Water Security: A Primer

2010

POLICY REPORT

WATER SECURITY: A Primer

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EXECUTIVE SUMMARY

Is Canada's water secure? According to Environment Canada, one quarter of all Canadian communities experienced water shortages during the latter half of the 1990s. Water quality in over a thousand small and rural communities is as bad as or worse than that in many developing countries. Likewise, at the time of writing, more than 100 First Nations communities live with permanent boil water advisories (Phare 2009). Across the country the effects of decades of under-investment in water treatment networks are now apparent: over the next two decades, Canada's aging water networks will have to be replaced at the cost of an estimated $100 billion (Bakker 2009; Environment Canada 2004).

Five years ago a report by the Senate Standing Committee on Energy, Environment, and Natural Resources termed the management of Canada's water "shocking" and "unacceptable" (Senate of Canada 2005). Other recent reports—notably from the Auditor General's Office, the National Water Resources Institute, and the FLOW Canada network of independent water experts—have suggested that Canada's water supply is not safe (Carter 2008; Environment Canada 2001, 2004; FLOW 2009; OAG 2009). These reports state that Canadians are not adequately protected from water shortages, floods, and other water-related hazards, and warn that our legislative and governance frameworks are not sufficiently robust to manage either domestic or international water issues effectively.

FOCUS OF THE PRIMER: THE WATER SECURITY CHALLENGE

One way of understanding the multiple threats to Canada's freshwater is through the concept of water security, an idea that offers a new way of thinking about water. The purpose of this Primer is to explain the concept of water security, and illustrate how it can be put to use in Canada.

What is Water Security?

Water security may be defined as "*sustainable access, on a watershed basis, to adequate quantities of water of acceptable quality, to ensure human and ecosystem health.***"**

Since threats to water are so disparate, a holistic approach that accounts for multiple stressors to the water supply is essential. In this Primer, we make the case that attention to maintaining water security, broadly defined, is one such approach that shows promise. To achieve water security requires good water governance.

What is Water Governance?

Water governance, simply defined, is the decision-making process through which water is managed. The term covers the entire range of political, organisational, and administrative processes involved in managing water supply. This includes the time when communities articulate their interests, and that input is absorbed, to the time when decisions are made and implemented. One indicator of good governance is that decision-makers are held accountable for the development and management of water resources and the delivery of water services (Bakker 2002; Bakker and Cameron 2002).

The Link between Water Security and Water Governance

The past two decades have brought radical changes to systems of water governance. These changes have come about as the result of increased concern about water security in Canada, as well as in other parts of the world. Well-publicised water contamination incidents in Kashechewan (Ontario), Walkerton (Ontario), and North Battleford (Saskatchewan) have alerted Canadians to public health issues related to water quality. Similarly, growing concerns for water scarcity and the cumulative impacts of global climate change are having an impact on water policy and management practices. Federal, provincial, and municipal governments together with First Nations communities and non-governmental organizations have started to develop new governance frameworks to address these issues, implementing new water-related legislation, regulatory frameworks, and water assessment tools.

In this Primer, we group this range of approaches under the umbrella term "water security". This is an emerging concept, and there are multiple

– often competing – definitions in use. We argue that water security must be broadly defined in order for water management to be effective and, moreover, that water security must be situated within a model that promotes good governance. This will require an integrative and holistic approach to water security. It also requires the participation of, and buy-in from, policy-makers, water managers, and community members.

Current Approaches to Monitoring Water Security

The development of environmental monitoring and reporting tools[1] has become increasingly common since the coining of the phrase "sustainable development" in 1987 (WCED 1987). Many tools for monitoring and reporting the state of water security – such as indices, indicators, report cards, hazard (or risk/vulnerability) frameworks, and checklists – have been developed in Canada, at federal, provincial, and local levels (Dunn and Bakker 2009).

These water security assessment tools provide guideposts for communities interested in monitoring trends and both developing and applying water security standards. For example, these tools help to establish baseline requirements for water resources management and ensure adequate quantities of acceptable quality water for both humans and local ecosystems, all of which affect and are affected by not only water management, but also ecosystem and public health parameters. In Canada, there has been a marked increase in the development of these tools, but without the parallel development of a coordinated approach to their use by governments, managers, and end-users. Accordingly, this Primer will present some highlights of the current landscape of indicators in Canada.

Fostering Water Security

Drawing on a large-scale survey and interviews with end-users, this Primer presents an inventory of key water security assessment tools relevant to Canadian water managers and users — including community groups, non-governmental organizations, and water managers. The goal of providing this information is to offer new tools for governing Canada's water supply over the coming decades.

1 We use the word "tool" as an umbrella term that encompasses indicators, indices, performance measures, report cards, and sustainability checklists.

Structure and Objectives of the Primer

The key objectives of the Primer are to:

- ✓ Present a working a definition of water security;
- ✓ Present illustrative case studies of new approaches which may help to improve water security in Canada;
- ✓ Discuss how governance tools could be used to improve water security;
- ✓ Evaluate water security assessment tools that may assist with the monitoring of water security;
- ✓ Situate water security within a wider governance model.

This primer is divided into three chapters:

Chapter 1 explains the evolving concept of water security, outlines competing definitions, and suggests a comprehensive working definition.

Chapter 2 explores water security in action. It presents an inventory of indicators designed to measure water security and defines good governance practices aimed at achieving water security.

Accordingly, **Chapter 3** concludes by making recommendations for future action, as improved water security is only possible when partnered with strong governance of water systems.

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Chapter 1 The Evolving Concept of Water Security

The objectives of this chapter are to:

- ✓ Explain the threats to Canada's water, and the associated management challenges (section 1.1)
- ✓ Explain debates over the concept of water security (1.2)
- ✓ Provide an overview of emerging approaches to water security in Canada (1.3 and 1.4)
- ✓ Provide a working definition of water security (1.5)

1.1 THE WATER SECURITY CHALLENGE

Over the past decade the issue of water security has become a source of growing concern in Canada. Well-publicised water contamination incidents in Kashechewan (Ontario), Walkerton (Ontario), and North Battleford (Saskatchewan) were among the first to alert Canadians to public health issues related to water quality. Federal reports on increased threats to water issued by the National Water Resources Institute (NWRI) and the Senate also attracted considerable attention to the issue.

Rural and remote communities, including First Nations and Inuit, are at ground zero for many of the water security-related issues in Canada - hundreds of these communities have ongoing boil water advisories. Exacerbating these issues are limited infrastructure and the vulnerabilities associated with the leaching of contaminants to groundwater. As a result, First Nations communities throughout Canada have, on the whole, significantly less access to potable water and direct piping to treatment plants (Phare 2009). The impact of this deficit is illustrated by the high

rate of shigellosis in First Nations communities, a rate that is twenty times higher in these communities than in non-First Nations communities in Canada (PRI 2007).

But even First Nations and rural communities with water purification systems in place tend to be at higher risk for contamination. The health crisis of Ontario's Kaschechaewan reserve underscores this point. This high-profile crisis led the Government of Canada to commit $600 million towards a new water quality initiative aimed to "close the gap in life chances between Aboriginal and non-Aboriginal Canadians and build healthy communities" (Environment Canada 2008). Despite the new initiative, ninety-seven reserve communities in Canada were listed as having high-risk water systems in 2008. A recent Health Canada report found that more than one-third[2] of those living on reserves believe their water unfit to drink (Butler 2008). Despite large financial investments in the water systems, only forty-one percent of the respondents reported an improvement in their water quality. Strikingly, one in four respondents believed the water had worsened.[3]

Water-related health concerns are pervasive in communities throughout Canada, however. Urban centres and agricultural communities also experience water-related health issues. Leaching of surface contaminants into groundwater are a concern for many of our agricultural communities who rely on wells as their primary source of drinking water. Even urban centres have experienced boil water advisories in recent years. In 2006, one million people in the Greater Vancouver Region experienced a twelve-day boil water advisory following a major rain storm (CBC 2006).

Aquatic ecosystems systems are also under tremendous strain throughout Canada. A recent report by World Wildlife Fund – Canada (2009) identifies three main areas of threat for Canada's freshwater: flow regulation and fragmentation by dams, locks, and weirs have altered flows and water levels that negatively impact species; water withdrawals and diversions for cities and agriculture are drawing down rivers and aquifers at alarming rates; and climate change, which is altering the flow of water that must be managed as glaciers melt, precipitation patterns shift, and droughts and floods become more frequent and intense (WWF-Canada 2009).

2. Thirty six percent out of 1,502 First Nations residents surveyed.

3. The remainder reported no change.

In addition, continued commercial and residential development is leading to the reduction of permeable surfaces, which, in turn, is limiting the natural recharge of groundwater. This slowing of recharge is a concern because many aquifers are already considered a non-renewable resource (CCA 2009). The conversion of forest land to a built environment compromises the quality of water as sedimentation increases. It is also important to note that non-point and point source pollution impacts the quality of water as well, as industrial and agriculture waste leach into aquatic systems.

Canada is not unique in dealing with water quality and water quantity concerns. Water has played centre stage in some of human histories greatest tragedies. Even in this time of unprecedented economic wealth, 1.2 billion people worldwide go without access to safe water and 2.6 billion without access to sanitation. Every year, approximately 2 million children die due to lack of access to clean water and sanitation and millions of young girls and women spend large portion of their days collecting clean water to support their household (UNDP 2006). In turn, the demand for reliable sources of freshwater and flood control has encouraged engineering practices that compromise the sustainability of freshwater systems throughout the world (UN 2003, 2006, 2009). This trend is not predicted to slow any time soon, with global freshwater use being seen to expand at a rate of 10% from 2000 to 2010 (Vörösmarty, Lévêque, and Revenga 2005).

Complicating these matters is the fact that water is a flow resource that is difficult to manage at fixed jurisdictional scales. Specifically, water presents managers with three main issues which are difficult to resolve:

- competition between users of water resources;
- coordination between the multiple scales at which water is used and managed;
- and a mismatch between geopolitical and administrative boundaries, on the one hand, and hydrological boundaries on the other.

These issues flow, in part, from the fact that water is a multi-purpose resource, which implies that multiple sets of users operate at different scales and with different interests.

Resolution of these issues must take into account these competing users and thus the diverse views of stakeholders within the policy debate. This

is easily observed in an urban context. Cities are located within watersheds, and the water within cities is often the subject of competing claims both upstream and downstream: industrial, tourism, amenity, residential, agricultural, and resource (e.g. hunting and fishing) uses. The competing views of water underlying these debates are not easily reconcilable at the local scale. One view, often expressed by industry, is that water is a resource to be exploited, processed, traded, and dealt with much as any other commercial asset. Another view, often expressed through public interest groups, is that water is an inherently shared "social asset" vital to ecological and human health. The relative degree of power and legitimacy of these groups within the policy-making process is the subject of contestation. In such situations, disagreements tend to arise over issues such as who gets to participate in decision-making, the types of information that decision-makers employ (or discount), and how to assure accountability for decision-making.

As a result, Canada (like many other countries) has experienced conflicts over water use and water allocation. These conflicts are most likely to occur at the local or regional level, and are usually disputes related to development and water allocation; however, for disputes over transboundary water, cooperation is at least as prevalent as conflict (Wolf 1999; Wolf et al. 2003). Current water management approaches are rarely adequate to deal with the cumulative social and ecological impacts of these trends and this situation is intensifying. Inadequate assessment and insufficient mitigation exacerbate these issues.

What are the most important threats? Pressing environmental issues such as climate change raise the stakes for the creation – and buy-in – of a comprehensive approach to achieving water security (UN 2009). Climate change will likely foster significant changes to the availability of water resources throughout Canada. In particular, elevated temperatures which are predicted with climate change will alter runoff and groundwater recharge, and contribute to seasonal and long term changes in both water quality and quantity. An increase in demand for water resources across agriculture, energy, and municipal sectors will likely accentuate water supply problems and contribute to an increase in water-stressed[4] areas across Canada (Lemmen et al. 2008).

4. Water stress occurs when the demand for water exceeds the available amount during a certain period or when poor quality restricts its use. "Water stress" is a term also used to describe a quantifiable threshold of water available per person (Falkenmark 2004).

The impact will likely be greatest in regions that are already experiencing water stress. For example, drier climates such as the Okanagan region of British Columbia may not be able to meet future demands based on the current water supply capacity (Cohen and Kulkarni 2001). In addition, poverty-struck communities with access to fewer resources, including rural, remote and First Nations communities, are also highly vulnerable to growing water security concerns. Northern communities, such as the Inuit, are also facing vast challenges to cultural and economic ways of living by the impacts of global warming and changing patterns of water flow and increased threats due to flooding (Phare 2009; WWF-Canada 2009).

In addition to the potential severity of climate change impacts, numerous other trends threaten Canada's waters, and put a ready supply for human uses into question, including for example:

- growing urbanization and increasing challenges of allocation;
- natural hazards such as flooding due to increased urbanization;
- threats to water quality, from a range of sources: invasive species imports through ballasts and migration, or the set of emerging contaminants — the chemical cocktail of compounds found in everything from sunscreen to prescription medications — whose effects and interactions within the water cycle are only now being identified and qualified by scientists;
- industrial demands and impacts (e.g. three to four barrels of water are used to produce every barrel of oil in the Alberta tar sands);
- effects on ecosystems arising from construction and removal of dams. [5]

Despite the prevalence of these issues, and of regional water disputes, public concern in Canada is frequently preoccupied with the perceived risk of large-scale water transfers to the United States. The persistent calls for tighter controls on large scale water transfers between Canada and the United States is further evidence of public *insecurity* over water in the future. We suggest that water security efforts need to include focus on domestic issues, at the regional scale (most likely at the watershed scale) to stave off the most pervasive and widespread water security threats.

5. See: Environment Canada (2004)

Water cuts across many fields of human endeavour and plays a critical role in ecosystems. Since the threats are so diverse, a water management approach that accounts for these multiple stressors in an integrated way is essential. Below, we make the case that water security, broadly defined, is one such approach that shows promise to improve the directions of water governance activities in the future.

1.2 HOW WATER SECURITY IS DEFINED: EVOLUTION OF WATER SECURITY DEFINITIONS

The definition of water security has evolved over the past fifteen years. Some definitions are quite comprehensive, while others focus on the one or two elements of water security that are relevant to a particular discipline(s).

Examples of non-comprehensive definitions with a single-discipline focus include:

- clean and available drinking water (engineering/municipal infrastructure);
- reliable basic water services (development);
- counter-terrorism measures to ensure the security of drinking water infrastructure (U.S. water engineering and Department of Homeland Security);
- environmental security to reduce conflict and national security concerns (political science)

The definition of water security is evolving through on-going dialogue about these issues, primarily in international development arenas and academic disciplines (Table 1.1). According to the 2008-2009 Water Security Survey results, the term water security has become more common in Canada at the local and regional level over the last few years (Norman, Bakker, and Dunn Under Review; 2010).

The first comprehensive definition of water security was introduced during the Second World Water Forum in 2000. At the forum, the Global Water Partnership reported that:

> [W]ater security at any level from the household to the global means that every person has access to enough safe water at affordable cost to lead a clean, healthy and productive life, while ensuring that the natural environment is protected and enhanced (Global Water Partnership 2000).

TABLE 1.1: DEFINITIONS OF "WATER SECURITY": COMPARING CRITERIA

	Global Water Partnership (2000)[6]	Changing the Flow (2007)[7]	Canadian Water Sustainability Index[8] (2007)	Water Allocation & Water Security[9] (2007)
Water Resources	Water Resources – sharing	Enhancing Capacity for Freshwater Protection & Responding to Climate Change	Availability, Supply, Demand	Economic Production Climate Variability and Change
Ecosystem Health	Ecosystem Protection	Protecting Aquatic Ecosystems	Stress, Quality, Fish	Ecosystem Protection
Human Health	Meeting Basic Needs Securing Food Supply	Securing Safe Drinking Water	Access, Reliability, Impact	
Infrastructure	Managing Risk Valuing Water	Water Conservation	Demand, Condition, Treatment	Water Conservation
Governance	Governing Water Wisely	Protecting Aboriginal Rights Preventing Interjurisdic-tional Conflicts and Bulk Water Exports Quality Science Program Design	Capacity: Financial, Education, Training	Equity & Participation Transboundary Sensitivity

In the past several years, increasingly holistic understandings, if not explicit definitions, have emerged from disciplines such as economics (Savenjie and Van Der Zaag 2008), hydrology (Falkenmark 2001, 2004), and engineering (Grey and Sadoff 2007; Swaminathan 2001).

6. Global Water Partnership: Toward Water Security (2000)
7. Changing the Flow, Gordon Water Group (Morris et al. 2007)
8. Canadian Water Sustainability Index (PRI 2007)
9. Water Allocation and Water Security in Canada: Initiating a Policy Dialogue for the 21st Century. (de Loë et al. 2007)

Most definitions refer to integration of water quality and quantity, and link water's role in the natural environment with water essential for human needs. For example, the Guelph Water Management Group defines water security as:

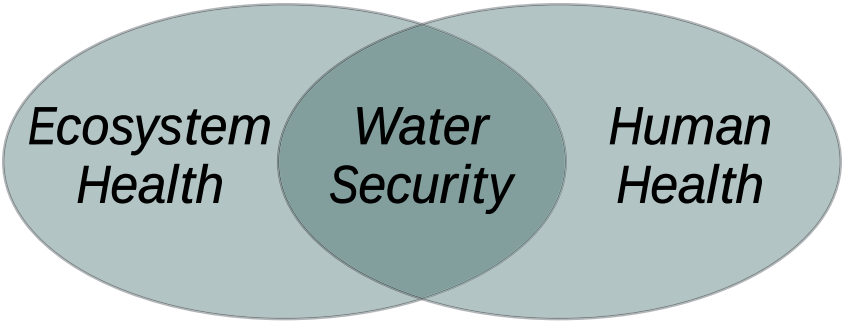
> A multi-dimensional concept that recognizes that sufficient good quality water is needed for social, economic and cultural uses while, at the same time, adequate water is required to sustain and enhance important ecosystem functions (de Loë et al. 2007).

Another defining feature of water security is to be found in the discussion of the scale of governance and management. Some definitions imply water security should be conceived at a national scale; while others suggest that the regional, or watershed scale, is better suited to governing water resources (Parkes et al. 2008). In the second Walkerton Report, Justice O'Connor reinforced the latter approach – clearly underscoring the point that governing water resources at the watershed scale helps to promote best practices (O'Connor 2002).

Another feature found in several of the definitions is an emphasis on sustainability or sustainable development, which aims to balance environmental, economic, social, cultural, health and political needs. For example, the Council of Canadian Academies criteria for evaluating sustainable groundwater management includes: protection of ecosystem health; protection of groundwater supplies from depletion; application of good governance; achievement of social and economic well-being; protection of groundwater quality from contamination (CCA 2009). Our approach to water security builds on these previous definitions, broadly defined through five dimensions: **Water Resources, Ecosystem Health, Human Health, Infrastructure, and Governance**; recognizing that there is overlap or perhaps redundancy between these five dimensions.

One helpful way to categorise these water security criteria is the interface between ecological health and human health. (See Figure 1).

FIGURE 1: WATER SECURITY: ECOLOGICAL HEALTH AND HUMAN HEALTH



1.3 ELEMENTS OF A WATER SECURITY PARADIGM IN CANADA

Over the past decade, water governance and management have undergone intense debate and rapid change at the provincial level. Provincial governments have revised legislation and introduced innovations in water management. Leading not-for-profit organizations, environmental groups, and unions have launched high-profile water campaigns. These developments suggest an emerging water security culture in Canada. Some of the defining characteristics of the emerging water security paradigm in Canada include:

- The prioritization of good governance;
- The prioritization of source water protection (and planning) over land use needs (such as development);[10]
- The integration of groundwater and surface water management through the creation of wellhead capture zones and protection of water supplies from contamination;
- Water conservation: for example, reducing water consumption before developing new sources of supply;
- Holistic water quality regulation (i.e. total maximum daily loads);
- Recognition and protection of the ecological services associated with water through environmental flow identification and protection, biomonitoring, and climate change adaptation strategies; and
- Protection of all values of water.

10. For more information on the social benefits of prioritizing water source protection as a first line of defense for managing drinking water see Patrick (2008), Barten and Ernst (2004) and Gullick (2003).

1.3.1 Water Security versus Secure Water

Governments in Canada rarely use the term "water security". More frequently, governments employ the term "secure water", often in relation to security of supply of desired quantities of water. For example, Environment Canada's 2007-2009 Sustainable Development goals include "clean and secure water for people, marine and freshwater ecosystems" (Environment Canada 2007). The Canadian Council of Environment Ministers is launching an initiative on water security. Several provinces use this language as well.

In British Columbia, the Ministry of Environment uses the term "security" in its Living Water Smart plan. The overall goal of the plan is to "secure stream health" and provide farmers secure access to water (British Columbia MOE 2008). The term has a broader meaning in Alberta's renewed Water for Life strategy. Their strategy is based on three outcomes: safe, secure drinking water supply; healthy aquatic ecosystems; and reliable, quality water supplies for a sustainable economy (Alberta MOE 2008). The water stewardship program in Manitoba treats security as one of its primary goals: "Manitobans are adequately protected from floods, water shortages, droughts and other water-related hazards" (Manitoba 2009).

Box 1: Water Sustainability versus Water Security

Although frequently found in both policy and academic literature, water sustainability is rarely explicitly defined. Water sustainability (the term sustainability derives from the 1987 Brundtland Commission Report) requires the balancing of economic, ecological, and social components in developing a community's water resources (WCED 1987). Sustainability is a malleable term and water sustainability does not identify any baseline outcomes for water resources management.

A comprehensive definition of water security emphasises governance while requiring "sustainable access, on a watershed basis, to adequate quantities of water of acceptable quality, to ensure human and ecosystem health." This definition sets baseline requirements for water resources management in a watershed on a continual basis – there must be access to adequate quantities of acceptable quality of water for both humans and environment.

Box 2: Water Security – Growing International Interest

The concept of water security is becoming increasingly common in international environmental circles. The Ministerial Declaration from the Second World Water Forum in The Hague in 2000 - "Water Security in the 21st Century" - helped to launch this concept into the public arena (World Water Forum 2000).

Recent examples of the growing interest in Water Security include the European Union's 2007 Water Security meeting, the Water Security work program sponsored by UNESCO, and the dialogue on water security recently sponsored in the United States by the Woodrow Wilson Center. The World Economic Forum (WEF) has also recently taken to the concept of water security, describing it as: "the gossamer that links together the web of food, energy, climate, economic growth and human security challenges that the world economy faces over the next two decades (WEF 2009a)."

Furthermore, at the WEF annual meeting, the WEF Water Initiative reported,

> [W]orsening water security will soon tear into various parts of the global economic system. It will start to emerge as a headline geopolitical issue. The volatility in food prices in 2008 should be treated as an early warning sign of what is to come (2009a).

In developing countries, a strong link exists between water security, poverty eradication and sustainable development goals. For example, international water commitments such as Millennium Development Goal No. 7, Target 10, commits nations to "halve, by 2015, the proportion of people without sustainable access to safe drinking water". The World Bank uses the term to encourage developing countries to combine investment in water infrastructure with governance and management reforms, with the ultimate aim of achieving economic growth (Grey and Sadoff 2007).

In Saskatchewan, "secure" water generally refers to ensuring adequate supplies for residents and farmers. The *Saskatchewan Water Conservation Plan* describes "a safe and secure water supply for the long-term health and prosperity of Saskatchewan and its citizens". The Farm and Ranch Water Infrastructure Program aims "to help lessen the impact of drought by providing a secure water source for Saskatchewan farmers and ranchers" (Saskatchewan 2009). Similarly, the Saskatchewan Business Journal pronounces, "a severe drought has renewed concerns about the security of our water resources, not only for domestic and municipal consumption, but also for irrigation and industrial use" (Matthuis 2002). At the municipal level, the City of Regina's water utility goals are "security of delivery, acceptable quality, adequate supply, and affordable cost".

Box 3: World Economic Forum Releases "startling" findings on International Water Security

In January 2009, the World Economic Forum published a comprehensive water initiative report. Some of the startling findings of the report include:

Agriculture: By 2025, water scarcity could affect annual global crop yield to the equivalent of losing the entire grain crops of India and the US combined (30% of global cereal consumption). Yet, food demand is expected to grow 70-90% by 2050.

Energy: Energy production accounts for about 39% of all water withdrawals in the US and 31% of water withdrawals in the EU. While only 3% is actually consumed, the competition for access to water between energy and other sectors will intensify over the next two decades. Water requirements for energy production are expected to grow by as much as 165% in the US and 130% in the EU. This means water for agriculture will be squeezed at the same time as the demand for agricultural production sharply increases.

Environment: Glaciers act as huge water banks. The glaciers of the Himalayas and Tibet alone feed seven of the world's greatest rivers, providing water to more than 2 billion people. These glacial banks are disappearing at an accelerating rate. Most analyses suggest the majority of them will disappear by 2100 under current trends. Further, 70 major rivers around the world are close to being totally drained in order to supply water for irrigation systems and reservoirs. Extensive environmental damage is occurring as a result.

Finance and economics: Within two decades, water will become a mainstream theme for investors; for many, water is already a better "pick" than oil.

(WEF 2009b)

By way of comparison, water security in U.S. policy usually refers to prevention of terrorist threats to water and water infrastructure. This usage most certainly reflects the post 9/11 preoccupation with terrorism. As underscored in the 2002 U.S. National Security Strategy for Homeland Security, the Bush administration noted, "There is a strong consensus that protecting the people from terrorist attacks...is among the highest, if not the highest, priority any government can have." The post-9/11 focus on domestic security translates directly to water security (Grosskruger 2006). One report from Arkansas State Health Department stresses this focus: "A water system is an attractive target to a terrorist....The potential for causing panic among the public is great due to the essential nature of safe drinking

water and the public's trust in their drinking water systems" (Stone 2004). The U.S. Environmental Protection Agency continues to link water security with counter-terrorism. For example, the "vulnerability assessment tools" showcased on their website are designed for water utilities to "assess their vulnerabilities to adversarial actions" (US EPA 2009).

However, the recent shift in attention (and political discourse) to economic security, coupled with a new presidential administration, may contribute to a change in meaning for water security in the U.S. The new meaning may likely reflect a more basic protection of water resources and supply.

Box 4: Departmental Goals of Manitoba Water Stewardship

Human Health
Manitobans have safe drinking water and are protected from water- and fish-related health threats

Ecosystem Health
Aquatic life support systems are protected and improved

Quality of Life
Sustainable and productive use of water and fishery resources benefits all Manitobans

Security
Manitobans are adequately protected from floods, water shortages, droughts and other water-related hazards

1.4 TRANSBOUNDARY WATER SECURITY

The term "water security" also has a transboundary dimension. In Canada, water security can mean ensuring that residents have a guaranteed priority of use over potential U.S. claimants. The shared water resources of Canada and the U.S. pose particular challenges for water security. The 1909 Boundary Waters Treaty (BWT), one of Canada's longest-standing treaties, was developed to address these binational concerns. The governing body created under the BWT, the International Joint Commission, continues to address issues surrounding co-management and equitable distribution of shared water resources (among other issues).

Transboundary protection is also important intra-provincially. For example, Alberta Environment "Sharing Water" (across Alberta's borders) helps to guide management decisions regarding the storage and use of water within the province. This indicator measures the surplus water volume that exists between the amount of water that downstream users are allocated, and what is actually delivered to those users. It represents the upper limit of the water that Alberta has available to meet future demands. For those rivers that originate outside of Alberta, the surplus water volume that exists between what Alberta is entitled to, and what is delivered, represents an amount of water that Alberta could potentially go without.

In some cases, non-governmental organizations (NGOs) and research institutes use the term "water security" as a synonym for Canadian water self-sufficiency; control of bulk water exports to the U.S.; and restrictions on water-intensive energy developments designed primarily for U.S. markets. For example, the Polaris Institute notes that "[I]t's high time that Canada developed a clear policy and strategy on bulk water exports as part of a comprehensive water security program" (Clarke 2008).

1.5 SUMMARY: WHAT IS WATER SECURITY?

To date, there is no single, generally agreed upon definition of water security. Rather, multiple and often competing definitions exist. To complicate matters, each of these definitions employs a somewhat different set of criteria to account for the multiple dimensions of water (see Table 1.1).

In this Primer, we advocate identifying a comprehensive and broad definition of water security:

Water security may be defined as: "sustainable access, on a watershed basis, to adequate quantities of water, of acceptable quality, to ensure human and ecosystem health."

From this perspective, "water security" is a broad, holistic concept of water management that prioritizes the goal of protecting ecosystem and human health. Our definition suggests that the stressors of water (in)security stem from a combination of the built environment, the biophysical environment and human governance. Achieving water security thus requires an assessment of communities' stressors, and a subsequent plan to reduce those stressors.

Applying water security at a watershed scale, we believe, serves two main purposes: it allows communities to take ownership over water governance issues at a more localized scale and it provides room for a more geographically nuanced approach to governance that takes into consideration localized geographic and climatological patterns. Our conceptualization of a watershed scale is not limited to just surface water, however. Given the increasing number of Canadians relying on groundwater for daily use – recently estimated to be 10 million people – it is important to clearly include groundwater in the scope of water security (CCA 2009).

Why is this sort of definition useful? One reason is that setting a goal of water security may make it easier for decision-makers to effectively assess and mediate between conflicting demands for water use and minimize potentially adverse impacts from land and water management practices. For example, the definition above sets baseline requirements for water resources management in a watershed on a continuous basis – there must be access to adequate quantities of acceptable quality of water for both humans and environment—and in doing so draws a line that is not to be crossed. The definition also calls for a higher degree of integration of land and water use planning. Finally, it suggests that attempts to attain water security require monitoring, assessment and prediction over scales (time and space) that rarely coordinate with political scales (Dubé 2003). That is, part of attaining water security is a governance process, which seeks to align political cycles and ecological cycles.

How do water managers and end-users across Canada perceive the concept of water security? To find out, we conducted a large scale survey across Canada in 2008, followed up with interviews in 2009 and a well-attended water security workshop in Vancouver, British Columbia at which attendees discussed the possibilities of the concept of water security.

During each of these phases, people representing multiple sectors of water governance (policy makers, water managers, public and private employees) reflected on the potential application of applying a "water security" model in Canada. Overall, the water managers and end-users resoundingly agreed that "water security" was a term that could help move people and policies to action. (The information gathered from this research is available at www.watersecurity.ca). We now turn to some examples of emerging approaches to water security in Canada to help readers understand the concept of water security more fully.

Box 5: Highlighting Best Practices: Yukon Intertribal Watershed Council

The Yukon River Inter-Tribal Watershed Council (YRITWC or the Council) is a collective initiative of 70 First Nations and tribes across Alaska and the Yukon Territory that aims to improve the health and well-being of the watershed and the people who live within it. The Council's vision, simply put, is "to be able to drink water directly from the Yukon River" (YRITWC 2009).

The multijurisdictional (and transboundary) nature of the watershed had, in years past, complicated the governance of the watershed. While agencies at the federal, state, and / or territorial level had some regulatory responsibility for the watershed, no single group existed to manage the watershed in its entirety. Recognizing that need, the Council was established in 1997 as a treaty-based organization of indigenous governments dedicated to preserve and protect the environmental quality of the Yukon River for the health of their communities, and the continuation of a traditional Native way of life for generations to come.

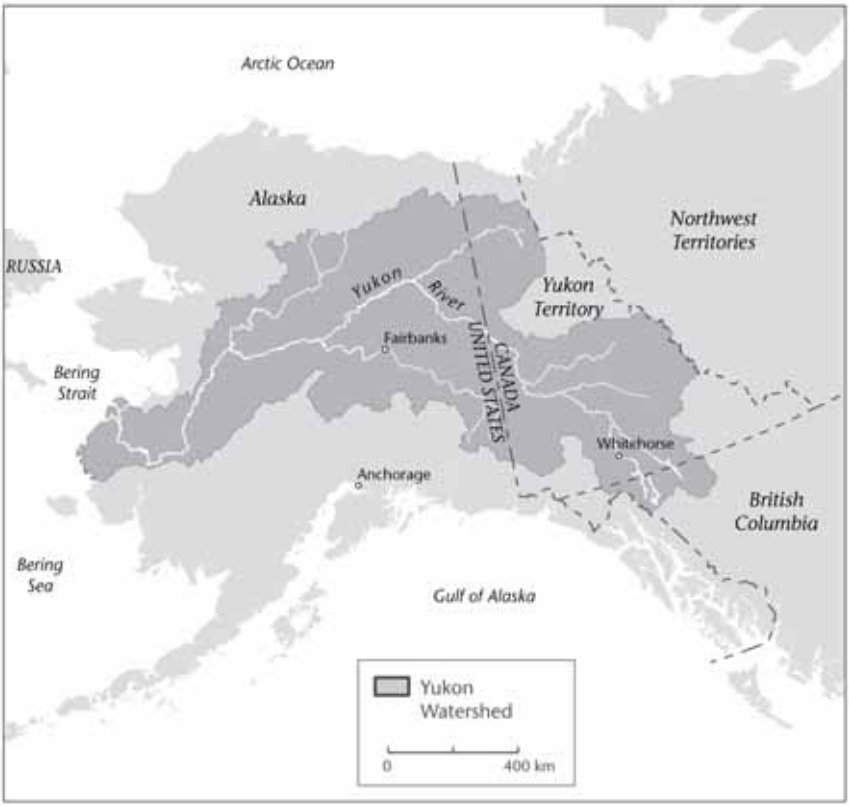
The YRITWC is an innovative and highly collaborative organization. It is the first dedicated solely to promoting the responsible management, use, protection, and enhancement of the watershed. The council achieves these goals through a variety of methods, including education programs, water quality monitoring, stewardship and land management practices. In addition, the Council serves as a vehicle to involve the First Nations and tribal communities in direct decision-making related to the governance of the watershed and to provide a forum in which to express the needs of the member villages, tribes, and nations collectively (YRITWC 2009).

In 2005, Harvard University recognized the innovations of the Council as an award-winning program. The Council was described as a model of self-determination, governance, and collaboration, with high achievements in three main areas: the initiation of the YRITWC; the development of a complex and high quality operational system; and the impact and reach of the Council on the health of Native peoples along the Yukon River and beyond (Harvard University 2005).

The Council continues to develop new programs with a focus of five main tenets: understanding, education, stewardship, enforcement, and organization.

- Understanding the Watershed through monitoring, measuring and researching, and using this knowledge to clean, enhance and preserve life along the River.
- Education: Promoting environmental and traditional education for the Indigenous Peoples of the Watershed through education programs, scholarships, internships, volunteer opportunities and incentive programs.
- Stewardship: Honoring the traditional heritage through good stewards of the Watershed and its tributaries, and to restore and preserve its health for the benefit of future generations.
- Enforcement: Developing and enforcing strong state, federal, territorial and provincial environmental standards to preserve the long-term health of the Watershed.
- Organization: Providing greater organizational strength to the Indigenous Peoples of the Yukon River Watershed, both by assisting and improving Indigenous governments, and by being a model of organization built on collaboration and mutual respect. (YRITWC 2009)

FIGURE 2: MAP OF YUKON WATERSHED



Box 6: The Okanagan Basin, British Columbia

The Okanagan Basin, located in south-central British Columbia, is almost 200 kilometres long and 8,000 square kilometres in area.[11] As one of the most arid watersheds in Canada, the basin is at risk of severe water shortages, particularly in summer months. The Okanagan Basin is experiencing significant population growth, recently becoming one of the fastest growing regions in British Columbia. So much so, that the Okanagan Basin now has the smallest volumes of fresh water per capita in British Columbia (Cohen and Kulkarni 2001).

The water users in the basin are primarily agricultural, making up approximately 70 percent of the total annual water consumption. However, there is now growing demand from commercial, institutional, and residential users (Patrick 2008). The pressure of agricultural and industrial demand coupled with growing household needs is placing strain on both surface and ground water sources in the basin. Similarly, a large proportion of the region's aquifers are highly vulnerable to surface contamination. Limited knowledge about the region's aquifers and their susceptibility to contamination exacerbates the issue (Neilson-Welch and Allen 2007).

The increasing population growth coupled with growing water scarcity prompted the lead basin water institution, the Okanagan Basin Water Board (OBWB), to develop the "Sustainable Water Strategy". Launched in October 2008, the plan includes methods to protect the area's water resources and secure the region's water supplies. This plan builds on more than forty years of water planning for the region; starting with the Municipalities Enabling and Validating Act of 1969, which created the OBWB. The original mandate of the OBWB was to coordinate the eradication of invasive weeds and provide grants to improve local water waste treatment. Since its inception the OBWB has expanded its mandate to tackle more holistic water security issues.

As a response to mounting ecological and social stresses, the Okanagan Basin is making great strides in achieving water security. Foremost among these strides are the partnerships between the OBWB, government agencies and universities which have produced useful studies such as the Water Supply and Demand Study and the Groundwater Assessment of the Okanagan Basin Program.

Other governance innovations include:

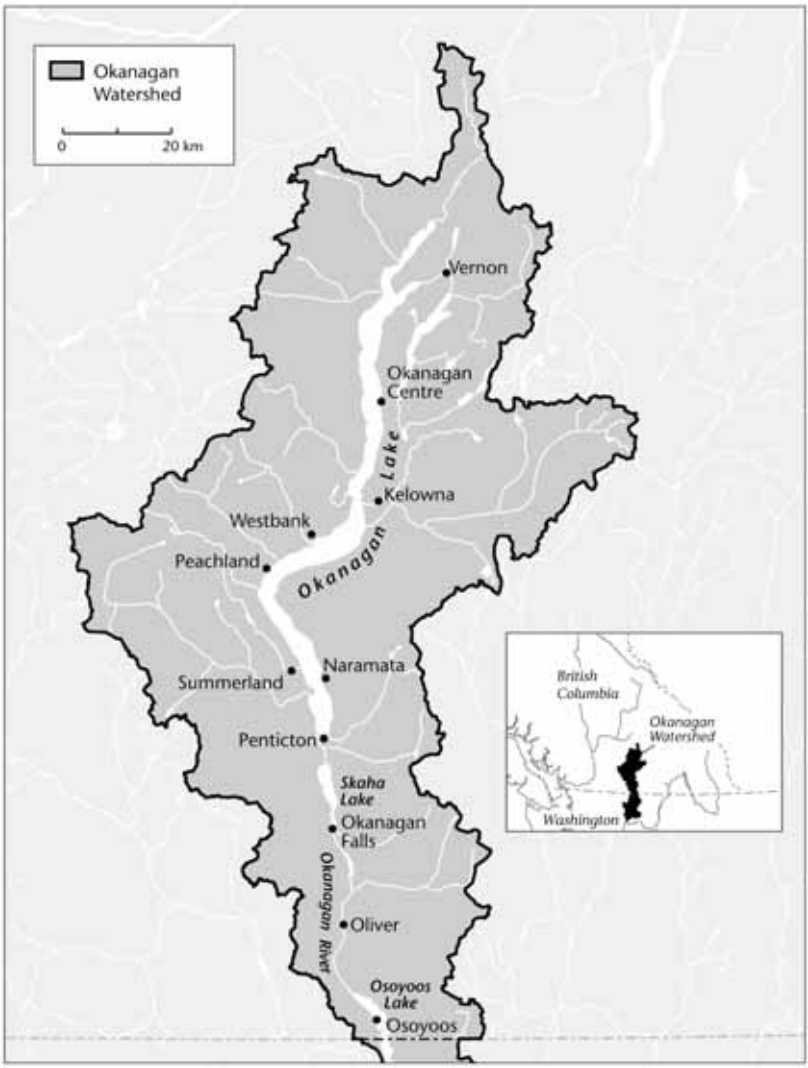
- The Smart Growth on the Ground Partnership in Oliver, British Columbia with a focus on groundwater and land use,[12]
- The Groundwater Bylaws Toolkit which brings together a number of tools for integrating land and water management,
- The development of an integrated information system - Okanagan Basin Information Network Water Balance model, and
- Assistance with groundwater mapping and vulnerability assessments by those at senior levels of government.

In sum, although the Okanagan Basin has not fully achieved water security in its region, it exhibits great strides in meeting its goals.

11. The Basin spans the communities of Osoyoos to the south to Armstrong in the north.

12. See, http://www.sgog.bc.ca/uplo/OliverSummaryMarch2007.pdf

FIGURE 3: MAP OF OKANAGAN BASIN



Text Box 7: Oak Ridges Moraine, Ontario

Water security has become an important flash point in the ongoing debate about development in the environmentally sensitive, geological landform known as the Oak Ridges Moraine, which extends 160 kilometres from the Niagara Escarpment in the west to the Trent River in the east, north of Toronto. The moraine covers 190,000 hectares, contains the largest concentration of headwater streams in the Greater Toronto Area, and is an important recharge area for groundwater.

The moraine is a regional groundwater recharge area and the source of drinking water for more than 250,000 people through municipal groundwater supplies and more than 135,000 private domestic wells. The moraine's water resources also support industrial uses, sand and gravel extraction, and processing which serves the Greater Toronto Area and a vibrant agricultural base (Bradford 2008; Holysh 2009). Land and water management on the moraine is challenging given the 32 municipalities involved, as well as by the high concentration of privately-held land (upwards of 90 percent). The pressure to develop land on the moraine for housing and urban settlement is increasing as the Greater Toronto Area population grows and greenfield land is in short supply.

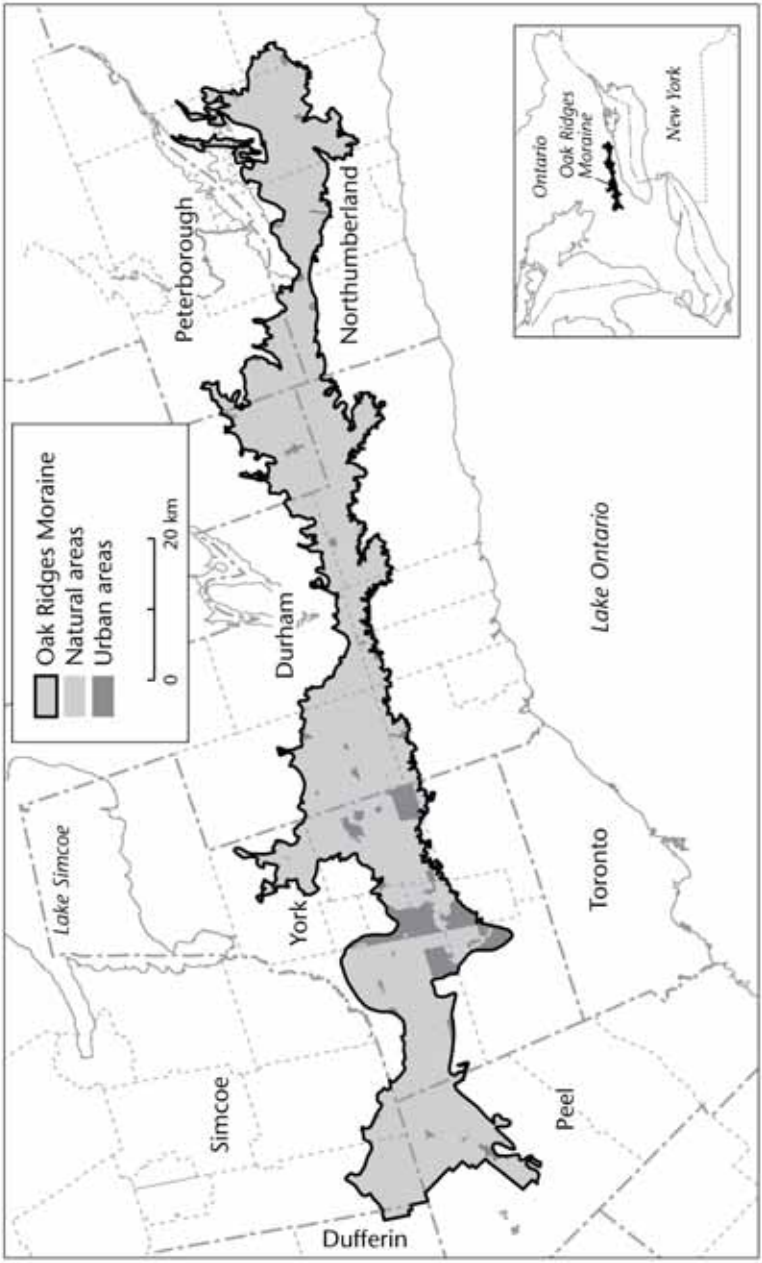
Although proposals to preserve the moraine have circulated for more than 60 years, the implementation of a comprehensive plan to protect groundwater and ecologically sensitive areas did not occur until 2001. In 1991, the Ontario Ministry of Natural Resources undertook a broad hydrogeological review of the Oak Ridges Moraine, which was followed by a five-year study by the Geological Survey of Canada. Despite these efforts, development continued on the moraine. A lengthy and controversial series of hearings at the Ontario Municipal Board in 2001 surrounding proposed new housing for an additional 100,000 people precipitated the development (and enforcement) of a conservation plan for the moraine.

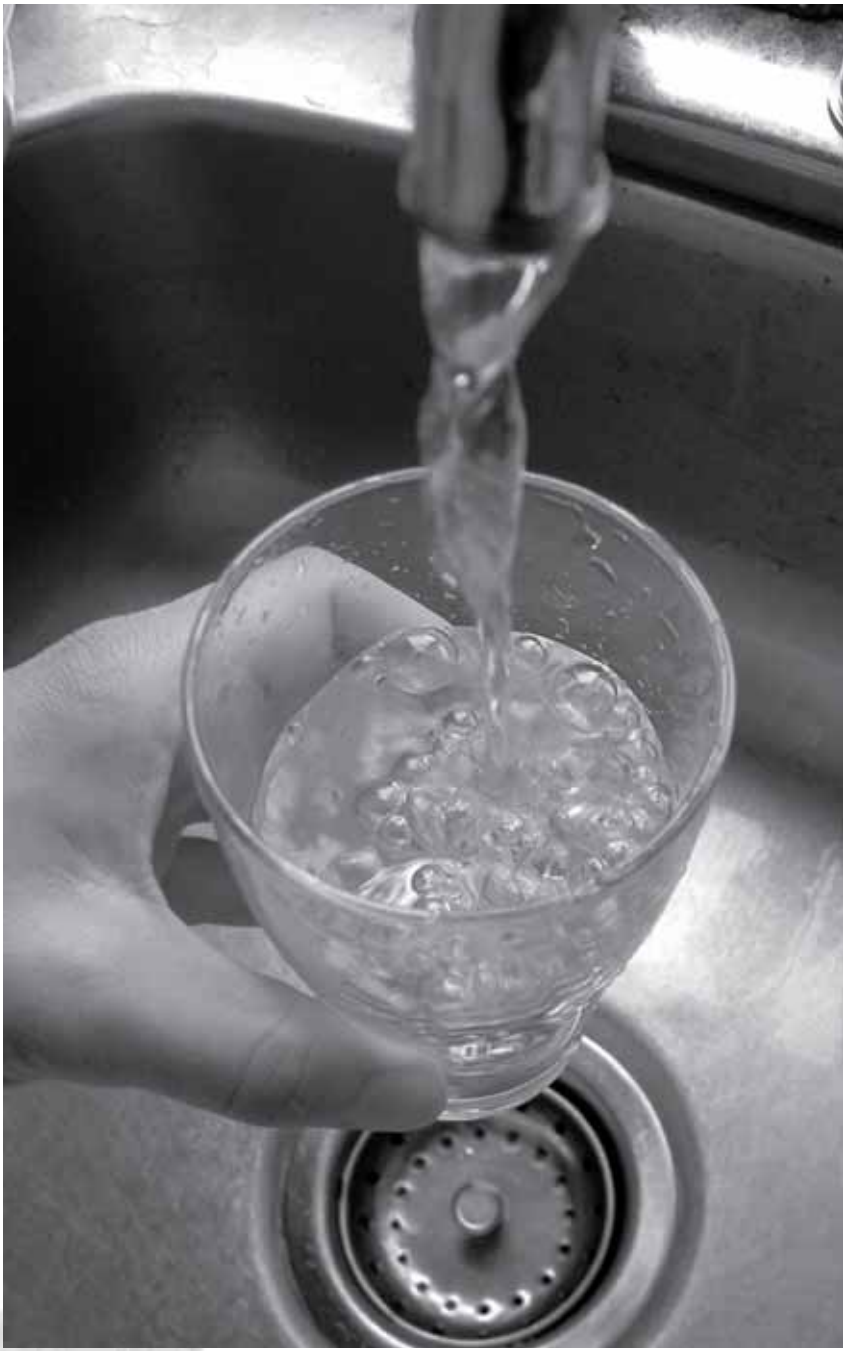
An advisory panel made up of key stakeholders as well as an inter-ministerial team of senior Ontario Government officials were established, both of which made a series of recommendations to the government. An extensive outreach process, involving a series of day-long stakeholder sessions and evening public meetings, strengthened the protection strategy. From this the Province developed and passed the Oak Ridges Moraine Conservation Act with all-party support on December 14, 2001. This was followed by the Oak Ridges Moraine Conservation Plan (ORMCP), which was released in April 2002.

The main objective of the ORMCP is to protect the ecological and hydrological integrity of the Oak Ridges Moraine Area. Although the ORMCP was created by the Provincial Government, it is administered by local and regional municipalities. At the same time as the ORMCP was released, the Province announced the creation of the Oak Ridges Moraine Foundation – a registered corporation with its own Charter. The Foundation operates primarily by funding others in five program areas including land conservation, land stewardship, education, research and support for the Oak Ridges Trail. It also offers leadership or coordination for moraine-wide activities by bringing people and interests together to identify common ground.

Despite great social and ecological challenges, the communities and government agencies are working together to achieve water security in the Oak Ridges Moraine.

FIGURE 4: MAP OF OAK RIDGES MORAINE





CHAPTER 2: Water Security in Action

The objectives of this chapter are to:

- ✓ Introduce the concept of indicators (2.1.1.-3)
- ✓ Highlight current approaches to monitoring and characterising water security and show how indices are incorporated and enacted in current governance practices (2.1.4-6)
- ✓ Introduce the concept of "good governance" for water, and explain how it relates to water security (2.2)

2.1 ASSESSING WATER SECURITY[13]

Growing interest in environmental indicators is a global phenomenon. The development and use of environmental indicators has proliferated in Canada and internationally since the early 1980s. The central drivers of this recent surge in interest include:

- greater engagement with environmental information to support economic policies;
- legal and political obligations to report on environment and human health interactions and trends; and
- the need to address the changing role of governments where governments must demonstrate accountability, work in partnership and fulfill international commitments.

A broad range of indicators has been designed to measure progress towards sustainable development.[14] Despite this proliferation, a recent

13. This section is drawn from the report "Canadian Approaches to Assessing Water Security: An inventory of indicators" (Dunn and Bakker 2009).

14. See Pinter et al. (2005) for history of Sustainable Development indicators.

TABLE 2.1: KEY INTERNATIONAL INDICATORS TO ASSESS WATER

INDICATOR/INDEX	REFEREE	SPATIAL SCALE
Water Stress Indicator	Falkenmark et al. (1989)	country
Vulnerability of Water Systems	Gleick (1990)	watershed
Basic Human Needs Index	Gleick (1996)	country
Water Resources Vulnerability Index	Raskin (1997)	country
Indicator of Water Scarcity	Heap et al., (1998)	country, region
Water Availability Index	Meigh et al. (1998)	region
Index of Water Scarcity	OECD (2001)	country, region
Water Poverty Index	Sullivan (2002)	country, region
Index of Watershed Indicators	US EPA (2002)	watershed
Relative Water Stress Index	WSAG (2005)	country
Canadian Water Sustainability Index	PRI (2007)	community

United Nations Committee on Sustainable Development Report suggested that the sustainable development (SD) indicators remain "largely underdeveloped". Similarly, indices in the water sector are often narrowly focused, trending towards water quality and quantity.

For example, a recent report from Alberta Environment lists environmental performance indicators for watersheds as: land condition and pressure indicators, water quantity condition and pressure indicators, water quality condition and pressure indicators, individual indicator species, and integrated multi-species measures (Alberta MOE 2008).

2.1.1 What is an Indicator?

Indicators play an important role in the distribution of information. They help us transform complex scientific and social data points into a simplified and quantified expression easily communicated to the general public.[15]

How can indicators lead us to improved water security? First, they enable us to characterize the state of Canada's water. Currently, little monitoring

15. Indicators are also used in the context of measuring the ecological health of defined geographic region such as a watershed. For example, a response indicator for watershed Cumulative Effects Assessment (CEA) is the response of flow, or a water quality parameter, or a fish to something. When that response indicator is compared to a benchmark, it measures a change. A water quality index measures the response relative to a guideline or objective (a benchmark) and is at least a two-step process. (Dube' 2009)

of this sort exists in Canada, and this gap impedes our ability to adequately manage water resources. Second, indicators help us identify progress (or lack thereof), because the indicators can be used to create baselines against which water-related variables can be measured over time. Third, indicators (under certain conditions) can be used to compare different locales, and thus build a comparative picture of how well (or poorly) communities across Canada are faring in terms of water security. In short, indicators help us understand where we are, where we are going, and how well we are doing in relation to others.

2.1.2 Who Develops Indicators?

In Canada, all levels of government (federal, provincial and municipal) develop indicators, as do industry and NGOs. Indicators are "intended to assist those responsible for governance (i.e., those who are responsible for developing policy and measuring performance), as well as to offer all Canadians information about environmental status and trends, and about the implications of the choices they make that impact the sustainability of the environment" (Government of Canada 2007).

2.1.3 Who Uses Indicators?

There are three typical audiences that use indicators (see Table 2.2):

TABLE 2.2: AUDIENCE FOR INDICATORS

TARGET AUDIENCE	INDICATOR NEEDS
1) General public and media	- desire a small number of indicators - easy-to-understand - represent issues of direct concern
2) Policy makers, decision-makers and resource managers	Indicator are directly related to: - policy objectives - evaluation criteria - target values
3) Technical experts and science advisors	- raw data - highly detailed and complex indicators - emphasis on scientific validity and system complexity

Source: Environment Canada and Canada Mortgage & Housing Corporation Guidelines for the development of Sustainability Indicators, August 2001

In the 2008 Water Security survey, 60% of the water practitioners surveyed said they use water monitoring and assessment tools, with 43% using indicators. These indicator users include utility managers, industry associations, municipalities (water boards) and NGOs, as well as federal and provincial governments. The survey respondents said they use water monitoring and reporting tools to:

- Identify priorities and budgets (planning)
- Raise / improve awareness (particularly in communicating with the public)
- Translate knowledge and educate
- Enable *informed* decision-making
- Aid in the evaluation and approval (through decision-making) processes
- Monitoring and measure progress
- Compare outcomes (either with other areas or past, versus current trends and future scenarios)

The key characteristics of a good indicator are:

- Easy to access
- Easy to understand
- Timely and relevant
- Reliable and consistent
- Credible, transparent and accurate
- Developed with the end-user in mind

2.1.4 Approaches to Assess Water Security in Canada: An Inventory of Indicators

To better assess water security in Canada, we recently compiled a comprehensive **Inventory of all Canadian freshwater-related indicators**.[16] This list includes federal, provincial and (some) community level indicators and indices, as well as water related monitoring and reporting tools and indicators currently under development.[17]

16. The inventory was compiled through reports, Internet searches, and guidance from practitioners. To ensure that the list is exhaustive and comprehensive, federal and provincial agents reviewed the list. Of the 13 provinces and territories contacted, 75% gave feedback on the accuracy of the provincial/territorial indicator inventory.
17. For the full report, see Dunn and Bakker (2009) downloadable at the PoWG website: http://www.watergovernance.ca.

To date, more than 295 indicators in Canada exist that measure fresh water security. Federal and provincial agencies, together with municipalities and NGOs compiled these indicators. Our research indicates that there are 40 federal level, 143 provincial and territorial level, 112 regional level indicators and at least 70 indicators developed at the small-scale (community) watershed level.

Despite the flurry of environmental indicator development and the number of organizations producing them, the current trend is a "large number of indicators addressing a small number of issues" (Bond et al. 2005a, 2005b). As in many other facets of sustainable development, crisis appears to be the catalyst for action (Nevarez 1996, Bakker 1999, Kaika 2003). In Canada, that crisis was Walkerton.

The contaminated water tragedy that struck Walkerton, Ontario in 2000 underlines the current view that watershed management is less about managing natural resources and more about managing human activities that affect those resources. Walkerton Inquiry Commissioner Dennis O'Connor recognized that source water protection is primarily an exercise in land use planning (Environment Canada 2009).

Despite the post-Walkerton drive for "greater emphasis on source water protection [and] higher water quality standards" exists; there are still substantially fewer water quality indicators that address human health directly (i.e. drinking water quality) (Hill et al. 2008, Parr 2005).

Furthermore, the current indicators do not represent water quantity and ailing infrastructure equally, despite their noted significance.

2.1.5 Key Findings

Highlights of our systematic review of freshwater-related indicators include:

- Water quality indicators are more prevalent than water quantity indicators
- Ecosystem health indicators are more prevalent than human health indicators
- Surface water indicators are more prevalent than groundwater indicators
- There are few very integrated (surface and groundwater) indicators
- Governance indicators are sparse and poorly developed
- Infrastructure indicators are limited in number and in scope

2.1.6 Existing Water Resource Indices

When looking at a watershed, practitioners of water governance should place greater emphasis on the sum of all the parts, such as flow, use, quality, biodiversity. The need for this information crosses sectors. Policymakers, water resource managers, NGOs, industry and agricultural sectors all require a complete picture to make appropriate governance decisions that support and maintain a functioning ecosystem over the long-term. The lack of a comprehensive understanding of a watershed poses unnecessary risks to both ecosystem and human health, and may lead to significant social and ecological costs.

Presently, a widely-accepted, standardized index of water security does not exist in Canada, despite the development of several indices. Because current water-related indices tend to have a narrow focus (e.g. solely on drinking water) they do not allow decision-makers to effectively assess and mediate between conflicting demands for water use, nor minimize the potential adverse impacts from land and water management practices.

At the community level, it is common to find a lack of integrated knowledge and effective incorporation of water-related decision-making tools. We suggest the need to prioritize this coordination. Across the country, efforts to develop comprehensive water-security indicators must be linked. The involvement of end-users in these indicators is crucial, in order to ensure applicability and uptake. Adopting a comprehensive approach implies not only requires the integration of water-related variables, but also an inclusive approach to indicator development, dissemination and implementation.

2.1.7 Indicators of Healthy Ecosystems / Evaluating Stressors

In sum, then, to achieve water security we must develop baseline knowledge about the ecological health of a watershed system and the water-related health of humans living within that watershed. Collecting this information is no small task considering the dynamic nature of water, the multiple uses (and users) of water resources, and the diverse range of pollutant inputs. Jurisdictional fragmentation further complicates the process. Coordinating data collection and analysis between different political jurisdictions and different governmental (and non-governmental) agencies will require a tremendous amount of effort and funds. In fact, water managers and end-users throughout Canada consistently report that a lack of coordination between agencies, coupled with a lack of

a centralized data clearing house, are the central barriers to effective water governance (Dunn and Bakker 2009; Norman and Bakker 2007, 2009). The general lack of data on groundwater in Canada exacerbates this issue (Nowlan 2005). Furthermore, it has proven difficult to maintain an on-going evaluation of the health of most aquatic systems because measurement is often done on a piecemeal, rather than consistent, basis. What measurement there is tends to be undertaken for specific programs or research projects, and so both regulation-specific, and operated under fixed funding cycles (Dubé et al. 2009). Evaluating the stressors of ecological health and human health is instrumental to achieve water security, but to achieve that security it will be imperative to link governance mechanisms to assessment tools.

As noted above, there are tools available to help formally evaluate the changing environment. In Canada, the two main tools designed to measure environmental disturbances include environmental impact assessment (EIA) and cumulative effects assessment (CEA). Although these assessment tools have clearly helped to lay the foundation for evaluating environmental change, they often fall-short in capturing the complexities of physical systems in an integrated and holistic manner (Dubé et al. 2009; Duinker and Greig 2006). At this point their use is complemented by the wide variety of tools used by provincial and local government to assess and mitigate risk to water, some of which have been discussed in this section. Commonly, these tools are referred to as source water protection tools and are targeted primarily at the protection of human health. The degree of source protection planning differs significantly from province to province. Again, achieving water security will require closer coordination between assessment and governance practices.

2.2 PUTTING WATER SECURITY IN ACTION

Over the past decade, the terms “governance” and “good governance” have gained increasing attention from water managers.

2.2.1 What is Water Governance?

> Water governance, simply defined, is the decision-making process through which water is managed. This includes the entire range of political, organisational and administrative processes involved in managing the water supply: from the time when communities articulate their interests, and that input is absorbed, to the time when decisions are made and implemented, and decision-makers are held accountable for the development and management of water resources and the delivery of water services (Bakker 2002).

"Water governance" is the process by which water resources and water services are organised and managed. It includes not only laws and regulations, but also the norms and processes through which decisions on the content of laws are made, legal obligations are met, and disputes are mediated (UNESCO 2003). Governance has attracted increasing public attention in recent years because, many experts argue, a lack of good governance is a major contributor to poor water management.

2.2.2 What is "Good Governance"?

Creating a framework for good governance is a challenge. The paradigm of Integrated Water Resources Management (IWRM) (for which national governments confirmed their support at the 2002 World Summit on Sustainable Development) would ideally integrate a broad array of issues ranging from drinking water protection and human health, to fisheries management and other economic interests based on water systems, to ecosystem sustenance and protection, and include them all in any analysis of systems of both water quality and water quantity. However, IWRM does not (and indeed cannot) provide simple answers to governance issues: there is no "one-size-fits-all" model and the model adopted by different communities will reflect hydrological, cultural, economic, and political factors.

Definitions differ, but those in favour of "good governance" when it comes to water generally define it in terms of principles associated with substantive democratic practices. For example, good governance is participatory, consensus-oriented, accountable, transparent, responsive,

Box 8: What are the Consequences of Poor Governance?

Fragmented governance between different jurisdictions has reduced Canada's ability to regulate drinking water quality. Drinking water guidelines are established through a process involving federal, provincial, and territorial governments on a joint committee (the Federal-Provincial-Territorial Committee on Drinking Water (CDW) whose primary charge is to establish Guidelines for Canadian Drinking Water Quality). In 2004, Canada's Commissioner for the Environment and Sustainable Development audited the process the federal government uses to develop the guidelines, and found a "significant backlog" (of approximately 10 years) in updating the guidelines, despite Health Canada's recommendation that a set of guidelines should take two to three years to develop or review (CESD 2005). The Commissioner found that many known contaminants are not listed in the guidelines, because of the time taken to update them (Bakker 2007). Examples such as these have led many water experts to argue that we need to focus on improving governance and include the goal of achieving good governance within broader water management plans.

effective and efficient, equitable and inclusive and follows the rule of law (Bakker 2002).

This definition implies that "good governance" entails the democratization of water management decision-making, entailing, for example, the substantive participation by stakeholders in the definition of goals and direction of water policy. Indeed, many jurisdictions in Canada have begun to integrate these practices, often through delegated water governance, which involves delegating decision-making for water management issues to the local (usually watershed) level. Alberta's Watershed Planning and Advisory Councils and Quebec's Basin Organizations are two such examples. Of course, long-standing examples in various parts of the country, such as Ontario's Conservation Authorities and River Basin Boards, continue to operate as they always have (Nowlan and Bakker 2007). This trend is similar to that in other countries, such as the United States (Sabatier et al. 2005).

Governance is an often-underemphasized element in achieving water security. Respondents from our 2008 Water Security Survey echoed this point, calling for more transparency, and greater participation and accountability in the governance of water in Canada.

2.2.3 Delegated and Collaborative Water Governance

Delegated (or "shared" or "collaborative") water governance may be broadly defined as the involvement of non-government participants in decision-making for water management; this frequently (but not always) implies the delegation of decision-making to lower scales of governance such as the watershed, municipality, or region (Nowlan and Bakker 2007). Delegated water governance may not be appropriate, or necessary, in all contexts.

Jurisdictions throughout Canada are experimenting with delegated governance models. To date, no province has completely changed the historical basis of water regulation, allocation and protection. New governance models will be constrained in their ability to govern according to the water security paradigm if historical licences cannot be changed, and if compensation is required to enable making these changes to water. In addition, the failure to redress historic Aboriginal grievances related to damage from water developments such as dams, or to enter into meaningful partnerships about water management with Aboriginal groups who may have rights to the water, will be another major constraint on new governance models such as source protection committees in Ontario, and Alberta's Watershed Planning and Advisory Councils.

Ontario is an example of a province in which a shift in governance is occurring – where taking source protection to its logical end will mean putting water quality and quantity before land use to ensure water security. Whether or not the examples from Ontario and British Columbia are isolated cases, or representative of a new trend in governance in Canada, is yet to be seen. Regardless, they will likely serve as outstanding benchmarks for Canada's efforts in achieving water security.

Figure 5: Water Security Workshop

Box 9: Distinguishing IWRM and Water Security

As noted in the text, it is imperative to practice good governance in order for communities to achieve water security. One such method is through applying the concepts of IWRM to water management plans.

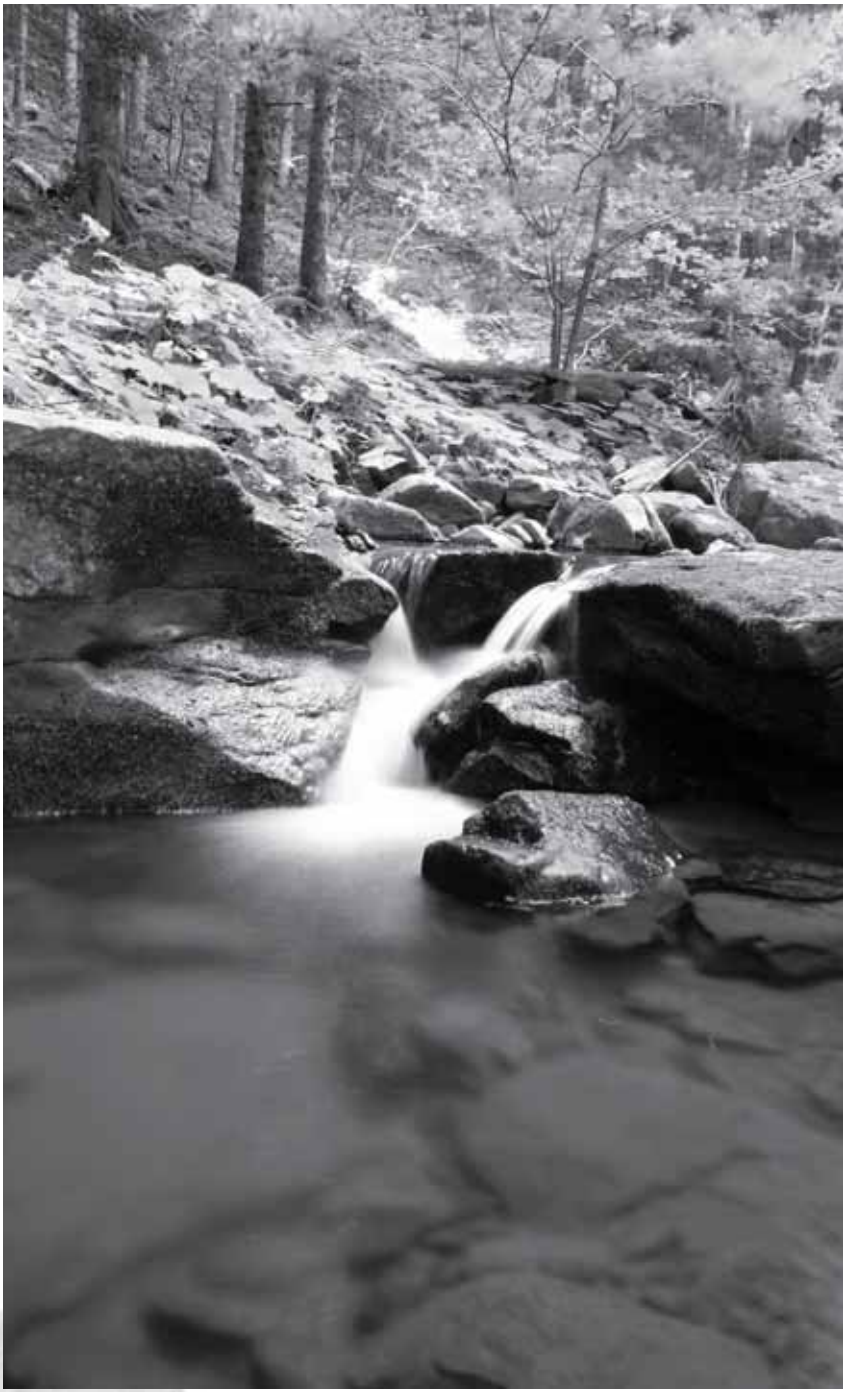
Integrated Water Resources Management (IWRM) has become "the dominant paradigm by which to view and discuss water policy issues in an international context" (Conca 2006). Most commonly, IWRM is defined as:

> a process which promotes the coordinated development and management of water, land and related resources, in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital eco-systems (Global Water Partnership 2000, 2008).

However, despite the broad acceptance and adoption of this definition, considerable debate continues as to the meaning of IWRM (Biswas 2004). We suggest that IWRM is best understood as a process or a means of sustainable water management. Water security, in contrast, is the goal to be reached by a variety of means, including IWRM. In this way, IWRM and water security are complementary.

Figure 6: Water Security Workshop

Photos by Albert Teng



CHAPTER 3: Securing Water for our Future - Our Next Steps

The objective of this chapter is to:

- ✓ Summarize the potential contribution of a water security framework
- ✓ Provide an overview of the work of our Canadian Water Network-funded project team

The above chapters introduced the concept of water security (Chapter 1); outlined the key indicators available for measuring water (Chapter 2 section 1); and discussed current approaches to governance of water in Canada (Chapter 2 section 2). In the concluding chapter, we ask the essential question: What will it take to achieve water security in Canada?

Securing water sources for future generations requires action today. In this Primer, we suggest that the concept of water security is a useful way to characterize the ecological health of a watershed as well as the human health issues related to water use. For a community to achieve water security means that they have "*sustainable access, on a watershed basis, to adequate quantities of water of acceptable quality, to ensure human and ecosystem health*".

The concept of water security is promising because it is action-oriented and comprehensive. That is, it incorporates both the human side and the ecological side of water issues. Our definition of water security builds on previous models of water security, taking a more holistic and integrative approach to governance.

Achieving water security requires good governance. Achieving water security does not fall on a single group, government agency, or individual. Rather, it will require a multitude of actions from a collective of people. There are many ways that decision makers, researchers, and community members can work towards achieving water security.

3.1 STEPS TO HELP ACHIEVE WATER SECURITY:

Part of our goal is to provide tools that will help link research, policy, and stewardship. The first step in this process is to identify needs and priority areas. In a recent survey of water managers and end-users, we asked what it would take to achieve water security in Canada. Below is a list of priority areas identified in this survey:

1. Coordination of data sets
2. Increased funding for local and regional level stewardship projects
3. Better coordination of water management between political jurisdictions
4. A more holistic approach to water governance (including ecological, health, economic and cultural)
5. Wider adoption of a watershed approach
6. Better coordination of groundwater and surface water systems
7. Better understanding of groundwater systems
8. Ongoing monitoring of ecological systems (both spatially and temporally)
9. Better communication between academic research, policy decisions, and community
10. Increased involvement / re-engagement of Federal level governmental officials.

Over the next several years, our team of researchers is committed to creating a suite of tools that will directly address the above points (among others) (www.watersecurity.ca). The goal of our project is to create a Water Security Framework (WSF) with the objective of improving water security in Canada, specifically through improving governance for source protection and land use. The four-year project is funded through the Canadian Water Network and runs from 2008 – 2012. (See Tables 3.1 and 3.2 for details of the project participants and project themes).

The main outcome of our project is to design a user-friendly tool-kit to assist communities in assessing the ecological and human health of their

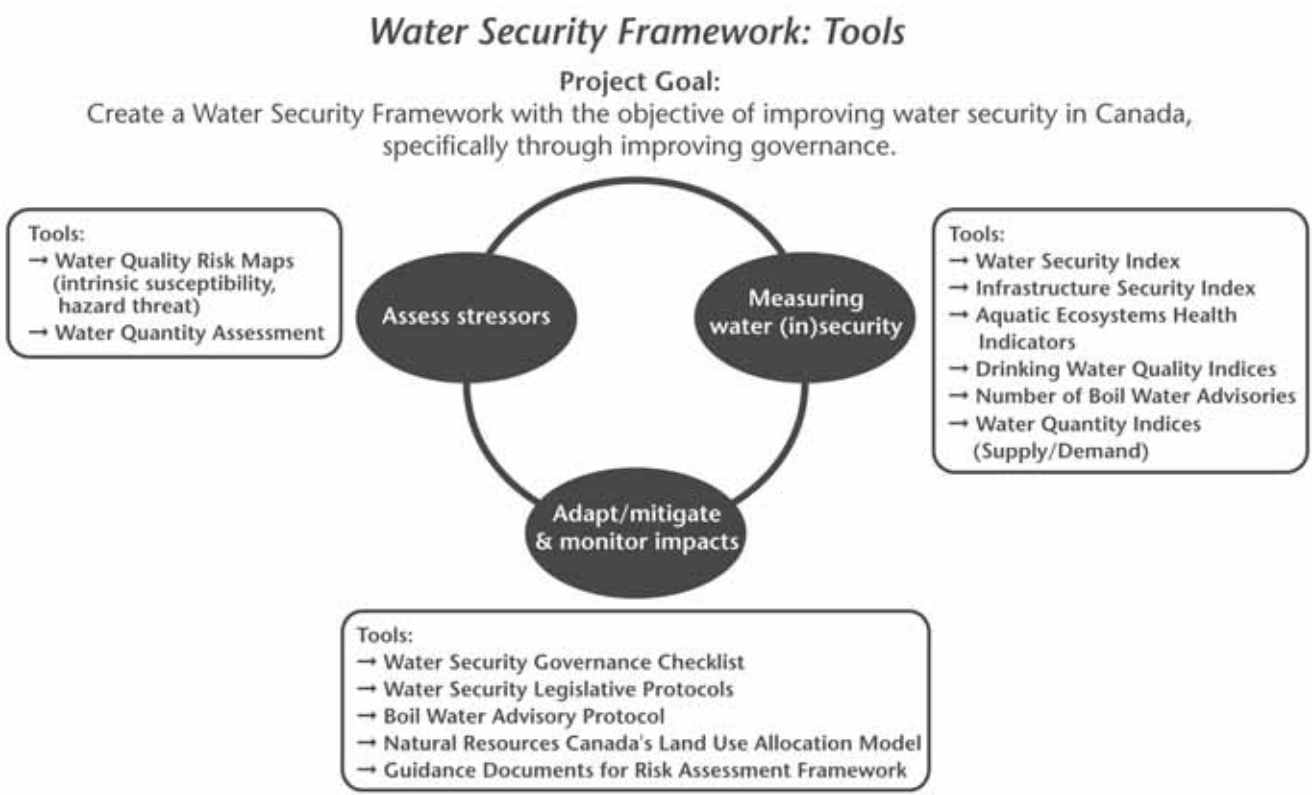


FIGURE 7: WATER SECURITY FRAMEWORK

watershed and to create action-plans to help communities move towards the goal of water security. The Water Security Framework schematic shown in figure 7 depicts how our team plans to design tools to assess the physical system and improve governance mechanisms related to achieving water security.

These tools will be made available not only for policy-makers, but also for community members interested in and concerned about the ecological health of their watershed as well as the human health issues related to water use. The ability to assess water security at a watershed level will, we suggest, empower local communities to become more involved in the governance of their water. This type of "bottom-up" approach, in which scientific research considers how the information can be used practically, transcends theoretical and academic debates to produce something applied, should be a cornerstone of future research practice.

For Canada to achieve water security requires a commitment to good governance. This needs to occur at all levels. The ability to streamline information on water, coordinate datasets, and share best practices is one step in achieving water security. However, this process will also require a commitment from the federal and provincial governments to work more collaboratively to streamline and strengthen existing legislation and to enforce existing legislation (Bakker 2009). Working on a more collaborative system, where roles and responsibilities are clearly defined and water quality standards are enforceable, is a crucial step for achieving water security in Canada. Encouraging conservation practices that lead to smart decisions at the individual level is another important step. Lastly, we suggest that thinking about water-issues at the watershed scale – in addition to government restructuring and individual life choices – will most likely help encourage best practices in water management (O'Connor 2002).

In sum, achieving water security may seem like a daunting task, but through systematic planning and good governance, we suggest that water security can and should be achieved throughout Canada. Our project will seek to contribute to that goal; we plan to summarize our findings in a Water Security Manual to be published in 2012. For publications and research results, be sure to visit our project website: www.watersecurity.ca.

TABLE 3.1: CORE RESEARCH TEAM AND STUDENTS PARTICIPATING IN WATER SECURITY PROJECT

Name	*Institution*	*Project Topic*	*Output/Tool*
Core Research Team			
Dr. Diana Allen	*Simon Fraser University*	*Water Risk Assessment Framework*	*A GIS-based risk assessment that integrates groundwater and surface water*
Dr. Karen Bakker	*University of British Columiba*	*Governance*	*Assessment of governance risks; development of decision - support tools for end-users*
Dr. Monique Dubé	*Saskatchewan Reseach Council*	*Aquatic Ecosystem Health*	*Software instrument that allows for a threat assessment of cumulative impacts, targeted for use by decision-makers*
Dr. Ed McBean	*University of Guelph*	*Infrastructure Index*	*Assessment of infrastructure risks a the intersection of health, energy, environment, and economics*
Dr. Kay Teschke	*University of British Columbia*	*Boil Water Advisories*	*Exploration of causal relation-ships between stressors on water quality and human health impacts*
Student/Post Doctorate Team			
Christina Cook	*University of British Columbia*	*Governance and legal regimes*	*PhD dissertation looking at private property rights and how they impact upon water governance in British Columbia and Ontario*
Mike Simpson	*Simon Fraser University*	*Integrated aquifer vulnerability*	*Master's thesis focusing on vulnerability assessment in Langley and Surrey*
Rafael Cavalcanti de Albuquerque	*Simon Fraser University*	*Arsenic mapping*	*Master's thesis focusing on contamination mapping to help assess natural vulnerability*
Renuka Grover	*University of British Columbia*	*Boil water advisories*	*Master's thesis exploring linkages between water quality, governance decisions, and human health*
Cassandra Banting	*University of Guelph*	*Infrastructure vulnerabilities*	*Master's thesis using GIS to create a set of infrastructure-related indices for infrastructure vulnerability*
Gemma Dunn	*University of British Columbia*	*Water security end-user tools and Indicators*	*Water security index, development of infrastructure component of the WSI*
Dr. Emma Norman	*University of British Columbia*	*Water security end-user tools*	*Water security index, community-level checklist*

TABLE 3.2: ADVISORY COLLABORATORS IN WATER SECURITY PROJECT

Name	Institution	Department
Dr. Rob de Loë	University of Waterloo	Environment and Resource Studies
Dr. Judy Isaac-Renton	University of British Colubmbia	Pathology
Dr. Murray Journeay	University of British Columbia	Earth and Ocean Sciences
Dr. Michael MaGonigle	University of Victoria	Faculty of Law and School of Environmental Studies
Dr. Michel Robin	University of Ottawa	Earth Sciences
Dissemination Leader		
Oliver Brandes	University of Victora	POLIS Institute

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Water Security: A Primer

Developing a Canadian Water Security Framework as a Tool for Improved Governance in Watersheds

The Program on Water Governance at UBC conducts basic research on water management, engages the wider community in outreach and education on water issues, and facilitates dialogue on water governance among universities, communities, government, NGOs, and the private sector.

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