INITIATIVES IN OTHER JURISDICTIONS

To give context to the Canadian groundwater pricing comparison above, it is useful to look at water pricing initiatives in other jurisdictions, specifically the European Union and the United States.

European Union Water Framework Directive

The Water Framework Directive of the European Union (EU)²⁹⁵ has received considerable attention since it was drafted. The directive was created in response to the need to harmonize water-related directives throughout the EU. Previous to its introduction there were many separate directives designed to protect water quality. These included directives for drinking water, fish waters, shellfish waters, bathing water, and groundwater. The EU concluded that the policy was fragmented in terms of both objectives and means and that a single piece of framework legislation was needed to resolve these problems.

One of the goals of the Water Framework Directive is to “require water pricing policies and ensure that the polluter pays.” The EU has stated that:

Water is not a commercial product like any other but should be seen rather as a heritage. However, it is important to give water a price since pricing acts as an incentive to encourage more sustainable use... The Water Framework Directive requires member states to develop water-pricing policies where *all users* – agricultural, industrial, and households – contribute in an adequate way. Member states will be required to ensure that the price charged to water consumers – such as for the abstraction and distribution of fresh water and the collection and treatment of waste water – reflects the true costs. However, derogations will be possible... to provide basic services at an affordable price.

Under the directive, member countries must introduce pricing policies by 2010.²⁹⁶

United States

Although traditionally water has been free in the United States, some states have recently introduced limited pricing policies.²⁹⁷ For example, California, until 2004, funded the administration of structures related to water use and rights through general budget allocations. California now assesses an annual water right fee to each holder of a permit or licence based on the volume of water in acre-feet (one acre-foot = 1233 cubic metres or 1.2 million litres) authorized for diversion under that water right permit or licence. The annual water right fee for permits and licences in fiscal year 2003–2004 is the greater of \$100 or \$0.03 per acre-foot based on the total annual amount of diversion.²⁹⁸

Another example is Minnesota, which has implemented an “increasing block rate” for water usage (including groundwater usage). Minnesota’s fee structure ranges from \$101 for up to 50 million gallons (1 gallon = 3.7 litres) to a price of \$7.50 per million gallons (where use exceeds 500 million gallons).²⁹⁹

WATER MARKETING

Water marketing, or water transfers, allow current holders of water rights to sell or lease their water to others, who usually put the water to use in a different location for a different purpose. The water market allows individuals to profit from these transactions and allows water to move to move valued economic uses.

A primary benefit of a water market is that it encourages water efficiency investments by existing users as the “saved” water may be transferred to other users. As water transfers generally occur when water sources are fully allocated, the transfers are a means of creating water availability where there is none.

While water markets may be a practical response to the governance problem of gridlock, if improperly structured or inadequately balanced with other interests, they may actually exacerbate

problems by allowing the water to flow exclusively toward money, by damaging rural and other less influential communities, and by undermining productive agriculture.³⁰⁰

Additionally, water transfers will not make additional water available for environmental needs unless specifically structured to do so. Such a mechanism exists in Alberta, which has created the possibility of a “water conservation holdback” when water rights are transferred. This allows the withholding of up to ten percent of an allocation of water right being transferred to protect the aquatic environment or to implement a water conservation objective.³⁰¹

Water marketing may take many forms besides the outright sale of water. For example, it may be tied to conservation programs. Washington State has legislation that seeks to encourage investment in water conservation. The state is authorized to finance conservation projects for water-user organizations in the basin, but in return the users must convey the conserved water to the state.

Water markets have come under considerable criticism as many water rights holders often receive water fraught with subsidies, but are allowed to receive full market price for the water.³⁰²

In addition to Alberta, BC is another jurisdiction that allows the transfer of a licence from one party to another, as well as transfer of the “appurtenancy” (the place where water may be used).³⁰³

Table 13: Comparison of water pricing, use, and quantity

Jurisdiction	Is groundwater ownership explicitly vested in the public?	Price charged for groundwater use (if so, price variables)	Classes of usage charged fees/ exempt from fees	Administrative cost recovery	Verification of quantity use universally required (e.g., metering)	Environmental concerns addressed in decision-making process
BC	Yes	No	n/a	n/a	No	No
AB	Yes	No	n/a	Yes, through licence fees	No	Discretionary
SK	Yes	Yes, costs range \$0-\$12.53 per 1 million litres	All uses except industrial are exempt	Yes, through licence fees	Yes (where licence is in place)	Discretionary
MB	Yes	Yes, costs range from \$0.01-\$0.02 for 1 million litres	All uses except industrial are exempt	Yes, through licence fees	Yes (not required by regulation, but administrative practice is to require metering as a condition of licences)	Mandatory
ON	No	No	n/a	Yes, through well drilling and permit fees (use over 50,000 litres/day)	No	Mandatory
QC	Yes	No	n/a	Yes, through licence fees	No	Discretionary
NB	Yes	No	n/a	Yes, well driller fees	No	No
NS	Yes	Yes, costs range from \$117-\$143.77 per 1 million litres	Fees payable where water used pursuant to licence (use over 23,000 litres per day)	Yes, through licence fees and annual fees	Yes (where licence is in place)	Mandatory
PEI	No	No	n/a	Yes, well driller fees	Yes	Mandatory
NL	Yes	No	n/a	Yes, through licence fees	Yes (where licence is in place)	Mandatory
YK	Yes	Yes, costs range from \$1.50-\$2.00 per 1 million litres	Water use under 100 m ³ per day is exempt	Yes, through licence fee	Generally a condition of water licensing	Mandatory
NWT	Yes	Yes, costs range from \$1.50-\$2.00 per 1 million litres	Fees payable where water used pursuant to licence (eight types of undertakings require licence)	Yes, through licence fees	Generally a condition of water licensing	Mandatory
NUN	Yes	Yes, costs range from \$1.50-\$2.00 per 1 million litres	All water users pay fees, except domestic and emergency	Yes, through licence fees	Generally a condition of water licensing	Mandatory

Conclusion

Groundwater is valuable “buried treasure” that needs to be protected and managed for sustainability.

Since the early 1900s the demand for water has increased, and society’s priorities for allocating water have also changed. However, some Canadian provinces still use water management clauses, doctrines, and acts created to suit conditions prevalent at the time of settlement in the late 1800s and early 1900s. There are obvious problems with using allocation rules based on historical priorities – to encourage settlement and economic development, and maximize resource extraction – rather than basing rules on today’s recognition that sustainability needs to incorporate environmental, social, and economic priorities.

The law of groundwater allocation, like most water laws, has proved adaptable. Progress is being made in adapting to new priorities such as watershed-based planning and environmental flows. But much progress remains to be made.

While regulation alone is not sufficient to conserve any resource, groundwater included, governments

must incorporate changing priorities into water management laws and policies.

The Global Water Partnership points out the need for four types of management strategies for integrated water resources management:

- Direct regulations, whereby government bodies or independent regulatory agencies establish laws, rules, or standards which water and land users and water service providers are required to follow, often known as command and control regulation.
- Economic or market regulation – economic instruments such as unit pricing, marketable rights, or subsidies are employed instead of or in conjunction with direct regulations to influence water or land using behaviour.
- Self regulation – professional bodies, industry groups, or community groups establish their own rules of conduct and mechanisms to ensure compliance. Governments may still have an important role, however, in allowing self-regulating systems to operate, in encouraging, enabling, and building regulatory capacity, and in providing vital information.

- Social regulation – this involves changing water use behaviour through persuasion, information, and education.³⁰⁴

All these management strategies are important for groundwater in Canada, though this report has focused on the first two listed.

Good reporting is one basis for sustainable allocation decisions. Access to information and public access to decision-making are also vital. The ability to obtain information and participate in and challenge groundwater decisions varies markedly across Canadian jurisdictions. In many cases, non-governmental organizations (NGOs) play a substantial role in informing the public about the main regulations and policies, water conservation, and efficiency (including measures individuals may take), and research that is taking place.

The characterization and assessment of aquifers is another key to better management. Progress is being made through provincial and coordinated federal/provincial programs. However, a publicly accessible and thorough database on aquifers is far from complete. Knowledge about groundwater hydrodynamics in Canada, which would provide a scientific foundation for developing policy, is also incomplete.

Adequate staff, funding, and clear mandates are necessary to develop and administer more comprehensive groundwater management regimes. These challenges should be acknowledged.

When groundwater is a priority, government funding decisions will reflect this priority. Ontario's recent investments are an example: the province has invested significant sums to support mapping of groundwater conditions and wellhead protection areas in every municipality and conservation

authority in the province, and it has supported the development of water budgeting tools through partnership agreements with selected conservation authorities. It assessed water availability in all 144 tertiary watersheds comparing estimated water use by permit holders to estimated natural stream flows, information which was compiled on maps referenced in the new *Water Taking and Transfer Regulation*, used to justify specific requirements and restrictions in high use watersheds. The Ontario government is also funding source protection plans and watershed-based water budgets across the province.

Many good examples of the sustainable management of groundwater exist, such as the incorporation of the water budget concept into source protection plans in Ontario, the better use of market forces through water transfers in Alberta (even though this is not yet being applied to groundwater), the precautionary approach to management as in the PEI moratorium on new irrigation licences, the collection of actual use data in Manitoba, and the development and implementation of comprehensive water strategies as in Quebec and elsewhere. More discussion of the existing regulatory frameworks may help uncover the key variables for improved management.

This report is a snapshot of the current framework for groundwater management in Canada. It is changing rapidly. But the report provides the first-ever comprehensive compilation of groundwater permitting requirements, reporting requirements, pricing structures, and public reporting requirements. It is intended to shed light on the variation among jurisdictions, uncover some "best practices" that may be shared, and highlight the gaps that still exist across the country.

Endnotes

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18. See http://www.pc.gc.ca/pn-np/nt/nahanni/natcul/natcul1d_e.asp.
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44. *Constitution Act*, 1867. Reprinted RSC 1985, Appendix II, No. 5.
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96. We chose the bottled water industry not to suggest that it has any greater impact than any other industry, but simply to highlight an example of one use of groundwater, and in this case, a use that is on an uptrend.
97. BC's data appear as "actual use" data, but since groundwater takings are not regulated, the volumes can only be inferred from monitoring and are not actual measures (BC Ministry of Water, Land and Air Protection, "Environmental Indicator 2000," 1.) As part of its review of its Permit to Take Water Program, Ontario is now considering requiring some users to report actual use of water, including municipal water supplies, major industrial dischargers, and water takings that remove water from the watershed. See Proposed Regulation, June 2004, further to EBR Registry No. RA04E0011.
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117. P.H. Gleick et al., *The World's Water 2004-5*, The Biennial Report on Freshwater Resources. (Washington, DC: Island Press), 2004, 60.
118. For example, s 3(2) *Alberta Water Act*: "The property in and the right to diversion and use of all water in the province is vested in Her Majesty in Right of Alberta except as provided in the regulations."
119. For full pricing details for each province, see "Groundwater Pricing Policies in Canada" on the website of author or on the website of Sierra Legal Defence Fund, www.sierralegal.org.
120. *Northwest Territories Water Act 1992*, s 12, c 39.
121. See *Alberta Water Act*, RSA 2000, c W-3 s 2, and *Manitoba Water Protection Act*, CCSM c W80 s 2.
122. Ontario regulation 387/04, made under the *Ontario Water Resources Act*, http://www.e-laws.gov.on.ca/DBLaws/Statutes/English/90o40_e.htm.
123. *The Report of the Walkerton Inquiry*, Part 2, Chapter 4, "The Protection of Drinking Water Sources," www.attorneygeneral.jus.gov.on.ca/english/about/pubs/walkerton/, especially s 4.3.5.3 Groundwater Management.
124. Ontario Ministry of the Environment, "White Paper on Source Protection Planning." (Toronto: Queen's Printer), 2004, 19.
125. "Protecting Ontario's Drinking Water: Toward A Watershed-Based Source Protection Planning Framework," 2003, <http://www.ene.gov.on.ca/envision/techdocs/4383e.pdf>.
126. Ontario Ministry of the Environment, "Science-Based Decision-Making for Protecting Ontario's Drinking Water Resources: A Threats Assessment Framework" and "Watershed-Based Source Protection Planning: Implementation Committee Report," 2004, <http://www.ene.gov.on.ca/envision/water/spp.htm>.
127. J. Abouchar and B. Spiegel, "Navigating Multi-Jurisdictional Compliance Obligations for Safe Drinking Water," April 26, 2004, The Canadian Institute's 4th Annual Conference.

128. Part 5 of the *Drinking Water Protection Act*, SBC 2001 c. 9 (amended by SBC 2002 c. 59; 2003 c. 52), passed in 2001, amended in 2002 and brought into force in 2003.
129. *BC Water Act* [RSBC 1996] s 63(6) c 483.
130. *Drinking Water Protection Act*, [SBC 2001] Part 3, c 9.
131. NB Reg. 2000-47, s 14(3)c.
132. NB Department of the Environment and Local Government, *Understanding the Law: Guide To New Brunswick's Wellfield Protected Area Designation Order*, <http://www.gnb.ca/0009/0371/0004/watershed-e.pdf>.
133. Quebec, OC696-2002.
134. See <http://www.gov.ns.ca/enla/water/sourcewater.asp>.
135. NS Environment Act, SNS 1994-95, c 1. See list of regulations at <http://www.canlii.org/ns/laws/sta/1994-95c.1/index.html>.
136. Environmental Protection Act, RSPEI 1988, c E-9.
137. Alberta, *Water Act*, RSA 2000, c W-3, <http://www.canlii.org/ab/laws/sta/w-3/20040802/part1.html>.
138. Section 164 of the act gives the Director the discretion to establish water management areas for the purposes of (a) administering priority to divert water, (b) groundwater management, (c) temporarily assigning water, directing that the diversion of water for household purposes cease, (d) directing that applications for licences are not to be accepted, and (e) any other matter specified in the regulations.
139. Saskatchewan Watershed Authority, *Protecting our Water: A Watershed and Aquifer Planning Model for Saskatchewan*. (Saskatoon: SWA), 2004, <http://www.swa.ca/publications/documents/ProtectingOurWater.pdf>.
140. October 3, 2003 News Release, Saskatchewan Watershed Authority, <http://www.gov.sk.ca/newsrel/releases/2003/10/03-755.html>.
141. Bill 22, the Water Protection Act passed Second Reading in June 2004, <http://web2.gov.mb.ca/bills/sess/b022e.php>.
142. See an overview of the Arizona law prepared by the Department of Water Resources at <http://www.water.az.gov/adwr/Content/Publications/files/gwmgtovw.pdf>. The Code itself is at <http://www.azleg.state.az.us/ArizonaRevisedStatutes.asp?Title=45>.
143. See, e.g, Part 5, s 77, of the revised *BC Water Act* [RSBC 1996] c 483. This provision needs regulations to guide implementation.
144. Legislation to protect wetlands runs the gamut in Canada from no legislation to protected buffer zones for select wetlands. The WetKit website, a project of the North American Wetlands Conservation Council (Canada) and Environment Canada's Canadian Wildlife Service, is a comprehensive bibliography and searchable database of practical tools for wetland conservation, including a collection of materials on Canadian legislation. See <http://www.wetkit.net>.
145. Some provinces have a drought policy that could affect groundwater allocation, such as : *Ontario Low Water Response* (OLWR), and Alberta's Agriculture Drought Risk Management Plan.
146. See Environment Canada Freshwater website: "Bulk Water Removal and Water Export" at http://www.ec.gc.ca/water/en/manage/removal/e_remove.htm and individual provinces' fact sheets at http://www.ec.gc.ca/water/en/links.cfm?category_id=8&sub_section_id=18
147. *Water Rights Act*, CCSM c.W80, s 1.
148. Wisconsin Department of Natural Resources, "Groundwater protection law requires state notification of all new wells," 2004, http://www.greatlakesdirectory.org/wi/042704_great_lakes.htm.
149. The regulation, which came into effect Jan. 1, 2005, is at <http://www.ene.gov.on.ca/envregistry/023109er.htm> and the revised manual is at <http://www.ene.gov.on.ca/envregistry/024265ep.htm>.

150. Alberta *Water Act*, RSA 2000, c W-3s 34 (1).
151. Alberta *Water Act*, RSA 2000, c W-3 s 51 (4).
152. *Groundwater Evaluation Guideline*, 2003, and *Guidelines for Groundwater Diversion for Coalbed Methane/Natural Gas in Coal Development*, 2004, at <http://www3.gov.ab.ca/env/water/Legislation/Guidelines/GroundwaterEvaluation.pdf>.
153. NB Dept. of the Environment and Local Government, *Guidelines to the Water Source Supply Assessment Process*, 2004, <http://www.gnb.ca/0009/0021-e.pdf>.
154. NS Dept. of Environment and Labour, *Guide to Groundwater Withdrawal Approvals*, 2004, <http://www.gov.ns.ca/enla/water/pdf/guideToGroundwaterWithdrawalApprovals.pdf>.
155. O. Reg. 285/99.
156. *Guide for Applying for Approval of Permit to Take Water*, Interim Guide, 2004, <http://www.ene.gov.on.ca/envision/gp/3151e.pdf>.
157. See <http://www.ene.gov.on.ca/envregistry/023109er.htm>.
158. Section 4(1) of the Manitoba *Water Rights Regulation* Man. Reg. 126/87 requires all applications for licences to include "all plans, documents, information and particulars specified in the applicable application form."
159. The *Guideline* is currently being upgraded. A second guideline, *Alberta Environment Guidelines for Groundwater Diversion for Coalbed Methane/Natural Gas in Coal Development*, is also available at <http://www3.gov.ab.ca/env/water/Legislation/Guidelines/GroundwaterEvaluation.pdf>
160. Telephone interview with G. Somers, Manager of the Drinking Water Management Section of the Water Management Division of the Dept. of Environment and Energy.
161. *Guide to Groundwater Withdrawal Approvals*. (Halifax: NSDEL), 2004, <http://www.gov.ns.ca/enla/water/withdrawalApproval.asp>.
162. NS Reg. 48/95, Environment Act, SNS 1994-95, c 1.
163. NL *Water Resources Act's* Part III – Well Drilling, section 60 SNL 2002, c W-4.01.
164. Interviews with provincial regulators.
165. Saskatchewan recently released a discussion paper for public consultation, *Conserving Our Water – A Water Conservation Plan for Saskatchewan*, <http://www.swa.sk.ca/WaterConservation/documents/WaterConservation.pdf>.
166. See e.g., Alberta's *Water Act* s 15 RSA 2000, c W-3.
167. Section 13(1), Manitoba *Water Rights Act* CCSM c W80.
168. Section 8(1), *Ground Water and Water Well Act*, CCSM c G110. Further, Section 12(e) entitles the Lieutenant Governor in Council to make regulations respecting the establishment of groundwater conservation programs and restriction of the use of groundwater, its flow, and output for such a purpose. Section 12(l) allows regulations to be made "respecting any other matter relating to the conservation, development, and control of groundwater resources and the drilling and operation of wells and the production of groundwaters therefrom."
169. Section 13(1) of the Yukon *Waters Act* SY – Ch. 19 entitles the Board to include any conditions on a licence, including conditions relating to the manner of use of waters permitted to be used under the licence, and conditions relating to studies to be undertaken, works to be constructed, plans to be submitted, and monitoring programs to be undertaken. Telephone conversation with T. Polyck, Manager of Water Use Inspections, Department of Environment, Yukon.
170. CELA and Environmental Defence, "Protecting Ontario's Water Now and Forever – A Statement of Expectations for Watershed-Based Source Protection from Ontario Non Governmental Organizations." CELA Publication 486, November 2004, Para 7.0.

171. Glennon, *Water Follies*, 210.
172. Washington Dept. of Ecology, "Instream Flows in Washington," <http://www.ecy.wa.gov/programs/wr/instream-flows/isfhtm.html>.
173. *Flow – The Essentials of Environmental Flow*. (Gland, Switzerland: IUCN), 2003.
174. Gartner Lee Limited, 2002, 31.
175. Alberta *Water Act*, RSA 2000, c W-3, s 51 (2) and Alta. Reg. 307/1991.
176. Alberta *Water Act*, RSA 2000, c W-3 s 83 (1).
177. Bill 22, *The Water Protection Act*, s 9.1 (1) and 14 (1), (proposed amendments to *Water Rights Act*), <http://web2.gov.mb.ca/bills/sess/b022e.php>.
178. Personal communication with Rob Matthews, Manager of the Water Licensing Branch, Dept. of Water Stewardship, Manitoba.
179. *Saskatchewan Watershed Authority Act*, SS 2002, c S-35.02 s45(5).
180. Telephone interview with C. Rogal, Coordinator of Groundwater Approvals, Saskatchewan, September 13, 2004.
181. *Water Resources Act*, SNL 2002, c W-4.01 s 4(1).
182. *Ontario Water Resources Act*, RSO 1990, c O40, s 34 (1).
183. Alberta *Water Act*, RSA 2000, c W-3 section 21(2).
184. Alberta *Water Act* RSA 2000, c W-349(2) exempts activities referred to in the schedules. Schedule 4 of the Water (Ministerial) Regulation refers to the 5,000 cubic metre exemption, indicated here.
185. Alberta *Water Act*, RSA 2000, c W-3 s 19(1)(b).
186. *Nunavut Waters and Nunavut Surface Rights Tribunal Act*, RS 2002, c 10, s 11 (2).
187. *Northwest Territories Water Act*, RS 1992, c 39 s 8 (2).
188. *Northwest Territories Waters Regulations* PC 1993-1213 8 June, 1993, s 5 (1).
189. *Northwest Territories Water Regulation*, SOR/93-303; *Nunavut Waters and Surface Water Rights Tribunal Act*, RSC 2002, c 10; *Waters Regulation*, Yukon OIC 2003/58.
190. *The Taking and Use of Water*, O Reg 434/03.
191. Telephone interview with George Somers, Manager of the Drinking Water Management Section of the Water Management Division of the Department of Environment and Energy.
192. *Water Resources Act*, SNL 2002, c W-4.01, s 82.
193. *Water Rights Act*, CCSM c W80 , s 14.
194. S. 41 of the *Watershed Authority Act* concerns cancellation, amendment, or suspension for cause without compensation and s. 42 outlines cancellation when compensation will be payable.
195. BC *Water Act* [RSBC 1996] s 19, c 483.
196. D. Percy, "The Limits of Western Canadian Water Allocation Law." *Journal of Environmental Law and Practice*, 2004: 14, 319.
197. S. 81 (7) of the *Water Act*.
198. Government of Alberta, *Water Act* Fact Sheet, "Transfer of Allocation of Water Under A Licence," <http://www3.gov.ab.ca/env/water/legislation/Transfer.html>.
199. Pers. comm, with M. Wenig, Canadian Institute of Resources Law, based on copies of licences obtained by request from Alberta Environment, January–February 2005.

200. Yukon *Waters Regulation* s. 14(1); Manitoba, *Water Rights Regulation* s 8; PEI, policy requirement; Newfoundland, *Water Resources Act* s 31(2); Saskatchewan, policy requirement.
201. Auditor General of Ontario, 2004 Annual Report, s 3.05, <http://www.auditor.on.ca/english/reports/en04/305en04.pdf>.
202. Reg 387/04, under the *Ontario Water Resources Act*, <http://www.ene.gov.on.ca/envision/news/2004/121401mb.htm>.
203. S. Hutson et al., "Estimated Use of Water in the United States in 2000." USGS Circular 1268. (USGS), 2004.
204. CELA Publication No. 444, "Submission on the Proposed Amendments to the Water Taking and Transfer Regulation." (Toronto: CELA), 2003.
205. The report from the workshop is at <http://pes.rncan.gc.ca/pdf/winnipeg.pdf> . Most of the information in this section is derived from that report.
206. See http://wlapwww.gov.bc.ca/rfc/river_forecast/grwater.html#well_map.
207. See http://www.gov.mb.ca/waterstewardship/waterstrategy/pdf/water_use_allocation.pdf.
208. See New Brunswick Water Quantity Information Website at <http://www.gnb.ca/0009/0371/0007/0001-e.asp>.
209. The Approvals Procedure Regulations makes approval holders undertake "compliance monitoring a pre-scribed in an approval, or as prescribed in the Act or regulations made pursuant to the Act" (s 20(1)). S 20(2) states the approval holder must submit the results of it to the department whenever the minister specifies. S 20(4) places the cost of monitoring on the approval holder.
210. Telephone interview with George Somers, Manager of the Drinking Water Management Section of the Water Management Division of the Department of Environment and Energy.
211. Telephone conversation with Dr. Abdel-Razek, Manager of Water Rights.
212. The Alberta *Water Act*, s. 16(1) provides that unless the regulations provide otherwise, the Director may not issue or amend an approval, preliminary certificate, or licence, or approve a transfer of an allocation of water under a licence if the Director is of the opinion that Part 2, Division 1 of the *Environmental Protection and Enhancement Act*, if applicable, has not been complied with.
213. *Environmental Impact Assessment Regulation - Clean Environment Act*, NB Reg 87-83.
214. RSO 1990, ss 16, 34.
215. RSBC 1996, s 907 (2), c 323, as amended.
216. D. Curran, *Smart Bylaws Guide*. (Vancouver: WCEL) 2004, <http://www.wcel.org/issues/urban/sbg/Part2/>. Also see CMHC's Research Highlights Technical Series, *Stormwater Management Alternatives*, <http://www.cmhc-schl.gc.ca/publications/en/rh-pr/tech/01-117.pdf>.
217. *Gold Mountain Springs v. Oro-Medonte (Township)* (2002) 44 CELR 287 (OMB); *Gray Association for Better Planning v. Artemesia* (2002) 44 CELR 287 (OMB) discussed in J. Abouchar and B. Spiegel, "Navigating Multi-Jurisdictional Compliance Obligations for Safe Drinking Water." April 26, 2004 The Canadian Institute's 4th Annual Conference Safe Drinking Water: Meeting Your Obligations in an Era of Transition.
218. *Niagara Escarpment Planning and Development Act*, RSO 1990, c N.2.
219. S 21(a) of the *Conservation Authorities Act* requires conservation authorities to "study and investigate the watershed and to determine a program whereby the natural resources of the watershed may be conserved, restored, developed. and managed."
220. See <http://conservation-ontario.on.ca/faqs/faqs.htm>.
221. Alberta Environment, *SSRB Water Management Plan Phase Two Terms of Reference*, <http://www3.gov.ab.ca/env/water/regions/ssrb/index.asp>.
222. *Mackenzie Valley Resource Management Act*, 1998, s 58, c 25.

223. For more detail on provincial drinking water laws see Water Quality on Environment Canada's Freshwater website at http://www.ec.gc.ca/water/en/manage/qual/e_qual.htm; Health Canada's Summary of Drinking Water Quality Guidelines at http://www.hc-sc.gc.ca/hecs-sesc/water/publications/-drinking_water_quality_guidelines/toc.htm; and CCME's Source to Tap website at www.ccme.ca/sourcetotap/story.html. For a critical view see SLDF's 2001 report "Waterproof: Canada's Drinking Water Report Card" at <http://www.sierralegal.org/issue/waterproof.html>.
224. RSPEI c W-2.
225. "Guide for Applying for Approvals Related to Municipal and Non-Municipal Drinking-Water Systems," Parts V and VI of the *Safe Drinking Water Act* and *Drinking-Water Systems Regulation* (O Reg 170/03).
226. A full discussion of how provincial oil and gas laws impact groundwater is outside the scope of this report. The Pembina Institute for Appropriate Development has published reports on the oil and gas industry's use of water in Alberta; see www.pembina.org. See especially "Oil and Troubled Waters: Reducing the Impact of the Oil and Gas Industry on Alberta's Water Resources," http://www.pembina.org/publications_item.asp?id=154, and "Unconventional Gas: The Environmental Challenges of Coalbed Methane Development in Alberta," http://www.pembina.org/publications_item.asp?id=157.
227. See the committee's final report at http://www.waterforlife.gov.ab.ca/docs/Final_Recommend_Online.pdf.
228. See J. Castrilli, "Environmental Regulation of the Mining Industry in Canada: An Update of Legal and Regulatory Requirements," (2000) 34 *UBCL Rev.* 91-158, and L. McGuire and J. Pak, *Protecting Your Water Rights: A Guide to Environmental Legislation and Limits on Mining Activities in Ontario* (Ottawa: Canary Institute), 2004.
229. "Introducing the Aarhus Convention," <http://www.unece.org/env/pp/welcome.html>.
230. Dublin Statements and Principles, 1991, Global Water Partnership website, <http://www.gwpforum.org/servlet/PSP?iNodeID=1345>.
231. See, e.g., from the most recent forum in Japan in 2003, this statement from the Ministerial Conference: "In managing water, we should ensure good governance with a stronger focus on household and neighbourhood community-based approaches by addressing equity in sharing benefits, with due regard to pro-poor and gender perspectives in water policies. We should further promote the participation of all stakeholders, and ensure transparency and accountability in all actions," http://www.world.water-forum3.com/en/finalreport_pdf/fr108_113.pdf.
232. World Bank, GW Mate Briefing Note 1, "Groundwater Resource Management – an introduction to its scope and practice," 2001, at [http://inweb18.worldbank.org/ESSD/ardext.nsf/18ByDocName/BriefingNoteNo1GroundwaterResourceManagement-anIntroductiontoitsScopeandPractice/\\$FILE/BN1.pdf](http://inweb18.worldbank.org/ESSD/ardext.nsf/18ByDocName/BriefingNoteNo1GroundwaterResourceManagement-anIntroductiontoitsScopeandPractice/$FILE/BN1.pdf).
233. See "Improved Access to Groundwater Data and Information," in *Canadian Framework for Collaboration on Groundwater* (Ottawa: Government of Canada), 2003.
234. Hon. Dennis R. O'Connor, *Part 1 Report of the Walkerton Inquiry*, 2002, 434.
235. See <http://www.ene.gov.on.ca/envision/water/groundwater/groundwatermain.htm>.
236. See "Monitoring the Groundwater Table on PEI" at <http://www.gov.pe.ca/infopei-/onelisting.php3?number=51930>.
237. Alberta Environment, 2001, http://www3.gov.ab.ca/env/water/GWSW/Quantity/WaterInAlberta/Allocation/AL3_Purpose.cfm.
238. Alberta Environment 2001.
239. Environmental Commissioner of Ontario, "Ontario's Permit to Take Water Program and the Protection of Ontario's Water Resources." Brief to the Walkerton Inquiry, (Toronto: ECO), 2001.

240. The Prairie Provinces Water Board put forward a template for a comprehensive database in its 1995 report, "A Review of Groundwater Legislation in the Prairie Provinces," 1995.
241. See <http://wlapwww.gov.bc.ca/wat/waterbot/gwell-out.html>.
242. See <http://wlapwww.gov.bc.ca/wat/aquifers/index.html>.
243. See Water Resources Act, SNL 2002, c W-4.01 s 13(1) and (2). The Registry of Water Rights has been in place since April 30, 2004, http://www.gov.nl.ca/env/Env/waterres/WaterRights/Registry_of_Water_Rights.asp.
244. Part 4 of the *Water (Ministerial) Regulation*, Alta. Reg. 205/1998, ss 15–17 is dedicated to access to information.
245. See <http://www3.gov.ab.ca/water/groundwater/>.
246. Telephone conversation with T. Polyck, Manager of Water Use Inspections, Department of Environment, Yukon. Section 23 *Waters Act*, SY, c 19. The board is required to issue and make available to the public written reasons for its decisions or orders relating to any licence or application (s. 24, WA). The *Waters Regulation*, Yukon OIC 2003/58, s 13(1) requires the register referred to in s 23 of the WA to have the following contents in each file: a copy of the application and all supporting documents, all records from any public hearing; a copy of any licence issued in respect of the application and the reasons for decision, and all correspondence and documents submitted to the board in respect of compliance with the conditions of any licence issue in respect of the application.
247. NS Environmental Registry at <http://www.gov.ns.ca/enla/ess/er/>. CBCL Consulting Engineers, "Agricultural Water Supply Issues: Nova Scotia, New Brunswick, Newfoundland, PEI," 2003, http://www.agr.gc.ca/pfra/water/nwsi_atl_e.pdf.
248. See <http://132.203.71.97/index.html>.
249. This is because of an exemption in the *Environmental Bill of Rights* for approvals issued under the *Environmental Assessment Act*. Canadian Environmental Law Association, Water Taking FAQs, http://www.cela.ca/faq/cltn_detail.shtml?x=1504.
250. "Ontario's Permit to Take Water Program and the Protection of Ontario's Water Resources." Brief to the Walkerton Committee, January 2001, Environmental Commissioner's Office, <http://www.eco.on.ca/english/publicat/walker01.pdf>.
251. Telephone communication with C. Rogal, Coordinator of Groundwater Approvals for Government of Saskatchewan.
252. Telephone interview with George Somers, Manager of the Drinking Water Management Section of the Water Management Division of the Department of Environment and Energy.
253. *Canadian Environmental Assessment Act*, 1992, c 37.
254. Telephone communication with C. Rogal, *Saskatchewan Watershed Authority Act*, SS 2002, c s-35.02, s. 52.
255. The regulations state: "Before approving an application, the Minister or an Administrator may require that the applicant provide a consultative process in the area where the activity or the proposed activity is or will be located," <http://www.gov.ns.ca/just/regulations/regs/env4895.htm>.
256. *Alberta Water Act*. R.S.A. 2000, s 109(1), c W-3.
257. TransAlta Energy Corporation 900-MW Keephills Power Plant expansion, EUB Decision 2002-014, February 2002., <http://www.eub.gov.ab.ca/BBS/decisions/utilitydecisions/2002/2002-014.htm>.
258. Regulation 681/94, "Ministry of the Environment Classification of Proposals for Instruments," lists the types of proposals that are subject to EBR and their corresponding classifications.
259. R.D. Kreuzwiser, et al., "Water Allocation and the Permit to Take Water Program in Ontario: Challenges and Opportunities, 2004, <http://pubs.nrc-cnrc.gc.ca/cwrj/cwrj29/cwrj135.pdf>.
260. Auditor General of Ontario, 2004 *Annual Report*, s 3.05, <http://www.auditor.on.ca/english/reports/en04/305en04.pdf>.

261. *Water Rights Act*, CCSM, c W80, s 6.
262. Telephone interview with Charles Lamontagne, MENV, Province of Quebec.
263. See <http://www.waterforlife.gov.ab.ca/html/council.html>; <http://www.gov.sk.ca/newsrel/releases/2003/09/18-681.html>; and s.31 NB *Clean Water Act*.
264. See Ontario www.ert.gov.on.ca/; BC, www.eab.gov.bc.ca/; Alberta, <http://www3.gov.ab.ca/eab/>; and Quebec, <http://www.justice.gouv.qc.ca/english/tribunaux/trib-adm-a.htm>.
265. Manitoba *Water Rights Act*, CCSM, s 24, c W80.
266. Sections 114-117 govern appeals. Alberta *Water Act* RSA 2000, c W-3.
267. See <http://www.albertawilderness.ca/Issues/WAT/Archive/NR041105.pdf>.
268. Yukon *Waters Act*, SY, s 26(1), c 19; Telephone conversation with T. Polyck.
269. J. Abouchar, "Water Taking: Municipal Role in Ontario." *Municipal World*, March 2004, 23.
270. *Water Resources Act* SNL, 2002, ss 86(4) and (5), c W-4.01.
271. Telephone interview with George Somers, Manager of the Drinking Water Management Section of the Water Management Division of the Department of Environment and Energy..
272. Subsection 7(3) *Water Well Regulations*, PEI Reg. EC188/90 states that the holder of a groundwater extraction permit is liable for all adverse effects to any person resulting from the withdrawal of water from the well for which the permit was issued.
273. Committee on Valuing Ground Water, *Valuing Ground Water: Economic Concepts and Approaches* (Washington, DC: National Research Council), 1997.
274. Stratos Inc., *Economic Instruments for Environmental Protection and Conservation: Lessons for Canada*, External Advisory Committee On Smart Regulation, 2003, <http://www.smartregulation.gc.ca/en/06/01/su-11.asp>.
275. "Environmental Performance Review of Canada." (Paris: OECD) 2004.
276. A. Vourc'h, "Encouraging Environmentally Sustainable Growth in Canada," (Paris: OECD), 2001. Environment Canada responded to the statistic of 56% of households being metered by noting that "in 1999 56% of households in Canada were metered."
277. See, e.g., Policy Research Initiative, "Economic Instruments for Freshwater Management in Canada," PRI Symposium, June 14-15, 2004; External Advisory Committee on Smart Regulation, *Smart Regulation - A Regulatory Strategy for Canada* (Ottawa: EACSR), 2004; Polis Project series on *Urban Water Demand Management* (Victoria: Polis Project); Canada West Foundation, *Drop by Drop: Urban Water Conservation Practices in Western Canada* (Calgary: CWF).
278. See, e.g., articles in feature issue on "The New Economy of Water," *Impact*, 4: no. 1 (2002).
279. For a description of this program, see http://www.deschutesrc.org/DWE/Groundwater%20Mitigation/groundwater_2.htm.
280. Environment Canada, *Municipal Water Pricing 1991-1999* report.
281. See http://www.ec.gc.ca/soer-ree/English/Indicator_series/new_issues.cfm?issue_id=6&tech_id=25#bio_pic.
282. CCME Water Use Efficiency Task Group, "National Action Plan to Encourage Municipal Water Use Efficiency," 1994, http://www.ec.gc.ca/water/en/info/pubs/action/e_action.htm.
283. S. Renzetti and D. Dupont, "An Assessment of the Impact of Charging for Provincial Water Use Permits," *Canadian Public Policy*, XXV (1999), 361.
284. *Sustainable Water and Sewage Systems Act*, 2002, SO 2002, c 29.

285. Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy, at http://europa.eu.int/comm/environment/water/water-framework/index_en.html.
286. Committee on Valuing Ground Water, *Valuing Ground Water: Economic Concepts and Approaches*. (Washington, DC: National Research Council), 1997.
287. M. Troyak, "An Assessment of the Ecological and Economic Value of Groundwater 1996: Town of Caledon Case Study, 1996. Adapted in "Groundwater: Our Hidden Treasure," http://www.on.ec.gc.ca/community/groundwater-caledon/page8_e.html.
288. S. Kulshreshtha, "Economic Value of Groundwater in the Assiniboine Delta Aquifer in Manitoba." Social Science Series No. 29, Environmental Conservation Service. (Ottawa: Environment Canada), 1994.
289. See <http://www.ene.gov.on.ca/envision/news/2004/122301.htm>.
290. See [http://www.cbwa-bottledwater.org/en/CBWA%20Complete%20Official%20Response%20\(Final\).pdf](http://www.cbwa-bottledwater.org/en/CBWA%20Complete%20Official%20Response%20(Final).pdf).
290. See [http://www.cbwa-bottledwater.org/en/CBWA%20Official%20Response%20\(Final\).pdf](http://www.cbwa-bottledwater.org/en/CBWA%20Official%20Response%20(Final).pdf)
291. Manitoba Water Use and Allocation Task Force, *Water Use and Allocation Summary and Conclusions 1999 Public Consultation* (Winnipeg: Government of Manitoba), http://www.gov.mb.ca/waterstewardship/water-strategy/pdf/water_use_allocation.pdf.
292. G. Pinfold et., *Monitoring the Value of Natural Capital: Water*, prepared for Environment Canada and Statistics Canada, 2002.
293. Numerous court cases in the US have used valuation techniques to account for ecosystem, and a recent Supreme Court of Canada decision validated and encouraged their use in Canada. *British Columbia v. Canadian Forest Products Ltd.*, [2004] 2 SCR 74, 2004 SCC 38.
294. *Water Act*, CCSM, s 2, c W80.
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Canadian Water Resources Association - CWRA. The CWRA is a national organization of individuals and organizations interested in the management of Canada's water resources: <http://www.cwra.org/>

Canadian Water and Wastewater Association. CWWA is the national body representing the common interests of Canada's public sector municipal water and wastewater services and their private sector suppliers and partners: <http://www.cwwa.ca/>

Environment Canada: http://www.ec.gc.ca/water/e_main.html

Environment Canada Freshwater: Facts and figures on groundwater and water: http://www.ec.gc.ca/water/en/nature/grdwtr/e_gdwtr.htm, and http://www.ec.gc.ca/water/en/manage/use/e_use.htm.

Health Canada: <http://www.hc-sc.gc.ca/waterquality>

National Water Research Institute - NWRI (Canada) The National Water Research Institute (NWRI) is Canada's largest freshwater research establishment. NWRI conducts a comprehensive program of research and development in the aquatic sciences, in partnership with the Canadian and international science communities: <http://www.nwri.ca/>

British Columbia: <http://www.gov.bc.ca/wlap/>

Alberta: <http://www3.gov.ab.ca/env/water/index.cfm>, <http://www.waterforlife.gov.ab.ca/>

Saskatchewan: <http://www.se.gov.sk.ca/environment/protection/water/water.asp>, and <http://www.swa.ca>

Manitoba: <http://www.gov.ns.ca/enla/water/>

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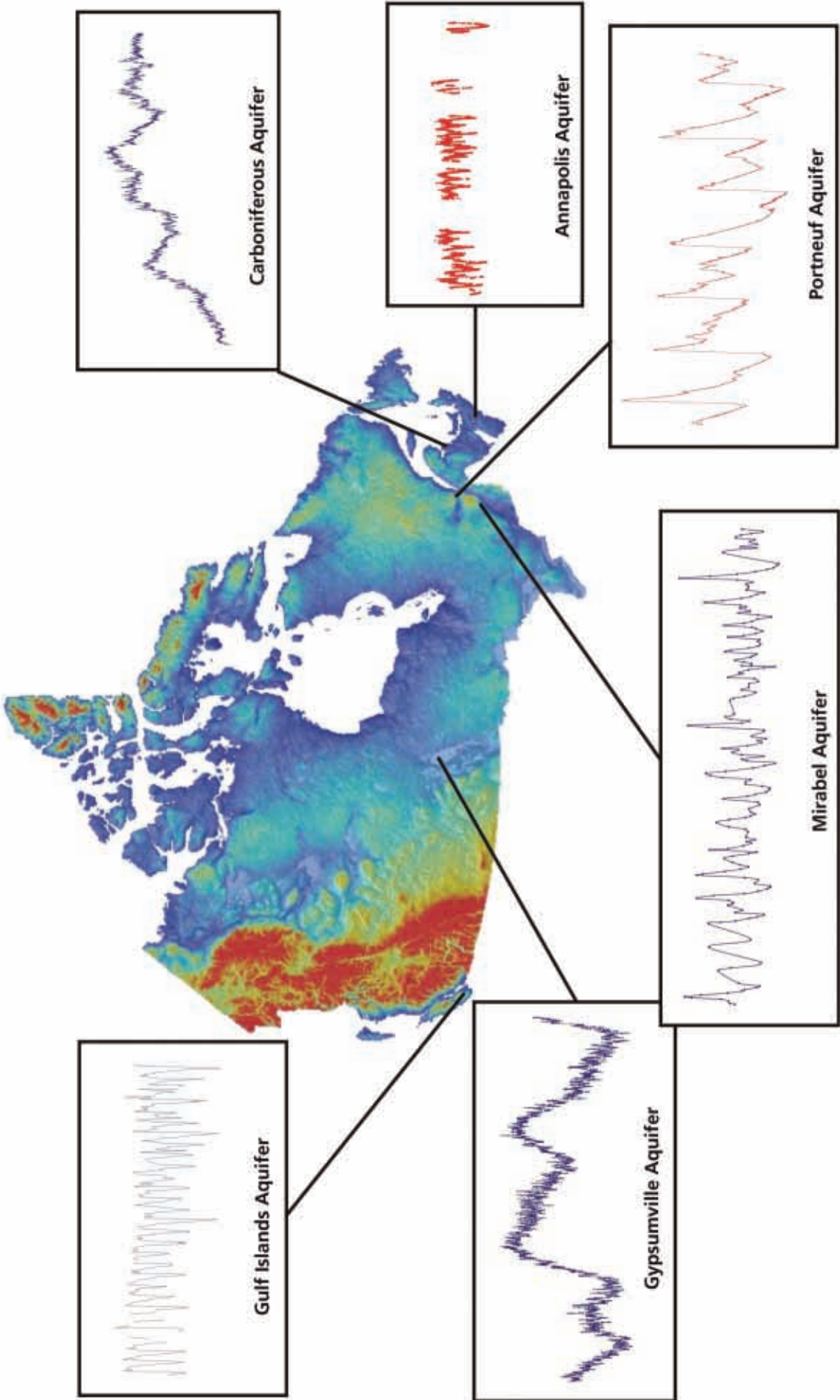
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GROUNDWATER LEVELS OF SOME REGIONAL AQUIFERS





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