From H_2O

Turning Alberta's Water Headache to Opportunity

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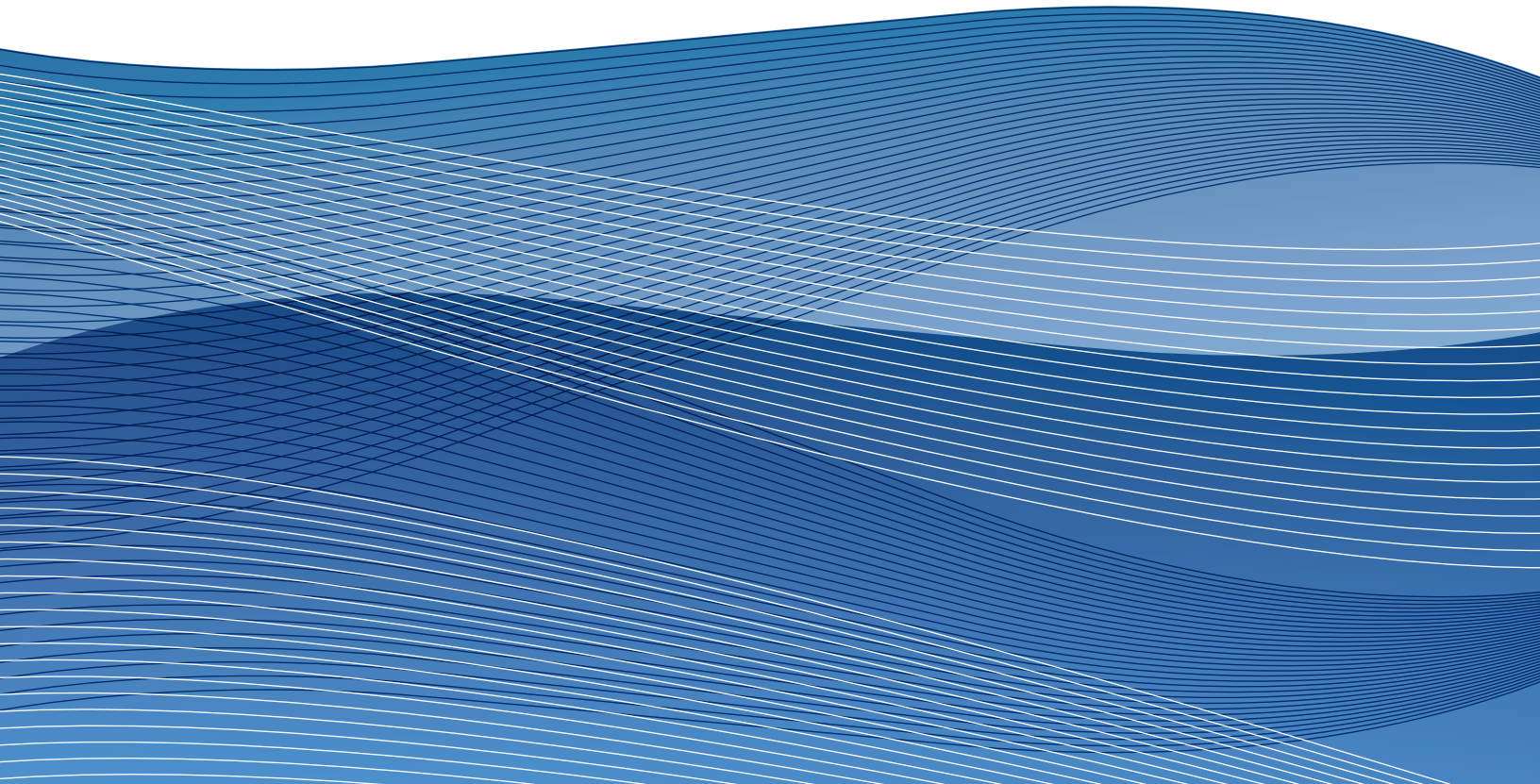


TABLE OF CONTENTS

Prepared for the Alberta Water Research Institute's project on Financial Market-Based Instruments for Sustainable Water Management.

This paper was prepared by Casey G. Vander Ploeg, Senior Policy Analyst with the *Canada West Foundation*. The opinions expressed in this document are those of the author and are not necessarily those of the Canada West Foundation's Board of Directors, advisors, or funders.

The study is the first in a larger series of research papers exploring financial or market-based mechanisms for sustainable water resource management. The paper is part of a larger project of the *Alberta Water Research Institute (AWRI)* that is being managed by the *Canada West Foundation*. This paper is intended to set the stage for the larger AWRI project by identifying Alberta's water challenges and opening discussion on possible solutions.

EXECUTIVE SUMMARY

Introduction

The mandate of the *Alberta Water Research Institute (AWRI)* is to explore how various national and international efforts at water resource management can be adapted and applied to ensure better management of Alberta's water resources. In connection with this, AWRI recently launched a major research project on financial or market-based instruments for sustainable water resource management. The goal of the larger AWRI project is to determine whether financial and market-based instruments applied across the entire water sector can complement or supplement the current system of legislatively allocating and regulating water use. A key objective is to identify which types of financial or market-based mechanisms — there are many — may offer the best potential. Alberta serves as an interesting and appealing case study in which to ground this innovative work, especially considering the increasing water scarcity in southern reaches of the province.

Purpose

Alberta's environmental integrity and prospects for continued economic and social development all hinge on the current and future state of the province's water. At the same time, all is not well with Alberta's water. The purpose of this paper is to set the stage for a robust discussion of the potential offered by various financial and market-based instruments to strengthen and renew water resource management in the province. To that end, the paper explores the natural waterscape of Alberta, patterns of water usage, and the current stresses and potential future strains on the province's water. The paper highlights an ambitious vision for water, and explores a set of options on how that vision might be realized.

Alberta's Waterscape

Alberta's natural waterscape has always meant a certain vulnerability for the province, which is the result of three intersecting factors. First, a lack of easily accessible and high quality groundwater means the province is heavily reliant on surface water sources. Second, the absence of any sizeable lake bodies in close proximity to the provincial population means Alberta is singularly dependent on "flows" of water in rivers as opposed to "stocks" of water in lakes. Third, the maddening irony is that almost 90% of the water in the province's rivers flow north, away from 90% of the province's population. This, combined with the relatively dry climate in the south, means water is never far from the public policy table.

Water Usage In Alberta

Water usage in Alberta is shared by six sectors that include agriculture, industry, municipalities, petroleum production, commerce, and the environment or water management. Each of these sectors hits disproportionately on the province's seven major river basins. The impact of agriculture, especially irrigation, dominates the South Saskatchewan and Milk River basins, while industrial use

dominates the North Saskatchewan River Basin. While petroleum production uses water across the province, it still dominates usage in the Athabasca River Basin. The Peace and Hay River Basins remain largely untouched. However, all sectors are in play across the South Saskatchewan River Basin (SSRB), which is the most heavily used river system in the province. In 2006, Alberta Environment closed off the SSRB to any new surface water allocations. While the Red Deer River was exempted, the province did place a cap on future water taking from this river. In short, the SSRB has reached the limit, if not entirely surpassed the limit. Questions are now emerging on how to accommodate and allocate water among sectors in the SSRB in a closed and constrained environment.

Stresses And Strain

Water issues in Alberta — at least broadly conceived — are not a lot different from water issues elsewhere. Water is indeed plentiful, but not always when and where it is needed, or in the right quality for its intended use. At the same time, there are more than a few signs that water in the province is under strain. Alberta is still very much poised to see continued population and economic growth, both of which will cause demand for water to grow right alongside. Going forward, it is not difficult to envisage increasing competition and perhaps conflict over water as well, largely driven by who is going to have access to a limited water supply. If this were not enough, there is also a set of future threats — climate change among them — that may see today's limited supply of water become tomorrow's diminishing supply of water. Historically, Alberta has always been confronted with the headache of securing adequate supplies of water. In the future, this recurring headache could grow into a more chronic migraine. *Should Albertans be concerned? You bet.*

A Vision For The Future

At a minimum, Albertans need to protect what water they do have, and work to reduce what is quickly becoming a significant and growing vulnerability. If Albertans do not succeed here, the future economic and social development prospects of the province, along with its standard of living, quality of life, and natural environment are more than just called into question. The real risk is that Alberta starts falling backward. At the same time, merely protecting what Albertans have is hardly an inspiring vision. It is an entirely defensive and reactive posture rather than aggressively offensive and proactive. At the other end of the spectrum lies a much more emboldened and exhilarating ideal. That vision is not about managing water so that Albertans have enough to *survive,* but turning the challenge into an opportunity so that Alberta is set to *thrive.* It is a vision where Alberta has found the right balance between the social, environmental, and economic uses of water, coupled with a strong water ethic. Rather than being a point of division and contention, water in Alberta is what binds Albertans together. Not only is water seen and viewed as a source of important political and social stability, concerns about water hampering the future growth of the province are non-existent.

Solutions And Options

Given the robust vision of what might be, how do Albertans get there? There are certainly a number of directions to which Albertans can turn — supply-side options, demand-side options, and financial or market-based options. In sorting through the possibilities, it is important to keep a number of things in mind. First, the environment is a legitimate user of water in its own right. Second, solutions for allocating water can be held separate from decisions to improve the environment. Third, some options can still advance environmental objectives at the same time as they allocate a scarce resource.

When it comes to financial and market-based mechanisms and water, attention is being increasingly drawn toward two particular options — attaching a charge or *"price"* to water and water use, and the regulated *"trading"* of water allocations, licences, or water use rights. Both options present themselves with a range of potential promises as well as pitfalls. On the upside, both can put some real muscle behind the essential demand-side goal of water conservation, as well as increasing the efficiency and productivity of water use. All of these objectives are a central feature of the Government of Alberta's *Water for Life Strategy*. When viewed from this perspective, both options can help with allocation, but also be levered to secure significant environmental gains. On the downside, marrying such financial or market-based options to the public good characteristics of water takes careful consideration and more than a little hard work. There is much to be found here that is not straightforward.

In assessing the potential of financial and market-based options, it is important not to become overly sidetracked with negative perceptions and perspectives that draw attention away from the fundamental water issues facing Albertans. To this end, the paper concludes its discussion by interacting in a significant way with potential objections to these options.

Conclusion

The current water headaches of the province provide Albertans with opportunity — the chance to become real leaders when it comes to water resource management. Now is the time to do something "big" on the water front. If Albertans can do that decisively, and do it well, then opportunities abound. But if Albertans let the opportunity pass them by, the brakes may indeed slam on Alberta's future economic and social development. Alberta's historic battle with water security will be over, and Albertans will have lost.

BACKGROUND

> *Beyond funding leading edge research within Alberta, we see the Water Institute serving as a knowledge broker — providing analysis and context to water research for decision and policy makers, and ensuring that the information is understandable, relevant and accessible. Dedicated to seeking the best solutions and ideas, the Water Institute's scope is not limited by geographic boundaries. We seek out both the best thinkers and the best information provincially, regionally, nationally and internationally to help secure the long term safety, quality and sustainability of Alberta's water resources.*
>
> — Lorne Taylor, Chair, *Alberta Water Research Institute*

In 2000, the Government of Alberta established with a $500 million endowment the *Alberta Heritage Foundation for Science and Engineering Research*, more colloquially known as *Alberta Ingenuity*. Its mandate is to fund and facilitate world-class research and ensure application of that research to benefit Albertans and help build a more prosperous future for the province. Operating within this larger framework — now entitled Alberta Innovates — is the *Alberta Water Research Institute (AWRI)*, established in 2007 to coordinate leading edge research and support for Alberta's provincial water strategy, *Water for Life: A Strategy for Sustainability*.

AWRI is exploring how various national and international efforts at water resource management can be adapted and applied to ensure better management of Alberta's water resources. The intent is to uncover the best solutions and the best ideas and determine if they can be harnessed to help address Alberta's current and future water challenges *(see Discussion Box 1)*. In connection with this, AWRI recently launched a major research project on financial or market-based instruments for sustainable water resource management. In 2009, the Canada West Foundation was invited by AWRI to help manage this ambitious project and also lend its policy expertise.

Discussion Box 1: *Alberta Water Research Institute (AWRI)*

The *Alberta Water Research Institute (AWRI)* was established as a separate program area under the *Alberta Ingenuity Fund* in 2007. The purpose of AWRI is to provide funding, guidance, and technical support for various research initiatives and demonstration projects that will help Alberta develop world class information, tools, procedures, processes, and technologies in support of sustainable water resources management. In doing this work, AWRI is a key player in implementing the province's *Water for Life Strategy*.

AWRI is convinced that Alberta needs to have its water issues resolved by 2015 if the province is to maintain its economic competitiveness. At a minimum, there must be a concrete plan in place. Between 2010-2015, AWRI will be facilitating research and pulling together pilot projects that will help guarantee safe drinking water, especially in the province's rural areas. In the municipal context, AWRI will be working to design and develop the next generation of urban water management and the infrastructure needed to increase water conservation and efficiency. AWRI will also be working to define practical parameters that will ensure a sustainable aquatic ecosystem across the province. When it comes to agriculture, AWRI will explore scenarios that will enable agriculture to expand through responsible

agronomic practices and more efficient water use. With respect to the oil and gas industry and the oil sands, AWRI will develop pilot projects that demonstrate water reuse technology and also identify best practices that will allow continued development without increased water use. Safe limits for the by-products of oil sands development, and technology to reclaim tailings ponds and perhaps even eliminate them altogether, will also be pursued. Across all forms of industry, AWRI will work to establish guidelines for water use and identify and test various technologies for improving water use efficiency and productivity.

As part of this widespread mandate, AWRI will identify and evaluate various market-based instruments already in play in many other jurisdictions, and whether or not those instruments might be adopted for use in Alberta. In conducting this work, AWRI will be instrumental in bringing together international experts and water practitioners to see what adaptations might be needed given Alberta's specific water challenges, and more important yet, understand both the benefits and limitations of these mechanisms.

SOURCE:

Alberta Water Research Institute (AWRI).

The Canada West Foundation may not come immediately to mind when considering issues of water and its linkages to public policy. However, the Foundation has most certainly engaged this important and growing concern. In 1982, the Foundation published *Nature's Lifeline: Prairie and Northern Waters*, a detailed technical study examining the state of western and northern Canadian water. More recently in 2005, the Canada West Foundation released *Balancing Act: Water Conservation and Economic Growth*. Given the critical importance of water and water resource management to the future of western Canadians, the Foundation is pleased to assist AWRI in its ambitious research efforts.

PROJECT OBJECTIVES

> *"With water becoming an increasingly scarce resource, it is timely to think about mechanisms and instruments that will allow transferring water across sectors, with benefits for both supplier and receiver. To avoid complicated regulatory mechanisms, intelligently designed market-based instruments may link different sectors together, creating a water market where water can flow freely between users and across sectors."*
>
> Roger Gibbins, President and CEO, Canada West Foundation, 2009.

The goal of the larger AWRI project is to determine whether financial or market-based instruments applied across the entire water sector (e.g., agricultural users, industrial users, municipal, residential, and domestic users, institutional users, commercial users, petroleum and other natural resource users, and nature's own need for water) can complement or supplement the current system of legislatively allocating and regulating water use. A key objective is to identify which types of financial or market-based mechanisms — there are many — may offer the best potential.

Alberta serves as an interesting and appealing case study in which to ground this innovative work, especially considering the water scarce southern reaches of the province. No new water licences have been issued for the Milk River since 2000, and the entire South Saskatchewan River Basin (SSRB) with the exception

of the Red Deer River has been closed to new surface water allocations since 2006. In addition, the full range of economic sectors are in play across southern Alberta, and each sector is critically important to the local economy, the provincial economy, and by extension, the larger western Canadian regional economy. What is more, water use by each sector in southern Alberta has its own particular impact upon the ecological health and integrity of the broader aquatic ecosystem that Alberta shares with its neighbours.

When it comes to financial or market-based mechanisms for water resource management in Alberta, at least two questions must be asked at the outset. First, what is it about water in Alberta that would require such a policy innovation, if not a radical departure from current practice? The answer finds its roots within the context of Alberta's current water challenges and future threats that loom on the horizon.

Second, can financial or market-based instruments gain any traction given the unique political, economic, and sociological nature of the province, particularly Alberta's historical development and the importance of water in securing that development? If the prospects here are poor to marginal, we may end up with a buffet of mechanisms that looks promising on paper — even proven quite successful elsewhere — but with limited applicability for Alberta.

This paper is designed to set the stage by exploring water in Alberta. In particular, the paper seeks to explain why Albertans should be concerned with their water and current approaches to water resource management, and why new approaches must be considered today if Albertans are to have a water future tomorrow. In exploring new approaches, what unique historical, political, and economic features of the province should be kept in mind? How do various financial or market-based approaches fit with recent changes in provincial water policies and Alberta's *Water for Life Strategy*?

INTRODUCTION

> *"The scenario that I see developing is a huge increase in population and industrial development in Alberta. The periodic droughts that I think we can expect, if we return to anything like pre-20th century conditions, and the accelerated evaporation from climate warming, at some point in this century will come together. My guess is, earlier rather than later in the century. We will know what water shortage is all about in Alberta."*
>
> — David Schindler quoted in Standing Senate Committee, 2005.

In 2003, the province of Alberta released *Water for Life*, a strategic planning document designed to guide the future of water resource management in the province of Alberta. *Water for Life* was prompted by serious and growing concern over the state of Alberta's water resources, coupled with the need to better position water policy to meet a wide range of anticipated future challenges, whether that be declining water availability, threats to water quality, or the health of the province's aquatic ecosystems on which both water quantity and quality depend. *Water for Life* was updated and renewed in 2008 and has received critical acclaim for the policy directions it is proposing, and the means by which those directions might be secured.

Discussion Box 2: *Water for Life Strategy*

At the turn of the millennium, a severe and multi-year drought elevated concerns about water in Alberta, especially the future of water resources management. In response, the Government of Alberta initiated a province-wide public consultation between November 2001 and June 2002 to gather the opinions and ideas of Albertans in crafting a provincial water strategy. What emerged was *Water for Life: Alberta's Strategy for Sustainability*, which was released in 2003 and updated in 2008. The strategy recognizes that Albertans' quality of life — and life itself — depends on a healthy and sustainable water supply for the environment, for growing communities, and for Albertans' continued economic wellbeing.

The strategy is a broadly-worded document with a vision for water that spins tightly around three specific objectives: (1) safe and secure drinking water, (2) healthy aquatic ecosystems, and (3) reliable and quality supplies of water for a sustainable economy. The strategy goes on to identify three core areas of focus in achieving these objectives:

Vastly expanding our knowledge and research of the province's water, its water challenges, and potential solutions: This is perhaps the most critical element affecting Alberta's ability to manage water effectively. The strategy commits the province to enhancing scientific knowledge of Alberta's water resources, better understanding of both current and emerging water issues, and ensuring that Albertans are aware of the issues and have the knowledge and tools to make good decisions. In short, a critical part of the solution is to invest in knowledge, research, and technology.

Developing partnerships to manage the province's water resources within local and regional watersheds: Each watershed has its own unique set of issues. Best practice asserts that water be managed within the local and regional watershed. To give this realization traction, to involve all stakeholders, and to promote shared responsibility, three partnerships are envisioned. The provincial *Alberta Water Council (AWC)* is a multi-stakeholder advisory body that will oversee overall implementation of Water for Life, examine water issues across the province and prioritize them, provide policy advice, and recommend solutions to the province. Regional *Watershed Planning* and *Advisory Councils (WPACs)* will take the lead in watershed planning and will foster stewardship, educate water users, and create and implement watershed management plans for all major provincial watersheds. *Local Watershed Stewardship Groups (WSGs)* will gather together volunteers to protect their local creek, streams, or stretch of river.

Conservation: The strategy notes that within each watershed there is a limited amount of water that can be withdrawn or diverted for use and still maintain a healthy aquatic ecosystem. Once this limit has been reached, there is no further water available without significant ecological effects. In several watersheds, the available limit has already been reached and others are approaching the limit. A key focus is to improve the usage of water, by conservation, increased efficiency, and higher productivity. The strategy calls for the development of water plans for various industry, implementation of best practices, water re-use, and a significant conservation effort that would increase the productivity of water province-wide by 30% in 2015.

The strategy goes on to highlight a dozen principles that will guide water resources management in the future. Albertans must recognize that there are limits to the available water supply, they must begin using and reusing water more effectively and efficiently, and all water resources must be managed within the capacity of individual watersheds. Further, healthy aquatic ecosystems are vital to sustaining both water quantity and quality, and citizens, communities, industry, and government all share responsibility for water management and must work together to preserve the quality of both surface and groundwater while pursuing economic and community development. Alberta remains committed to meeting its transboundary agreements on water, and is equally committed to preserving the current system of prior allocation ("first-in-time-first-in-right"). Alberta will pursue policies that ensure safe and

secure drinking water and the province will manage water infrastructure for long-term sustainability. Most importantly, *Water for Life* recognizes that knowledge and research is the foundation for effective water decision-making, that best practices and market-based instruments will also be used to maintain flexible and adaptive water resources management, and that the goals and aims of Water for Life will be integrated into other policies and plans such as the province's new *Land Use Framework* released in 2008.

The conventional wisdom on *Water for Life* is that the document constitutes an excellent strategy, although questions do remain concerning the implementation of these ambitious goals. The strategy promotes public education on water conservation, promotes water savings plans for sectors that use significant amounts of water, and has an explicit goal of increasing the productivity of water by 30% between 2005 and 2015. The strategy commits the province to expanding knowledge and research of this critical resource, including the merits of various economic and market-based instruments to meet the strategy's ambitious goals.

SOURCE:

Alberta Environment. 2003. *Water for Life Strategy*.
Alberta Environment. 2008. *Water for Life Renewal*.

At the outset, Albertans should know that their province is not the only one pursuing a more strategic, intentional, and rational approach to water resource management. Other provincial efforts include Ontario's *Water Opportunities Act* (Ontario 2010) and British Columbia's *Living Water Smart* (British Columbia 2010). In the same vein, concern over water is not a uniquely Canadian phenomenon. There has been a literal explosion of concern right across the globe. While water shortages in California, Arizona, Egypt, the Sudan, and Australia may not seem at all relevant to Alberta, this is far from the case. Water could well be the most important and pressing global issue of the 21st century, and innovative ideas with broad applicability are already emerging. Much of the province's history has been marked by a continual challenge in coping with a range of water concerns. The point here is that Alberta cannot see itself as isolated from the broader international concern, and this reinforces where water should be on the provincial policy agenda as well.

The issue of water and water resource management is a burgeoning policy field that is quickly becoming increasingly complex and congested. As more and more voices wade into the discussion, each voice strains louder and louder to be heard. On the one hand, this is a positive development. As the issue of water ascends higher up the policy agenda, governments are compelled to more seriously address the issue in meaningful and substantial ways. On the other hand, the number of voices and the sheer volume emanating from those voices often strikes a somewhat dissonant chord.

For example, there may be broad agreement on a number of water challenges, but there is by no means agreement on the most important and most threatening challenges, and even less agreement on the best way to tackle those challenges. For individual Albertans, all of this makes it difficult to get a handle on the most important water issues. For governments that must keep their hand on the policy rudder, piloting their way through the rapids is accompanied by the very real danger of capsizing.

As such, it is helpful to take a step back, scan the provincial "waterscape", and sharpen our focus on Alberta' specific water challenges today and the potential water threats of tomorrow. Keeping our eyes on the fundamental issues helps set the stage for identifying a set of policy responses that will enable Alberta to not only overcome its water headache, but maybe even transform it into opportunity.

PURPOSE

> *"Water touches every aspect of our lives and directly influences the economic prosperity and the quality of life of Canadians. It will be the key issue of the next decade."*
>
> — Mark Servos quoted in Standing Senate Committee, 2005.

Alberta's environmental integrity and prospects for continued economic and social development all hinge on the current and future state of the province's water. At the same time, all is not well with Alberta's water. The purpose of this paper is to set the stage for a robust discussion of the potential offered by various financial or market-based instruments to strengthen and renew water resource management in the province of Alberta. In pursuing this objective, the paper will explore the following:

- What is the natural "waterscape" in Alberta? How much water does the province have? What happens to that water? What are some of the key features of water in Alberta?
- What does water usage in Alberta look like? What sectors use how much water? Where is that water drawn? What is the current pattern of water use in Alberta? How have usage patterns changed over time? What might water usage look like in the future?
- Should Albertans be concerned? What are the critical strains and stresses on the province's water resources? What are the fundamental issues here that require a policy response?
- What is our vision? When it comes to water, what is it that Albertans need to be striving toward? What should Albertans be trying to achieve?
- How can Alberta achieve the vision? What is the range of possible solutions? What directions are being pursued today? What directions might be pursued tomorrow? Where do financial or market-based mechanisms fit, particularly given the goals in the *Water for Life Strategy*? What are the pitfalls, promises, and perspectives on the various policy responses?
- What are the opportunities? What do Albertans stand to gain through a renewed water resource management policy? What do Albertans risk losing if the provincial water challenge is not met?

From H_2O: Turning Alberta's Water Headache to Opportunity is designed to lay a foundation for the larger AWRI water project. In pouring this foundation, we hope to draw attention to Alberta's critical water issues, outline the broader rationale for change, and establish some helpful and useful boundaries for that change.

ALBERTA'S "WATERSCAPE"

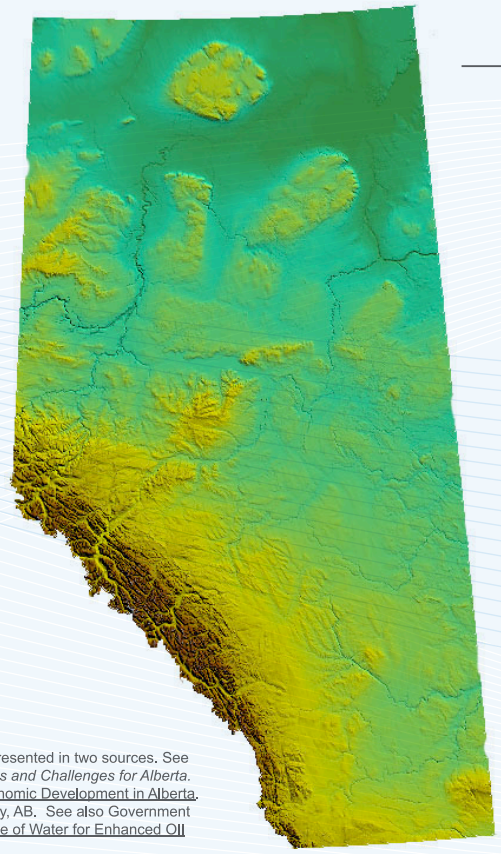
> *As Canadians, we generally don't spend much time thinking about water because we assume that there is plenty of it in this country to which we have ready access. Because most of us don't pay very much for water, we tend to take it for granted. We don't think we have a problem. The fact is that certain regions of Canada, notably in the prairies, face important water challenges … Alberta is the area of greatest concern …*
>
> — Standing Senate Committee, 2005.

When considering water in Alberta, a logical starting point is to consider some seemingly simple questions. How much water does Alberta have? Of what quality is the water? How does water in Alberta move? Where does the water come from and where does it end up? What does water in Alberta look like?

1. Water in Alberta: Quantity

Figure 1 provides a snapshot of water in Alberta. During an "average" year, the province receives about 510 mm of precipitation, which represents a block of water 336 cubic kilometers (km^3) in size, or 336 billion cubic meters (m^3). To put this amount in perspective, simply imagine a cube 7 km long, 7 km wide, and 7 km high. If the water was stretched out over the province like a blanket, Alberta would be covered to a depth of about one and a half feet. Another

Figure 1: A Broad View of Water In Alberta



Water Sources

Precipitation:
336 Billion Cubic Meters (m^3)

River Inflow:
70 Billion Cubic Meters (m^3)

Total:
406 Billion Cubic Meters (m^3)

Water Uses

Transpiration:
195 Billion Cubic Meters (m^3)

Evaporation:
30 Billion Cubic Meters (m^3)

Agriculture:
35 Billion Cubic Meters (m^3)

Groundwater Recharge:
15 Billion Cubic Meters (m^3)

Total:
275 Billion Cubic Meters (m^3)

Outflow
131 Billion Cubic Meters (m^3)

Source:
Derived by Canada West Foundation by merging data presented in two sources. See Zehnder, Alexander. 2008. *Global Water Issues: Trends and Challenges for Alberta.* As reported in Sustainable Water Management and Economic Development in Alberta, 2008. Alberta Economic Development Authority. Calgary, AB. See also Government of Alberta. 2005. Water and Oil: An Overview of the Use of Water for Enhanced Oil Recovery in Alberta. Edmonton, AB.

70 km³ of water enters the province from rivers that originate in BC and the US. In an "average" year, the total amount of water entering Alberta is about 406 km³ — a block 7.4 km wide, 7.4 km long, and 7.4 km high (Alberta Environment 2004a).

Of course, water never stays put. Water is always on the move. In Alberta, about 195 km³ of the 336 km³ of precipitation is transpired back to the atmosphere by the province's natural vegetation, primarily forests and grassland. Another 30 km³ evaporates off land and water surfaces. Total evapotranspiration is about 77% of all precipitation after adding in agricultural water use and transpiration of 35 km³. Another 15 km³ is absorbed as groundwater recharge (5%). The remaining water — about 60 km³ — runs off into the province's various river basins. Combined with the 70 km³ of inflow, total average annual outflow from Alberta is about 130 km³.

While the amount of surface water in the province is well established, there is less certainty about Alberta's groundwater resources, which have been studied less intensely. Groundwater research, and much of the policy that surrounds groundwater, is still in its infancy across Canada. Many aquifers are still in the process of being mapped and evaluated. Most believe, however, that there is much more groundwater in Alberta than surface water.

One study estimated Alberta's groundwater at a whopping 40,000 km³ or 40 trillion cubic meters (m³). That is a block of water 34.2 km long, 34.2 km wide, and 34.2 km high, an amount 100 times the average annual precipitation and river inflow into the province. This much water would cover all of Alberta to a depth of 60 meters — about 180 feet. However, up to 34,500 km³ of this groundwater may not be fresh, and the little that is fresh is locked away in very deep underground formations or is inaccessible because of unfavourable geological conditions. Alberta's recoverable and sustainable fresh groundwater has been estimated at only 16 km³ or 0.05% of the estimated total groundwater supply (Alberta Environment 2006b). This amount would cover the province with a thin layer of water only 2.4 cm thick — about an inch. Some argue that groundwater in Alberta should be treated as a "non-renewable" resource because much of it is tens of thousands of years old and it takes tens of thousands of years to recharge in very deep aquifers (Maas and Telfer 2007).

2. Water in Alberta: Quality

Compared to many other jurisdictions, both national and international, Alberta's naturally occurring sources of water would have to be considered at least as good, if not wholly superior, in terms of overall quality. Alberta enjoys relatively clean surface water sources, which are primarily comprised of rain and snow falling across the province in addition to the annual spring and summer melt of mountain snowpack and glacial ice. Of course, this does not at all mean there are no concerns with water quality in the province. For example, a study of some 30 stream segments or "reaches" in the South Saskatchewan River Basin showed that 22 reaches were moderately impacted, 5 were heavily impacted, and 3 were degraded (Alberta Environment 2003d). In the North Saskatchewan River Basin, permanent water withdrawals are small and

effluents are widely spaced. But there has still been a slow degradation of water quality downstream. Of the major tributaries examined in one study, four were rated as "good", nine were "fair," and five were "poor" (Schindler and Donahue 2005). But these issues of quality speak primarily to the impact of human activity as opposed to the province's natural "waterscape."

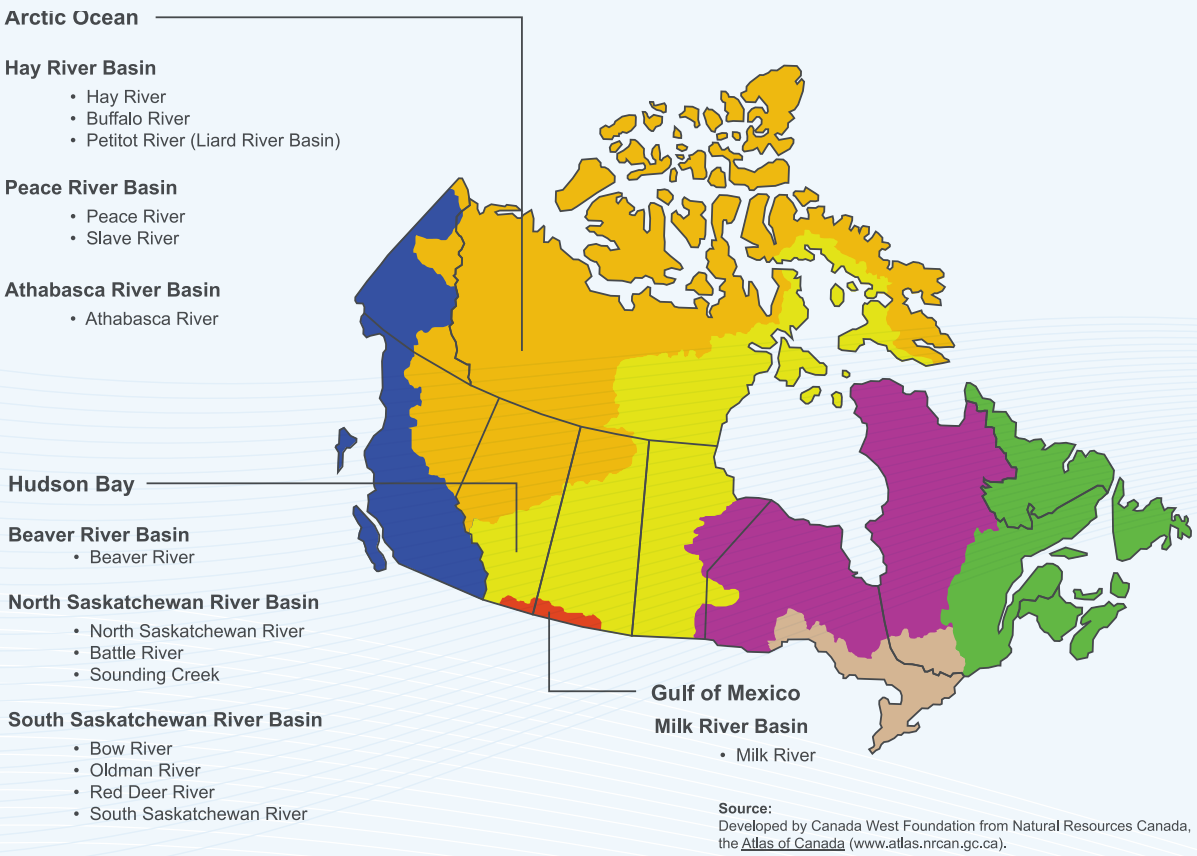
Alberta's groundwater is a different story. It is generally conceded that groundwater in Canadian prairie aquifers is often of naturally poor quality, and some of it can be unsuitable for drinking or irrigation (Agriculture and Agri-Food Canada 2000). Alberta's groundwater sources can be brackish if not saline, and the water can also have high concentrations of ions that result from various minerals absorbed by water as it moves through the soil. In Alberta, groundwater quality is closely linked to the type of aquifer from which the water is drawn. Still, there are some 600,000 rural Albertans who do rely on groundwater for domestic and household needs (McKenna 2008) and there are over 500,000 well records registered with Alberta Environment. Another 5,000 new drilling records are added annually (Alberta Environment 2010). Unlike the majority of the province's surface water, however, the matter of groundwater's natural quality is just as much a concern as its quantity.

3. Water in Alberta: On the Move

Alberta is situated at the headwaters of three major continental drainage systems, including the Arctic Ocean, Hudson Bay, and the Gulf of Mexico *(see Figure 2)*. Water in the northern part of Alberta eventually finds its way to the Mackenzie River, which empties into the Arctic. Water in the central and southern part of the province eventually spills into the Churchill or Nelson rivers and drains into Hudson Bay. A small portion of water in southeast Alberta drains into the Missouri and Mississippi rivers, which empty into the Gulf of Mexico.

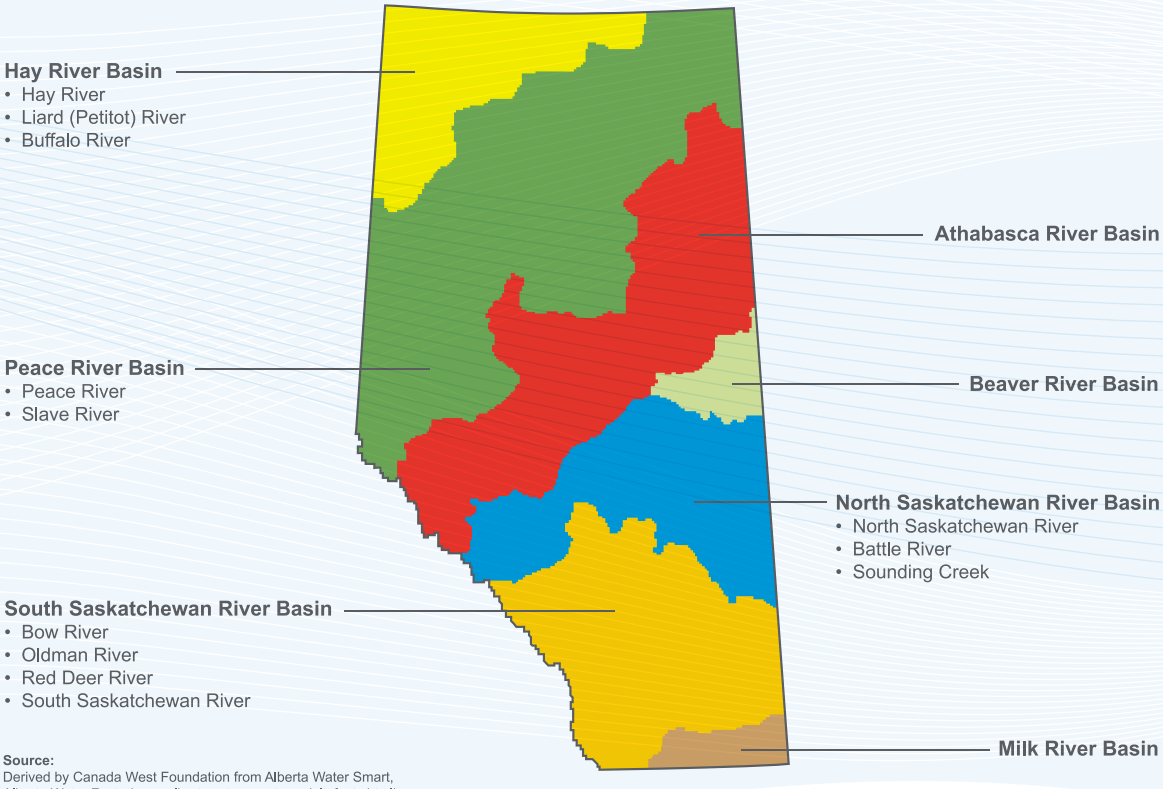
When considering the more detailed provincial scene, geographers view the province as containing seven major river basins within the three large continental drainage systems *(see Figure 3)*. Located in the Arctic system are the Hay River Basin (including the Petitot River, a small tributary of the Liard River Basin), the Peace River Basin (including the Slave River), and the Athabasca River Basin. Within the Hudson Bay system are the Beaver River Basin, the North Saskatchewan River Basin, and the South Saskatchewan River Basin. The Milk River Basin is the smallest of Alberta's major river basins, and is part of the Gulf of Mexico system. Within Alberta's seven major river basins are a number of smaller, but no less important, sub-basins. For example, the South Saskatchewan River Basin (SSRB) is comprised of four separate tributaries including the Bow (flowing through Calgary), the Oldman (flowing through Lethbridge), the Red Deer (flowing through Red Deer), and the South Saskatchewan (flowing through Medicine Hat).

Figure 2: Continental Drainage Systems in Canada



Source:
Developed by Canada West Foundation from Natural Resources Canada, the Atlas of Canada (www.atlas.nrcan.gc.ca).

Figure 3: Alberta's Major River Basins



Source:
Derived by Canada West Foundation from Alberta Water Smart, Alberta Water Facts (www.albertawatersmart.com/altafacts.html).

4. Water in Alberta: Distinguishing Features

Canada is often considered to be a relatively water rich country. When stacked against the water woes of many other places around the globe, this may indeed be the case *(see Discussion Box 3 and 4)*. Whether or not one shares that sentiment, it certainly does not apply with any sense of reasonableness to Alberta. While Alberta comprises over 10% of Canada's population and 7% of its total area, the province has only 2% of Canada's surface freshwater area.

Discussion Box 3: Earth's Water

The surface area of planet earth is approximately 510 million square kilometers. Of this, 70.8% is water and 29.2% is land. This prevalence of water was dramatically captured in the famous "blue marble" photograph taken by Apollo 17 astronauts on the last lunar mission in 1972. While the photograph gives the impression of a planet with plenty of water to go around — we are literally surrounded by the stuff — it is all quite illusory.

The earth's water is a story of managing maddening scarcity in the face of apparently abundant supply. This paradox results from the fact that water comes in various forms, with most of it being either unfit for use or inaccessible. The earth is estimated to hold almost 1.4 billion cubic kilometers of water (see the chart below). This is equivalent to a cube of water about 1,100 kilometers long, 1,100 kilometers wide, and 1,100 kilometers tall. But 97.5% of this vast expanse is saltwater. Only 2.5% is freshwater (Gleick 1996).

What is more, of the 2.5% of water that is fresh, 70% of it is trapped as ice or permanent snow within the polar caps, mountain glaciers, or permafrost. That leaves less than 1.0% of all the water on earth remaining, of which the bulk is groundwater of varying quality that may or may not be readily accessible depending on local conditions. Less than 0.01% of all the water on earth is fresh surface water found in lakes, ponds, rivers, streams, and swamps, and even much of that water is located away from where it is needed or found flowing in the opposite direction. A small amount of remaining freshwater exists as vapour in the atmosphere, as soil moisture, or within plant and animal biota (Gleick 1996).

Across history, human beings have always had to grapple with the physical and geographical scarcity of freshwater, and even today, we are not always succeeding. Across the globe, the World Health Organization estimates that 3.6 million people die every year from water-related disease (Pruss-Ustun, Bos, Gore, and Bantram 2008) and almost 900 million people live in a state of "water stress" lacking ready access to a safe supply of freshwater (World Health Organization 2008). This means that 1 in 8 of the world's 6.8 billion people do not have access to clean, safe, and secure water. According to the 2006 UN Human Development Report, some 1.4 billion people live in river basins where current patterns of water use exceed sustainable levels (Hadjigeorgalis 2008).

Some of the problem here relates to very real concerns with water scarcity in certain parts of the world. However, many also maintain that the larger problem is fueled less by scarcity and more by improper water governance, fragmented decision-making, outdated and ineffective water policies, and a lack of rational water resources management. All of that will have to change quickly, because if the current situation represents a very real challenge, then the future could very well represent a full-blown crisis. While the world's population grew three-fold in the 20th century, our use of renewable water resources has grown six-fold (World Water Council 2010). For the past 100 years, water demand and water use has outpaced population growth two to one. Current demographic trends indicate a global population of 8 billion by 2025 and 9 billion by 2050, and much of that growth is expected to occur in already water-short areas (United Nations 2008).

Global population growth will result in increased demand for water across all sectors, whether that be expanding irrigated agriculture, increasing industrial production, or satisfying the thirst of rapidly expanding urban areas. At least one thing is certain — existing water sources and the earth's natural ecosystems will be subjected to even more pressure, and competition for scarce water resources is certain to intensify. And, all of this carries serious consequences for the global environment, especially considering the threat of climate change.

If the demand for food is to be met in 2025, an additional 2,000 cubic kilometers of water will need to be put into irrigation. By 2050, food production could require an additional 3,800 cubic kilometers of water — close to all the freshwater presently being withdrawn from the surface of the earth. In the minds of many, the earth will simply not make it to 9 billion people — there is not enough water (Sandford 2010).

All of this has fuelled growing international concern and debate about the state of the global water supply and the future of that water supply. The consensus is that pressure on the world's water supply is rapidly escalating, and with it, the very real prospect that water will be the biggest political issue and public policy concern of the 21st century.

The Earth's Water Resources

Water Form	Amount (km^3)	% Share of Total
Oceans and Seas	1,338,000,000	96.5379%
Groundwater	12,870,000	0.9286%
Lakes	85,400	0.0062%
Saltwater	**1,350,955,400**	**97.4726%**
Ice, Snow, Permafrost	24,364,000	1.7579%
Groundwater	10,530,000	0.7597%
Lakes	91,000	0.0066%
Soil Moisture	16,500	0.0012%
Atmosphere	12,900	0.0009%
Swamps	11,470	0.0008%
Rivers	2,120	0.0002%
Biota	1,120	0.0001%
Freshwater	**35,029,110**	**2.5274%**
Total Water Resources	**1,385,984,510**	**100%**

SOURCE:

Gleick, P. H. (Peter). 1996. *Water Resources* in the Encyclopedia of Climate and Weather. S. H. Schneider (ed.). Oxford University Press, New York, NY.

For the average Albertan, a water crisis in northern Africa, the Middle East, Pakistan, India, southeast Asia and even Australia is so far removed as to have little relevance. But this is not so. The global water challenge is certainly finding clear expression much closer to home. In August 2006, the Alberta government stopped issuing new surface water licences across most of the South Saskatchewan River Basin (SSRB). When the river is closed, you know that the limit has been reached. International water modeling shows much of the American midwest and southwest as being highly stressed, and the Canadian prairies — especially southern Alberta — showing up stressed as well. In many ways, Alberta has already joined the much larger global water concern.

SOURCE:

Gleick, Peter H. 1996. Water Resources in the Encyclopedia of Climate and Weather.
Hadjigeorgalis, Ereny. 2008. A Place for Water Markets: Performance and Challenges.
Pruss-Ustun, Annette; Bos, Robert; Gore, Fiona; and Bantram, Jamie. 2008. Safer Water, Better Health.
Sandford, R.W. 2010. When the Well Runs Dry: The World Water Crisis and What it Means to Canada.
United Nations. 2008. World Population Prospects Database.
World Health Organization. 2008. Progress on Drinking Water and Sanitation.
World Water Council. 2010. Water Crisis.

Discussion Box 4: Canada's Water

Canada is a country whose history and development is closely intertwined with water. This comes as no real surprise, given that Canada lays claim to 20% of all the world's freshwater (McFarlane and Nilson 2003). Equally impressive is the fact that Canada has more lake area than any other country in the world. The Great Lakes, shared with the US, hold about 18% of all of the world's surface fresh water, and Canada itself is home to more than a million lakes that together cover almost 7.6% of the country's total area. In fact, nearly 15% of all the world's lakes with a surface area over 500 square kilometers are located in Canada (National Water Research Institute 2004). When rivers, wetlands, and other freshwater areas are added, 8.9% of Canada's total area is covered by surface freshwater *(see chart on next page)*.

But like so many things with water, reality is not always as simple or clear cut. First, much of Canada's water is locked up in polar ice, mountain glaciers, and deep underground aquifers that are not readily accessible. When this is taken into account, Canada has about 6.5% of the world's renewable freshwater supply — water that circulates freely through the hydrological cycle (Sandford 2010). Canada is the second largest country in the world with a total area of almost 10 million square kilometers. This translates into 6.8% of the globe's total land and freshwater surface area. In short, Canada's renewable supply of freshwater is roughly proportionate to its land base. Canada has as much water as it should based on geographical size.

Second, it is important to note that the great majority of Canada's water lies in the north, or flows to the north draining into Hudson Bay and the Arctic Ocean. In fact, 60% of Canada's water is unavailable for use by 85% of the population, which lives in the extreme south of the country along the Canada-US border (Wilkie 2005). The reality is that most Canadians live quite far from the majority of the country's freshwater.

Third, it is very important to understand the extreme variability in how water is distributed across the various regions and provinces of Canada. The distribution of water across Canada varies widely. For example, the province of Quebec has 19.9% of Canada's surface freshwater supplies while Alberta has only 2.2% *(see the chart on next page)*.

Finally, not all water in Canada is equally suitable for its intended purpose, including human consumption. Water quality is just as important a consideration as water quantity. For example, Canadian groundwater supplies vary in quality, with some of them being poor quality brackish water.

So while it may indeed be true that Canada has the largest surface area of freshwater of any country, that statement — left standing on its own — is somewhat misleading. The real question is not how much water there is in Canada. The more relevant question is whether there is enough water where it is needed, whether that water is readily accessible, and whether that water is of sufficient quality. For all the reasons above, securing adequate supplies of quality water for Canadians has required the investment of considerable financial resources and the application of expensive technology and infrastructure to harness water, treat it, move and distribute it, and protect it.

In many ways, Canada can only be considered relatively water rich. With 6.5% of the world's renewable freshwater and less than 0.5% of the world's global population, Canada does have more water than most countries and can be considered generously supplied comparatively speaking (McFarlane and Nilson 2005). But this does not mean that Canada is water-rich in an absolute sense, particularly when considering certain provinces and certain localized areas within those provinces. And, Alberta is a case in point.

SOURCE:

McFarlane, Susan and Nilson, Erik. 2003. On Tap: Urban Water Issues in Canada.

National Water Research Institute. 2004. Threats to Water Availability in Canada.

Wilkie, Karen. 2005. Balancing Act: Water Conservation and Economic Growth.

Sandford, R.W. 2010. When the Well Runs Dry: The World Water Crisis and What it Means to Canada.

Relative Measure of Freshwater Resources in Canada

Province or Territory	Land Area (km^2)	Freshwater Area (km^2)	Total Area (km^2)	2006 Census Population	Total Area as a % of Canada	Population as a % of Canada	Freshwater Area as a % of Total Area	% of Canada's Freshwater Area
British Columbia	925,186	19,549	944,735	4,113,487	9.5%	13.0%	2.1%	2.2%
Alberta	642,317	19,531	661,848	3,290,350	6.6%	10.4%	3.0%	2.2%
Saskatchewan	591,670	59,366	651,036	968,157	6.5%	3.1%	9.1%	6.7%
Manitoba	553,556	94,241	647,797	1,148,401	6.5%	3.6%	14.5%	10.6%
Ontario	917,741	158,654	1,076,395	12,160,282	10.8%	38.5%	14.7%	17.8%
Quebec	1,365,128	176,928	1,542,056	7,546,131	15.4%	23.9%	11.5%	19.9%
New Brunswick	71,450	1,458	72,908	729,997	0.7%	2.3%	2.0%	0.2%
Nova Scotia	53,338	1,946	55,284	913,462	0.6%	2.9%	3.5%	0.2%
Prince Edward Island	5,660	6	5,666	135,851	0.1%	0.4%	0.1%	0.0%
Newfoundland	373,872	31,340	405,212	505,469	4.1%	1.6%	7.7%	3.5%
Yukon	474,391	8,052	482,443	30,372	4.8%	0.1%	1.7%	0.9%
Northwest Territories	1,183,085	163,015	1,346,100	41,464	13.5%	0.1%	12.1%	18.3%
Nunavut	1,936,113	157,077	2,093,190	29,474	21.0%	0.1%	7.5%	17.6%
Canada	**9,093,507**	**891,163**	**9,984,670**	**31,612,897**	**100.0%**	**100.0%**	**8.9%**	**100.0%**

SOURCE:

Derived by Canada West Foundation from Statistics Canada.

NOTE:

Percentage of freshwater area may not necessarily reflect total freshwater supplies as land area alone fails to account for depth of water bodies, and hence, total volume.

Alberta is Canada's driest province. A permanent water deficit exists across southern Alberta, where the average water gain through precipitation does not equal water loss through transpiration, evaporation, and withdrawals of water (Maas and Telfer 2007). While most of southern Saskatchewan and parts of Manitoba are also semi-arid, as well as the interior of British Columbia, these neighbours of Alberta do have considerably larger provincial water resources. Saskatchewan has about 7% of Canada's total freshwater area and Manitoba has 11%. While BC has the same proportion as Alberta, two-thirds of British Columbians live in either Vancouver, Victoria, or Abbotsford. All of these large cities are near the mouth of the Fraser River, which has an average annual flow almost as large as all Alberta rivers combined — 110 km^3 per year, or 85% of Alberta's 130 km^3 (Natural Resources Canada 2010). For the majority of British Columbians who live on the province's southern Pacific coast, rain is the order of the day from November to March.

Aside from its generally semi-arid climate, a unique feature of water in Alberta is the extreme variation in how water is distributed across the province. Again, many regions in Canada face similar issues with variability, but it is particularly acute in Alberta. For example, annual average precipitation in the mountains and foothills of Alberta can range from 1,000–1,500 mm or more. This stands in stark contrast to the 300–350 mm that typically falls in the province's southeast (Alberta Environment 2005a).

When it comes to variability, the more important factor is how four of the province's seven major river basins originate well north of the City of Edmonton, including the Hay, the Peace, the Athabasca, and the Beaver. Together, these four major river basins comprise 87% of Alberta's total average annual river flow, with the Peace alone representing almost 70% *(see Figure 4)*. Only 13% of Alberta's total average annual river flow heads east or south through the North Saskatchewan, South Saskatchewan, and the Milk basins. At the same time, only 12% of Albertans live in the north while 88% live in the south *(see Figure 5)*. The maddening irony in Alberta is that almost 90% of what little water the province does have originates and flows away from 90% of the population.

Water in Alberta is also highly unpredictable. Precipitation can vary from season to season and also year to year. For example, between 1883 and 2003, records of annual precipitation in the City of Edmonton show a low of 208 mm and a high of 745 mm (Alberta Environment 2005a). This aspect of Alberta's natural "waterscape" has always presented a very real "water-threat" in the form of rivers whose flow naturally varies in any given season, and where a lack of precipitation can dramatically reduce annual flows in any given year. On the other hand, an unusually warm spring combined with a few days of spring rain can spell equal disaster, melting Alberta's mountain snowpack so quickly that rivers surge and swell with too much water at one time. In many ways, water in Alberta is feast or famine — Albertans familiar with the flood of 1997 are equally familiar with the drought of 2001.

Figure 4: Average Annual Natural Outflow of Alberta River Basins

(000s of Cubic Meters or m^3)

Regional Location	Major River Basin	Average Annual Flow	% of Total Alberta Flow
Northern Basins	Hay River Basin	4,516,000	3.4%
	Peace River Basin	89,091,000	67.9%
	Athabasca River Basin	19,962,000	15.2%
	Beaver River Basin	613,000	0.5%
	Northern Total	**114,182,000**	**87.0%**
Southern Basins	North Saskatchewan River Basin	7,555,000	5.8%
	South Saskatchewan River Basin	9,262,000	7.1%
	Milk River Basin	160,000	0.1%
	Southern Total	**16,977,000**	**13.0%**
	Alberta Total	**131,159,000**	**100.0%**

SOURCE:

Derived by Canada West Foundation by merging data presented in two statistical studies. See Government of Alberta. 2008. Water for Life: Current and Future Water Use in Alberta. Edmonton, AB. See also Alberta Economic Development Authority. 2008. Sustainable Water Management and Economic Development in Alberta. Calgary, AB.

NOTE:

Hay River Basin includes the flow of the Liard River, which is technically in a separate river basin.

Figure 5: Population Resident in Each River Basin

Regional Location	Major River Basin	2006 Population	% Share of Total Alberta Population
Northern Basins	Hay River Basin	7,438	0.2%
	Peace River Basin	175,103	5.3%
	Athabasca River Basin	166,867	5.1%
	Beaver River Basin	39,368	1.2%
	Northern Total	**388,776**	**11.8%**
Southern Basins	North Saskatchewan River Basin	1,242,297	37.8%
	South Saskatchewan River Basin	1,646,883	50.1%
	Milk River Basin	12,394	0.4%
	Southern Total	**2,901,574**	**88.2%**
	Alberta Total	**3,290,350**	**100.0%**

SOURCE:

Derived by Canada West Foundation from Statistics Canada.

NOTE:

While many of the province's census divisions align nicely with the geography of the various river basins, they do not do so perfectly in all cases. Thus, the reported populations in some river basins may be slightly higher or lower than is really the case. Any deviations would, however, be generally quite small.

High variability and low predictability might not be so problematic were it not for another unique feature of water in Alberta — very few naturally occurring lake bodies of any real size. Alberta has only three lakes larger than 500 km² and all of them are located in the province's far north *(see Figure 6)*. Of the province's 25 largest and naturally occurring lakes, only 8 are located in the three southern river basins. While some of these lakes might be considered "big" by Alberta standards, adding the eight southern lakes together would produce a puddle 27 km long and 27 km wide, representing only 0.1% of the province's total area.

Standing bodies of water in Alberta are limited to numerous small lakes, ponds, wetlands, and sloughs. Some of these do hold at least some water on a permanent basis, but many also alternate between wet and dry states. This is particularly the case in southern Alberta, where freshwater bodies tend to be shallow and where the region itself experiences high rates of evaporation caused by hot summers and strong westerly winds.

5. Water in Alberta: Natural Vulnerability

Alberta's natural "waterscape" has always meant a certain vulnerability for the province. This vulnerability is the result of three intersecting factors drawn from the discussion above. First, a relative lack of easily accessible and high quality groundwater means that Albertans draw heavily on surface water sources. There is a reason why 97% of all water allocations issued by the province are for surface water and only 3% are for groundwater. Second, the absence of any sizeable lake bodies in close proximity to the provincial population has left Albertans almost singularly dependent on highly variable and unpredictable "flows" of surface water — rivers — as opposed to "stocks" of water — lakes. Third, this singular dependence does not hit on the province's largest sources of water, which are all found in the north. Rather, dependence is sharply concentrated on Alberta's smaller southern river basins.

This natural vulnerability has meant that water in Alberta is never far from the municipal, provincial, and even federal policy table. Much of the province's history is marked by significant efforts to reduce Alberta's natural vulnerability by harnessing the power and potential of the province's water, whether that be huge financial investments in irrigation works, municipal water and wastewater infrastructure, or even the construction of major dams and private water storage reservoirs for hydro electricity (e.g., TransAlta's hydro projects on the Bow River). Because of Alberta's natural "waterscape" and the locational reality of its continually expanding population, water has always been actively administered and heavily regulated if not aggressively managed.

Again, there is a reason why 23 of the province's 25 largest water reservoirs are located in the south *(see Figure 7)*. Man-made impoundments are an essential prerequisite if Albertans are to have sufficient water during seasons of low precipitation, low river flow, and the inevitable drought hanging just around the corner. Nowhere in the province is this more true than in the South Saskatchewan River Basin (SSRB). It is here where one finds virtually all of Alberta's largest water reservoirs, with most of them in only two sub-basins — the Bow and the Oldman.

Figure 6: Alberta's 25 Largest Natural Lakes

Regional Location	Name of Lake	Size (km^2)	Basin or Sub-Basin
Northern Basins	Lake Athabasca	2,295	Athabasca
	Lake Claire	1,436	Peace
	Lesser Slave Lake	1,160	Athabasca
	Bistcho Lake	426	Hay
	Cold Lake	248	Beaver
	Utikuma Lake	296	Peace
	Lac La Biche	236	Beaver
	Wabasca Lake	161	Athabasca
	Calling Lake	134	Athabasca
	Winefred Lake	123	Athabasca
	Peerless Lake	83	Peace
	Chip Lake	73	Athabasca
	Muriel Lake	64	Beaver
	Zama Lake	56	Hay
	Cardinal Lake	50	Peace
	Sturgeon Lake	49	Peace
	Winagami Lake	47	Athabasca
	Northern Total	**6,937**	
Southern Basins	Beaverhill Lake	139	North Saskatchewan
	Pakowki Lake	124	Milk
	Pigeon Lake	97	Battle (NSRB)
	Buffalo Lake	94	Red Deer (SSRB)
	Wabamum Lake	82	North Saskatchewan
	Gull Lake	81	Red Deer (SSRB)
	Lac St. Anne	55	North Saskatchewan
	Sylvan Lake	43	Red Deer (SSRB)
	Southern Total	**715**	
	Alberta Total	**7,652**	

SOURCE:

Compiled by Canada West Foundation from the University of Alberta Press. 1990. Atlas of Alberta Lakes. Edmonton, AB. See also Alberta Environment. Alberta's River Basins. (www.alberta.environment.ca). Some data as reported from these sources on Wikipedia (www.wikipedia.org).

Commentary:

While almost 15% of the globe's lakes larger than 500 square kilometers are in Canada, Alberta has only three such lakes. Most of Alberta's natural lake bodies are well under 150 square kilometers in size, and the largest lakes are located in the far north of the province. The southern part of the province has only a small number of relatively small lake bodies.

With a total are of 661,848 square kilometers, lakes over 50 square kilometers in northern Alberta comprise only 1.0% of the total area of the province.

Naturally occurring lake bodies of any real size in northern Alberta cover an area that is only about 83 km long and 83 km wide. Naturally occurring lake bodies of any real size in the southern part of Alberta cover an area only 27 km long and 27 km wide.

Figure 7: Alberta's 25 Largest Storage Reservoirs

Regional Location	Name of Reservoir	Storage Capacity (000s of m^3)	Size (km^2)	Basin or Sub-Basin
Northern Basins	South Heart Reservoir	42,000	8	Athabasca
	Paddle River Reservoir	16,000	3	Athabasca
	Northern Total	**58,000**	**11**	
Southern Basins	Lake Abraham	1,418,000	54	North Saskatchewan
	Oldman Reservoir	495,000	45	Oldman (SSRB)
	Brazeau Reservoir	485,000	99	North Saskatchewan
	St. Mary Reservoir	396,000	38	Oldman (SSRB)
	Lake McGregor	367,000	51	Oldman (SSRB)
	Lake Minnewanka	224,000	22	Bow (SSRB)
	Glennifer Lake	202,000	18	Red Deer (SSRB)
	Lake Newell	178,000	66	Bow (SSRB)
	Spray Lake	177,000	20	Bow (SSRB)
	Waterton Reservoir	170,000	10	Oldman (SSRB)
	Milk River Ridge Reservoir	128,000	14	Milk
	Crawling Valley Reservoir	115,000	25	Red Deer (SSRB)
	Travers Reservoir	104,000	23	Oldman (SSRB)
	Upper Kananaskis Reservoir	102,000	8	Bow (SSRB)
	Keho Lake	96,000	18	Oldman (SSRB)
	Ghost Reservoir	71,000	12	Bow (SSRB)
	Lower Kananaskis Reservoir	63,000	6	Bow (SSRB)
	Twin Valley Reservoir	62,000	8	Oldman (SSRB)
	Pine Coulee Reservoir	51,000	5	Oldman (SSRB)
	Barrier Reservoir	25,000	3	Bow (SSRB)
	Glenmore Reservoir	24,000	4	Bow (SSRB)
	Chain Lakes Reservoir	14,000	3	Oldman (SSRB)
	Clear Lake	12,000	2	Oldman (SSRB)
	Southern Total	**4,979,000**	**554**	
	Alberta Total	**5,037,000**	**565**	

SOURCE:

Compiled by Canada West Foundation from the University of Alberta Press. 1990. Atlas of Alberta Lakes. Edmonton, AB. See also Alberta Environment. Alberta's River Basins. (www.alberta.environment.ca). Storage capacities calculated from Alberta Environment, Status of Major Water Storage Reservoirs. Some data as reported from these sources on Wikipedia (www.wikipedia.org).

NOTE:

Area in km^2 for the Waterton, Keho, Twin Valley, Pine Coulee, South Heart, Paddle River, and Clear Lake reservoirs are estimates only.

Commentary:

Of the 25 major water storage reservoirs in the province, 23 are located in the southern region. More important yet, 20 are located in the South Saskatchewan River Basin. Nine are on the Oldman river sub-basin, 8 are on the Bow river sub-basin, and 2 are on the Red Deer river sub-basin.

To secure sufficient supplies of water for Alberta, the province has had to build significant infrastructure to capture water and store water from a small portion of the province's total water supply.

With all of that aside, there is at least one bright spot on Alberta's unique "waterscape." A geographical reality often left unspoken is that most of Alberta's rivers have their origin within the province itself. With headwaters located on the eastern slopes of the Rocky Mountains, Alberta's most important sources of water remain unaffected by upstream users in adjoining jurisdictions. This confers the province with a considerable advantage — not only is water quantity unimpeded by upstream activity, but the natural quality of that water is as pristine as anywhere on earth.

All of Alberta's rivers except for the largest (the Peace which flows in from BC) and the smallest (the Milk which flows in from Montana) originate in Alberta. Because the Milk is small and water from the Peace is not heavily used by Albertans, 97% of all water allocated in Alberta is drawn from sources that originate within the province itself. In at least one important way, then, Alberta's water is truly the most "natural" of all natural resources — it arrives in the province virtually untouched. Viewed from this perspective, many of the decisions about Alberta's water can and are made by Albertans themselves, and this is something that most other jurisdictions can only dream about.

At the same time, this privilege comes with great responsibility. What little water Alberta does have is water as good as nature itself can provide. Not only must Alberta use and manage this water for its own sake, it must do so, as required by the 1969 *Master Agreement on Apportionment*, for the sake of Saskatchewan, Manitoba, and the Northwest Territories as well. In short, how water is used and whether that use is economically and environmentally sustainable are questions of no less importance than questions over water availability. Sketching in this use of water in Alberta is where we turn next.

WATER USAGE IN ALBERTA

> *"Alberta has a diverse range of watersheds, wetlands, and riparian areas. The north is not like the south, and the east is not like the west. Each region and each industry sector has its own unique opportunities and challenges. Every industry sector in the province diverts and consumes different amounts of surface and groundwater from different sources and for different purposes, and then returns different amounts of this water in different forms back to different environments. This environmental and economic diversity has an environmental impact, but also presents an economic opportunity."*
>
> — Alberta Economic Development Authority, 2008.

1. Historical View

In Alberta, up to 1,250 cubic meters (m^3) of water for domestic or household use can be taken without a water licence — typically called a water "allocation." Water taking that exceeds this amount, or that will be used for other purposes, can only occur if one has an allocation or a licence issued by the province. A water allocation stipulates the maximum amount of water that could potentially be taken.

Discussion Box 5: Terminology

In 2005, water licences issued by the Government of Alberta allowed 9.563 billion cubic meters (m^3) of water to be withdrawn or diverted from surface and groundwater sources across the province. These licences or *"allocations"* represent the maximum amount of water that can be potentially withdrawn. Allocations, then, do not represent the amount of water actually withdrawn, which can vary from year to year depending on river flow and rainfall.

Allocations of water also need to be distinguished from the actual *"use"* of water. Use refers to the amount of water actually withdrawn. But use itself does not equal *"consumption."* Much of the time, water is withdrawn and then used, but after use it is returned. The difference between what is used and then returned constitutes water *"consumption."*

In one sense at least, water is never really consumed. No matter what happens to it, water never completely exits the larger hydrological cycle. As one commentator notes:

> *"In fact, water has not changed in amount or nature for million of years. It just keeps cycling and recycling from atmosphere to earth and back again."*
>
> — Agriculture and Agri-Food Canada, 2000.

When it comes to water resources management, however, water is generally considered to be consumed when it is not directly returned after use to the same source from which it was withdrawn. In Alberta, most water *"allocations"* stipulate the maximum amount of water that can be withdrawn, as well as when, where, and for what purpose it can be *"used."* Some allocations also contain provisions that mandate specified return flows, thus limiting the amount of water that can be *"consumed"* as well.

SOURCE:

Wilkie, Karen. 2005. Balancing Act: Water Conservation and Economic Growth.

Water allocations from 1900-2005, and Alberta's population over the same time period, are shown in *Figure 8*. Growth in the province's water allocations has not always proceeded at a measured pace, but has come in phases. The settling of the province from 1900–1920 produced an initial surge in water allocations, after which growth tailed off. From 1920–1950, the number and volume of water allocations grew marginally. A second burst occurred during the 1950–1970 period, largely commensurate with the establishment of several new large-scale irrigation projects in the south, the enhancement of existing irrigation works, and the emerging oil and gas industry. All of this fueled a boom in the province's population, and with it, a much wider industrial and commercial economic base, and the thirst that goes with it. By the end of the 1970s, water allocations in Alberta had more than doubled over 1950 levels.

Fast-forwarding to the turn of the century tells a much different — if not somewhat distressing — story. Between 2000-2005, annual growth in water allocations averaged a meager 0.6%. This stands in sharp contrast to historical growth, such as the 5.2% average annual growth of the 1950s, the 3.9% of the 1970s, and even the 1.6% of the 1990s. At no point in Alberta's history has the licensed use of water grown so slowly, especially considering the province's recent economic and population growth.

Figure 8: Historical Water Allocations in Alberta, 1900-2005
(000s of Cubic Meters or m^3)

Year	Allocations	% Growth	Population	% Growth
1900	300,000	0.0%	73,022	0.0%
1910	1,600,000	433.3%	374,295	412.6%
1920	2,100,000	31.3%	585,454	56.4%
1930	2,300,000	9.5%	731,605	25.0%
1940	2,400,000	4.3%	796,169	8.8%
1950	3,100,000	29.2%	939,501	18.0%
1960	4,700,000	51.6%	1,331,944	41.8%
1970	5,100,000	8.5%	1,627,874	22.2%
1980	7,100,000	39.2%	2,237,724	37.5%
1990	8,000,000	12.7%	2,545,553	13.8%
2000	9,300,000	16.3%	2,974,807	16.9%
2005	9,563,000	2.8%	3,290,350	10.6%

SOURCE:

Allocations drawn from Alberta Economic Development Authority. 2008. Sustainable Water Management and Economic Development in Alberta. Calgary, AB. Population statistics are from the closest census year as reported by Statistics Canada.

There are two ways to interpret the data. First, Albertans could be "doing more with less" water, and to some extent this is certainly true *(see Discussion Box 6)*. But second, the data may also be echoing what is becoming a widespread and growing concern — Alberta may be bumping up against the limits of its water capacity.

Discussion Box 6: Doing More With Less Water

Each economic sector in Alberta uses water for a wide variety of purposes. Many of the sectors have also changed the way in which they use water, having found and implemented various efficiencies over time. What follows is a brief snapshot of water usage in each of the sectors and some of the biggest changes in water usage trends *(all data are found in the chart on the next page)*.

Agriculture

Over 96% of all water allocated for agriculture is used for crop irrigation, with the remainder reserved for livestock and feedlot operations. The biggest change in water usage by agriculture is the dramatic increase in irrigation efficiency seen over the past 50 years. On-farm water application efficiency — a ratio of the amount of water applied and retained within the active root zone relative to the total amount of water delivered to the on-farm irrigation system — has increased substantially. For example, a 2004 study on the Magrath, Raymond, St. Mary, and Taber irrigation districts reported that on-farm water application efficiency increased from 36% in 1965 to 74% in 2000 (Alberta Agriculture, Food, and Rural Development 2004).

Efficiency gains in irrigation have resulted from two factors. First, Alberta's 13 irrigation districts have invested heavily in infrastructure improvements to reduce water evaporation and seepage, replacing open ditches with pipelines and re-lining the open canals that remain. The Taber Irrigation District, for

Water Allocations and Estimated Consumption by Sector and Function, 2005 (000s of Cubic Meters or m^3)

Agricultural Sector Functions	Allocation by Function	Function as % Sector Allocation	Estimated Consumption	Function as % Consumption	% of Total Allocation Consumed
District Irrigation	3,454,351	80.2%	1,764,218	79.5%	51.1%
Private Irrigation	693,454	16.1%	354,163	16.0%	51.1%
Stock Watering	107,851	2.5%	67,612	3.0%	62.7%
Feedlots	51,768	1.2%	32,453	1.5%	62.7%
Total	**4,307,424**	**100.0%**	**2,218,446**	**100.0%**	**51.5%**

Industrial Sector Functions	Allocation by Function	Function as % Sector Allocation	Estimated Consumption	Function as % Consumption	% of Total Allocation Consumed
Electrical Power Plant Cooling	2,324,808	87.2%	97,739	52.6%	4.2%
Forestry & Pulp and Paper	214,048	8.0%	20,852	11.2%	9.7%
Fertilizer Plants	53,196	2.0%	44,309	23.8%	83.3%
Chemical Plants	39,701	1.5%	13,252	7.1%	33.4%
Mining	17,364	0.7%	6,537	3.5%	37.6%
Manufacturing	13,493	0.5%	1,971	1.1%	14.6%
Other Industrial	2,136	0.1%	1,128	0.6%	52.8%
Total	**2,664,746**	**100.0%**	**185,788**	**100.0%**	**7.0%**

Municipal Sector Functions	Allocation by Function	Function as % Sector Allocation	Estimated Consumption	Function as % Consumption	% of Total Allocation Consumed
Residential	603,733	56.0%	73,285	56.0%	12.1%
Industrial & Commercial	377,333	35.0%	45,803	35.0%	12.1%
Institutional/Other	97,029	9.0%	11,778	9.0%	12.1%
Total	**1,078,095**	**100.0%**	**130,866**	**100.0%**	**12.1%**

Petroleum Sector Functions	Allocation by Function	Function as % Sector Allocation	Estimated Consumption	Function as % Consumption	% of Total Allocation Consumed
Oilsands Mining	523,693	65.3%	170,291	65.2%	32.5%
Gas & Petrochemical Plants	104,838	13.1%	53,823	20.6%	51.3%
Oilsands Thermal (CSS and SAGD)	93,723	11.7%	25,865	9.9%	27.6%
Oilfield Injection	76,143	9.5%	8,058	3.1%	10.6%
Other Petroleum	3,211	0.4%	3,211	1.2%	100.0%
Oil & Gas Well Drilling	10	0.0%	10	0.0%	100.0%
Total	**801,618**	**100.0%**	**261,258**	**100.0%**	**32.6%**

Environment and Management Sector Functions	Allocation by Function	Function as % Sector Allocation	Estimated Consumption	Function as % Consumption	% of Total Allocation Consumed
Flood Control & Water Management	447,704	71.9%	300,819	68.2%	67.2%
Habitat Preservation	170,995	27.5%	138,107	31.3%	80.8%
Water Conservation & Other	3,603	0.6%	2,326	0.5%	64.6%
Total	**622,302**	**100.0%**	**441,252**	**100.0%**	**70.9%**

Commercial Sector Functions	Allocation by Function	Function as % Sector Allocation	Estimated Consumption	Function as % Consumption	% of Total Allocation Consumed
Parks, Recreation, Golf Courses	49,592	56.0%	35,074	52.6%	70.7%
Food Processing and Bottling	16,436	18.5%	13,149	19.7%	80.0%
Washing	9,321	10.5%	6,522	9.8%	70.0%
Gardening	6,071	6.8%	6,068	9.1%	100.0%
Other Commercial	5,811	6.6%	4,905	7.3%	84.4%
Construction	1,398	1.6%	1,019	1.5%	72.9%
Total	**88,629**	**100.0%**	**66,737**	**100.0%**	**75.3%**

SOURCE: Derived by Canada West Foundation from the Government of Alberta. 2008. Water for Life: Current and Future Water Use in Alberta. Edmonton, AB.

NOTE: Consumption by some sectors and in some river basins was estimated or assumed to be 100% of allocations due to a lack of data on return flows.

example, has completed 90% of its delivery system rehabilitation, and similar efficiency improvements continue in the other districts (Alberta Agriculture and Food 2000). In the Magrath, Raymond, St. Mary, and Taber irrigation districts, water evaporation and seepage has been reduced from 15% of gross water diversions to 5% (Alberta Agriculture, Food, and Rural Development 2004).

Second, improvements within the irrigation district have combined with increased efficiency on the farm, primarily through better irrigation management techniques, more efficient practices, and better on-farm irrigation equipment. In 1965, there were 700,000 irrigated acres in Alberta, of which 600,000 acres were watered through surface or flood irrigation. By 2003, the irrigated acreage in Alberta had expanded to 1.6 million acres, with 65% being watered through more efficient centre pivot systems, 23% through wheel-move systems, and only 13% through surface or flood irrigation (Alberta Agriculture, Food, and Rural Development 2004).

Improvements in the irrigation districts and the shift to higher efficiency, low-pressure centre pivot irrigation has allowed for water savings, higher water productivity, and an increase in the amount of acres that can be irrigated. A review conducted in 2000 identified additional improvements in water management efficiencies that would allow even more expansion to occur within the confines of current water allocations.

With all that said, the majority of crop production in Alberta is still dependent on "green" water — "rainfed" or "dryland" farming. Even here, changes in agricultural practices hold additional promise. Around the world, better dryland practices could result in a 15% rise in global food production. Better management of rain-fed agricultural practices, as well as irrigation, could achieve much.

Industry

Almost 90% of all water allocations for industry are for purposes of thermal electrical power generation while 8% is allocated to various forestry, pulp, and paper operations. The remaining 2% is shared by fertilizer and chemical plants, mining, manufacturing, and other industrial purposes, all of which use relatively little water. As Alberta grows, the water needs of industry are sure to grow alongside, especially to service additional electrical generation. The extent to which water efficiencies can be found here are unclear, although there are some hopeful signs. The potential of wind power is one such alternative.

As of 2009, Alberta had 500 megawatts (MW) of wind power connected to the provincial electrical grid, providing 4% of total electrical capacity. This is enough to power 500,000 homes. While approximately 11,000 MW of wind power projects have applied to connect to the transmission system, managing wind power is neither easy or straightforward (Alberta Energy 2009). The amount of power being supplied to the electrical system has to be balanced with demand across the province at all times. Because wind can change quickly — both starting and stopping — wind power carries the risk of causing an imbalance in the electricity system. When wind suddenly stops, conventional generation must be immediately put online to offset the imbalance. When wind suddenly starts, power must be immediately expended.

Changes in forestry practices have also been encouraging. Forests — like wetlands — are important water purifiers and filters. Better forestry practices include reducing the size of clear-cuts, more selective logging, and better rates of reclamation. Today, almost 90% of forestry sites are regenerated within ten years of the initial harvest (National Water Research Institute 2004).

Petroleum

Almost 80% of all water allocated for the petroleum sector is reserved for the oil sands, with 65% allocated for oil sands mining and 12% for thermal or in-situ recovery through cyclic steam stimulation (CSS) or steam assisted gravity drainage (SAGD). Another 13% is allocated for gas and petrochemical plants, and 10% for oilfield injection purposes. Here too, there have been some dramatic changes in how water is being used.

As conventional oil and gas reserves decline, Alberta has seen an increase in oilfield injection to enhance recovery. This has not, however, correlated with an increase in water used for this purpose. For example, in 1975 about 80 million m^3 of water was injected for enhanced recovery. In 2007, less than 60 million m^3 was used. This is a clear gain in water efficiency. Perhaps more important, the type of water being used for injection has also changed. In 1975, about 80% of the water used for oilfield injection came from fresh surface water sources. In 2007, about 40% of all oilfield injection came from fresh surface water sources. The use of saline or brackish groundwater for oilfield injection has grown from 2% in 1975 to over 40% in 2007 (Alberta Energy Resources Conservation Board 2006).

The search for water efficiencies is also ongoing in the oil sands. Petro-Canada's Mackay River in-situ project is instructive in this regard. Mackay River is a fully-functioning zero liquid discharge SAGD operation where brackish groundwater comes up with the bitumen. This water is treated and then heated to produce steam. Petro-Canada claims that more than 90% of this water is continuously recycled, and the operation withdraws very little water from underground aquifers. While the oil sands industry standard is typically 2-5 barrels of water for each barrel of oil produced, Petro-Canada's Mackay River operation uses 1/6th of a barrel of new water for each barrel of oil (CAPP 2008). If oil sands expansion is to continue to any large degree, such efficiency gains will become even more important.

Municipalities

The actual usage of water in an average Alberta municipality has proven difficult to estimate. Most commentators, however, believe that about 55% of municipal water use is for residential purpose, 35% is for industrial and commercial purpose, and 10% is for institutional purpose. Municipalities in Alberta have been very active in trying to secure increased water efficiencies. Developments within the City of Calgary provide but one example.

Calgary's population has increased steadily for the last 25 years, but the amount of per capita water used has declined over the same time. In 1979, about 800 litres of water per person per day was being used in Calgary. By 2005, water usage had fallen to 500 litres per day per person (City of Calgary 2007). Calgary's total water use has increased at a slower rate than the population has increased — a clear water efficiency gain.

In 2005, the City also passed changes to its Water Utility Bylaw, which now requires all new homes and commercial construction — including renovations that require a plumbing permit — to install low water use fixtures. For example, toilets must use no more than 6.0 litres per flush and urinals no more than 3.8 litres per flush. Public restroom faucets must have a flow not larger than 1.8 litres per minute. New homes and renovations must use showerheads restricted to no more than 9.5 litres per minute. Faucets are restricted to no more than 8.3 litres per minute (City of Calgary 2006).

Environment and Management

Water management and environmental purposes hold about 6% of all provincial water allocations, of which 70% are allocated for flood control, stabilizing lakes and reservoirs, and other water management purposes, and 30% are allocated for ecosystem and habitat preservation, and restoring wetlands. The majority of these licences have been issued to Alberta Environment itself and Ducks Unlimited.

Commercial

Water allocations for commercial purposes constitute less than 1% of all water allocations. Within this sector, about 55% of the water is used to irrigate parks and golf courses, and provide other recreational opportunities. Another 20% is used for food processing and beverage bottling. Efficiency gains across this sector are difficult to measure — much of the water is self-supplied and the total water used is very small. The sector has not been a focus for efficiency gains.

In many places and in many ways, Albertans are doing more with less water. There is a history here upon which the province can and must build. In an era marked by growing water demand and diminishing supply, Albertans cannot rest on their laurels. Rather, the challenge is to push the water efficiency and productivity envelope even further.

SOURCE:

Alberta Agriculture, Food and Rural Development. 2004. Irrigation Development in Alberta.

Alberta Agriculture and Food. 2000. Irrigation in Alberta.

Alberta Energy. 2009. Talk About Wind Power.

Alberta Energy Resources Conservation Board. 2006. Water Source Tables.

Canadian Association of Petroleum Producers (CAPP). 2008. Canada's Oil Sands.

City of Calgary. 2007. Calgary's Demand for Water.

City of Calgary. 2006. Low Water Use Fixture Requirements FAQ.

2. Broad Alberta View

In 2005, water licences issued by the Government of Alberta allowed 9.563 billion cubic meters (m^3) of water to be withdrawn or diverted from surface and groundwater sources across the province *(see Figure 9)*. As already noted, 97% of these allocations apply to surface water, with the great majority of them drawing on the province's various rivers. With an average annual river flow of some 131.159 billion m^3, current allocations represent 7.3% of Alberta's total river flow. Actual consumption of that water is estimated to be much lower — about one-third of all allocations. In 2005, Alberta Environment estimates that about 3.304 billion m^3 of water was actually consumed, or about 2.5% of the province's average annual flow.

At first glance, these numbers would not appear to be a cause of much concern. After all, Albertans are licensed to use less than 10% of the water in provincial rivers, and much of that water is not even consumed. What is the problem?

Well, there are at least three. First, Alberta's river flows are highly variable. Withdrawing 1% of a river's flow over a short period during high spring run-off is one thing. Withdrawing 50% over an extended season of much lower flow is another matter altogether, regardless of how the numbers shake out at the end of the year. Second, Alberta's river flows are unpredictable. A particularly dry year presents the prospects of dramatically lower flows at the same time that demand rises. Not only are more allocations put into play, but more of each allocation is used as well. Third, the province-wide data tells us nothing about the impact of current water use on individual river basins.

3. A View From The River

When it comes to water usage in Alberta, there is a sharp distinction to draw between the province's northern river basins and the southern river basins. Almost 90% of all water allocations in Alberta are held in only two basins — the North Saskatchewan and the South Saskatchewan *(see Figure 10)*. The Peace River, which represents almost 70% of all river flow in Alberta, has less than 3% of the province's licensed allocations. When it comes to water consumption, almost 80% is estimated to occur in just one river basin — the South Saskatchewan.

Figure 9: River Flows, Allocations, and Consumption by Major River Basins and Sectors, 2005

(000s of Cubic Meters or m^3)

Water Allocations

Major River Basin	Average Annual Flow	Agricultural Allocations	Industrial Allocations	Municipal Allocations	Petroleum Allocations	Management Allocations	Commercial Allocations	Total Alberta Allocations
Hay	4,516,000	9	0	686	4,968	960	25	6,648
Peace	89,091,000	9,161	90,690	27,140	20,586	92,437	3,383	243,397
Athabasca	19,962,000	12,597	145,364	46,097	581,791	59,989	3,802	849,640
Beaver	613,000	2,199	3	11,708	21,112	12,114	322	47,458
North Saskatchewan	7,555,000	60,146	2,352,460	186,351	103,434	87,382	18,563	2,808,336
South Saskatchewan	9,262,000	4,168,608	76,229	803,574	69,727	365,110	61,724	5,544,972
Milk	160,000	54,704	0	2,539	0	4,310	810	62,363
Total	**131,159,000**	**4,307,424**	**2,664,746**	**1,078,095**	**801,618**	**622,302**	**88,629**	**9,562,814**

Water Consumption

Major River Basin	Average Annual Flow	Agricultural Consumption	Industrial Consumption	Municipal Consumption	Petroleum Consumption	Management Consumption	Commercial Consumption	Total Alberta Consumption
Hay	4,516,000	9	0	281	1,680	960	25	2,955
Peace	89,091,000	6,943	9,950	1,457	6,915	89,833	3,378	118,476
Athabasca	19,962,000	9,699	22,567	5,508	183,665	47,508	3,750	272,697
Beaver	613,000	2,169	3	750	9,183	5,016	322	17,443
North Saskatchewan	7,555,000	44,430	101,090	12,965	31,653	70,077	15,237	275,452
South Saskatchewan	9,262,000	2,106,967	52,178	107,845	28,162	224,114	43,215	2,562,481
Milk	160,000	48,229	0	2,060	0	3,744	810	54,843
Total	**131,159,000**	**2,218,446**	**185,788**	**130,866**	**261,258**	**441,252**	**66,737**	**3,304,347**

SOURCE:

Derived by Canada West Foundation by merging data presented in two statistical studies. See Government of Alberta. 2008. Water for Life: Current and Future Water Use in Alberta. Edmonton, AB. See also Alberta Economic Development Authority. 2008. Sustainable Water Management and Economic Development in Alberta. Calgary, AB.

NOTE:

Consumption by some sectors and in some river basins was estimated or assumed to be 100% of allocations due to a lack of data on return flows.

FIGURE 10: Allocations and Consumption by Major River Basin as a % of the Provincial Total, 2005

Summary Data

Major River Basin	% of Alberta Allocations	% of Alberta Consumption
Hay	0.1%	0.1%
Peace	2.5%	3.6%
Athabasca	8.9%	8.3%
Beaver	0.5%	0.5%
North Saskatchewan	29.4%	8.3%
South Saskatchewan	58.0%	77.5%
Milk	0.7%	1.7%
Total	**100.0%**	**100.0%**

Sectoral Details of Allocations

Major River Basin	Agricultural Allocations	Industrial Allocations	Municipal Allocations	Petroleum Allocations	Management Allocations	Commercial Allocations	% of Alberta Allocations
Hay	0.0%	0.0%	0.1%	0.6%	0.2%	0.0%	0.1%
Peace	0.2%	3.4%	2.5%	2.6%	14.9%	3.8%	2.5%
Athabasca	0.3%	5.5%	4.3%	72.6%	9.6%	4.3%	8.9%
Beaver	0.1%	0.0%	1.1%	2.6%	1.9%	0.4%	0.5%
North Saskatchewan	1.4%	88.3%	17.3%	12.9%	14.0%	20.9%	29.4%
South Saskatchewan	96.8%	2.9%	74.5%	8.7%	58.7%	69.6%	58.0%
Milk	1.3%	0.0%	0.2%	0.0%	0.7%	0.9%	0.7%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Sectoral Details of Consumption

Major River Basin	Agricultural Consumption	Industrial Consumption	Municipal Consumption	Petroleum Consumption	Management Consumption	Commercial Consumption	% of Alberta Consumption
Hay	0.0%	0.0%	0.2%	0.6%	0.2%	0.0%	0.1%
Peace	0.3%	5.4%	1.1%	2.6%	20.4%	5.1%	3.6%
Athabasca	0.4%	12.1%	4.2%	70.3%	10.8%	5.6%	8.3%
Beaver	0.1%	0.0%	0.6%	3.5%	1.1%	0.5%	0.5%
North Saskatchewan	2.0%	54.4%	9.9%	12.1%	15.9%	22.8%	8.3%
South Saskatchewan	95.0%	28.1%	82.4%	10.8%	50.8%	64.8%	77.5%
Milk	2.2%	0.0%	1.6%	0.0%	0.8%	1.2%	1.7%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

SOURCE:

Derived by Canada West Foundation from Government of Alberta. 2008. Water for Life: Current and Future Water Use in Alberta. Edmonton, AB.

NOTE:

Consumption by some sectors and in some river basins was estimated or assumed to be 100% of allocations due to a lack of data on return flows.

Existing allocations on southern river basins also represent a very high percentage of average annual river flows *(see Figure 11)*. For example, almost 60% of the average annual flow across the South Saskatchewan River Basin has been allocated, while 40% of the average flow in the North Saskatchewan and the Milk has been allocated. It is much the same with consumption. About 35% of the average annual flow in the Milk River basin is consumed, while 28% of the flow in the South Saskatchewan River basin is consumed.

The proportion of allocations consumed in each of the major basins also differs *(see Figure 12)*. While almost 90% of all allocations in the Milk River basin are estimated to be consumed, the rate of consumption is only 10% of all allocations in the North Saskatchewan basin. In the remaining basins, the percentage of allocations consumed ranges from 40% to 50%. All of these differences between Alberta's river basins are intimately connected with the various sectors that are using the water.

4. A View From The Economic Sectors

Water use in Alberta is typically divided among six sectors that include agriculture, industry, municipalities (providing residential, industrial, institutional, and commercial users with water through municipal licence), petroleum production, management (flood and flow control and environmental protection and enhancement), and commercial use that is largely self-supplied. Agriculture represents 45% of all provincial allocations, industry 28%, municipalities 11%, and petroleum production 8%. Water management allocations represent 7% and commercial allocations represent 1% *(see Figure 13)*.

The water usage and consumption patterns of each sector are very different. Agriculture not only holds the biggest share of provincial water allocations, it is also the highest water consuming sector. In 2005, agriculture constituted 70% of all water consumption in the province. Most other sectors constitute between 5% to 10% of all consumption in Alberta. The rate at which each sector's allocations are consumed also differs. Only 7% of all industrial allocations in Alberta are estimated to be consumed, compared to over 50% of all agricultural allocations. These sectoral differences are fundamental to understanding water usage and consumption in Alberta, particularly when they meet up with individual river basins.

5. A View From The Intersection

Sectoral allocations on the various river basins in Alberta differ widely. As a result, the overall impact of water use and consumption on the various river basins is different as well. The intersection here is defined by the fact that certain river basins are dominated by certain sectors. Several distinct patterns are evident *(all data are detailed in Figures 10-13)*.

- Agriculture: The impact of agriculture (45% of all provincial water allocations) lands overwhelmingly on the South Saskatchewan River Basin, which holds 97% of all provincial agriculture water allocations and where 95% of all provincial agricultural consumption also occurs.

FIGURE 11: Allocations and Consumption by Major River Basin as a % of the Provincial Average Annual Flows, 2005

Summary Data

Major River Basin	Allocations as a % of Alberta Flow	Consumption as a % of Alberta Flow
Hay	0.1%	0.1%
Peace	0.3%	0.1%
Athabasca	4.3%	1.4%
Beaver	7.7%	2.8%
North Saskatchewan	37.2%	3.6%
South Saskatchewan	59.9%	27.7%
Milk	39.0%	34.3%
Total	**7.3%**	**2.5%**

Sectoral Details of Allocations

Major River Basin	Agricultural Allocations	Industrial Allocations	Municipal Allocations	Petroleum Allocations	Management Allocations	Commercial Allocations	Allocations as a % of Alberta Flow
Hay	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%
Peace	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.3%
Athabasca	0.1%	0.7%	0.2%	2.9%	0.3%	0.0%	4.3%
Beaver	0.4%	0.0%	1.9%	3.4%	2.0%	0.1%	7.7%
North Saskatchewan	0.8%	31.1%	2.5%	1.4%	1.2%	0.2%	37.2%
South Saskatchewan	45.0%	0.8%	8.7%	0.8%	3.9%	0.7%	59.9%
Milk	34.2%	0.0%	1.6%	0.0%	2.7%	0.5%	39.0%
Total	**3.3%**	**2.0%**	**0.8%**	**0.6%**	**0.5%**	**0.1%**	**7.3%**

Sectoral Details of Consumption

Major River Basin	Agricultural Consumption	Industrial Consumption	Municipal Consumption	Petroleum Consumption	Management Consumption	Commercial Consumption	Consumption as a % of Alberta Flow
Hay	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
Peace	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.1%
Athabasca	0.0%	0.1%	0.0%	0.9%	0.2%	0.0%	1.4%
Beaver	0.4%	0.0%	0.1%	1.5%	0.8%	0.1%	2.8%
North Saskatchewan	0.6%	1.3%	0.2%	0.4%	0.9%	0.2%	3.6%
South Saskatchewan	22.7%	0.6%	1.2%	0.3%	2.4%	0.5%	27.7%
Milk	30.1%	0.0%	1.3%	0.0%	2.3%	0.5%	34.3%
Total	**1.7%**	**0.1%**	**0.1%**	**0.2%**	**0.3%**	**0.1%**	**2.5%**

SOURCE:

Derived by Canada West Foundation by merging data presented in two statistical studies. See Government of Alberta. 2008. Water for Life: Current and Future Water Use in Alberta. Edmonton, AB. See also Alberta Economic Development Authority. 2008. Sustainable Water Management and Economic Development in Alberta. Calgary, AB.

NOTE: Consumption by some sectors and in some river basins was estimated or assumed to be 100% of allocations due to a lack of data on return flows.

FIGURE 12: Allocations Consumed in Major River Basins and by Sector, 2005

Summary Data

Major River Basin	% of Allocations Consumed
Hay	44.4%
Peace	48.7%
Athabasca	32.1%
Beaver	36.8%
North Saskatchewan	9.8%
South Saskatchewan	46.2%
Milk	87.9%
Total	**34.6%**

Economic Sector	% of Allocations Consumed
Agricultural	51.5%
Industrial	7.0%
Municipal	12.1%
Petroleum	32.6%
Management	70.9%
Commercial	75.3%
Total	**34.6%**

Sectoral and River Basin Details

Major River Basin	Agricultural % Allocations Consumed	Industrial % Allocations Consumed	Municipal % Allocations Consumed	Petroleum % Allocations Consumed	Management % Allocations Consumed	Commercial % Allocations Consumed	Total % Allocations Consumed
Hay	100.0%	0.0%	41.0%	33.8%	100.0%	100.0%	44.4%
Peace	75.8%	11.0%	5.4%	33.6%	97.2%	99.9%	48.7%
Athabasca	77.0%	15.5%	11.9%	31.6%	79.2%	98.6%	32.1%
Beaver	98.6%	100.0%	6.4%	43.5%	41.4%	100.0%	36.8%
North Saskatchewan	73.9%	4.3%	7.0%	30.6%	80.2%	82.1%	9.8%
South Saskatchewan	50.5%	68.4%	13.4%	40.4%	61.4%	70.0%	46.2%
Milk	88.2%	0.0%	81.1%	0.0%	86.9%	100.0%	87.9%
Total	**51.5%**	**7.0%**	**12.1%**	**32.6%**	**70.9%**	**75.3%**	**34.6%**

SOURCE:

Derived by Canada West Foundation from Government of Alberta. 2008. Water for Life: Current and Future Water Use in Alberta. Edmonton, AB.

NOTE:

Consumption by some sectors and in some river basins was estimated or assumed to be 100% of allocations due to a lack of data on return flows.

FIGURE 13: Allocations and Consumption by Sector as a % of the Provincial Total, 2005

Summary Data

Economic Sector	% of Alberta Allocations	% of Alberta Consumption
Agricultural	45.0%	67.1%
Industrial	27.9%	5.6%
Municipal	11.3%	4.0%
Petroleum	8.4%	7.9%
Management	6.5%	13.4%
Commercial	0.9%	2.0%
Total	**100.0%**	**100.0%**

Sectoral Details of Allocations

Major River Basin	Agricultural Allocations	Industrial Allocations	Municipal Allocations	Petroleum Allocations	Management Allocations	Commercial Allocations	Total Allocations
Hay	0.1%	0.0%	10.3%	74.7%	14.4%	0.4%	100.0%
Peace	3.8%	37.3%	11.2%	8.5%	38.0%	1.4%	100.0%
Athabasca	1.5%	17.1%	5.4%	68.5%	7.1%	0.4%	100.0%
Beaver	4.6%	0.0%	24.7%	44.5%	25.5%	0.7%	100.0%
North Saskatchewan	2.1%	83.8%	6.6%	3.7%	3.1%	0.7%	100.0%
South Saskatchewan	75.2%	1.4%	14.5%	1.3%	6.6%	1.1%	100.0%
Milk	87.7%	0.0%	4.1%	0.0%	6.9%	1.3%	100.0%
Total	**45.0%**	**27.9%**	**11.3%**	**8.4%**	**6.5%**	**0.9%**	**100.0%**

Sectoral Details of Consumption

Major River Basin	Agricultural Consumption	Industrial Consumption	Municipal Consumption	Petroleum Consumption	Management Consumption	Commercial Consumption	Total Consumption
Hay	0.3%	0.0%	9.5%	56.9%	32.5%	0.8%	100.0%
Peace	5.9%	8.4%	1.2%	5.8%	75.8%	2.9%	100.0%
Athabasca	3.6%	8.3%	2.0%	67.4%	17.4%	1.4%	100.0%
Beaver	12.4%	0.0%	4.3%	52.6%	28.8%	1.8%	100.0%
North Saskatchewan	16.1%	36.7%	4.7%	11.5%	25.4%	5.5%	100.0%
South Saskatchewan	82.2%	2.0%	4.2%	1.1%	8.7%	1.7%	100.0%
Milk	87.9%	0.0%	3.8%	0.0%	6.8%	1.5%	100.0%
Total	**67.1%**	**5.6%**	**4.0%**	**7.9%**	**13.4%**	**2.0%**	**100.0%**

SOURCE:

Derived by Canada West Foundation from Government of Alberta. 2008. Water for Life: Current and Future Water Use in Alberta. Edmonton, AB.

NOTE:

Consumption by some sectors and in some river basins was estimated or assumed to be 100% of allocations due to a lack of data on return flows.

While the Milk River Basin comprises only a small share of province-wide allocations and consumption because of its relatively small size, the impact of agriculture there is equally felt. Agriculture accounts for 88% of the allocated flow in the Milk River Basin and 88% of any allocated flow consumed. Agriculture's impact here is largely due to the favourable growing conditions in southern Alberta, which has fertile soils, hot summers, high heat units, plenty of sunshine, and a long growing season. But annual precipitation is less than half of what is required, so the region relies heavily on irrigation, much of it from the province's smallest river systems. It is in the south where the province's 13 large irrigation districts are located, largely defined by a geographical triangle marked by Calgary in the northwest, Medicine Hat in the southeast, and Lethbridge in the southwest. Since the south is where most of the forage is also grown, it is also home to a significant share of provincial livestock production. The agricultural sector has little to no impact on other Alberta river basins, at least relative to the impact on the South Saskatchewan and Milk River basins.

» Industry: The impact of industry (28% of all provincial water allocations) lands with disproportionate force on the North Saskatchewan River Basin, which holds almost 90% of all provincial industrial allocations and where 54% of all industrial consumption of water occurs. In the North Saskatchewan, 84% of all the flow allocated is for industrial purposes such as chemical plants, fertilizer plants, manufacturing, and especially thermal power production, which alone accounts for 95% of all allocations on the river, primarily for generating steam and for cooling. While industry accounts for the second largest share of total water allocations in the province, much of that water is eventually returned rather than consumed. In the North Saskatchewan River Basin, only about 4% of all water allocations are eventually consumed. While industrial allocations constitute a much smaller percentage of water allocations in most other river basins, they cannot be completely discounted. For example, take the hydro projects on the Bow in the South Saskatchewan River Basin. While hydro supplies only 5% of Alberta's total power needs, it does constitute 85% of the province's "peak power" capacity. Hydro, in other words, feeds the peaks in electrical demand. Coal-fired thermal power plants cannot meet these peaks because they cannot be switched "on-and-off."

» Municipalities: The water needs of Alberta's municipalities (11% of all provincial water allocations) also lands squarely on the South Saskatchewan River Basin (SSRB) where 75% of the province's municipal water allocations are found. Again, most of Alberta's population is located in the south, and most of that population lives within the SSRB. The basin is home to four of Alberta's largest cities, including Red Deer, Calgary, Medicine Hat, and Lethbridge. Like industrial usage on the North Saskatchewan, however, municipal consumption rates are generally quite low. Only about 13% of all municipal allocations in the SSRB are consumed. The remainder of the allocation is eventually returned to the watercourse, or in the case of some large licence holders like the City of Calgary, the full allocation is not typically withdrawn.

- Petroleum production: There are few areas of the province that remain untouched by activities of the oil and gas sector (8% of all provincial water allocations), whether that be conventional oil and gas wells, enhanced recovery through oilfield injection, coalbed methane production, or the oil sands. Every river basin with the singular exception of the Milk has at least some allocations held by oil and gas producers. However, the industry does land with the most impact on the Athabasca River Basin, where 75% of all petroleum allocations are found. This is largely the result of the water needed for the oil sands.
- Management: The river sub-basins that comprise the South Saskatchewan River Basin are among Alberta's most aggressively managed watercourses. It is no surprise, then, that almost 60% of all water management, habitat, and environmental and ecosystem protection allocations are on the South Saskatchewan. The complex infrastructure of dams, storage reservoirs, and irrigation works requires water use of its own, and the high water usage and consumption in the South Saskatchewan River Basin has prompted numerous allocations to reserve portions of the watercourse for habitat protection and other environmental objectives.
- Commercial: Self-supplied commercial use and consumption of water represents only a very small fraction of the total allocations (0.9% of all provincial water allocations). But even here, 70% of those allocations also reside in the South Saskatchewan River Basin.

Two conclusions emerge from the above. First, while there are certainly a wide variety of sectors in play across Alberta, their relative reliance and impact on various provincial river basins differs dramatically. Only 3% of industrial allocations are found in the South Saskatchewan River Basin, only 1% of agriculture allocations are found in the North Saskatchewan River Basin, and both the Hay and Peace Rivers remain relatively untouched. On the other hand, 88% of all industrial allocations are on the North Saskatchewan River Basin while 75% of all petroleum allocations are on the Athabasca.

Second, and even more important, attention must clearly focus on the South Saskatchewan River Basin, where almost 60% of all water allocations in the province are found, and where 80% of all water consumption in Alberta occurs *(see Discussion Box 7)*. Unlike all other river basins in Alberta, the South Saskatchewan is where all sectors are actively in play, many of them decisively so. Almost 97% of all agriculture allocations, 75% of all municipal allocations, 60% of all management allocations, and 70% of all commercial allocations are found in this one river basin alone. While the impact of industrial allocations and petroleum is significantly lower, they too are competing for water.

This is not to say that Alberta's water concerns are limited to the South Saskatchewan. There are a range of concerns that speak to every major river basin in the province. While there is little concern with overdrawing water from the Peace River, that does not detract from concerns over the effluent from pulp and paper mills, for example. In the North Saskatchewan, most of the water for industrial use is eventually returned, but often at temperatures that are higher, with attendant concerns over fish habitat. Concerns in the Athabasca spin around such water quality concerns as well as quantity. In the Athabasca, there are issues with water withdrawals during low flow periods in addition to both current concerns and the future threat posed by oil sands tailing ponds.

But in the South Saskatchewan River Basin, concerns over water quality and quantity are coupled with intense intersectoral competition, and the stakes have now been raised. On August 31, 2006 Alberta Environment closed off the South Saskatchewan River Basin (SSRB) by announcing that no new surface water licences would be issued for the Oldman River (including the St. Mary, Belly, and Waterton Rivers), the Bow River, and the South Saskatchewan River. While the Red Deer River was exempted, Alberta Environment stated that surface water allocations on the Red Deer River would be subject to a cap. When allocations reach 550 million m^3 the province will undertake a thorough review to identify the maximum allocation for the Red Deer (AEDA 2008). In 2007, allocations in the Red Deer River were 373 m^3. The other major river basin in southern Alberta — the Milk — has seen no new water allocations issued since 2000 (Water Matters 2010).

In short, the South Saskatchewan River Basin has reached the limit, if not surpassed it. It is at the South Saskatchewan where any "collision" in the intersection is most likely to occur. The sound of sirens could already be heard during the drought of 2001-2002, when the combined allocations across the SSRB exceeded discharge for the first time (Alberta Environment 2004b). Water rationing was introduced, irrigation districts provided less water to farmers, holders of junior licences found themselves water-short, sharing and trading of water occurred, and Alberta just barely met its obligation to pass half of the flow onto Saskatchewan as required by the 1969 *Master Agreement on Apportionment* (about 54% of the severely diminished SSRB flow was passed on). Clearly, a sharp focus on the SSRB is warranted. At the same time, Albertans need to realize that what is happening in the SSRB is both symbolic and symptomatic of what might begin happening in other river basins as well.

Discussion Box 7: Focus on the South Saskatchewan River Basin (SSRB)

Just like the provincial picture, the smaller sub-basins that make up the South Saskatchewan River Basin (SSRB) are unique as well *(see Charts 1-5 at the end of Discussion Box 7)*. The largest rivers in the SSRB are the Bow River and the Oldman River, which together comprise 79% of the total flow in the basin. The Red Deer River comprises 20%. Because the South Saskatchewan River collects and drains a very dry area, the incremental water that it adds to the system — independent of flows contributed by the Bow and Oldman rivers — comprises less than 1% of total SSRB flows.

The Bow and the Oldman are the most heavily used rivers, containing almost 90% all allocations in the SSRB and 90% of all water consumed. About 67% of the average annual flow in the Bow and 66% of the average annual flow in the Oldman have been allocated by the time the two join to form the South Saskatchewan River. Allocations on the Red Deer are about 20% of average annual flows. Allocations on the South Saskatchewan River exceed estimated flow because they were calculated on the incremental water drained and carried by that river itself, ignoring the flow contributed by the Bow and Oldman. In other words, allocations along the South Saskatchewan River itself are very dependent on water that originates in the Bow and Oldman sub-basins. Without that contribution, allocations along the South Saskatchewan River would outstrip the available flow by a factor of four to five times what is available.

When it comes to the various sectors, the weight of agriculture lands heaviest on the Bow and the Oldman, which together hold 96% of all agricultural allocations in the SSRB. Almost 77% of all allocations on the Bow are for agriculture, as are 87% of all allocations on the Oldman. Agricultural allocations on the Red Deer and South Saskatchewan are 25% to 30% of all allocations.

Thus, there are some differences within the SSRB itself in terms of what sectors land on what rivers. For example, the Bow River holds the largest share of all industrial allocations in the SSRB (45%) and the largest share of municipal allocations (62%). On the other hand, industrial allocations are non-existent on the Oldman. Usage patterns in the Red Deer River also diverge. The Red Deer River holds only 3% of all SSRB agricultural allocations, but over 70% of all SSRB allocations for petroleum. Unlike other rivers in the SSRB, the majority of allocations in the South Saskatchewan River (60%) are for municipalities. While the Bow holds the lion's share of all municipal allocations, they still constitute only 19% of all allocations on the Bow.

The long-term sustainability of water use in the SSRB has been called into question — total allocations in the basin approach 60% of average annual flows and allocations in the two most important tributaries approach 70%. While actual consumption of water across the SSRB is estimated at just under 30% of average annual flows, this level of consumption may be increasingly unsustainable.

First, consuming 30% of the average flow leaves 70% of the water in the river during an average year. But again, this is merely an average. A reduction in annual flow from one year to the next will increase the relative amount of water consumed. What is more, some studies estimate that as much as 85% of the natural flow is needed if the water ecosystem is to be maintained, protected, enhanced, and sustained over the long-term. This level is already significantly out of reach right across the SSRB, and was clearly recognized in background studies for the South Saskatchewan River Basin Water Management Plan:

> *"Meeting instream flow needs in the Bow and Oldman river downstream of the major water withdrawals requires more flow than is presently available. With existing allocations, restoring flows to these reaches would be very difficult."*
>
> — Alberta Environment, South Saskatchewan River Basin Water Management Plan, 2003.

Second, while it may be possible to easily meet all allocations for use and pass enough water onto Saskatchewan during a normal or wet year, the prospect of a very dry year or set of dry years is a different matter. When flows are down and more of the allocations are put into play, Alberta might find it increasingly difficult to pass on sufficient flows that it has guaranteed to Saskatchewan under the apportionment agreement. Since this cannot happen, that means junior allocations will go without, and this has already happened. Water shortages in the SSRB are very much a present reality.

Third, while there is bound to be interruptions in the annual flows in the SSRB across the short-term due to variable conditions, there is also the very real threat of longer-term reductions in water flow. If the SSRB becomes increasingly subjected to warmer temperatures, higher rates of evaporation, and lower flows, it may prove difficult to furnish current licence holders with the water that has been allocated to them. Annual and seasonal variability is one concern. A continually diminishing water resource is another concern altogether.

In the end, the Government of Alberta has concluded that there is simply not enough water under even the most modest of growth scenarios. Existing water licences and allocations, the water needed to enhance and protect the aquatic environment, the need to pass half of all water flow onto Saskatchewan, and the water needed to accommodate future growth, when combined, exceed the water that is available.

The 2006 closure of the Bow, the Oldman, and the South Saskatchewan rivers to any new allocations of surface water, and the cap on new surface water allocations in the Red Deer river sub-basin, means the search for any substantial sources of "new" water must be found within the current allocations already held. The only other possible source would be groundwater, which may or may not provide sufficient amounts given anticipated growth, where questions of quality remain, and where depletion here may only exacerbate issues of over-use already experienced across the basin given the interconnection between groundwater and surface water flows.

In short, "supply-side" solutions may offer little relief for the SSRB. The focus must now turn toward a range of less familiar options for most Albertans — water conservation, demand management, water efficiency, increased water productivity, water recycling and re-use, and even the trading of water licences.

Chart 1: River Flows, Allocations, and Consumption by SSRB Sub-Basins and Sectors, 2005

(000s of Cubic Meters or m^3)

Water Allocations

SSRB Sub-Basin	Average Annual Flow	Agricultural Allocations	Industrial Allocations	Municipal Allocations	Petroleum Allocations	Management Allocations	Commercial Allocations	Total SSRB Allocations
Bow	3,908,000	1,987,447	34,100	500,472	9,556	30,666	35,648	2,597,889
Oldman	3,453,000	1,998,753	11	64,149	4,270	211,124	14,094	2,292,401
Red Deer	1,837,000	107,447	22,315	69,339	49,021	114,640	9,947	372,709
South Saskatchewan	64,000	74,961	19,803	169,614	6,880	8,680	2,035	281,973
Total	**9,262,000**	**4,168,608**	**76,229**	**803,574**	**69,727**	**365,110**	**61,724**	**5,544,972**

Water Consumption

SSRB Sub-Basin	Average Annual Flow	Agricultural Consumption	Industrial Consumption	Municipal Consumption	Petroleum Consumption	Management Consumption	Commercial Consumption	Total SSRB Consumption
Bow	3,908,000	1,013,800	20,925	60,321	1,409	2,912	24,742	1,124,109
Oldman	3,453,000	962,258	11	16,568	993	150,821	10,331	1,140,982
Red Deer	1,837,000	94,899	13,893	22,753	21,317	63,360	6,691	222,913
South Saskatchewan	64,000	36,010	17,349	8,203	4,443	7,021	1,451	74,477
Total	**9,262,000**	**2,106,967**	**52,178**	**107,845**	**28,162**	**224,114**	**43,215**	**2,562,481**

SOURCE:

Derived by Canada West Foundation by merging data presented in three statistical studies. See Government of Alberta. 2008. Water for Life: Current and Future Water Use in Alberta. Edmonton, AB. See also Alberta Economic Development Authority. 2008. Sustainable Water Management and Economic Development in Alberta. Calgary, AB. See also Alberta Environment. 2003. South Saskatchewan River Basin Water Management Plan (Phase 2 Background Studies). Edmonton, AB.

NOTE:

Consumption by some sectors and in some river basins was estimated or assumed to be 100% of allocations due to a lack of data on return flows. Flows of the various sub-basins (except the Red Deer) were estimated based on their estimated share of total SSRB flows as suggested in the SSRB Water Management Plan. The proportions are: Bow River (42%); Oldman (37%); South Saskatchewan (0.7%). Flows of the Red Deer River were stipulated in the Water for Life document as was the SSRB total annual average flow.

Chart 2: Allocations and Consumption by Sub-Basin as a % of the SSRB Total, 2005

Summary Data

SSRB Sub-Basin	% of SSRB Allocations	% of SSRB Consumption
Bow	46.9%	43.9%
Oldman	41.3%	44.5%
Red Deer	6.7%	8.7%
South Saskatchewan	5.1%	2.9%
Total	**100.0%**	**100.0%**

Sectoral Details of Allocations

SSRB Sub-Basin	Agricultural Allocations	Industrial Allocations	Municipal Allocations	Petroleum Allocations	Management Allocations	Commercial Allocations	% of SSRB Allocations
Bow	47.7%	44.7%	62.3%	13.7%	8.4%	57.8%	46.9%
Oldman	47.9%	0.0%	8.0%	6.1%	57.8%	22.8%	41.3%
Red Deer	2.6%	29.3%	8.6%	70.3%	31.4%	16.1%	6.7%
South Saskatchewan	1.8%	26.0%	21.1%	9.9%	2.4%	3.3%	5.1%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Sectoral Details of Consumption

SSRB Sub-Basin	Agricultural Consumption	Industrial Consumption	Municipal Consumption	Petroleum Consumption	Management Consumption	Commercial Consumption	% of SSRB Consumption
Bow	48.1%	40.1%	55.9%	5.0%	1.3%	57.3%	43.9%
Oldman	45.7%	0.0%	15.4%	3.5%	67.3%	23.9%	44.5%
Red Deer	4.5%	26.6%	21.1%	75.7%	28.3%	15.5%	8.7%
South Saskatchewan	1.7%	33.2%	7.6%	15.8%	3.1%	3.4%	2.9%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

SOURCE:

Derived by Canada West Foundation from data in Government of Alberta. 2008. Water for Life: Current and Future Water Use in Alberta. Edmonton, AB.

NOTE:

Consumption by some sectors and in some river basins was estimated or assumed to be 100% of allocations due to a lack of data on return flows.

Chart 3: Allocations and Consumption by Sub-Basin as a % of SSRB Average Annual Flows, 2005

Summary Data

SSRB Sub-Basin	Allocations as a % of SSRB Flow	Consumption as a % of SSRB Flow
Bow	66.5%	28.8%
Oldman	66.4%	33.0%
Red Deer	20.3%	12.1%
South Saskatchewan	440.6%	116.4%
Total	**59.9%**	**27.7%**

Sectoral Details of Allocations

SSRB Sub-Basin	Agricultural Allocations	Industrial Allocations	Municipal Allocations	Petroleum Allocations	Management Allocations	Commercial Allocations	Allocations as a % of SSRB Flow
Bow	50.9%	0.9%	12.8%	0.2%	0.8%	0.9%	66.5%
Oldman	57.9%	0.0%	1.9%	0.1%	6.1%	0.4%	66.4%
Red Deer	5.8%	1.2%	3.8%	2.7%	6.2%	0.5%	20.3%
South Saskatchewan	117.1%	30.9%	265.0%	10.8%	13.6%	3.2%	440.6%
Total	**45.0%**	**0.8%**	**8.7%**	**0.8%**	**3.9%**	**0.7%**	**59.9%**

Sectoral Details of Consumption

SSRB Sub-Basin	Agricultural Consumption	Industrial Consumption	Municipal Consumption	Petroleum Consumption	Management Consumption	Commercial Consumption	Consumption as a % of SSRB Flow
Bow	25.9%	0.5%	1.5%	0.0%	0.1%	0.6%	28.8%
Oldman	27.9%	0.0%	0.5%	0.0%	4.4%	0.3%	33.0%
Red Deer	5.2%	0.8%	1.2%	1.2%	3.4%	0.4%	12.1%
South Saskatchewan	56.3%	27.1%	12.8%	6.9%	11.0%	2.3%	116.4%
Total	**22.7%**	**0.6%**	**1.2%**	**0.3%**	**2.4%**	**0.5%**	**27.7%**

SOURCE:

Derived by Canada West Foundation by merging data presented in three statistical studies. See Government of Alberta. 2008. Water for Life: Current and Future Water Use in Alberta. Edmonton, AB. See also Alberta Economic Development Authority. 2008. Sustainable Water Management and Economic Development in Alberta. Calgary, AB. See also Alberta Environment. 2003. South Saskatchewan River Basin Water Management Plan (Phase 2 Background Studies). Edmonton, AB.

NOTE:

Consumption by some sectors and in some river basins was estimated or assumed to be 100% of allocations due to a lack of data on return flows. Flows of the various sub-basins (except the Red Deer) were estimated based on their estimated share of total SSRB flows as suggested in the SSRB Water Management Plan. The proportions are: Bow River (42%); Oldman (37%); South Saskatchewan (0.7%). Flows of the Red Deer River were stipulated in the Water for Life document as was the SSRB total annual average flow.

Chart 4: Allocations Consumed in SSRB Sub-Basins and by Sector, 2005

Summary Data

SSRB Sub-Basin	% of Allocations Consumed
Bow	43.3%
Oldman	49.8%
Red Deer	59.8%
South Saskatchewan	26.4%
Total	**46.2%**

Economic Sector	% of Allocations Consumed
Agricultural	50.5%
Industrial	68.4%
Municipal	13.4%
Petroleum	40.4%
Management	61.4%
Commercial	70.0%
Total	**46.2%**

Sectoral and Sub-Basin Details

SSRB River Sub-Basin	Agricultural % Allocations Consumed	Industrial % Allocations Consumed	Municipal % Allocations Consumed	Petroleum % Allocations Consumed	Management % Allocations Consumed	Commercial % Allocations Consumed	Total % Allocations Consumed
Bow	51.0%	61.4%	12.1%	14.7%	9.5%	69.4%	43.3%
Oldman	48.1%	100.0%	25.8%	23.3%	71.4%	73.3%	49.8%
Red Deer	88.3%	62.3%	32.8%	43.5%	55.3%	67.3%	59.8%
South Saskatchewan	48.0%	87.6%	4.8%	64.6%	80.9%	71.3%	26.4%
Total	**50.5%**	**68.4%**	**13.4%**	**40.4%**	**61.4%**	**70.0%**	**46.2%**

SOURCE:

Derived by Canada West Foundation from data in Government of Alberta. 2008. Water for Life: Current and Future Water Use in Alberta. Edmonton, AB.

NOTE:

Consumption by some sectors and in some river basins was estimated or assumed to be 100% of allocations due to a lack of data on return flows.

Chart 5: Allocations and Consumption by Sector as a % of the SSRB Total, 2005

Summary Data

Economic Sector	% of SSRB Allocations	% of SSRB Consumption
Agricultural	75.2%	82.2%
Industrial	1.4%	2.0%
Municipal	14.5%	4.2%
Petroleum	1.3%	1.1%
Management	6.6%	8.7%
Commercial	1.1%	1.7%
Total	**100.0%**	**100.0%**

Sectoral Details of Allocations

SSRB Sub-Basin	Agricultural Allocations	Industrial Allocations	Municipal Allocations	Petroleum Allocations	Management Allocations	Commercial Allocations	Total Allocations
Bow	76.5%	1.3%	19.3%	0.4%	1.2%	1.4%	100.0%
Oldman	87.2%	0.0%	2.8%	0.2%	9.2%	0.6%	100.0%
Red Deer	28.8%	6.0%	18.6%	13.2%	30.8%	2.7%	100.0%
South Saskatchewan	26.6%	7.0%	60.2%	2.4%	3.1%	0.7%	100.0%
Total	**75.2%**	**1.4%**	**14.5%**	**1.3%**	**6.6%**	**1.1%**	**100.0%**

Sectoral Details of Consumption

SSRB Sub-Basin	Agricultural Consumption	Industrial Consumption	Municipal Consumption	Petroleum Consumption	Management Consumption	Commercial Consumption	Total Consumption
Bow	90.2%	1.9%	5.4%	0.1%	0.3%	2.2%	100.0%
Oldman	84.3%	0.0%	1.5%	0.1%	13.2%	0.9%	100.0%
Red Deer	42.6%	6.2%	10.2%	9.6%	28.4%	3.0%	100.0%
South Saskatchewan	48.4%	23.3%	11.0%	6.0%	9.4%	1.9%	100.0%
Total	**82.2%**	**2.0%**	**4.2%**	**1.1%**	**8.7%**	**1.7%**	**100.0%**

SOURCE:

Derived by Canada West Foundation from data in Government of Alberta. 2008. Water for Life: Current and Future Water Use in Alberta. Edmonton, AB.

NOTE:

Consumption by some sectors and in some river basins was estimated or assumed to be 100% of allocations due to a lack of data on return flows.

STRESSES AND STRAINS

> *In looking at the health of Canada's water, there are two main issues — quality and quantity. Canadians have traditionally considered water as a natural resource to be managed and controlled for human use. In meeting continually growing demands for water, we have excelled in developing and manipulating our water supply. However, the general acceptance of a supply management philosophy has contributed to high rates of water use, degradation of the water resource, and a disregard for the vital role of water in the ecosystem.*
>
> — Agriculture and Agri-Food Canada, 2000.

Water issues in Alberta — at least broadly conceived — are not a lot different from water issues elsewhere, even if the province does have a somewhat unique water usage pattern *(see Discussion Box 8)*. Our review of the "waterscape" in Alberta shows that water is plentiful, but not always when and where it is needed, or in the right quality for its intended use. The regions north of Edmonton are relatively "water-rich" while the regions south of Edmonton are relatively "water-poor." Right across the province, Albertans rely heavily on variable and unpredictable flows of surface water. Many of the province's most pressing water concerns, then, are in the south — home to the largest population centres, the bulk of provincial industry, and the heartland of Alberta's agriculture.

There can be no doubt that the South Saskatchewan River Basin is stressed. When the river is closed — the maximum allowable allocation reached — something big has happened. While this is problematic in its own right, neither is it the end of the matter. Alberta is still very much poised to see continued population and economic growth, both of which will cause the demand for water to grow right alongside. Going forward, it is not at all difficult to envisage growing competition and the potential for conflict over water as well, largely driven by the question of who is going to have access to the limited water supply. If this were not enough, there is also a set of future threats — climate change among them — that may see today's *limited* supply of water become tomorrow's *diminishing* supply of water. And this presents the very real threat of water becoming a limit on Alberta's future economic growth and continued development.

Is Alberta in crisis? No. At the same time, the province does have all the makings of a growing predicament. Historically, Alberta has always been confronted with the headache of securing adequate supplies of water. In the future, this recurring headache could grow into a more chronic migraine. The water Albertans have today may be less in the future at the same time that demand for water increases. What is more, a lot of this will develop across the South Saskatchewan River Basin, which is already under strain.

1. Growing Water Demand

» **Population growth:** In the next 25 years, the population of Alberta is expected to increase anywhere from 20% to 40% (Statistics Canada 2005). Virtually all of this growth will land squarely in the province's largest urban centres, five of which are located in the most heavily used basins — the North Saskatchewan and South Saskatchewan. A lot

of the growth will occur in the "Calgary–Edmonton Corridor" which has already emerged as one of North America's fastest growing urban regions. Not only will a growing urban population result in increased domestic demand, it will feed demand across most other sectors as well, such as the need to ramp up electrical generation. Across Canada, some urban water supplies are already stressed. From 1994–1999, 26% of all Canadian municipalities reported some form of water shortage (National Water Research Institute 2004). Managing this reality is almost certain to become much more problematic in Alberta.

» Economic growth: A growing population is both a generator of, and a response to, higher rates of economic growth. Alberta's main economic drivers — whether energy in the north, industry and manufacturing in the centre, or agriculture in the south — are all highly water dependent. Thus, any expansion is sure to increase the demand for water. For example, Alberta's energy sector has large water requirements that are almost sure to rise if oil sands development continues to expand. Coupled with growing demand from expansion is the prospect for more intensive water use. For example, many of the province's conventional oil and gas reserves are becoming more difficult to access. The intensity of water use will grow if more oilfield injection becomes necessary to enhance the recovery of declining conventional reserves. (An often mentioned concern here is the permanent loss of water, whether it is injected underground or held for years in oil sands tailing ponds. It should be noted, however, that more and more oilfield injection is using brackish or saline groundwater, which has eased up on the use of fresh surface water sources.) Agriculture already holds the largest share of water allocations, and expansion and more intensive water use will come in the form of the demand to irrigate more acres, the need to irrigate more on the same acreage if drier conditions prevail, and higher density livestock production. Finally, new uses of water will also come into play. Examples include the bio-fuel industry and new high-tech applications that rely not just on water, but water of very high quality.

» Environmental needs: Growth in demand will not be limited to population growth and existing industry. There is a new and even more fundamental use of water in play as well. There is a strong and growing realization that the environment — the ecosystem itself — is a legitimate user of water in its own right. Maintaining adequate flows is essential to protecting the ecology of river systems, and withdrawing too much water or withdrawing it at the wrong time can seriously alter the ecology of a watercourse and lead to serious impacts downstream. Until recently, the water needs of the environment itself have been largely overlooked, and there is a growing realization that this was more than just a little short-sighted. The need to maintain the health of Alberta's aquatic ecosystems will further constrain the water available for human use now and into the future. The demand challenge, then, is not just about finding water to move forward, but also to ratchet back the current level of water use as well, whether that be through simple conservation or increased water efficiency. Many are starting to realize that aquatic systems have their own limits, and there is simply not enough water to meet urban needs, the requirements of agriculture, and future industrial development while at the same time ensuring

enough water to sustain critical ecosystem function. At the same time, there is one bright side on the conservation side. Before Albertans had any real consideration of how much water the environment needed, the province did have to pass 50% of the water on to Saskatchewan through the 1969 *Master Agreement on Apportionment*. At times, this level may not be sufficient for all ecological purposes, but it does remain as a relatively "unseen" ecosystem benefit that can serve as a base upon which to build.

Discussion Box 8: Placing Water Use in Context

Across the globe, about 70% of all surface and groundwater use is dedicated to agriculture, primarily for purposes of crop watering and irrigation. All other forms of industry and commerce use 20%. About 10% of the globe's water is used for household, residential, or domestic purposes (Brown 2002). Of course, these are simply averages. Across developed countries, up to 65% of all water can be used for irrigation, but that rises to 90% in some of the drier developing countries (Nicol 2005).

This pattern of global water use tells us that any current or future shortage of water has the very real potential to hit hard on the global food supply. If the amount of water is relatively fixed at any one place at any given time, ensuring enough water for growing urban populations and industrial development without short-changing the water needs of the global environment implies that any substantial sources of "new" water will have to come through increasing the efficiency and productive use of water in agriculture. The sheer volume of water dedicated to agriculture is no small matter. A 10% increase in agricultural water efficiency conserves the same amount of water as a 70% increase in domestic efficiency.

Canada's water usage pattern does diverge from the larger global pattern, and Alberta's usage pattern also diverges from the Canadian one. Across Canada, agriculture constitutes about 10% of all water withdrawals. Industrial, utility, and manufacturing constitute 80% and municipal and domestic use another 10% (Agriculture and Agri-Food Canada 2000). In Alberta, allocations of water are about 50% agricultural, 40% industrial and commercial, and 10% municipal (Alberta Economic Development Authority 2008; Alberta Environment 2008.)

Canadians are also heavy users of water. The OECD ranks Canada second in terms of its total per capita water consumption. While the US uses more water per capita, water use in Canada is growing at a faster rate than the US. Since 1980, water use in Canada has increased by 25.7%, which is five times the OECD average of 4.5% (McFarlane and Nilson 2003). Household use of water in Canada in 1999 averaged 343 liters per capita per day, and when all uses of water are considered, that rises to 4,400 liters per day (Roach, Huynh, and Dobson 2004).

Across the Canadian water policy community, cheap water has been fingered as a significant contributor to Canada's heavy use of water. In terms of residential use, this may indeed be the case given the large number of Canadian homes that remain unmetered, and for those that are metered, municipal water rate structures that do little to promote efficient use or conservation.

But again, municipal water use is only about 10% of the total water withdrawn, and residential use itself is only about half of that 10%. What is more important — and often overlooked — is Canada's role as a global exporter of "virtual" water embedded in the production of goods and services exported internationally, whether that be grain and other agricultural produce, manufactured goods, auto parts, and even oil or natural gas.

There are few if any products and services that do not require water as an essential input in the production process, and with 80% of Canada's GDP resulting from international exports, it is clear that a lot of the water "used" in Canada is water actually "used" by foreign consumers of Canadian exports. The same applies to Alberta. Agriculture in Alberta currently uses about 35 km^3 of water per year. But 27 km^3 of that water — over 75% — is exported abroad as a "virtual" water (Zehnder 2008.) Of course, Canada and Alberta imports a lot of "virtual" water as well.

The point here is not to defend the profligate use of water by Canadians, argue against the merits of water conservation, or forestall ways to improve water resources management practices. Far from it. In fact, all of these goals are of paramount importance. If the world is indeed to become more water-short in the future, then Canada's role as a virtual exporter of water — one of the world's few remaining "lifeboats" for water — will only grow in importance. Given the role played by Alberta within the larger Canadian export economy, this fact is as relevant here as anywhere else.

SOURCE:

Brown, Lester R. 2002. Water Deficits Growing in Many Countries.
Nicol, Lorraine. 2005. Irrigation Water Markets in Southern Alberta.
Agriculture and Agri-Food Canada. 2000. The Health of our Water: Toward Sustainable Agriculture in Canada.
AEDA. 2008. Sustainable Water Management and Economic Development in Alberta.
Alberta Environment. 2008. Water For Life: Current and Future Water Use in Alberta.
McFarlane, Susan and Nilson, Erik. 2003. On Tap: Urban Water Issues in Canada.
Roach, Robert; Huynh, Vien; and Dobson, Sarah. 2004. Drop by Drop.
Zehnder, Alexander. 2008. Global Water Issues: Trends and Challenges for Alberta.

Across the province, concerns are mounting about water, especially whether there will be enough to meet the increasing demands of a rapidly growing and continually developing province without further sacrificing essential water ecosystems. By 2020, some estimate that the consumption of water in Alberta will increase by almost 25% over 2005 levels *(see Figure 14)*. Consumption in Alberta's northern river basins — the Hay, Peace, Athabasca, and Beaver — is expected to grow by 82% from 411 million m^3 to 747 million m^3. Much of this growth will be driven by the growing water needs of the petroleum sector. Consumption in the southern basins — the North Saskatchewan, South Saskatchewan, and the Milk — is expected to grow by 15% from 2.893 billion m^3 to 3.324 billion m^3. In the south, much of the growth is expected to come from increased agricultural and municipal demand.

While the rate of growth in water consumption is anticipated to be much higher in the north, most of the pressure will still land in southern Alberta. It is in the south where most Albertans live, where the great bulk of Alberta's water is used, and where all economic sectors are in play. Over 56% of the total increase in water consumption is expected to occur in the three southern river basins compared to 44% in northern river basins. Recent demographic patterns reinforce the point. Between 2001 and 2006, over 90% of all provincial population growth occurred in the three southern river basins, with the North Saskatchewan River Basin comprising 33% of all growth and the South Saskatchewan River Basin comprising of 57% *(see Figure 15)*.

Figure 14: Estimates of Future Water Consumption in 2020

(000s of Cubic Meters or m^3)

Future Consumption by Regional Location

River Basin	2005 Usage	2020 Usage	% Increase	% Share of Total Increase
Southern Basins	2,892,776	3,323,610	14.9%	56.2%
Northern Basins	411,571	747,346	81.6%	43.8%
Total	**3,304,347**	**4,070,956**	**23.2%**	**100.0%**

Future Consumption by Economic Sector

Economic Sector	2005 Usage	2020 Usage	% Increase	% Share of Total Increase
Agricultural	2,218,446	2,490,592	12.3%	35.5%
Industrial	185,788	215,686	16.1%	3.9%
Municipal	130,866	171,496	31.0%	5.3%
Petroleum	261,258	606,232	132.0%	45.0%
Management	441,252	507,180	14.9%	8.6%
Commercial	66,737	79,770	19.5%	1.7%
TOTAL	**3,304,347**	**4,070,956**	**23.2%**	**100.0%**

SOURCE:

Derived by Canada West Foundation by merging data presented in two statistical studies. See Government of Alberta. 2008. Water for Life: Current and Future Water Use in Alberta. Edmonton, AB. See also Alberta Economic Development Authority. 2008. Sustainable Water Management and Economic Development in Alberta. Calgary, AB.

NOTE:

Total water consumption between the two studies varied slightly. An estimated growth rate was calculated from the Alberta Economic Development (AEDA) study and then applied to the 2005 consumption as reported in the Water for Life study.

Figure 15: Impact of Population Growth on Various River Basins

Major River Basin	Population 2006	Population 2001	Growth Rate (2001-2006)	% Share of Total Growth
Hay River Basin	7,438	7,215	3.1%	0.1%
Peace River Basin	175,103	159,216	10.0%	5.0%
Athabasca River Basin	166,867	154,097	8.3%	4.0%
Beaver River Basin	39,368	38,300	2.8%	0.3%
North Saskatchewan River Basin	1,242,297	1,138,335	9.1%	32.9%
South Saskatchewan River Basin	1,646,883	1,466,144	12.3%	57.3%
Milk River Basin	12,394	11,500	7.8%	0.3%
Total	**3,290,350**	**2,974,807**	**10.6%**	**100.0%**

SOURCE:

Derived by Canada West Foundation from Statistics Canada.

NOTE:

While many of the province's census divisions align nicely with the geography of the various river basins, they do not do so perfectly in all cases. Thus, the reported populations in some river basins may be slightly higher or lower than is really the case. Any deviations would, however, be generally quite small.

In sum, a good portion of the growing demand will meet up with the naturally uneven distribution of Alberta's water, widening a fundamental mismatch that already exists. If growing demand cannot be satisfied, there is bound to be conflict among competing uses, whether municipal, agricultural, industrial, or petroleum production. Coupled with all of this is the demand generated by an important legitimate water user in its own right — the water ecosystem itself.

2. Diminishing Water Supply

- The baseline: At the same time that water demand is expected to grow, there are a host of questions surrounding historical, current, and future water supply, some of which relate to the natural waterscape of Alberta. One of the more important turns on whether our basic perceptions about water are even correct. Some say that Alberta's past was much more dry than the present, raising important questions about the supply of water in the future. Policy commentators have pointed out that much of the 20th century — regarded by Albertans as normal — was in reality an unusually wet period across western Canada's prairies (Schindler and Donahue 2005). If Albertans are living in a generally wet period, or leaving one, this has serious implications for the amount of water that can be expected going forward. From an allocative perspective, it raises the serious question whether today's water allocations are based on flows of water that will be less significant in the future.
- Lower flows today than yesterday: The flows in Alberta's rivers have been tracked since the early 1900s, and some say there is evidence that flow rates today are indeed lower than in the past. Some statistics, often cited, peg the reduction in flows anywhere from 20% to 60% since 1900 (Griffiths and Woynillowicz 2003). But many of these data were taken only during certain times of the year and did not control for the increased volume of water being diverted for human activities. There appears to be less certainty surrounding any decline in historical natural flows. One study for Alberta Environment that tracked data for nine Alberta rivers from 1912-2001 concluded that there was no significant long-term decline in natural flows, and recent year-over-year variability is also within historical parameters. However, the long-term trend line was slightly negative for six of the nine rivers — statistically significant for some but not for others (Seneka 2004). Other commentators believe that the available data suggests that total natural river flow in Alberta has declined somewhat, but likely no more than 10% since the turn of the century. There is more agreement on the loss of Alberta wetlands. About two-thirds of wetlands have disappeared from urban and rural areas settled within the province (Wetlands Alberta 2009.)
- Lower flows tomorrow than today: While all of the above is not unimportant, the real concern is whether river flows in the future will be lower than they are today, regardless of where current flows compare to yesterday's flows. According to the same study for Alberta Environment, if recent dry conditions continue, this could very well cause what appears to be a slight trend of lower natural flows today to become more clearly established going forward (Seneka 2004). This is the worry. Some are now predicting that minimum flows in Alberta's

rivers could diminish by 7% to 10% as early as 2025 (Maas and Telfer 2007). If flows will indeed be lower, then more and more water will be used in the future *relative to supply* even if the number of allocations and the volume of water allocated remains the same — shortages will arrive even in the absence of any increase in demand. Not only will this jeopardize the current level of water allocations, other problems will intensify as well, such as reduced capacity of the ecosystem to filtrate impurities and contaminants, which will result in lower quality water.

» Climate change: While the specific effects of long-term climate change remain somewhat of a "wild card" in Alberta's water future, there is little to no doubt that it will widen the anticipated disconnect between growing demand and any diminishing supply *(see Discussion Box 9)*. The prospect of climate change presents a very real threat to Alberta's water supply and water security in the form of less water in the future at the same time that it prompts demand to rise. To be sure, agreement is not at all complete on the specific effects of climate change. But the prospect of climate change still needs to be taken seriously. The possibilities go beyond mere concern, and range from the slightly frightening to the completely terrifying. Water in Alberta has always been vulnerable, and climate change offers the very real prospect of that vulnerability growing in the future. While we may be meeting water demand now, our water is not so secure that it may meet all demands in the future.

» Water agreements: Water in Alberta is bound by two important water agreements. The *Master Agreement on Apportionment (1969)* is an interprovincial agreement between the Government of Canada and the Governments of Alberta, Saskatchewan, and Manitoba. The agreement restricts Alberta to using only 50% of the natural flow of water arising in or flowing through and out of the province. The agreement is overseen by *Environment Canada* and the *Prairie Provinces Water Board*, and requires Alberta to allow half of its natural water flow to go east to Saskatchewan. The second agreement is the *Boundary Water Treaty (1909)* between Canada and the US, which governs all shared water bodies and is administered by the *International Joint Commission (IJC)*. This agreement speaks to the St. Mary River (a small tributary of the Oldman and the larger South Saskatchewan River) and the Milk River. This agreement allocates roughly 75% of the combined flow of both to Alberta and 25% to Montana. Both of these agreements serve to limit Alberta's usable supply of water, and compound any shortage. If Alberta's water supply in the future is diminished, it will be increasingly difficult to meet demand without compromising these flow agreements. Concerns are also emerging that these agreements could be a source of conflict as well. In 2004, for example, Montana approached the IJC to try and secure a review of the agreement affecting the St. Mary and Milk rivers, aimed at gaining a greater portion of the water shared with Alberta (Wilkie 2005).

Discussion Box 9: Climate Change

The specific effects of climate change on Alberta's water supply are not crystal clear, but there is growing agreement on the broader pattern, and certainly, the range of possibilities. Seen individually, none of them are particularly pleasant. When combined, the entire nest presents a serious challenge for water resources management and policy in the future.

Warmer Temperatures

Although the term "global warming" has given way to "climate change", the expectation is that most places around the globe will experience a warming trend, although the effect will vary from one place to the next. Warmer temperatures are expected to increase rates of evaporation and transpiration, and are expected to hit hardest in locations that are already dry.

Precipitation

The effect of climate change on precipitation is hard to gauge, but a number of scenarios continue to dominate. Lower amounts of precipitation are likely to widen the moisture deficit in already dry areas and create new moisture deficits in other areas. At the same time, higher amounts of precipitation could be experienced in already wet areas. The conventional thinking is that precipitation will see more seasonal and annual variability, and become less certain and less predictable. In some areas, precipitation type, timing, seasonal pattern, and geographic distribution could all undergo change, amplifying uncertainty well beyond current seasonal and annual variability. On top of changing precipitation patterns could come the prospect of long-term changes in the timing and amount of spring melt that feeds water into Alberta's river basins.

Extreme Weather Events

For some, the concern with precipitation is less about the amount and more about how it arrives. Some scenarios show that precipitation may come in the form of more extreme weather events. There may well be less rain, but the rain that does come will do so through more intense weather, producing too much water at one time and in one place. Climate change, then, brings the prospect of increased instability in the climate and this should be as much a concern as any overall change in the climate itself. Extreme events will run the gamut — more drought in some areas, more floods in other areas, more tornados here, and stronger hurricanes there. There is also the potential for impact on Alberta's water and wastewater infrastructure, including storm drainage. Much of this infrastructure was built for a stationary climate, and was not designed to accommodate a downpour of 5 inches of rain within a 20 or 30 block radius. Some estimates of retro-fitting infrastructure to accommodate increased weather volatility could reach up to $40,000 per household.

Drought

Of all extreme weather possibilities, drought is the biggest risk for Alberta. While drought can occur in any climate, semi-arid regions like southern Alberta are the most vulnerable as they already have a moisture deficit and variable precipitation patterns. Fueled by warmer temperatures and lower precipitation, droughts in the future are expected to be more frequent, more intense, more persistent, and of longer duration. Western Canada has seen at least 40 severe droughts in the past 200 years. Multi-year droughts were seen in the 1890s, the 1930s, and the 1980s. The 1930s is generally considered a severe drought, where precipitation was 40% less than normal. But in 1988, the precipitation received was only 50% of normal. The most recent drought of 2001-2002 was quite unusual, both in its vast spatial extent and its intensity. The drought stretched from southern BC through the prairies and into the Great Lakes. This may be a sign of things to come — the western Canadian prairies have been identified as one of the locations where climate changes will bring a much higher risk of drought.

Retreating Glaciers

Glaciers in the Rocky Mountains supply about 10% of the base flow for rivers in central and southern Alberta, and in particularly dry years, that proportion can rise considerably. Glaciers are particularly important to some rivers, such as the Bow. Climate change is almost certain to accelerate the retreat of glaciers. From 1975-1998, the size of glaciers decreased by 50% in the South Saskatchewan River Basin and by 23% in the North Saskatchewan. Some are predicting that most glaciers may disappear completely within the next 50 to 60 years. Any permanent reduction in glacial ice amounts to the loss of a critically important backstop, making Alberta's rivers completely dependent on precipitation, which itself is predicted to be lower and more variable.

Long-Term Reduction in River Flows

Glacial retreat and less precipitation is almost certain to reduce water flows across Alberta in the future. At the same time, the drier climate will increase the need for water, especially for irrigation. Climate change is expected to widen the water gap — just as the water supply slows, demand will rise. The pressure of less water will also be amplified by more seasonally concentrated increases in demand.

Water Quality

Water quantity is intimately connected with water quality. If Alberta has less water, there is less opportunity for nature itself to filter urban storm water run-off, absorb industrial effluent, assimilate commercial contaminants, and filter and purify agricultural run-off. Existing problems with eutrophication of prairie waterways will worsen, being fuelled by warmer temperatures as well. Even bigger problems are likely to emerge with depleting oxygen levels. Lower surface flows are expected to slow groundwater recharge, stress aquifers, and reduce surface supplies even further. All of this carries serious implications for the quality of water Albertans can expect, in addition to the growing concerns over water quantity.

If there is any good news at all with respect to climate change, it is the potential prospect of a longer frost-free season, warmer northern temperatures, and a longer growing season. Some argue that this is expected to increase the potential of agriculture in the northern Canadian prairies, where there is currently a water surplus available for irrigation.

This should not be discounted. In the future, some predict that agriculture will become more important than oil and gas, with Canada serving as one of only a few critical "lifeboats" to secure the global food supply. Viewed from this perspective, there may indeed be a silver lining here. But it is still a slim sliver of silver. Whether that sliver can be turned to opportunity depends heavily on Alberta's ability to prepare and adapt to a water future that could be considerably different in the future. If not, then it is quite unlikely for any single advantage to even begin offsetting the threats expected elsewhere.

SOURCE:

Standing Senate Committee. 2005. Water in the West: Under Pressure.

National Water Research Institute. 2004. Threats to Water Availability in Canada.

Agriculture and Agri-Food Canada. 2000. The Health of Our Water. Toward Sustainable Agriculture in Canada.

Grosshans, R; Venema, H; and Barg, S. 2005. Geographical Analysis of Cumulative Threats to Prairie Water Resources.

3. Quality Concerns

Water quality is a more subjective consideration and more difficult to measure than water quantity. Yet, it is no less important. Alberta could have all the water it needed, but if that water is of perpetually low quality or seriously degraded, any notion of water availability itself is quite meaningless. Quality is hard to define as it depends heavily on perception. On one side of the continuum is "zero-tolerance" and on the other lies "acceptable risk."

But at least one thing is clear. The issue of water quantity — the amount of water available — can never be entirely divorced from the question of water quality — is the water good enough to satisfy a particular need? The two are inextricably linked. The link here is largely a function of ensuring enough water in aquatic ecosystems so that nature does not lose its capacity to absorb, assimilate, dissolve, filter, and purify the water that returns to the environment after its use in a wide variety of human activities. Nature itself needs enough water to maintain ecosystem health and keep the purification process hard at work.

If the amount of water available to nature is reduced too far — and there is certainly disagreement on how much is too much — then nature loses the ability to clean. The result is degraded water quality and aquatic systems. If water is withdrawn too heavily, withdrawn at the wrong time, or returned in a significantly altered state, then quality will also suffer as effluent concentrations rise, the ecological function of streams, rivers and lakes is altered, and the purification function is hampered. Water quantity affects quality, and both combine to impact the environment. This is one of the larger concerns with wetlands in Alberta, which goes well beyond *Ducks Unlimited*. Some estimate that up to two-thirds of Alberta's wetlands have been lost in settled portions of the province, and with that loss has come the loss of a natural and very effective water filter. Wetlands retain contaminants, effectively filter them, and curb their movement into waterways (Agriculture and Agri-Food Canada 2000).

Each and every water user carries in their wake a set of potential effects on water quality that is linked with the quantity of water used and how that water is used. While it is outside the scope of this paper to significantly engage with the entire panorama of quality issues in Alberta, there are a number of broad concerns that relate to each economic sector.

- Agriculture: Agriculture is the biggest user of water and also one of the largest sources of non-point pollution. Threats to water quality include the run-off of nutrients (nitrogen and phosphorous in fertilizers), pesticides (including herbicides, insecticides, and fungicides), and organic bacteria and other pathogens from intensive livestock operations. While soil salinity from irrigation has not been a concern in Alberta since the 1970s, there is growing concern with the eutrophication and low oxygen levels of water bodies receiving more agricultural nutrients than can be filtered. Lake Winnipeg, for example, has received international attention because of an increasing eutrophication problem. The climate of Alberta, particularly its long and cold winters, may exacerbate these issues by inhibiting the

microbial break down of various agricultural compounds. On top of this, concerns continue to exist with the quality of groundwater used by many rural Albertans.

- Industry and commerce: Industrial use of water is the largest source of point-specific pollution, but such "end of the pipe" concerns are not the only way that quality is affected. Industry often withdraws huge amounts of water, but consumes little. Large withdrawals coupled with high return flows are not necessarily harmless. Often, the water being returned re-enters in an altered state or at a different point in the watercourse. Sometimes, withdrawals and returns cannot be timed to correspond with natural flows and may have relatively higher temperatures as well. In Alberta, the concentration of such activities in the industrial "heartland" on the North Saskatchewan River Basin is leading to growing concerns over water quality downstream.
- Municipal and domestic water: In May 2008, there were 1,766 boil water advisories issued across Canada. Of these, only 13 were issued in Alberta (Maas and Telfer 2007). Based on this measure, domestic water in Alberta would appear to be quite clean and safe — Alberta Environment recently assessed every water treatment plant in the province (Alberta Environment 2008c). In addition, Alberta's urban wastewater tends to be carefully and well treated because it must re-enter a watercourse that flows downstream. But as both Walkerton and North Battleford clearly demonstrate, water safety is by no means guaranteed, not to mention the many Aboriginal communities right across Canada that continue to struggle under boil water advisories. The effect of rapidly growing populations concentrated in large urban areas raises other concerns. Urban storm water run-off remains a significant source of non-point contamination, and as urbanization proceeds, there is an inevitable loss in ecological bio-diversity that has the potential to affect water quality in numerous ways.
- Petroleum: The oil and gas sector's use of water continues to draw attention across a wide range of quality concerns, whether it is the "de-watering" associated with coalbed methane production, oilfield water injection for enhanced recovery, or the current and future water needs required by ongoing development of the oil sands. The concerns here are quite diverse, and range from the huge volumes of water required, heavy reliance on the Athabasca River (which experiences significant seasonal variations in flow to the point where winter flows can be less than 10% of annual mean flows), toxic water kept in tailings ponds, and the possibility of groundwater contamination from thermal or in-situ production through CSS and SAGD production.
- Management: Across much of Alberta, but especially in the South Saskatchewan River Basin, numerous dams, reservoirs, water storage impoundments and irrigation infrastructure have significantly changed the natural water system. To be sure, much of that infrastructure is needed and also provides a range of obvious benefits such as creating new water habitat and recreational opportunities, ensuring municipal water supplies, and allowing for a more diversified agricultural base. However, none of these benefits come without some very real environmental cost, many of which continue to raise quality concerns downstream.

4. The Knowledge Deficit

When it comes to water, there are still far too many questions for which we do not have satisfactory answers, and this in itself is more than a little problematic. Albertans simply cannot manage and protect that which they do not properly understand. What is the state of the province's underground aquifers? What will be the long-term effects of climate change? How much water can you withdraw from a river and still have a well-functioning and sustainable ecosystem? All of these are important questions, and Alberta needs answers if water resource management is to be sustainable across the long-term. Of course, getting the answers is one thing. Building a political and social consensus around those answers as part of a concerted effort for change is a different matter altogether.

As part of the *Water for Life Strategy*, AWRI has committed to finding answers to more than a few pressing questions *(see Discussion Box 10)*. Of primary importance are the need to correct serious deficiencies in the province's water data collection, monitoring, forecasting, and prediction. A key goal here is to gain a better understanding of who is using water, and how much water, where, when, and for what purpose. Better knowledge about groundwater reserves is also an imperative, as well as uncovering ways to integrate ground and surface water resource management.

In short, research needs to be undertaken to close a number of knowledge gaps — the gap between water science and public policy, the gap between land use and water, and other important links such as energy use and water consumption. A lack of knowledge about water and water use makes it difficult to arrive at good policy decisions and to assess possible future policy directions, but research, knowledge, and dialogue are expanding, particularly as a result of the *Water for Life Strategy*. At the same time, there is a need to broaden the range of tools available, and gain a better understanding of new approaches and innovations whether that includes demand management, new technologies, or lessons learned elsewhere.

Discussion Box 10: Tackling the Information Deficit

The intent behind the *Alberta Water Research Institute (AWRI)* is to facilitate research and the development of information, tools, procedures, process and technologies in support of the goals contained in the *Water for Life Strategy*. Numerous areas have been identified where information and knowledge is lacking, or where information and knowledge needs to be better shared among key stakeholders and all Albertans.

Safe and secure drinking water and wastewater treatment:

- Finding ways to improve the training of water facility operators, managers, and technical personnel
- Finding ways to improve water facility operating systems and adopt water safety plans
- Identifying barriers to implementing new and emerging water technologies
- Identifying ways to inform public expectations about drinking water quality

- » Identifying and understanding contaminant threats to drinking water safety
- » Exploring technology options for water infrastructure and the potential for commercialization
- » Exploring issues of source water protection for surface and groundwater

Healthy aquatic ecosystems:

- » Developing indicators to measure ecosystem health
- » Building an inventory of wetlands and assessing their ecological importance
- » Better understanding the source and magnitude of non-point source contaminants
- » Finding ways to foster a better understanding of the requirements needed to sustain aquatic ecosystems
- » Developing strategies to improve the health of degraded water bodies and aquatic ecosystems
- » Understanding water requirements for ecosystem health in light of economic growth and land activities

Reliable and quality water supplies for economic development:

- » Determining new technology for water use and efficiency
- » Finding ways to reduce net water use and manage return flows
- » Finding ways to improve effluent treatment
- » Identifying ways to improve management of non-point sources of pollution
- » Finding ways to augment water storage and transfers within basins
- » Identifying emerging industries and processes that may require water

Institutional arrangements:

- » Assessing the efficiency of water rights transfers to accommodate demand in closed basins
- » Identifying cost effective approaches to monitor water diversions and water use
- » Evaluating opportunities for other market and financial mechanisms to improve water use efficiency
- » Understanding different allocation systems and how they might address water issues in Alberta

Education and outreach:

- » Determining the level of awareness of water issues in each of the major river basins
- » Sharing the knowledge and experience of others to Albertans and water managers
- » Informing Albertans about water issues and opportunities
- » Determining the best means to improve access to existing water data, information, and knowledge

An earlier Canada West Foundation report entitled *Balancing Act (2005)* also reported on water information needs as identified through a set of public and stakeholder consultations. These include:

- » Building an inventory of surface and groundwater supplies
- » Connecting groundwater to surface water
- » Researching the causal factors leading to water shortages and mapping their effects
- » Developing economic growth scenarios and their impact on water
- » Researching relevant case studies of experiences in other jurisdictions
- » Understanding the implications of inter-basin transfers and potential pressures to export water

» Better understanding of the potential implications of water pricing
» Running pilot projects of alternative water technologies to build public confidence
» Researching instream flow needs (IFNs)
» How to measure better, including water supplies and cumulative impacts at the watershed level
» How to measure and monitor the water demands of aquatic ecosystems
» Securing better data on actual water usage and consumption as opposed to allocations

SOURCE:

Alberta Water Research Institute. Vision, Challenges, Directions, Strategy, and Objectives.
Wilkie, Karen. 2005. Balancing Act: Water Conservation and Economic Growth.

5. Public Perceptions

Prevailing (if not entirely stubborn) public attitudes, perceptions, and perspectives add to the strains and stresses on Alberta's water in numerous ways. There is much work to be done here in terms of raising awareness about the importance of water, its precarious state, and the need to renew management of this most fundamental and critical natural resource.

Key here is dispelling the mistaken notion that water is abundant, a myth that permeates the public conscience despite the clear lack of security surrounding much of Alberta's water. The perception in the collective minds of Albertans is that the province has plenty of water, there is no need to change habits and behaviour, and no need to be worried about the amount of water in the future. Alberta, like many jurisdictions in Canada, has done a very good job of harnessing and manipulating its limited water resources. This has secured sufficient water supplies for most Albertans in the past, but has also "engineered" water as a concern out of the collective conscience. In short, water is taken for granted. It is under-valued, under-priced, and over-used.

Few really understand the critical importance of water beyond personal use. Few understand the link between water and virtually all forms of economic activity. Few understand the huge amounts of water used to produce the gas they are pumping into their gas tank. Few understand the water requirements of making the car itself, which includes the processing of steel, plastic, rubber, and glass. Few understand that almost everything they see, hear, touch, smell, and taste implies the usage of water. Few understand the significant amounts of energy required to divert, treat, distribute, recover and then treat once again the water as it moves from source to tap and back to source.

Broadly held attitudes and perceptions about water compound the stresses and strains primarily through deeply ingrained patterns of over-consumption. Such attitudes impede efforts at conservation and work against necessary water reforms. If Alberta is to protect the water it does have and ensure a sustainable water future for the next generation and beyond, a key issue going forward will be the urgent need to change how Albertans think about water and how they use it.

6. Water Policy

Public attitudes never develop within a vacuum. Rather, they reflect local circumstances and conditions, which are then reinforced by government policies and practices. Together, these combine to form a "system" that promotes and preserves public perceptions. Historically, government water policy has been marked by two distinct features that have contributed to current attitudes.

First, the overwhelming focus of water policy in the past has been to secure supply and harness the resource. When responding to new and increased demands for water, governments have traditionally worked to increase supply rather than manage demand. This fuels the mistaken assumption that there will always be enough water. The only substantial challenge is an engineering one — how can we "dam it, pump it, and pipe it?"

Second, water pricing has not been pursued as a way to ration the resource, but only as a mechanism to recover — and sometimes only partially recover — the operating and maintenance costs of the infrastructure required to treat and distribute water. A lack of pricing, incomplete pricing, sub-optimal pricing, or even irrational pricing amounts to a built-in disincentive to conserve water by distorting perceptions about supply and demand. Cheap water leads to the mistaken notion that there is abundance of water. It is well-known across the policy community that Canada has some of the lowest priced water in the world — "cheaper than dirt" to quote the OECD (Bitti 2010). Municipally, about one-quarter of Canadians pay a flat rate for water regardless of the amount consumed. Most of the remaining 75% do pay for each cubic meter, but they pay a constant rate (Renzetti and Busby 2009). Only in rare instances do prices rise with the amount of water used (Horbulyk 1997). In some instances, the amount paid actually falls if larger volumes of water are consumed. Among the OECD, Canadians have some of the lowest water prices and the highest rates of water consumption (McFarlane and Nilsen 2003).

Government structures and decision-making have also contributed to the problem. Across government, numerous departments and agencies with narrow mandates have tended to act independently from each other. The result has been a set of conflicting goals. For example, expanding irrigation might be the focus of the provincial Department of Agriculture. How does this match with a goal of the Department of Environment to use less water and use it more efficiently? For some, this amounts to the creation of a "meta-problem" that will not be easily solved (National Water Research Institute 2004). Such fragmented decision-making will need to be corrected, and *Water for Life* is a key step in that direction.

The problems confronting Alberta here are not at all unique. Under new, growing, and persistent demands for more water, government policies of the past are bumping up against a limited supply, raising serious questions about water in the future. The good news is that fragmented public decision-making, conflicting goals and priorities, and policies that discourage efficient water use or lack innovation or fail to integrate new scientific and technological discoveries, can all be changed. The Government of

Alberta cannot make rain. But it can certainly take the lead in devising new approaches to water resource management that will enable Albertans to respond and adapt to current and future water challenges.

7. Other Concerns

The list above is far from complete. There are many other water-related issues as well. These include source water protection, the identification and establishment of minimum instream flow needs (IFNs) to maintain water ecosystem integrity, transfers of water from one basin to another (both inter-basin transfers of water from one major basin to another and intra-basin transfers of water within one major basin), transboundary concerns that can arise when water crosses different political jurisdictions, the potential of groundwater resources, and the conjunctive management of surface and groundwater resources. What is more, each river basin has its own unique issues *(see Discussion Box 11)*. Without taking away from the importance of any of these, the focus of this paper generally remains on the question of ensuring that Albertans have access to affordable and sufficient sources of quality water for continued economic and social development without sacrificing the critical ecosystems which provide that water. Further, most of the focus remains on surface water, which constitutes 97% of all the water used by Albertans.

Discussion Box 11: Issues in the Major Rivers in Alberta

Each of Alberta's major rivers and river basins are experiencing their own unique set of stresses and strains. While there can be some overlapping concerns, the challenges of one river system are not identical to those of others. A quick overview of some of the key issues affecting each of Alberta's major rivers:

Hay River Basin: The Hay is virtually untouched, with all allocations comprising only 0.1% of average annual flows. There is limited demand for any domestic use. Petroleum allocations comprise three-quarters of the few allocations that exist. There are very few pressing issues on this river basin.

Peace River Basin: The Peace also has very few allocations relative to its sizeable flow. Total allocations comprise less than 0.3% of average annual flow. The single largest use is for industrial activity, which comprises about 37% of all allocations, and water management and environmental allocations, which comprise 38%. There are two large kraft pulp and paper mills on the Peace, including the Weyerheauser plant (1973) and Daishowa (1990). The Peace enters Alberta from British Columbia, which heavily manages the flow as the result of two hydro dams. BC Hydro is contemplating a third. A new hydro dam in Alberta has also been approved just south of Fairview, AB. The Peace drew significant attention in 2008 when Bruce Power made application with the Canadian Nuclear Safety Commission for a nuclear power plant near the town of Peace River.

Athabasca River Basin: The Athabasca is Alberta's only river that has no dams. The Athabasca supports a great portion of Alberta's forestry industry, including five pulp and paper mills. The two kraft mills include Weldwood (1957) and Al-Pac (1993), and the three CTMP mills include Millar Western (1988), ANC (1990), and Slave Lake Pulp (1991). The Athabasca provides all the water needs for the Athabasca oil sands deposits. Specific concerns include the potential for increased water withdrawals to feed oil

sands expansion, water withdrawals during low flow periods (winter flows in the Athabasca can be only 10% of average annual flows), as well as increased nutrient loading from forestry and pulp operations.

Beaver River Basin: The Beaver river basin is the smallest basin in Alberta, and is also home to the Cold Lake oil sands deposit. About 45% of all allocations are for petroleum production. Concerns in the Beaver have centered around the reliability of domestic water supplies, the increased use of saline groundwater, and the effects of in-situ production in the Cold Lake oil sands deposits, which currently provide 10% to 15% of all Canadian oil production.

North Saskatchewan River Basin: The North Saskatchewan supports the industrial heartland of Alberta, including the great majority of the province's thermo-electrical generation. The basin is home to two large dams including the Big Horn Dam (creating Lake Abraham) and the Brazeau Dam (creating the Brazeau Reservoir). The biggest concerns center around huge withdrawals for cooling in thermal power plants and the effects of return flows on downstream water. Studies show water quality upstream from Edmonton at 98 out of 100, but quality downstream falling to 74 out of 100.

South Saskatchewan River Basin: The South Saskatchewan River Basin is the most concentrated and fastest growing region in the province and contains Alberta's most productive soils and climate. At the same time, the Bow, Oldman, and South Saskatchewan rivers have been closed to new surface water allocations since 2006. The Bow is the most densely populated sub-basin, and the most actively managed. There are 11 hydro facilities on the Bow and numerous dams and reservoirs. Concerns on the Bow include water shortages, elevated nutrient and pesticides in downstream reaches and ongoing development in the sub-basin's headwaters. The Oldman is also heavily managed, home to one of Alberta's largest dams, and is used heavily for agriculture, which holds almost 90% of all allocations on the river. Concerns include nutrient loading from crop cultivation as well as intense livestock production. There is also growing pressure on groundwater resources. The Bow and Oldman converge to form the South Saskatchewan River, which is used less for agriculture (30% of all allocations) and more for municipal purposes (60% of all allocations). A key issue for the South Saskatchewan is water quality impacts from water use on tributaries upstream. The Red Deer River is the least used river in the SSRB. Concerns here include the need to reserve capacity to possibly meet apportionment requirements in the future (this has rarely happened to date, however) and pressure to supply additional water to regions both south and north.

Milk River Basin: The Milk is the smallest river in Alberta, constituting only 0.7% of total provincial average annual flow. Across the Milk, 88% of all allocations are for agriculture. Farms in the Milk River Basin total 2.7 million acres, covering almost 93% of the total area. The Milk shares a number of similar concerns with the South Saskatchewan River Basin where agriculture is also heavily concentrated. There are concerns over water shortages as no new surface allocations have been issued since 2000. Transboundary issues have also been a concern. In 2004, Montana approached the International Joint Commission (IJC) for a greater share of the Milk's flow.

SOURCE:

Manning Centre for Building Democracy. 2008. Market Mechanisms for Watershed Management and Conservation.
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THE "PERFECT STORM"

> *Many water resource problems can be termed 'wicked' or 'meta-problems' because they extend beyond the scope of a single government agency and level of government, and are associated with high levels of change, complexity, uncertainty, and conflict.*
>
> — National Water Research Institute, 2004.

> *As a consequence of growing populations and increased competition for land and water, humanity is converging upon the need to make uncommonly difficult public policy trade-offs. These are trade-offs that have never had to be made on a global scale before.*
>
> — Robert Sanford, 2008c.

The stresses and strains on Alberta's water are diverse and do not land with equal force on each of the province's river basins. This reality underscores the philosophical commitment of the province of Alberta to pursue water resource management within individual watersheds. The approach recognizes that each watershed and each river basin has its own unique challenges. This goal is clearly highlighted in the *Water for Life Strategy*, and it enjoys strong support from Albertans. Implicit in the strategy is that there are no panaceas — no "cookie-cutter" solutions.

At the same time, it would be a mistake to believe that Alberta's water challenges can be met through a "divide and conquer" strategy marked out by a series of small-scale, unrelated, and independent actions. The larger reality is that all of the diverse stresses, strains, challenges, and threats are converging at the same time. Convergence is not only taking place within the same province, it is also landing upon one of the most important river basins in the province, the South Saskatchewan. It is this convergence of stresses and strains that should cause Albertans to pause and seriously consider the current and future state of the province's water.

Alberta's water has always presented the province with a certain vulnerability, and the current convergence of numerous new water challenges serves to increase this vulnerability, regardless of whether it is acknowledged or not. This vulnerability results from high exposure to a combination and concentration of numerous current and future threats against which Albertans are ill-prepared to either cope or adapt.

The long and short of the matter is that Alberta's water today is not like it was yesterday, and Alberta's water tomorrow will not at all be like it is today. Growing demand, shrinking supply, heavily if not over-allocated rivers, reduced flows, retreating glaciers, more drought, less precipitation, more variability, less predictability, compromised aquatic ecosystems, misplaced public perception, rising tensions, disputes, and potential conflict are all floating down the river at one time. *Should Albertans be concerned? You bet.*

A VISION FOR THE FUTURE

> *In the past, Alberta has been able to manage our water supply while maintaining a healthy aquatic environment because there has been a relatively abundant, clean supply to meet the needs of communities and the economy. However, fluctuating and unpredictable water supply in recent years has stressed the need to make some major shifts in how we use and allocate this renewable, but finite, resource.*
>
> — Alberta Environment, *Water for Life Strategy*, 2003.

Alberta's *Water for Life Strategy* is a broad document intended to guide water policy in Alberta into the future. The strategy is based on achieving the three goals of safe and secure drinking water, healthy aquatic systems, and reliable supplies of water for Alberta's continued economic well-being. To achieve these goals, the strategy places significant emphasis on vastly expanding the knowledge of and research on Alberta's water and its challenges, developing partnerships to manage water within local watersheds, and conservation. The strategy calls for a 30% increase in the efficiency and productivity of water by 2015.

Each one of these goals is important, but they also raise a number of other questions. Can all three be achieved in an era of diminishing water resources? If so, how? Further, how can they best be achieved? What is the role of conservation? On what basis can Albertans become convinced that conservation is even necessary? How will it be defended and pursued? In many ways, *Water for Life* has set a high standard. Achieving it will take significant effort in terms of research, knowledge, information, data, new tools and procedures, processes, technologies, and institutional arrangements. And, getting over fears.

While the goals are clear enough, the larger vision still remains somewhat obscure. When it comes to water, what is it that Albertans should be striving toward? At a very fundamental level, what is it that we want water to provide Albertans? And, how does this relate to what Albertans want and need to achieve as a province?

At a bare minimum, Albertans need to protect what water they do have, and work to reduce what is quickly becoming a significant and growing vulnerability. If Albertans do not succeed here, the future economic and social development prospects of the province, along with its standard of living, quality of life, and natural environment, are more than just called into question. The real risk is that Alberta actually starts falling backward — — where the lack of water not only hampers future growth, but where a shrinking water supply forces people, jobs, investment, and capital out of the province. Without sufficient and well-managed supplies of water, Albertans run the very real risk of losing what they already have never mind achieving any increased prosperity in the future. That could be nothing more than an empty pipe dream — a pipe with no water.

At the same time, simply protecting what Albertans already have, or working hard not to lose what they do have, is hardly an inspiring vision for tomorrow. It is a completely and entirely defensive posture — reactive — rather than aggressively offensive and proactive. At the other end of the spectrum lies a much more emboldened and exhilarating ideal that goes well beyond ensuring that the quantity and quality of our water does not limit future economic and social progress.

It is a vision where vibrant and dynamic urban and rural communities are surrounded by ecologically healthy and robust aquatic systems, where water is recognized and treated as an essential and renewable but finite resource, and is highly valued by all. Each and every Albertan has access to sufficient, safe, and secure supplies of water to satisfy personal needs, and the economy of the province is marked by the highest and most productively efficient use of water in the world. Alberta has found the right balance between social, environmental, and economic uses of water, and there is a strong social consensus around this balance, which couples with a strong individual and personal water ethic. Alberta's water resource management and water policies and practices are sought out the world over, and there are international efforts that work to emulate how Alberta does things. Water resource management in the province continues to move forward, developing and progressing with little disruption, dispute, or conflict.

In fact, rather than being a point of division and contention, water in Alberta is what binds Albertans together. Water is seen and viewed as a source of important political and social stability and cohesion in the province, and concerns about water hampering the future growth of the province are non-existent. Water policy is viewed as much more than securing water resources over the long-term or protecting water ecosystems. Water policy actively works toward enhancing the aquatic environment and improving it, realizing that each and every success here is essential to securing high quality sources of water for future generations of Albertans.

This water vision is not at all about managing water so that Albertans have enough to *survive*. This vision is all about turning challenge into opportunity — taking a diminishing supply of water and using that circumstance so that Alberta is set to *thrive*.

Impossible? Achieving such a vision will require change on more than just a few fronts. The mentality that Alberta can continue to grow forever in the face of shrinking water resources is both old and tired. In fact, there are signs that such notions of boosterism could come to a rather abrupt and painful end sooner rather than later. Albertans may wake up one morning to find that the water is just not there, and they now face the same water woes as many other unfortunate places around the globe. Rather than casting a glance outside the bedroom window to check on one of the many grain or potato fields that now dot the typical rural southern Alberta landscape, one finds something more reminiscent of Arizona or Saudi Arabia.

Alarmist? Albertans have to decide for themselves. Wake-up call? The rivers are closed. If Albertans do not recognize and rise up to meet this new reality, the brakes could slam on Alberta, and not by choice, but by water. As one participant in a Canada West Foundation water consultation put it:

> *"In my opinion we ran out of water ten years ago…"*
>
> — Wilkie, 2005.

Many a water study starts with the all-familiar bromide that water is "essential for life." That is a self-evident truth. There is nothing new in that. And, neither is that the reason why water is an issue in Alberta today. The issue here is the

water essential to Alberta's *"way of life"* and *"quality of life."* In Alberta, there are no headlines about people in want of water to slake their thirst or sustain their very breath. Any Albertan can easily find water to drink and survive. That is not the concern. The real concern is over the water required for continued economic and social progress, and the water required to rebuild aquatic ecosystems and ensure future environmental sustainability. In short, the search for solutions and a reinvigorated water resource management policy must be outcome-driven, and drive to the heart of the matter. With that clearly in sight, Albertans can start down the road to some potential solutions to the water challenge.

SEARCHING FOR SOLUTIONS: SETTING THE STAGE

> *"The solution to emerging water challenges comes through a combination of both improving our ability to capture and store water during high flow periods and improving water use practices through significant conservation, efficiency, and productivity efforts. Water conservation, combined with a focus on getting the most production possible from the water already allocated, is a fundamental component of any provincial water strategy.*
>
> — Alberta Environment, Water for Life Renewal, 2008.

> *If we do not account for water for environmental services, we are certainly not on a sustainable pathway."*
>
> — Hans Schreier quoted in Policy Options [Fortin, Sarah, ed.], 2009.

Before identifying and exploring possible solutions, there are a number of important points to state up front. First, solutions that address emerging concerns with water allocation should not conflict with, or work against, important environmental objectives. The best solutions to managing increased demand for water in the face of potentially shrinking supply will align with, or even advance, efforts to preserve, enhance, and renew Alberta's water ecosystems. Second, in assessing and examining various solutions, it is important to appreciate that water has a number of dimensions that make it very complex. It is not helpful to view water as a "simple" or "homogenous" resource. The fact is, there are many different "types" of water. Third, transforming Alberta's water headache into opportunity will require a suite of solutions. There is no "silver bullet."

1. Solutions: Aligning Environmental and Allocative Concerns

The traditional approach to water has focused on harnessing the resource and developing an adequate supply as a first order consideration, while the environmental impact of water taking has been relegated to the backseat as a second order consideration. This ordering tends to dominate our thinking over water issues, and also clouds our judgment of certain solutions. Effective solutions help turn this traditional "ordering" on its head.

- The environment is a legitimate user of water in its own right: As already noted, nature itself needs sufficient water if healthy ecosystems are to be maintained, water quantity and quality are to be assured, and natural purification processes are to be preserved. Effective solutions

respect the fact that there are essential environmental demands on water. New, innovative, or creative approaches to allocating water should not be seen as taking anything away from the central importance of the environment's own need for water.

» Conceptually, effective solutions for allocating water can be held separate from decisions to improve the environment: Once the maximum allowable water taking from a watercourse has been defined, once environmental limits and boundaries have been set, and once rules, regulations, and controls have been put in place, the matter of water essentially becomes a question of allocation — who gets the water that remains, for what purpose, where, and when. Viewed from this perspective, solutions for allocating water in a time of increasing demand and potentially decreasing supply can be divorced from decisions made on the environmental side, as long as the environmental considerations come first. In short, governments can establish the environmental limits, and then decide how to allocate the water that remains. The notion of "protected" water and "available" water is helpful here. "Protected" water is left in the watercourse to maintain ecological integrity. This is a first order decision. The second order decision concerns allocating the "available" water that remains.

» In practice, some allocative solutions can still advance environmental objectives: Environmental needs for water have not been recognized sufficiently in the past, some southern Alberta watercourses are already over-allocated, and other watercourses could be headed in that direction. This places a premium on water conservation as a way to meet increasing water demand for both human use and the natural environment. Solutions that encourage conservation need to be seriously considered — if not aggressively pursued. For example, financial or market-based solutions to allocation — such as charging for water use and trading water allocations — can put some real muscle behind conservation by making it economically rewarding.

2. Solutions: Recognizing the Complexity of Water

In pursuing solutions, it is important to remember that water is not homogenous — there are many different types of water. Water is a complex resource that possesses a number of dimensions that require us to make critical distinctions when evaluating potential policy directions.

» Solutions target "blue" water as opposed to "green" water: Policy solutions, by necessity, need to focus on a particular type of freshwater — "blue" water as opposed to "green" water. While the distinction is not always recognized, precipitation generates two types of water (Falkenmark 1995; Yang and Zehnder 2008). Green water is immediately absorbed by soil and vegetation, and is evaporated or transpired back into the atmosphere as water vapor. Green water is inaccessible for direct human use, and is not open to manipulation. Public policy cannot generally touch on green water. Precipitation that moves in streams and rivers or collects in ponds, wetlands, lakes, and groundwater aquifers is blue water. Blue water is accessible for direct human use and can be conveyed and manipulated. It is the increasing demand and potentially decreasing supply of fresh blue water, and

the environmental impact of diverting and consuming blue water, to which public policy must respond. The interaction between green and blue water can be seen in agriculture. For example, the majority of crop agriculture is "rainfed" or "dryland" farming, which relies exclusively on green water. Irrigation adds blue water as a supplement to green water.

» Water is both infinite and finite: Viewed from a broad hydrological perspective, freshwater is an infinite and renewable resource in that the water cycle continually produces new freshwater. Oceanic saltwater evaporates to the atmosphere, condenses over land, precipitates as freshwater, and then drains to the ocean where the cycle begins once again. As long as the hydrological cycle continues, freshwater is renewable and ultimately infinite (Agriculture and Agri-Food Canada 2000). But viewed from a local and temporal perspective, water is finite. There is only so much freshwater available in any one place at any given point in time. Because both perspectives are correct, neither one should take precedence when it comes to conceptualizing water issues. Just because water can be finite in time and place does not mean it is non-renewable. Water is most certainly renewable. The only non-renewable water would be fossil groundwater, which can take thousands of years to recharge or does not recharge at all.

» Intended usage of water: Water is used in many different ways. For example, water for basic and fundamental human needs such as drinking is one type of water. Water diverted to irrigate a private golf course or produce oil, gas, electricity, and steel is another type of water altogether. Are the two "types" of water one and the same? No. The first scenario requires water that is very safe and of very high quality. The second scenario might make do with water of lower quality. In addition, all of us would certainly agree that no one should be denied access to a sufficient amount of quality water to meet their basic and fundamental human needs regardless of ability to pay. But does the same apply to the exploitation of water for private economic gain? Or, can the economic use of water be competitively priced? In other words, policy responses for one "type" of water may not be appropriate for other "types" of water. In looking at solutions, we need to be sensitive to such distinctions.

3. Solutions: A Suite of Options

Given the many stresses and strains on Alberta's water and the robust vision of what could be, any potential solutions certainly have a lot to accomplish. Solutions must run the gamut — preserving and renewing water ecosystems and enhancing aquatic habitat, fairly and equitably sharing and allocating the water resource among its many competing uses, and accommodating growing demand in light of shrinking supply. Solutions should also work to dispel the myth of water abundance, instil a new water conservation ethic, help change public perceptions, and improve agricultural and industrial practices and patterns of water use. Solutions should work toward finding new water efficiencies, making water more productive in the economy, and creating incentives to reduce and even reverse eutrophication of western Canadian water bodies. What is more, all of these goals need to be achieved with a minimum amount of conflict.

The obvious conclusion here is that no one solution will suffice. The answer to a renewed and sustainable water resource management policy lies in a "suite" of solutions where individual tools are targeted to address the unique challenges in each river basin but also combine to form a larger framework that takes Alberta further down the road to a safe and secure water supply within the context of long-term economic and environmental sustainability. In short, Albertans should not "tie their flag" to one option or alternative. What is required is a multi-faceted policy response.

In all likelihood, this response will have to develop incrementally. Giant policy swings one way or the other are not likely to be successful. But the various tools do need to be settled upon, decisive steps need to be taken now, and the girders under the larger policy framework must be erected. The potential actors in this suite of solutions are numerous, and include both supply-side and demand-side possibilities, as well as financial or market-based mechanisms. If none of these can get traction, then the brakes may eventually hit on Alberta's growth.

SUPPLY SIDE OPTIONS

> *"The newly launched RainXchange™ was created for capturing, filtering, and re-using rainwater. RainXchange™ combines a recirculating decorative water feature with a sub-surface rainwater harvest storage system. One inch of rainfall on a 2,000 square foot residential roof generates 1,250 gallons of water that can be reused. The RainXchange™ allows you to collect thousands of gallons of water anywhere — even in the desert."*
>
> — Nature's Corner Store, Edmonton, Alberta.

The supply-side approach seeks to resolve growing demand by directly increasing the amount of water available for use. While this is very much a traditional response to current and anticipated water shortages, the supply-side basket also includes some newer and unconventional mechanisms as well.

1. Large-Scale Water Provision

- The option: The typical response to growing water demand has been the construction of large-scale infrastructure to divert, store, and convey additional water through the construction of dams, on-stream and off-stream reservoirs and impoundments, water and wastewater treatment facilities, pumping stations, canals, and pipeline networks. Large-scale provision can also involve intra-basin transfers of water (water moved from one watercourse to another within the same watershed) and inter-basin transfers (water moved from one major watershed to another). In Alberta, large-scale projects provide huge volumes of water for millions — whether in the city or on the farm.
- Potential promise: In many circles and for many reasons, large-scale water provision has fallen into disfavour. Yet, it does have at least some upsides. Large-scale provision is a traditional approach with which Albertans are familiar, and it has played an essential role in the province's historic and continuing economic development. Large-scale provision is an efficient solution that employs sufficient

economies of scale. Irrespective of the many faults and short-comings of large-scale water provision, it does secure substantial new sources of water at relatively low cost for water users. While any new large-scale projects may be "off the books" for now, some argue that there is potential for more effective and efficient use of water projects that already exist, whether that be improving and enhancing water storage in existing impounds, implementing technologies and infrastructure upgrades to lower rates of evaporation, and even increasing storage capacity and management through aquifers. In other words, finding ways to maximize the effectiveness and efficiency of existing water infrastructure could offer at least some promise even if no new large-scale projects go ahead.

» Potential pitfalls: Much of the water that can be developed — at least in southern Alberta — has already been developed. Because the limits have largely been reached, any future large-scale provision and expansion of supply would likely involve a "re-plumbing" of the province through inter-basin transfers, which the Alberta government has already said is off the table — at least for now. Not only is it very expensive to build dams, canals, and water impoundments, all of these "mega" supply-side solutions carry some very real environmental and ecological costs. While large-scale provision might assure more water quantity across the short-term, it could work against water quality and the sustainability of any new quantity across the long-term.

» Perspectives and acceptability: The negative environmental implications of large water projects, along with their high price tag, has meant dwindling public support for this approach. The last significant large-scale water project in Alberta was the Oldman Dam, completed in 1992. While the project has generated significant benefits for the southern Alberta irrigation community, created new recreational opportunities, and also ensured more stable and secure water supplies for many southern Alberta communities, all of this was accomplished amidst substantial controversy and conflict, including a significant amount of litigation and inter-jurisdictional dispute between the federal government through Environment Canada and the Alberta government. There is little reason to suspect that such events would not occur with other new large-scale projects.

At the same time, the approach has not been completely discounted in the *Water for Life Strategy*, and in early 2008, Alberta Environment released a study assessing potential storage sites and diversion scenarios (Alberta Environment 2008d). While the study made clear that its purpose was to identify potential sites for further evaluation and not to suggest where any new future dams should be built, it does hint that the province has not completely eliminated the option. The report assessed 90 potential new diversion and storage sites that were originally identified in an earlier 2005 report. The perspective expressed by most Albertans would appear to mitigate against any expansion of large-scale water provision at this time, and policy geared toward that end would certainly seem to swim against the prevailing current of public opinion. However, it should also be kept in mind that public opinion is never static. One wonders if Albertans, and the

broader policy community, will begin embracing the option with more enthusiasm if water shortages become more acute and enduring, and if enough demand begins to build. The motto here may well be "more dams if necessary, but not necessarily more dams."

2. Small-Scale Water Provision

» The option: Advocates of supply-side solutions are increasingly focusing attention on small-scale provision, where individuals, industry, and business take responsibility for meeting some of their own water needs. The idea here is to augment large-scale provision with water secured locally through a decentralized process — small-scale and individually-owned and operated water capture and storage systems. Two examples of such small-scale techniques are "personal desalination" and "rainwater harvesting." Both approaches expand the supply of usable freshwater by capturing and storing "green" water locally, and transforming it into "blue" water that can be used. Across the world, engineering corporations are designing and building many types of small-scale systems to meet rising water demand, such as solar-powered personal desalination equipment and integrated rainwater harvesting systems for household use.

» Potential promise: The inherent strength of small-scale water provision is its sharp focus on addressing local water shortages through local solutions. Because such provision is self-supplied, it encourages people to take responsibility for their own water use and to conserve where possible. In this way, small-scale provision and self-supply systems can contribute to building a stronger water ethic across the province.

» Potential pitfalls: At the same time that future growth of the province will likely require significant new amounts of water, small-scale provision is largely restricted to augmenting existing sources of supply. In other words, "small-scale" provision is a "small-scale" solution. Another downside involves cost. People are not likely to invest in their own water systems unless it is absolutely necessary. Because water is still relatively cheap, it makes little sense to invest tens of thousands of dollars in a self-supply system to water a lawn or garden. Finally, in some locations, small-scale provision may just not be practical. Desalination, for example, is only practical in close proximity to the coast, and rainwater harvesting offers little relief during either a severe or prolonged drought.

» Perspectives and acceptability: Self-supply of water has always enjoyed a certain level of acceptability for Albertans, from the old-fashioned rain barrel to the locally owned and operated water-coop in the rural acreage community. Innovations in engineering continue to expand the options, such as the *Aquascape RainXchange*™ harvesting and storage system offered through a retailer in Edmonton, the *Rainwater Connection*™ system out of British Columbia, and *Bushman*™ systems with international operations in California, Toronto, London, and Sydney. A very unique home-grown example is the new *Vento* residential development in Calgary, a mixed-use commercial and residential condominium infill project located on the former General Hospital site and developed by the *Windmill Development Group*. The *Vento* employs a rainwater collection system for flushing toilets and

watering plants. Combined with low-flow fixtures, water use in the *Vento* is expected to be about 60% lower than in traditional buildings (Windmill Development Group 2005). The *Vento* project was the first multi-family residential development in North America to earn the *Leadership in Energy and Environmental Design (LEED) Platinum Certification* offered through the *US Green Building Council*.

3. Alternative Water Sources

- The option: Developing alternative water sources involves replacing fresh surface or groundwater with water of lower quality — such as brackish groundwater — to perform the same function. Using alternative sources reserves higher quality fresh surface and groundwater for those applications for which it is essential, such as drinking, irrigation, or stockwatering. Other functions, such as petroleum exploration and development, and certain industrial water uses, may be able to get by with water of lower quality.
- Potential promise: Securing alternative water sources reduces the demand pressure on freshwater supplies and capitalizes on available non-fresh sources. The solution recognizes that freshwater is too valuable for uses that do not require it. It is an innovative option that demonstrates leadership, as well as corporate and social responsibility.
- Potential pitfalls: Developing and employing alternate water sources maybe easier said than done. Not only does it require research, development, and technological expertise, it will also involve new investments as well. In many cases, there is a lack of knowledge about the opportunities available, and a lack of information about potential alternative supplies. The solution requires the establishment of pilot projects to assess feasibility, illustrate the benefits, determine costs, and identify facility and system upgrades. Misperceptions and concerns also remain regarding the long-term effects of using water of lower quality for some purposes.
- Perspectives and acceptability: Like self-supplied water, finding and using alternative sources of water appears to be acceptable to Albertans — at least where it is feasible and possible. The approach is already in play across Alberta's oil and gas industry, where water usage patterns have changed dramatically over the past 30 years. For example, brackish or saline groundwater, and even carbon dioxide gas, is increasingly being used to enhance recovery through oilfield injection as opposed to fresh surface or groundwater (ERCB 2006; Gatens 2007; Lunan 2006). The City of Calgary has also been employing alternative water sources, and is now using storm water run-off as well as untreated river water to irrigate its parks and public golf courses. This alternative has proven less expensive than using treated potable water, and has reduced the impact on municipal water treatment plants, saved energy, and reduced carbon dioxide emissions. The City has said that new parks and sports fields in the communities of Coventry Hills and Citadel will make use of storm ponds for irrigation, and the City is also pursuing a computerized control system — one of the largest of any municipality in Canada — to determine when the City's 700 plus pubic parks and green spaces need to be irrigated (City of Calgary 2006).

4. Water Recycling and Reuse

» **The option:** Traditionally, water is diverted, stored, treated, and then conveyed for one specific use, after which the wastewater is collected, treated, and released back to the watercourse. Recycling and reuse sees water being employed for two or more functions before it is returned. Recycling and reuse of wastewater — sometimes called "reclaimed" water — can be employed for specific applications that do not require potable water. Examples include irrigation for crops, parks, and golf courses, various industrial uses, and even recharge of groundwater aquifers or the restoration of wetlands. Depending on the intended application, the wastewater that is to be reused can be partially treated or completely treated. In most locations, reclaimed water is only intended for non-potable uses, such as irrigation, dust control, or fire suppression. But reclaimed water is also being used to boost potable water supplies as well, including jurisdictions like Singapore, Orange County California, and some places in Australia. Here, the wastewater is given much more advanced treatment before it is reused.

» **Potential promise:** Like alternative sources, the recycling of water reduces pressure on water supplies by reserving higher quality freshwater and restricting it for potable use. As noted above, recycling of water in some places is even used for potable purposes. Recycling can be a workable alternative for a wide range of water uses. Most important, recycling of water represents an efficiency gain — each litre of water diverted is made more productive as it is put to several uses. Water becomes more productive because it is used to accomplish two or more goals before being returned to the watercourse.

» **Potential pitfalls:** While the recycling of water is used in many jurisdictions including the US, Japan, Sweden, and Germany, the very idea continues to suffer from negative perceptions particularly when it comes to issues of water quality, potential risks to the environment, and especially human health. These concerns apply to the reuse of water for both non-potable purposes and potable purposes. In Alberta, regulations currently limit water recycling and reuse. Like other supply-side options, the use of reclaimed water implies significant expenditure to retrofit current water and wastewater infrastructure, especially if implemented on a large scale.

» **Perspectives and acceptability:** Concerns with water quality, risks to human health, and the lack of appropriate water infrastructure have meant that water recycling and reuse has yet to really take off in any substantial way, but some sectors are certainly experimenting. In the oil sands, Suncor has reduced its total water use by some 40% over the last five years, and some oil sands projects are reusing each barrel of water 18 times before it is disposed. About 85% to 90% of the water used in the major oil sands operations is now recycled and reused (CAPP 2008). An interesting on-farm example of water recycling and reuse is being developed by Livestock Water Recycling (LWR) systems of Calgary. The company has refined and patented a mechanical and chemical processing technology that removes manure contaminants from the discharge of livestock facility wastewater. The LWR process removes solids, phosphorous, potassium, ammonia, and nitrogen from the wastewater, and the result is water that is quite suitable

for other uses. The removed contaminants are used in processing fertilizers (LWR 2010). Going forward, Albertans need to realize that all people who live downstream must use water that has been recycled or reclaimed. It is only those upstream or first in line at the river — and this includes most Albertans — who do not have to use recycled or reclaimed water. But all those living downstream have no choice. They use reclaimed water for non-potable as well as potable purposes.

In general terms, there remains a growing suspicion about the benefits of any large-scale supply-side solution, but the same does not hold when considering innovative and small-scale supply solutions of which there are many concrete examples in play right across the province. At the same time, it is difficult to establish the environmental benefits of a strict supply-side approach. Focusing on continually expanding supply does little to change harmful behaviours or stem what many believe is the over-consumption of water. And, if small-scale supply-side solutions are limited in the amount of water that they can ultimately secure, then the focus must — by necessity — turn to the demand-side.

DEMAND SIDE OPTIONS

> *"Water management in Canada has traditionally focused on supplies. As competition for this resource grows, demand management tools are expected to achieve more efficient water use."*
>
> — Agriculture and Agri-Food Canada, 2000.

Demand-side solutions also work to increase the supply of water, but do so indirectly through conservation, increased water productivity, and maximizing water efficiency. The idea behind demand management is to "do more with less" and in the process, release "new" supplies of water through what is saved or conserved. Water conservation — at least broadly conceived — is at the heart of all demand-side solutions. Specific approaches and mechanisms tend to vary solely based upon how the conservation is brought about.

1. Technological Innovation

» The option: It is well-known by economists the world over that advances in technology — from the seemingly minor to the new and bold — are the "warp and woof" of productivity and efficiency gains. The same applies to water. Whether it is something as basic as a low-flow toilet or a complex computerized irrigation system, technological innovation is always at the heart of "doing more with less." Technology can also be seen behind much of the discussion over the *"soft water path"* which seeks to push the conservation envelope by finding ways to eliminate water from some functions entirely, whether that be the advent of the "waterless" toilet, or as already mentioned in Alberta, exploring and further developing the potential of using carbon dioxide gas instead of water for oilfield injection and enhanced oil recovery (Gleick and Wolff 2003).

» Potential promise: Pursuing and implementing technological advances to feed conservation carries three important benefits. First, water saving knowledge and numerous technologies are already available to help Albertans reduce the amount of water they use, and potentially

accommodate increased municipal populations, expanded irrigation, and additional industrial capacity without necessarily having to divert more water. Second, diverting, storing, treating, and moving water consumes a lot of energy. Thus, an important corollary to less water use is reduced economic and environmental costs over the long-term. Third, technology holds the most promise to reduce water use without forcing huge sacrifices in the lifestyle of Albertans or damaging the province's economic potential or production. As AWRI chairman Dr. Lorne Taylor rightly asserts, "An investment in knowledge always pays the best interest" (Taylor 2009).

» Potential pitfalls: Researching, inventing, developing, and adopting new technologies costs money. If the overall economic cost of water remains relatively low, few are likely to make the required investment. Thus, conservation through technology could very well need a boost. This boost will have to come in the form of other conservation approaches, whether that includes public campaigns, legislation, or financial incentives that either force or encourage the pick-up of new technology. Simply having the technology available is no guarantee it will be used. At the very least, people have to know that the technology exists.

» Perspectives and acceptability: Across many sectors, Albertans have showed themselves willing and able to adopt water saving technologies, and there is every reason to suspect that additional gains could be made. To the extent that water saving technologies can lower water use, lower cost, and improve environmental stewardship, Albertans are likely to embrace them.

2. Public Awareness Campaigns

» The option: Various public education, information, and awareness campaigns can be used to challenge perceptions, change public attitudes, highlight the potential consequences of unsustainable water use, and emphasize and underscore the need to engage in conservation. Aside from simply trying to secure conservation, public campaigns can engage citizens and provide essential information on the environmental, social, and economic importance of water.

» Potential promise: Campaigns and programs that draw the public's attention to water issues can help promote attitudinal shifts, encourage Albertans to see water as a valuable resource that they cannot afford to waste, prompt changes in behaviour, reduce individual water use, and increase public support for better water management practices across all sectors. An important focus for any awareness campaign is to inform and educate the public about new water saving technologies and innovations, many of which need to eventually "catch on" but have yet to do so. Many of these water saving technologies are part of a larger bevy of environmental home options such as solar energy and geo-thermal heating. While the technology is available, proven, and reliable, a lack of knowledge and the fact that it works against the traditional "way of doing things" often prevents its uptake.

» Potential pitfalls: It is difficult to change entrenched values and perceptions about water, especially when the changes envisioned swim against a strong financial current such as the relatively low cost of water. In the end, public awareness campaigns may paddle hard, but

they make very little headway. Success here will not be immediate but can only accrue across the long-term. While the information function is not at all unimportant, it should only be seen as the first step in building public support for other measures.

» Perspectives and acceptability: Informing and educating the public is a simple and relatively benign first step that should not be overly threatening for most Albertans. Going forward, there is the potential to build upon several existing public awareness programs such as Calgary's "Water Wise" campaign. At the same time, government should be careful to ensure that such campaigns do not lead to mounting frustration if they are seen as mere "window-dressing." At a minimum, campaigns should focus on filling the information gaps, providing practical answers on how to reduce water use, highlighting concrete water saving opportunities and examples, and linking to other initiatives.

3. Legislation and Regulation

» The option: Governments can also legislate water conservation — whether the goal is saving water in general or securing specific conservation objectives — by passing new laws or amending the rules and regulations that accompany existing laws. With the threat of legal sanction, governments can always compel water conservation through a "command-and-control" approach.

» Potential promise: Compelling water conservation through legislation is a conventional and traditional approach with which Albertans are familiar. And, when compared to other approaches, there is no reason to assume it would not be effective, as well as convenient, simple, and relatively straightforward. For example, modifications to the Alberta Building Code could mandate the uptake of water saving technology by requiring low-flow fixtures in all new construction.

» Potential pitfalls: Legislating water conservation is simple and effective, but it is a negative approach, being coercive and punitive. To be sure, legislation may be helpful in some circumstances, but it may not always work toward the valuable goal of building a new water ethic based on strong public and grassroots support.

» Perspectives and acceptability: Albertans certainly expect provincial and municipal leaders to protect the public interest, and as such, legislating water saving would seem to be a generally accepted mechanism. Again, the approach is already in play. For example, oil and gas producers are required to employ saline or brackish groundwater sources for oilfield injection wherever possible, as opposed to fresh surface or groundwater. Generally speaking, the approach would appear to raise few objections. However, specific outcomes, decisions, and conservation objectives may generate considerable debate.

4. Financial Incentives

» The option: As opposed to legislating conservation, governments can also design and implement positive measures that financially reward and encourage — with public dollars — certain actions or behaviours with respect to water use. Typical financial incentives include tax breaks, credits, rebates, grants, and even low interest loans that encourage individuals, institutions, and industry to adopt new water saving technologies.

- Potential promise: Providing financial incentives to adopt water saving technologies and innovation is a more positive approach than the traditional "command and control" model. A key advantage of the incentive approach is how it can help offset some of the financial cost to individuals and firms for implementing water saving technologies.
- Potential pitfalls: Whether or not financial incentives are more effective than legislation remains an open question, and the approach itself raises a number of concerns. First, can a user-friendly financial incentives-based system be constructed that is effective, inexpensive, and easy to administer? Second, providing financial incentives requires public funds. Where will the funds come from? Third, at what level do such financial incentives have to be set in order to accomplish substantial water savings? The answers to all of these questions are less than clear.
- Perspectives and acceptability: Numerous incentives are already in play across the province, with one of the most common being municipal cash rebates for purchasing low flow water fixtures such as toilets (which are a household's largest water consuming fixture). Currently, all of Calgary's residential water customers — who are metered and have an active water utility account — can apply for a rebate of $50 on the purchase and installation of each low-flow residential toilet (City of Calgary 2010). Because the concept of financial-based incentives is not alien or foreign, there could certainly be room to expand the idea.

In the final analysis, the success of all demand-side solutions hinges on whether sufficient quantities of water can be conserved in some sectors — or across all sectors — to meet growing demand and whether the incentives are in place to build and maintain a strong water conservation ethic in the province. It is also questionable whether the mantra of "conservation for the sake of conservation" will take Albertans very far. The fact is, conservation needs to be backstopped. For example, water-saving technology might be available, but if the water is cheap, why invest in the technology? Saving $50 on a low-flow toilet might have some attraction, but if it tends to plug up, why bother? It is precisely at this critical juncture where financial and market-based tools can put some "teeth" into conservation. The added bonus is how they can also help allocate water.

FINANCIAL OR MARKET-BASED OPTIONS

> *We've been treating water as a free good. If beer were a free good, we'd have a shortage of beer too.*
>
> — Terry Veeman quoted in the Edmonton Journal [authored by Brooymans, Hanneke], 2003.

> *The OECD has gone so far as to call Canada's water 'cheaper than dirt.' Typically, our fees do not reflect environmental costs and, in many cases, do not even cover the full financial costs associated with developing, treating and distributing water and administering water management programs.*
>
> — Tony Maas and Lindsay Telfer, Prairie Water Directive, 2007.

> *Working at their best, water markets have been an efficient way to achieve a balance between supply and demand, stimulate innovation, and promote water efficiency.*
>
> — Olivier Brandes, Linda Nowlan, and Katie Paris, 2009.

> *While there are many who are very upset about the potential for market commodification of water resources, our international experience is that water can at one level be a human right and at another a market commodity. They can perform these functions simultaneously, a fact proved by every human civilization that has existed in recorded history.*
>
> — Robert Sanford, 2009

> *Earlier this month, I reviewed a draft report which explored the potential for the marketing of water rights. I have no problem with the concept in principle — international experience has suggested that it could be useful in reallocating water to higher value uses and introducing water use efficiencies. But I do have a problem with it in the Canadian context where we don't generally have sufficient safeguards in place to protect the public interest. Water would indeed flow to higher value uses, but the more general public good would take a beating.*
>
> — Ralph Pentland, 2008b.

The *Water for Life Strategy* has set ambitious goals. Increasing the efficiency and productivity of water is one such goal. Ensuring reliable supplies of water for Alberta's continued economic well-being is another. And, protecting Alberta's aquatic ecosystems is yet another. In achieving these goals, the Alberta government has also made it clear that financial or market-based mechanisms will be explored and pursued in the drive to accomplish these objectives. In one sense, then, the die has already been cast. The *Water for Life Strategy* is not alone in this respect. The province's other major environmental strategy — the *Land Use Framework* — echoes similar themes (Alberta Sustainable Development 2008).

Among the various solutions, increased attention has landed on two particular financial or market-based approaches — attaching a charge or *"price"* to water or water use, and the regulated *"trading"* of water allocations, licences, or water use rights. Both mechanisms serve to marry the supply-side with the demand-side by promoting conservation and helping allocate available water. It is outside the scope of this effort to pursue either of these in a comprehensive manner. For now, the purpose is to explore only the basics. How would these options work? Can they help advance important environmental objectives? Can they help address Alberta's water challenges? Do they fit with the province's historical development? What are some of the objections that might arise? How are these objections best perceived?

1. Charging for Water

» The option: The purpose behind "pricing" is to promote conservation and the efficient use of water by attaching at least some monetary charge to each and every cubic meter of water withdrawn, diverted, used, or consumed. Broadly conceived, such charges would apply regardless of the intended use of the water. The idea of charging for

water use relates strongly to a key goal in the *Water for Life Strategy*, which is a 30% increase in water efficiency and productivity by 2015. To be sure, there are many ways increased water productivity could play out in different river basins. It could occur by using less water and producing the same economic output, using much less water and producing a little less, using the same amount of water and producing more, and even using more water and producing much more. Because the SSRB has been closed to new allocations, the thrust there will have to be producing the same with less water, or more consistent with our vision, producing much more with significantly less water.

Before pursuing this idea any further, however, it is important to engage with some terminology — to distinguish between the concepts of "pricing" and "charging" for water. Strictly speaking, a "price" for any good or service can only be arrived at through the interaction of supply and demand within a properly functioning market. This interaction establishes a *market price* that reflects the economic value of producing the good or service. When it comes to the concept of water "pricing" what is in view is better described as "charging" for water through an *administered price*. In the absence of a functioning market, any monetary charge applied to a good or service will not reflect its economic "value" or true "price" strictly speaking. In short, market prices are *economically* determined while administered prices are *politically* determined. The former is the result of market interactions while the latter is the result of a political decision to charge a notional amount for consuming a good or service. To avoid any confusion, this discussion on water "pricing" reflects the idea of "charging" an amount for water use that, while not completely arbitrary, may not reflect its true economic value.

» Potential promise: Water pricing — charging an amount for water — imposes a direct and personal monetary cost on water usage. In so doing, it provides an incentive to reduce water use in order to cut costs. Charging for water encourages efficiency in its use, promotes conservation, and encourages investing in and adopting new water-saving technologies and innovations. It is hard to envision the 30% increase in water efficiency and productivity in the *Water for Life* Strategy without some form of water charge. Specifically, the idea has a number of advantages:

1. *Charging for water equals conservation, which equals environmental benefit:* The components of our natural environment that seem to suffer the most from our economic activities — air and water — are the same components that are typically shielded and insulated from any form of price. This is no coincidence. By not charging a price, people are invited to use and abuse both of them. The irony is that when people so eagerly and readily do so, we are surprised. If a charge for water is levied, Albertans will be challenged to take a hard look at the artificial line that has been drawn between economic and environmental resources, especially those that we typically regard as existing in surplus — like water — but are now scarce and diminishing. If financial incentives like water charges can be harnessed, Albertans will be much more able to recognize

the importance of the resources they are using and respond accordingly. What is more, charging for water use will generate an income stream for governments, which can be employed to fund additional water conservation and productivity efforts, or ecological and environmental enhancement. There is a strong and logical link here where remediating the environmental effects of water use and protecting the water resource are both funded by the water users themselves.

2. *Environmental benefit and economic efficiency combine to form a powerful argument:* In the past, water conservation has often been urged through a moral appeal — that people have an ethical obligation to respect the environment. But such appeals swim against the lack of any pricing mechanism, which pulls Albertans in the opposite direction. Conservation and environmental protection, as a policy goal, will gain more traction when it is placed within a broader economic rationale that includes charging for water. The pursuit of economic growth and increased productivity is intimately related to efficiency — producing goods and services with the least inputs and the lowest cost. Not only does this provide goods and services at the lowest possible price to consumers, it is a key factor in lifting living standards through rising real incomes. Efficiency in water use can be connected with this larger economic concern, especially during times of scarcity. Efficiency is an economic imperative, and without it, Alberta's economy and social potential will be limited. Drawing all of these threads together offers Albertans a lot more to consider when it comes to conservation as opposed to making the "environmental" case alone.
3. *Charging for water demolishes the myth of water abundance:* Attaching a monetary consideration to the water resource dispels the notion that water is somehow "free" or that the resource is abundant in both quantity and quality. When any good or service is provided free of charge with no direct financial cost to individuals, consumption of that good or service is almost certain to rise beyond what people are actually willing to pay if they were required to do so. Requiring users to pay is an effective way to reign in demand and lower consumption because every additional drop involves a real and direct personal financial cost. As a result, people will work to use less water and avoid wasting it, all in an effort to save money that they would like to spend elsewhere. The concept of pricing, whether a market price or an administered price, demonstrates clearly that there is no such thing as a "free" good or service — that consuming any good or service imposes at least some cost to somebody or something whether that be another individual, the community as a whole, or even the environment. If something for one individual is offered for free, then someone, somebody, or something else is merely picking up the tab. Failing to charge for water directly — providing it "free" — clearly imposes a cost on the environment, which is forced to subsidize usage, and this shows up in the form of a degraded watercourse. Refusing to charge for water amounts to

a subsidy, which always causes consumption to rise. The idea of charging for water — even if it amounts to an indirect charge, an administered price, a direct user fee or an indirect user tax — can help lower consumption. While water is in many ways a unique and special resource, it is not so unique or special that it falls outside this general rule.

4. *Charging for water addresses intergenerational concerns:* Charging for water addresses a moral dilemma. When water use is not subjected to a monetary charge, it is often over-used and over-consumed — if not wasted. Such patterns of consumption by the current generation of users carries a very real ecological and environmental consequence that lands on watercourses today, but will hit harder on the watercourses needed by future generations tomorrow. In many ways, it is the future generation who will suffer with a compromised aquatic environment, having less water, and water with lower quality. It is future generations who will also have to pick up the tab for remediating the environmental consequences of irresponsible patterns of current water use.
5. *Charging for water can lever other policy goals:* While charging a price for water use is a powerful conservation tool, it also spins off in a number of helpful directions. When pricing is in play, there is potential to design flexible and sophisticated rate schedules that can lever other important policy objectives that reward positive and beneficial water behaviour and discourage or punish unhelpful or destructive water behaviour. Charges can be designed, for example, to incent increased return flows, increased quality of return flows, withdrawals of water that better coincide with variations in natural flow, or taking on local ecological enhancement. Water charges can always be adjusted, and this opens the door to all kinds of other important water resource management objectives that go well beyond conservation and efficiency, as valuable and important as those may be. Further, charging for water does this without forcing through complicated or burdensome government regulations, and the difficulties of enforcing the same.
6. *Charging for water enhances choice:* Lowering the demand for water can be done by "command and control" regulations imposed by government or by financial charges that impose costs on water use. But charging for water holds a significant advantage over government regulation in that it allows water users *themselves* to find the most effective and economic way to reduce their use based on personal preferences. The concept of charging for water does not describe the means by which conservation will occur, but allows users to make their own decisions. Confronted with a financial charge for water, one person may decide to replace their front lawn with gravel so they can fill the backyard pool. Another may decide against the pool in favour of sprinkling the front lawn.

» Potential pitfalls: While the concept of charging for water is relatively easy to grasp, the particulars of designing a pricing scheme is plagued with difficulties. Ways need to be found to negotiate a number of curves.

1. *Setting a charge that reflects the value of water is difficult:* As mentioned at the outset, charging for water in the absence of a functioning market — a competitive system that establishes the value of water based on what buyers are willing to pay and vendors are willing to sell — means that any "price" for water will by necessity be an *administered price* as opposed to a *market price*. When it comes to water, financial concepts like pricing bump up against water's public good characteristics. While administered prices need not be entirely arbitrary, they are somewhat artificial, and deciding upon the right charge is a complex matter open to debate and dispute. Setting an appropriate charge can also be difficult and expensive as significant data and information are required. Opportunity costs of water can be hard to measure and there are a wide range of factors involved. Water — in both quantity and quality — varies according to time and place and much also depends on the type of water needed and the intended use of the water. Water aside, even full cost accounting for any water and wastewater infrastructure — source supply, headworks, collection, treatment, distribution, wastewater collection and sewage treatment and disposal — is hard to determine, never mind considering the long-run costs of operations, maintenance, and capital replacement. To be sure, all of this makes arriving at an appropriate water charge difficult. However, this is somewhat tempered by the fact that a perfect "price" through full cost pricing or even marginal cost pricing may not be required for a charge to have an effect on water usage patterns. Even a modest charge is sure to provide at least some help (Pearse and Bocking 2002). One of the biggest issues here is simply getting basic agreement on charging for water in principle and then arriving on a rate schedule — at least to start.
2. *Charging for water use might not be effective:* Charging for water may not result in conservation if water consumption is unresponsive to the charge — if the "price elasticity" of water is low. Water has always been subjected to at least some debate on this point, but most evidence tends to be pretty consistent that charging for water can dampen demand — at least in the municipal context. Municipal studies in Canada have shown that flat rate charges regardless of the amount of water used can result in 50% more water consumption than when volumetric charges are employed (McFarlane and Nilsen 2003). But less is known about the possible impact of pricing in other sectors such as agriculture or industry. Regardless, one thing is clear — as long as water can be taken without some charge, users cannot be expected to recognize the importance of the water resource. If charging for water is to be effective, at least two things will have to happen. First, a large investment will need to be made in metering all water users. Second, considerable work will have to be undertaken to explore various types of water charges along with the level of any potential charge. There is certainly a risk here that Alberta goes through a lot of work to introduce a water charging system, and then for political reasons, the charge is set so low that it has little to no impact on consumption, and therefore, on conservation.

3. *Charging for water may hurt competitiveness:* Free and abundant supplies of water constitute a comparative economic advantage that gives any province a strong competitive edge. Charging for water will result in increased cost for business, could hurt competitiveness, and result in lower rates of future economic growth. While Albertans should not ignore the potential effects on economic competitiveness — many do — it needs to be remembered that government imposed restrictions on water use will do much the same. What is more, if conservation cannot be achieved, then the economic future of Alberta may become not just uncompetitive, but jeopardized. At least with a system of water charges, business is left to figure out for themselves how they can best lower their water costs, and that might involve investments in new water-saving technologies and systems that carry an initial capital investment but also result in lower long-run operating costs. Studies in this area have found that business can lower water use, can do so rather inexpensively, and can do without having it cut into profits (City of Toronto 2010; North Carolina 2009).
4. *Charging for water use has to be expanded to all sectors if it is going to help:* In Canada, most of the discussion about charging for water use has occurred within the municipal context, where such charges are used primarily to recover the costs of operating and maintaining municipal water and wastewater systems. While charging for water use is also practiced by irrigation districts to recover the costs of administering and maintaining irrigation works, this has been the focus of considerably less attention. But, if charging for water is to result in any conservation that releases substantially "new" sources of saved water, the concept will have to extend well past municipal water use and apply to all sectors and all uses. Across the South Saskatchewan River Basin, municipal water consumption constitutes only 4.2% of all consumption, while agriculture constitutes 82.2%. In the SSRB, a 5% water savings in agricultural consumption would free up enough water to cover all current municipal consumption right across the basin. On the other hand, a 5% reduction in municipal water consumption achieves very little in terms of expanding the total supply of available water for other use — about 5.4 million m^3. This is a tiny drop in a rather large water bucket, representing only 0.25% of average agricultural consumption. Municipal water users are quite familiar with paying for water, or more properly, the infrastructure systems that deliver their water. But many other users are not, especially industry, commerce, and the oil and gas sector, many of whom manage their own water sources and supplies and do so without paying. Expanding the concept of charging for water to these sectors may prove difficult even though it is necessary if significant new supplies of water are to be freed up from the conservation that results.
5. *Regional considerations are tricky:* Clearly, the water conservation imperative lands with more urgency on the South Saskatchewan River Basin and the Milk River Basin than on the province's other major river basins. While charging for water in southern Alberta

may need to move forward, should it do so in northern Alberta? If there is no water shortage there, and if water quality is still good, why should users pay? Is it because southern Alberta users are paying? Playing the "fairness card" rings a little hollow when it is the Hay River in view and the water is just flowing along with no other user in sight. Why pay? Because the irrigator along the Oldman has to pay? The concern rolls in other directions as well. Do some pay more if they pollute more? Do some pay more if they remove water from the active water cycle? Such concerns are more than a sticky wicket, and do have the potential to prevent any concerted effort at implementing a charge for water use.

6. *Unintended consequences:* Many roads are paved — and rivers crossed — with good intentions. But good intentions matter little if charging for water results in a set of unforeseen problems that prove difficult to sort out, solve, or correct once the charges are up and running. While many of the dangers here are not clear, there is certainly the potential for unintended consequences. Thus, a key research area going forward is to more fully explore water charges, with the intent of drilling into the details in a substantive way.

» Perspectives: The very idea of charging for water use has always been surrounded by significant debate. In the debate, there are a number of "hotspots" worth exploring.

1. *Water is a basic human right and should not be subjected to a charge:* Whenever financial mechanisms are considered as a means of rationing a scarce resource, the equity-efficiency debate begins in earnest. And nowhere is this more true than with water. For some, water should not be "priced" because it is an essential and fundamental resource — it is special. Water is critical to survival and a basic human need. Water is a "basic human right" and access to it should not be denied based on ability-to-pay. Charging for water may result in the efficient use of water, but it will certainly not be equitable. In short, any system of water pricing discriminates against the poor, and forces them to forego water use to others who can pay for using it. This is a critical juncture that needs to be explored in more depth.

   First, water is indeed a fundamental human need for survival, and in that sense, water can be said to be a fundamental human right. But in saying that, Albertans should not at the same time kid themselves into believing that this applies to all water. Water has a number of dimensions that require us to make critical distinctions. Water to drink, water to cook, and water for personal hygiene is one type of water. Water that is sucked out of a river and pumped into the ground to recover oil is another type of water altogether. Water in the first instance is necessary to sustain life. Water in the second instance is necessary to access a resource, recover a capital investment, and earn a profit for shareholders. Are the two "types" of water one and the same? Is water a fundamental human right in the sense that it can be appropriated in vast quantities for purposes of private financial gain? Hardly.

Second, it needs to be understood very clearly that water is already "priced." To be more clear, it is not the water that is subject to a financial charge, but the infrastructure systems for treating and delivering the water. While this is an important distinction to make, it carries little caché outside the water policy community. The fact of the matter is that the users of water do not make this distinction. When the tap is turned on, water users think they are paying for the water. What they do not know — and what they do not care about — is that they are really paying for the pipes coming out of the ground that hook up to their tap. What is more, the amount they pay for those pipes is charged according to the amount of water they use. The costs of the water infrastructure is divided up among water users according to how much water individual water consumers use, but the water itself is free. Across the water policy community, there are no fundamental philosophical objections to such charges — whether a simple volumetric charge or a complex increasing block rate — all of which are used in various cities in Canada and Alberta.

It is the same when buying a bottle of water at the convenience store. Consumers think they are paying for the water, but this is not so. The water in the bottle is "free." The amount being paid is used to cover the costs of manufacturing the plastic bottle, for purification equipment in the plant, for the shipping costs to get the full bottle from plant to store, and for marketing. Consumers also pay the retailer for the costs of keeping the water cool and for keeping the lights on in the store. The price attached to a bottle of water reflects all of that, but not the water. And, in the end, the consumer does not care. The consumer does not want an empty bottle. The consumer wants a bottle of water, and that is exactly what they think they are paying for — water. Viewed from this perspective, water is already subject to a charge and most consumers are comfortable with that. Charging for water is not illogical nor is it crazy. Most of us expect to pay for water, whether it comes from the washroom tap or the grocery store. The fact that we do not really do so may be a big issue for some in the water policy community, but it is not seen that way by most water users.

The same applies to irrigators. Irrigators pay the irrigation district based on the acreage that they are irrigating. The amount paid is used to cover the costs of the irrigation infrastructure, administrating the system, relining canals, and keeping weeds out of the ditches that might get onto the field. But again, it is not the irrigation infrastructure that the irrigator wants or needs, or even really cares about. He wants and needs water. And, at the end of the day, it is the water for which he believes he is paying. Irrigators are willing to pay as well, because they draw a personal financial benefit from the water in the form of better and higher crop yields.

Third, while many express the concern that charging for water will put sufficient quantities out of reach for those with low and moderate incomes, resolving such issues of equity by eschewing a "price" and providing water "free" for everybody results in over-use of the water resource. In the end, everybody is hurt if the ecological systems necessary for sustaining a supply of quality water are compromised. Everybody suffers. The better solution is to attach a charge to the water resource, but then neutralize the effect for those who may have difficulty affording the water they need for domestic, household, or personal use. There are more than just a few options, whether they include subsidies, rebates, credits, life-line rates, offsets, two-part tariffs, and even exempting from pricing altogether a basic amount of water for personal or domestic use.

There are ways to deal with the potentially regressive impacts of pricing, and it is done all the time. In the US, for example, special "life-line" rates are a common feature of pricing for natural gas and electrical utilities. In Canada, the GST tax rebate is another example. Sales taxes like the GST are less economically damaging taxes, but they can be regressive. So, an offset is provided for those with low and modest incomes through a monthly rebate. All of this is standard practice. Charging for water should not be seen as working against the goal of guaranteeing every Albertan easy and affordable access to a sufficient amount of water for personal use. Offsets are possible, and those with higher incomes can always pay their full way, as can the economic users who tap water to earn profit.

Fourth, it is helpful to consider that in the South Saskatchewan and Milk River Basins, the rivers are closed to new allocations of surface water. People there are already being denied access to their "fundamental human right." They are denied not on the basis of ability to pay, but simply because the river is shut down. But for someone who really needs water, do they really care why they cannot get water? When suffering from "thirst", does it really matter? No.

In some ways, then, the failure to charge for water in the past has already produced an equity concern today. Equity issues are complex, and throwing them out willy-nilly without giving the matter intense thought is unhelpful. At the end of the day, charging for water is certainly equitable in that those who use a fundamental, critical, and diminishing resource like water have to pay for what they consume. And, using some of the funds generated to offset the environmental consequences of that water use is equitable as well, since the costs are proportional to the water benefits received.

2. *Charging for water use and even conserving water amounts to a missed opportunity:* In the minds of some, conservation means that we are letting water flow downstream for others to use, or worse, allowing it to end up as saltwater when it hits the ocean. In other words, conservation amounts to a "missed opportunity" or to "taking something away." There is a need to make the case that when water resources are scarce, conservation is required to increase the supply of usable water at a particular place and at a particular time so that more users can have access — here and now — not at some point downstream tomorrow. Conservation is also necessary to begin preparing for the very real possibility of a lower water supply in the future. Conservation is also necessary because the river too needs its share of water if ecology is to be sustained. In short, conservation today is an investment in preserving and enhancing water for tomorrow. Once again, the vision is to produce twice, five, or even ten times while using half the water and half the energy to provide that water.
3. *Charging for water is the first step to privatization:* While many draw the link between pricing and privatization, the two are very much unrelated concepts. Governments set prices for publicly delivered goods and services all the time, and do so with delivery firmly centered in the public sector. Whether it is tuition at the university, the fare box in the bus, or fees to operate water and wastewater utilities, pricing is used by government to fund government. The ownership of water will always rest with the provincial Crown. It is a natural resource. To be sure, the private sector can play a role in administering, managing, and delivering water services and infrastructure, but they will never own the water itself. And regardless of whether the private sector is involved in water services delivery or not, governments never cede their ability to regulate, monitor, and enforce. Why? Water is just too important.
4. *Setting a price on water is unfair because there is no substitute:* When a good or service is priced, people who cannot afford to pay often use substitutes that are less expensive or perhaps "free." Since there is no substitute for water, pricing can be seen as imposing an unreasonable cost on those who have no choice but to pay. This is unlike paying for many private goods and services, many of which have practical substitutes — switching from butter to margarine. Even the pricing of some public goods, such as road tolls, have alternatives in the form of public transit, for example. But again, charging a price need not apply with equal force across all water. Conceptually, once the basic and personal requirements of people and the environment have been satisfied, attaching a charge for the use of the resource does little harm. Besides, there are other goods and services that have few effective substitutes as well. There are no effective substitutes for land, for example. Yet, land always comes with a price, and a hefty one at that. Again, the real issue here is not water for basic and personal use, which constitutes only a very small share of total water use, and where even significant conservation will save and produce very little "new" water. The real issue is water used for economic purposes —

huge amounts of water that are withdrawn by a wide variety of actors such as industry, commerce, and others — who access and use the water without paying.

» Accceptability: Across the world, water "pricing" is pursued aggressively in Australia, California, South Africa, Israel, and Beijing, among other places. While charges are in play across Canada as well, they are limited to funding water infrastructure. What is the potential for actually attaching a charge to water in Alberta, and would it be acceptable to Albertans?

To begin with, when it comes to *administered prices,* the public often perceives them more like a tax than a charge or fee. Given all the above, such sentiment is not wholly without foundation. What is more, a tax is certainly another option if charging users directly is deemed to be unacceptable. Taxing water use is a viable "second best alternative." At the same time, the public does view and respond differently to the idea of charging for something — whether a price or a user fee — and taxing something. In the end, both amount to having to pay, but the word "fee" is arguably more politically acceptable than "tax."

Drilling down a little further, Albertans, perhaps more than any other group of Canadians, have at least some experience with charging for the use of natural resources. Oil and gas royalties are one such charge. While royalties are often viewed as a tax, they are not a tax strictly speaking. Royalties are a "rent" that accrues from ownership of a non-renewable resource. While water is a renewable resource, the amount of water at any one place and time is still finite and limited. Thus, there is at least some practical experience here that can be drawn upon.

Albertans are generally considered a relatively practical and conservative bunch, but have in the past demonstrated a remarkable willingness to experiment and innovate. From the rise and fall of the provincial United Farmers and Social Credit to the federal Progressives and Reform, Albertans have shown themselves willing to take chances. The notion of "no free lunch" and "paying for what you get" also has a lot of traction at the grassroots as well.

On the other hand, Albertans tend to be suspicious of government, and those suspicions could be aroused if "water pricing" comes to be viewed as just another "tax grab." The case for charging for water and the conservation imperative will have to be strongly made and clearly stated. Along with this, earmarking the revenue that results to funding and enhancing water resource management offers the best way to convince Albertans that this is all about water and not a new "tax" that will disappear into general revenue.

Governments across Canada are generally reluctant to earmark revenue. But not doing so here will hurt the move toward charging for water use. Earmarking the proceeds will strengthen support for the concept. The complaint will probably still be heard that the "environment is the government's job" and water users should not have to pay. The

rejoinder to that is if users do not pay, then the costs of any protection will have to come from taxes. Either way, the aquatic environment needs to be protected.

In all of this, the support and participation of the broader agricultural community — especially the irrigation community — is more than important. It is absolutely essential. Agriculture, especially irrigation, is the largest user of water in Alberta, and this will always be so. Any attempt at charging for water must not be used, or even perceived, as a ploy against the water used by agriculture. This concern remains even though it is efficiencies in agriculture that offer the most potential for freeing up the greatest supply of "new" water. Significant research, thought, consultation, discussion, and debate will have to occur. Trust will be fundamental.

A good part of this conversation will need to revolve around ways that water charges can be used to stimulate and secure greater efficiencies across the agricultural community. For example, a good portion of the revenues from a charge on water could be earmarked to create a pool of investment capital that Alberta irrigators and ranchers can draw on to devise and adopt new water-saving technologies, as well as new and more sustainable agricultural practices. This type of compensation could form the core of an attractive and workable "offset." If charging for water can be levered with this important policy objective, Albertans will have accomplished something truly important — working together to protect and secure one of the province's most vital industries from one its biggest threats, and doing so by achieving new water efficiencies. In some ways, it is hard to conceive of a bigger step forward in achieving the water vision.

2. Regulated Trading of Water Allocations

» The option: The trading of water allocations allows water to move among various users and groups of users both in and across various sectors via some type of regulated "market" or "exchange" mechanism. At the outset, it is important to emphasis that the water is not traded. Rather, it is a portion of a water allocation, licence, or water use right that is traded. Allocations can be transferred permanently or leased temporarily. Vendors offer for sale or lease a portion of their water allocation, held under government licence, to buyers who do not have enough water or to those who need water but have no allocation. If a water user does not need all of their annual water allocation, trading allows the excess allocation to be sold, leased, or transferred to a willing buyer within a regulated market or exchange. *The concept of trading takes the idea of charging for water use a step further.* Trading results in a *market price* for water that reflects the laws of supply and demand — an economic price as opposed to an *administered price* — based on the value of water in all of its various and competing uses. Not only does trading set a price for water, it also serves to allocate water. Both of these happen as a result of voluntary transactions conducted between willing buyers and willing sellers, whose interaction results in a specific amount of water provided at a certain price that reflects what other buyers and sellers in the market or exchange might be offering.

Discussion Box 12: The Evolution of Water Policy in Alberta

To say that current water resources management in Alberta is not at all working would be too extreme. The concern with water resources management is that the current system may not work in the future. Simply put, changes are required to deal with a whole nest of emerging problems whether that be water shortages in the South Saskatchewan, the potential for growing conflict, the possible effects of climate change, and the need to ensure sufficient instream flows of water to maintain ecosystem integrity. To some extent, the need for change is also driven by the fact that Alberta has concentrated on managing the "paper" — water licences — but not always the "resource" — the water itself.

The Early Years

In 1882, the region of Alberta became a distinct district within the Northwest Territories, but legislative jurisdiction remained with the federal government. Water use was governed by a system of "riparian rights" where landowners close to a body of water had first right to make a "reasonable use" of the water. With the construction of the railways and the beginnings of private irrigation, the need to move water further from its source made "riparian rights" less practical. A decade later, Canada passed the *Northwest Irrigation Act (1894)*, which made changes to the governance and management of water for irrigation and other purposes.

Transfer of Water Ownership

The *Natural Resources Transfer Agreement (1930)* settled a long-standing concern of both Alberta and Saskatchewan by granting to both provinces legislative jurisdiction over all natural resources, including water. Soon after, Alberta passed the *Water Resources Act (1931)*, which affirmed that all water is considered to be the property of the province, which would grant the rights to use water through government licence.

Governance and Management Today

Alberta Environment is the provincial government department in charge of Alberta's water resources, and governs and manages it through the *Water Act (1999)* and the *Irrigation Districts Act (2000)*. All individuals, corporations, and municipalities must apply for a licence to divert water, but water withdrawals for domestic or household use under 1,250 cubic meters (m^3) annually are exempt. The licence sets the maximum amount of water that can be diverted or withdrawn, and stipulates when, where, and for what purpose water withdrawals can occur. These licences are often called a water "right" or a water "allocation."

Water Allocation

Water allocation systems decide who gets to use what water, especially in times of scarcity. The heart of Alberta's system is "prior allocation", which is common in most western Canadian and American jurisdictions, and has been used in Alberta since passage of the *Northwest Irrigation Act (1894)*. Systems of prior allocation grant the right to use water based solely on a "first-come-first-served" basis. Prior allocation is often called "first-in-time-first-in-right" or FITFIR. Systems of prior allocation grant first right over water to the first or most "senior" licence issued. Water is allocated year by year based on the available supply, and then parceled out among users. A water licence or allocation does not guarantee the right to water, however. An allocation only guarantees the right to take water if sufficient water is available. Under prior allocation, that right falls first to those who hold the oldest or most senior licence, who have the right to use all of their water allocation before "junior" licence holders can exercise their water right. In Alberta, private individuals, corporations, organizations, and municipal governments all hold water licences. Some of the most important are held by Alberta's 13 irrigation districts, which then grant water to irrigators based on their amount of acreage. Licence holders do not pay for the water that they withdraw. In applying for a water licence, a one time payment is made based on the volume of the water involved.

» *Advantages:* Under prior allocation, Alberta has been successful in harnessing its water resources for economic and social development. Prior allocation provides an assurance to water users that they will have enough water in the future to justify and recoup their investments in water infrastructure, whether that be a self-supply system or a modern and water-efficient centre pivot. Prior allocation provides a measure of economic security, and ensures that investments are made and used, rather than abandoned or made unprofitable due to a lack of water. Prior allocation is simple to understand, largely accepted, and allows everyone to know "where they stand."

» *Disadvantages:* At the same time, no system of allocation is perfect. Prior allocation, left to itself, has no mechanism to share water in times of scarcity, does not prioritize water based on its intended use or purpose, and provides little incentive to conserve. Prior allocation does not easily address new water issues that may arise, and works against accommodating new needs for water or even the changing use of water. Prior allocation entrenches senior rights and a particular type of water usage at the expense of new usages — even if the new usage is more economically or socially important, beneficial, efficient, productive, or highly-valued. In times of scarcity, the ecosystem can also become compromised if the usage rate of allocations rise despite lower flows of water. However, government certainly has the option of restricting water taking during such times, and has often done so. The bigger concern during scarcity is a certain amount of inequity that comes with the system. In times of water scarcity, those with "junior" licences may not be able to access water as "senior" licence holders have the priority.

The Challenge

Some today argue that prior allocation is simply unable to cope with the new water issues and water scarcity emerging in Alberta. Allocations already issued were based on requests received at the time, and on what was viewed as an abundant and continually replenishing water resource. Existing allocations were based on what was though to be a set flow, but water flows are proving less predictable and reliable, if not shrinking. As a result, Alberta is overdrawing on water. Can prior allocation — should it — be maintained within the context of an uncertain and diminishing water supply? If senior users start moving up toward their maximum allocation, others will be left out of the water game. There is a very real sense here that Alberta will hit the water wall. This prospect has prompted several important policy changes.

Recent Changes

In 1991, new water realities and anticipated challenges led to a review of provincial water policy. As a result, Alberta made a number of significant changes when passing the new *Water Act (1999)* and the *Irrigation Districts Act (2000)*. While the seniority of all water licences in good standing were protected, the system was augmented in several ways:

» *Statutory preferences:* Prior allocation was modified by legislating a "statutory preference" for domestic and household water use. Household and domestic use of water now has the highest priority over all water allocations, and cannot be superseded by any other user regardless of licence seniority.

» *Perpetual vs. term licences:* Older licences issued by the province were "perpetual" licences held indefinitely. The province now issues only "term" licences that expire, or must be renewed, at the end of a specified period. These new "term" licences are typically valid for a period of five years. When deciding to issue a licence, Alberta Environment considers the potential impact of the new licence on the environment and the need to maintain instream flows, the impact of the new licence on existing licence holders, and the impact on the province's ability to meet interprovincial and international water sharing agreements.

» *Trading water licences:* Under the *Water Act* and the *Irrigation Districts Act*, the province opened the door to temporary and permanent trades of water allocations held under licence. Water "rights" were separated from the land to which they were traditionally attached, and licence holders were allowed trade — sell or buy — portions of water allocations held by others.

» *Inter-basin transfers:* At the same time, Alberta prohibited the "inter-basin" transfer of water — water moving from one of the province's seven major river basins to another major river basin. Any such transfers in the future will require a special act of the legislature. However, "intra-basin" transfers — water moving from one sub-basin (e.g., the Bow) to another sub-basin (e.g., the Oldman) are not expressly prohibited.

A Shift in Thinking

In the past, Alberta has generally pursued a policy of supply management by constructing dams (there are 1,400 in the province) storage reservoirs, and irrigation works. The policy thrust was to secure adequate supply and harness the water resource. Water policy was pursued less as an objective in its own right, but as the handmaiden to economic development, whether that be agriculture, industry, commerce, or transportation.

The growing preoccupation now is with sustainable development, and the drive to reconcile future economic development with environmental protection. A clear objective, outlined in both the *Water for Life Strategy* and the province's new *Land Use Framework*, is to protect the larger ecosystem by pursuing economic performance and the efficient use of water.

Thus, the focus has turned toward demand management, conservation, increased efficiency, and higher water productivity. Such efforts have been pursued through new government rules and regulations — the "command and control" approach — that have seen new water allocation rules, caps on the issuing of new allocations, regulations limiting the allowable land under irrigation, and new limits placed on certain activities such as oilfield injection, which require the use of poorer quality or brackish groundwater over fresh surface water whenever possible.

The focus has also resulted in a few cautious steps toward the potential of financial and market-based mechanisms to achieve conservation. Examples includes municipal subsidies for low flow water appliances and amendments to the provincial *Water Act (1999)* and the *Irrigation Districts Act (2000)* that allow for the trading of some water allocations under close scrutiny of Alberta Environment.

The reasons for all this are clear enough. Intensity of water use has grown, consumption has increased despite shrinking supply, and real environmental limits are being reached if not already surpassed. Water shortages are becoming altogether more common and water quality is being affected by rising levels of contaminants. The focus now is on trying to find a new way forward through conservation, improved efficiency, increased water productivity, and demand management. Sharing of the water resource — how best to allocate a shrinking resource — is the new holy grail of water policy in Alberta.

SOURCE:

Alberta Environment. 2009. Legislative History of Water Management in Alberta.
Alberta Environment. 2005. Dam Safety.

Discussion Box 13: The Future of FITFIR

> *First-in-time-first-in-right is not unique to Alberta, but it is a policy that has served its purpose and time. In light of the current state of Alberta's water supplies, it is no longer an appropriate water management policy.*
>
> — Lorne Taylor, in Policy Options [Fortin, Sarah, ed.], 2009.

In light of Alberta's water woes, some have suggested that it is time to revisit FITFIR and design a new system of water allocation more in line with current realities. Practically speaking, there are only three possibilities. First, the entire system of prior allocation can be scrapped, and government can press the "re-set" button by coming up with a new allocation system. While there are advocates of this approach, it could be easier said than done. The holders of current water allocations have made significant investments in various water equipment (e.g., a centre pivot) on the basis of the water allocation they hold. Any change in the water allocation system will be rightly seen as jeopardizing those investments, if not destabilizing key sectors of the Alberta economy. Aside from this, there is just the more practical consideration of whether it is wise to "mess around with people's water." Any move in this direction will have to be considered very carefully. Not only would it be highly controversial, it could also require substantial amounts of government compensation, largely funded by the taxpayer. Pressing the "re-set" button on allocation carries a lot of risk.

Second, government could work to "claw-back" some of the allocations that exist. As stated earlier, allocations represent the maximum amount that a water user can withdraw or divert. Often, this maximum is not reached. What is more, the actual water consumed is usually a lot less than the amount of water that is licensed for use. The City of Calgary, for example, has a water allocation some two and a half times its average annual usage. Thus, it is entirely possible for the province to gather together the excess that exists in the current allocations, and dole it out to those who need water. The total allocations do not increase. At the same time, it needs to be recognized that at least some of the "excess" in current allocations are there for a purpose — to provide water users with a buffer just in case they need more water during a particularly dry year, or if water usage has to increase due to some other unforeseen circumstance. More problematic is how this move might bring into play a large portion of water allocations that are traditionally or historically unused. The move would push Alberta ever closer toward using every drop that has been allocated. Yet, we already know that if Albertans used all of their allocation every year, we would not be able to meet our commitments to pass sufficient water to Saskatchewan and Manitoba. While there is some potential here, any move in this direction is likely to be just as controversial as scrapping the entire system at the same time that it might secure less "new" water than starting over. Hardly a bargain when considering how to spend your "political capital" especially if the move is seen to target a single actor (e.g., the City of Calgary's water licence).

Third, the province can leave the current allocation system intact, and supplement it with a trading system that allows those who hold water allocations to sell or trade water they have conserved to those who need the water. If prior allocation is to remain, trading is one way to free up water across sectors. While the approach may be somewhat unconventional for the majority of Albertans, it may be the only way to accommodate new water demands within the current allocation system. At any rate, the current system of allocation makes less and less sense in those river sub-basins that have been closed. Something has got to give.

The path forward is not entirely clear. For example, the 2003 version of Water for Life said that Alberta "must preserve first-in-time-first-in-right" for granting and administering water allocations. The second version, updated in 2008 implies a weakened commitment — that Alberta "currently recognizes first-in-time-first-in-right." But one thing that is completely clear is the province's support for financial or market-based tools, whether in the *Water for Life Strategy (2003 and 2008)*, the *Water Act (1999)*, or the *Irrigation Districts Act (2000)*. What is more, the trading of allocations is already underway.

SOURCE:

Alberta Environment. 2004. Water and Oil.

Brandes, Oliver; Nowlan, Linda; and Paris, Katie. 2009. Going With the Flow.

Advisory Committee on Water Use Practice and Policy. 2004. Final Report.

Before exploring what role trading might play in addressing Alberta's water challenges, it is helpful to understand how water is currently allocated in the province *(see Discussion Box 12)*. Alberta, like many western Canadian and American jurisdictions, allocates water under a system of "prior allocation" or "first-in-time-first-in-right." This system allocates the rights to water by giving preference to those who secured a water licence first. Most of these licences were granted without a time limit attached to them. Because the South Saskatchewan River Basin — with the exception of the Red Deer River — is now closed to any new surface water allocations, only those with an existing allocation can access surface water, and those holding the most senior licences get priority. For those that need water but have no allocation, the only option is to locate in a municipality that has room in its allocation to provide water, or secure access to groundwater. If neither of these options are workable, you are out of luck. In a dry year, holders of a junior water licence might find themselves in a similar position.

With that said, it is conceivable that the system of prior allocation could be changed at some point, which could open up more water for those that need it. But that is of small comfort to those who need water now, and any such change carries its own unique set of difficulties *(see Discussion Box 13)*. A question that naturally arises, then, is how have Albertans been managing?

Well, part of the answer comes in the form of an emerging trading system in Alberta that is very much in its infancy *(see Discussion Box 14)*. A trading system in Alberta is developing, but it is not yet an established, permanent, and functioning "market" or "exchange" with ongoing or widespread participation. There has been some trading of water allocations and portions of allocations, but little to no permanent or ongoing activity. There is, for example, no central clearing mechanism like a regulated exchange. To date, most trades have been informal and temporary, and have occurred between irrigators who are granted a certain amount of water provided by the licence held by the irrigation district. There have been only a few permanent trades cutting across sectors. One of the more well-known trades involves *Cross Iron Mills* — the new mall in Balzac, AB. To secure water, owners of the mall convinced the Municipal District of Rocky View to purchase — permanently — a portion of the Western Irrigation District's water allocation. The trade resulted in water moving from agricultural use to commercial use.

While such instances have been rare, the question is now being posed whether the trading of allocations can evolve into something more permanent and enduring — such as a market or a specialized and regulated exchange — that can help address both environmental and water allocation concerns in Alberta. (Such mechanisms will be explored and discussed in a study entitled *The Potential Benefits of an Organized Exchange for the Sustainable Use of Water in Alberta*, also published under the AWRI project.)

» Potential promise: The potential of trading is often limited to its role as an allocative mechanism. While trading certainly allocates scarce resources, there are additional benefits that take off in a number of different directions:

1. *Trading promotes conservation, which again, equals environmental benefit:* The trading of water allocations provides a strong incentive for conservation and efficiency, but not in response to saving money as with water pricing, but for the prospect of securing a financial reward. If the holders of current water allocations can save water and build room within their allocation, the conserved water can be sold for profit. This prospect stimulates investment in new innovations and technologies to conserve. With a system of trading in place, failing to conserve could entail a very real opportunity cost. Like charging for water use, the idea of trading puts some real muscle behind conservation, certainly a lot more than the traditional "old guard" argument of "conservation for the sake of conservation."
2. *Environmental interests can participate directly in trading:* Many trading systems operating in the US allow conservation buyers and governments to enter the market and purchase allocations for environmental or ecological purposes, whether that be resurrecting wetlands or simply leaving more water in the river. In Alberta, all trades can be subjected to a 10% "holdback" where the province scoops up one-tenth of the water allocation traded to increase the flow in a watercourse. Such mechanisms, facilitated by the trading activity itself, can be tremendously important for over-allocated sub-basins that suffer from insufficient water flows, and where meeting minimum instream flow needs (IFNs) are difficult.
3. *Trading promotes efficiency:* Trading is an efficient way to solve the allocation problem because it resolves the scarcity issue without government having to make the decision. Government is shielded from making the choice — and making the wrong choice as well. West coast salmon, east coast cod, and over-allocation in the South Saskatchewan River Basin show that government too has not always made the right choices. Trading is a decentralized process marked by private transactions conducted voluntarily. Further, trading also resolves the difficult problem of setting the right charge for the water. Trading reveals the economic or inherent value of water based on the competing use of that water. This is more accurate than simple pricing alone, which involves setting an administered price that may or may not reflect the actual economic or market value of the water.
4. *Trading is a flexible solution:* Trading of water licences keeps prior allocation intact (all markets needs something of value to trade and here it is a water licence) but injects the system with the means to accommodate new water users and new uses in constrained regions where the water supply has been closed or is severely limited. Prior allocation is a rigid system that does not adapt to the water needs of a changing economy or new social and environmental conditions. The benefit of trading comes in

how it forces an opening in prior allocation, and provides a way to continue distributing a scarce water resource. In addition, there are a number of institutional forms that trading can take, ranging from a relatively simple spot market to a specialized, regulated, and highly sophisticated exchange. Some have also suggested that it need not be water allocations that could be traded but perhaps some type of water "credits." Governments are also free to surround the trading system with strict rules and regulations that can tailor the system to meet Alberta's unique needs and preferences. In short, the concept of trading is a highly flexible mechanism.

Discussion Box 14: Water Trading in Alberta

The province's new *Water Act (1999)* and the *Irrigation Districts Act (2000)* allow for the trading of water allocations held under licence issued by the province. In Canada, Alberta is the only province that currently allows such trades. There are a number of unique features involved with this trading system.

Trades Under the Water Act

The Water Act governs all water allocation transfers that involve the holder of a provincial water licence, whether that licence holder is selling a portion of the allocation to another licensed or un licensed user, or buying an allocation from another licensed user. Trades between different sectors (e.g., from agricultural use to commercial or municipal use) are also governed by this legislation. Trades can be either informal (temporary) or formal (permanent) and can involve a portion of the allocation or even the entire allocation. Transfers can only involve a licence in "good standing" and the legislation prohibits speculation. Water allocations can be traded only within a major river basin (intra-basin) and before any trading can occur, a local water management plan must be in place.

These water management plans seek to identify the "inflow stream needs" or IFNs of the river in question, as well as a "water conservation objective" or WCO. Both are intended to help determine the amount of water needed to maintain the river's ecology and the habitat for fish and wildlife. Only when these have been determined will any trading of an allocation be considered. A unique aspect of the trading system is the ability of the province to "holdback" up to 10% of the water involved in any trade to meet a WCO and add water back to the river. Such holdbacks have already been used a number of times.

All trades are subject to a formal approval process and must be agreed to by Alberta Environment, which assesses the impact of the trade on existing water users, other third parties, and the environmental and ecological impacts of the trade in the context of IFNs and WCOs in the water management plan.

Trades Under the Irrigation Districts Act

The Irrigation Districts Act governs any trading that occurs among individual irrigators within one of the province's 13 irrigation districts. Again, such trades can be temporary or permanent. However, the trades do not involve a water licence, as that licence is held by the irrigation district. The trade here is the water "grant" that each irrigator is given based on the acreage that is registered on the assessment rolls of the irrigation district. Irrigators are "granted" a certain amount of water based on their acreage.

Trades under the Irrigation Districts Act typically face less scrutiny, because they do not involve a transfer from on sector to another sector and they do not involve any transfer from one sub-basin to another. Such trades, by definition, occur only within the irrigation district itself and are highly localized

in character. Transfers of an irrigation district's water allocation outside of the district are certainly possible, but that would proceed under the Water Act and can only occur after a plebiscite among the individual irrigators in the district.

Results

The trading of allocations has been researched and continues to be monitored, but its potential effectiveness and impacts will likely require more time to pass and more trading activity to occur before any definitive conclusions can be drawn. The level of trading activity has been difficult to track, especially with respect to the many temporary trades that have occurred between neighbouring irrigators who have proceeded through a private and verbal agreement. To date, intersectoral trades have been rare. Trades to date account for only 0.05% of all total water allocations in the South Saskatchewan River Basin. Some of the trading has been subjected to the 10% holdback, and several of them actually resulted in concessions during the trade that achieved more than the 10%.

As the process unfolds, trading itself has proven to be much less contentious than the setting of IFNs and WCOs that form part of the water management plans that must be completed before a trade can occur. The trades themselves have drawn less concern and less attention. Going forward, there is a growing recognition that participation and involvement of the irrigation districts can do much to legitimize the planning process and build social and public acceptance of a market for water allocation trading. The participation of environmental interests and organizations is also important, as well as the province, to ensure that trades do not impact upon important ecological objectives.

SOURCE:

Advisory Committee on Water Use Practice and Policy. 2004. Final Report.
Alberta Environment. 2004. Water and Oil.
Brandes, Oliver; Nowlan, Linda; and Paris, Katie. 2009. Going With the Flow.
Nicol, Lorraine. 2005. Irrigation Water Markets in Southern Alberta.

5. *Trading puts water to higher value uses:* Because the price of water in a system of trading is subject to supply and demand, water allocations that are traded are expected to move up to more highly valued uses. For example, a buyer that desperately needs water to take advantage of a tremendous economic opportunity will offer substantial sums to a seller that uses the water for a hobby farm to make a "few bucks on the side" or to "entertain the kids." Trading helps push water to its highest, most efficient, and most productive and valued use. One study on trades conducted in the St. Mary Irrigation District found this to be the case in the emerging trading system in Alberta (Nicol 2005). Again, the idea reflects a key objective of the *Water for Life Strategy*.
6. *Trading takes some of the "bite" out of charging for water:* One advantage of trading over a charge for water is the different incentives that are brought into play. When water use is subject to a financial charge, conservation accrues in order to avoid a cost. With trading, conservation accrues from the desire to earn a financial benefit — profit. A key concern with charging for water

use is how it might increase input costs for business, who are forced by the charge to undertake water saving investments. This is, on the face of it, somewhat punitive and coercive. Trading, however, drives investments in water saving technologies and innovation from the other end. Business is encouraged to undertake investments not to lower cost, but to secure new streams of revenue and enlarge profit by conserving water within their allocation and then trading the excess. In short, not conserving water could entail an opportunity cost. Trading results in a different — if not entirely more pleasant — set of incentives than simply charging for water.

» Potential pitfalls: The trading of water allocations in a private market or regulated exchange is not a straight-forward exercise.

1. *A number of barriers need to be overcome:* Trading takes place in a market, and all markets require a set of conditions if they are to work. Among the most important are scarcity, competition, numerous buyers and sellers, and information to facilitate choice. When it comes to trading water allocations, a whole set of new issues come into play, from establishing a clear definition of water property rights and an institutional framework to enforce those rights, to separating water rights from the land and establishing special institutional arrangements that can bring buyers and sellers together. Lowering transaction costs is critical. High costs of completing a trade — whether that is difficulty in finding a willing buyer or seller or onerous government approval processes — will prevent trades from occurring. Other barriers include the attitudes of government administrators, who might fear a loss of control, existing licences with different standards, and ambiguity over measuring and reporting "return flows" or water that users put back into the watercourse. In establishing a full-fledged trading system, there are many things to consider — environmental safeguards, registries, data banks, venues of exchange, dispute resolution mechanisms, ground rules, monitoring, enforcement, administration, water authorities, water brokers, water banks, water trusts, water marketing and government agency oversight, and how to ensure transparency and a level and competitive playing field. A key issue concerns how to design a trading system that levers important environmental objectives as a first order consideration *(see Discussion Box 15)*.
2. *Trading can be self-serving:* One of the biggest concerns with the trading of allocations is whether a market or exchange can be structured, harnessed, and tamed to serve, rather than trample, the broader public good. All markets are essentially driven by self-interest, and most of the time, this self-interest uniquely works to provide the most benefit for the greatest number of people. There is a reason why markets provide the bulk of various goods and services — they work. But markets can also fail miserably. Left to themselves or improperly structured and regulated, markets can collapse under the weight of their own self-interest. It can happen and it does happen — whether one looks as far back as 1929 or as close up as 2008.

3. *Trading may be perceived by some as unfair:* The fact that existing holders of water licences can trade a portion of their allocation, and profit from the sale, opens a trading system up to the accusation that it is not fair. The proceeds of trading are not earned by any effort on the part of the licence holder, but only because they hold a senior allocation with extra water room that can be sold. While the extent to which Albertans might express this complaint is not clear, it is helpful to keep two things in mind. First, the senior water allocation — protected by law — is already quite "unfair" in that the senior water licence holder has access to water that a junior water licence holder does not. This is not the fault of a trading system. It is the fault of "prior allocation." Second, any unfairness slips out of view if the only portion of an allocation that can be traded is water that has been conserved or saved over and above the amount of water that has been historically used. In order to benefit from a trade, both senior and junior water licence holders have to work to secure water efficiencies that they can then trade.
4. *Trading may result in prices that are unaffordable:* In a trading system, prices will rise during times of low supply and high demand, and fall during times of ample supply and low demand. Given the huge variabilities in water availability, prices could fluctuate significantly and may get out of reach of those who need the water. In some places that use trading, like Australia, prices have indeed gone quite high, sometimes well beyond what can be justified for agricultural production — $5,000 (US) per 1,000 m^3 in 2002. In Alberta, prices to date for traded water rights have varied from $140 (Cdn) per 1,000 m^3 to $740 (Cdn) per 1,000 m^3 (Brandes, Nowlan, and Paris 2009). At the same time, there are ways to address affordability. Again, much depends on how trading is being conducted, the rules surrounding any market or exchange, and the types of trading that are available. There are many different types of markets and institutional structures that can be employed — futures options, spot markets, bulletin markets, double-action markets, derivative markets, lease-purchase options, water exchanges, and water banks. Buying a portion of a water allocation on the spot market during a drought could get very expensive. But purchasing in a derivatives market allows a buyer to lock in at a price for a specific quantity at some point down the road. The price is fixed regardless of the conditions at the time the trade takes effect. Again, market structure is very important.

Discussion Box 15: Trading Allocations and the Environment

Left to themselves, markets do not tend to offer much in the form of environmental protection or ecosystem enhancement. Markets, in generating a price for various goods and services according to the dictates of supply and demand, do not always include the very real environmental costs of producing those goods and services. The environment is the classic case of an economic "externality." Just as smokers harm themselves, they can also harm others who inhale their smoke second hand. It is much the same with the environment.

However, none of this should cause Albertans to immediately dispense with the idea of trading water allocations within a regulated market or exchange mechanism. The reason is that the decision-making process by which a trading system is established is the same process that can also be employed to win some net environmental gains. The fact is, there are many different types of markets, and many different conditions under which those different markets operate. In making a decision to establish a market mechanism, including the type of market and how it will be regulated, government must — as a matter of practical necessity — deal with environmental issues and concerns as a first order consideration, up-front, and at the very outset before trading can occur. What is more, the process can unfold in no other way.

First, for any market or trading system to actually work, it has to be designed, constructed, encouraged, and prompted by government. The public good characteristics of water prevent a well-functioning market from emerging on its own. During the construction of this market, government will have to deal with environmental considerations, as well as a number of other practical issues. The very decision to start down the path of a market forces government to make first order environmental decisions that they can, and often have, postponed in the past. In this way, environmental protection can actually be facilitated by building a trading system. Even the limited trading that occurs in Alberta today is enough to make the point. Before any water allocations can be traded, a water basin management plan must be in place, the trade must not negatively affect third parties, and any trade is subject to a 10% holdback provision where the province can skim some water off the trade to keep it in the watercourse or put it back.

Second, the public good characteristics of water also make it clear that a market, once up and running, cannot stand on its own without government oversight. The concept is just not viable. Allowing allocations to be traded without government involvement, regulation, and enforceable oversight would undermine confidence in the market so badly that the market itself would probably not even get off the ground — or out of the water. Virtually all markets operate under a set of government imposed conditions, guidelines, rules, and regulations. In fact, there are very few modern examples of any pure and unfettered market operating completely out of reach from some form of government oversight and regulation. And, the markets that do, are usually illegal (e.g., drugs, prostitution). In short, government oversight and regulation of a market designed to trade water allocations is essential to its proper functioning, and this includes enforcement of environmental considerations as well.

In many ways, trading allocations would not diminish the role of government in water, but actually expand it. True, government may not be making the allocation decision as far as the market is concerned, but government must still design the system and provide the oversight. Government must define water rights, protect third parties, establish the circumstances under which trades can occur, determine minimum flow or instream flow needs (IFNs), reserve the right to stop trades, monitor and enforce the market, provide compensation if that is required, ensure transparency, prevent negative economic and environmental impacts, and fit the trading system itself into a broader water resources management framework in a way that makes sense, protects water ecosystems, and enhances water policy and practice in Alberta. To work, trading needs to be structured appropriately, embedded within a larger water resources management plan, and accompanied by safeguards and clear and effective government oversight.

Third, there are different types of water markets that could be constructed. An interesting idea concerns the creation of a regulated exchange. Market exchanges — whether the TSE, NYSE, or NASDAQ — are specialized markets subjected to strict regulatory oversight, usually through a securities and exchange commission. Exchanges often recognize additional dimensions typically ignored by traditional markets or trading because they have been structured in a specific way. For example, most markets have profit as the first order consideration, with everything else running a distant second. But in constructing an exchange, environmental considerations can, and indeed must, be decided upon before trading can

occur. In this way, environmental considerations come first. The creation of a regulated exchange can get governments, by virtue of having to create the exchange in the first place, to respond with a higher level of environmental consideration.

Theoretically, a pure trading market or exchange for water allocations would send water to those who value it the most and can afford to pay the price. And, all of that would happen with little to no impact on others or the environment. But all of that is theory about a standard market. Water is not standard — it is special. Without offering an exhaustive list, here are some of the critical issues that would need to be addressed up front:

> *Protecting water ecosystems:* Any trading system or exchange would have to set the environmental limits first, and this would include establishing a sustainability boundary that cannot be exceeded. Once the environmental limits have been decided upon, the market or exchange can allocate the remaining available water.
>
> *Protecting third parties:* Trading of water allocations can produce negative external effects that can injure "third parties" that have a stake in water, but are not party to the trade. Such parties include those living downstream and existing users.
>
> *Preventing activation of sleeper rights:* Water trading might activate "sleeper" or "dozer" rights within existing allocations. These refer to the portion of a water allocation that is not typically used, but in a trading system could be dumped onto an exchange and sold. Of course, that would result in more water withdrawals occurring. In a pressed river system, that is the last thing you need.
>
> *Preventing changed water use patterns:* Current allocations specify not just the amount of water that can be withdrawn, but when, where, how, and for what purpose. Each one of these factors carries impacts on other users and the environment. Trades can change the timing of withdrawals, for example, and that might give rise to negative impacts on the watercourse. Those who do not want to buy water, might try and go after groundwater. There are a range of issues here that need to be thought through.

Whether it is water hoarding or water speculation, unfettered markets cannot be trusted with managing and allocating a precious resource like water. But that does not mean that water trading has no role or potential for Alberta. In fact, the real challenge with water trading is not even finding a way to prevent such negative impacts. There is certainly significant experience around the world in achieving that. The real challenge is tailoring a specialized market or regulated exchange to Alberta's unique circumstances, identifying which issues are most likely to be problematic, and finding the best way to resolve those issues. The legislation guiding Alberta's emerging trading system has already addressed some of the more significant concerns, and provides a good base from which to build.

Is this difficult work? Yes. Is it impossible work? No. Those skeptical about the potential of a dynamic, robust, and vibrant market or regulated exchange can consider the following three simple suggestions. First, government can establish the environmental limits by determining the instream flow needs (IFNs) of all watercourses that might be affected by trading of allocations. This reserves for the river an amount of water for ecological integrity. It is done in Alberta already, and that is why the province requires a water management plan in place before any trading can occur. Note that the establishing of IFNs is separate from any allocative role accomplished by trading.

Second, no taking of water over the IFNs is allowed. If the current withdrawals and consumption already exceed the minimum IFNs, then government can take a slice of every trade through a "holdback" (already possible and even used in Alberta) and restore water to the river where it is needed. This can happen slowly over time until the IFNs are restored.

Third, no trading of unused allocations. Trades can be restricted to conserved water only, or excess water that exists in the allocation over and above historical rates of water usage in the allocation. This prevents waking up any "sleeper rights."

To be sure, markets can be plagued by political and institutional failure, and this also explains a lot of the skepticism — especially considering recent events with the Fannie Mae's and Freddie Mac's of the world. Markets are often promoted and pranced around as the panacea for a wide range of cares and concerns. Markets are no panacea. But markets can be made to work, they have been made to work, and they have been made to work well. And yes, even with allocating water. The extent to which they succeed, however, also depends on whether they address key environmental concerns.

Left to their own, markets will not work. But left to their own, governments have not always been successful either. After all, it was under long-standing public policy that rivers in the SSRB were over-allocated. The point here is not to cast blame. Rather, the point is that all allocation approaches — trading, markets, and exchanges included — must factor in the environment first. And, ensuring environmental integrity cannot be pursued outside the orbit of government action whether a system of trading allocations exists or not.

In the end, governments can and do choose among various tools to achieve environmental goals, and markets are not necessarily at odds with that. A lot will depend on whether the province is willing and able to take advantage of all that a market can offer in this respect. Is the province willing to put the environment first? Or, will it remain a secondary consideration as it has in the past? A market or regulated exchange for trading water licences will not make that choice. Government, which must design and oversee the market or exchange, must make the choice.

If the trading of water allocations is firmly planted within the confines of a clear sustainability boundary and then allowed to allocate only within the confines of that boundary, a lot of environmental concerns can resolved. Trading — in and of itself — is not what will deplete rivers beyond what they can bear. Albertans should know that because over-allocation occurred years ago.

SOURCE:

Brandes, Oliver; Nowlan, Linda; and Paris, Katie. 2009. Going With the Flow.
Wilkie, Karen. 2005. Balancing Act: Water Conservation and Economic Growth.

5. *Trading allocations will push out low value use of water:* If trading water allocations can move water to higher value uses, the corresponding reality is that low value uses are pushed out, including low-end or low-valued agricultural production. This is a very real concern, and a potential reality. At the same time, it is not altogether that simple or straightforward. At one level, irrigating alfalfa can be seen as low-end, certainly compared to canola or potatoes. But the alfalfa itself is a critical input for a very highly valuable and productive livestock industry — Alberta beef. There is a connection here that cannot be easily ignored. If the combined value of the production is considered, the risks are blunted, if not lowered. Mechanisms to sort some of this out are not impossible to conceive, even if the answer is not straight-forward right now. With that said, there is still the threat of economic disruption and dislocation within local economies, and

that cannot be ignored. Yet, Albertans do need to understand that change occurs across local, regional, and provincial economies all the time, and this also brings to the fore efforts designed to help economies and people make successful transitions. With trading, there is at least some potential to secure financial compensation, which comes from earnings in the market itself. This can provide a source of income for those who find themselves having to exit an activity because the price of securing water no longer justifies continuing the enterprise. While Albertans certainly should not ignore the potential for creating difficulties in already struggling rural communities, that alone should not completely derail exploring how trading might help the bigger provincial picture.

» Perspectives: Water markets and trading of water rights are occurring in a number of countries around the world. Yet, the very idea still attracts significant controversy. Again, there are a number of typical objections worth exploring.

1. *Trading may promote efficiency but not equity:* Like the concept of pricing, the very spectre of trading raises again the efficiency-equity debate. While some of this territory has already been explored, it is worth discussing a few more considerations that relate specifically to trading, markets, or an exchange. Fundamentally, there are only two ways to allocate a scarce resource. The resource can be allocated through a market where those who cannot afford to pay go without. This is efficient, but not necessarily equitable. The other option is public provision or public allocation. Here, everybody is provided with an equal but limited share of the resource without payment. This is not very efficient, but it is certainly equitable.

   But the whole matter of equity itself has two faces. Markets are actually quite equitable in the sense that they require people to pay for what they consume. This is the face of equity viewed from the "benefit-principle." If you consume or "benefit" more, you pay more. In a very important sense, that is more than equitable. The other face of equity is viewed from the "ability-to-pay-principle." If you cannot afford to pay, you cannot consume. Viewed from this angle, markets are inherently inequitable.

   Oftentimes, what is conveniently forgotten is the very wide and important middle ground between these two poles. When it comes to water, we need to think about that middle, and where we might find the balance. Part of the solution here is avoiding a situation of *intolerable* inequity — outcomes that society deems to be unacceptable and completely out of line. Albertans, as a society, make these choices all the time. Publicly-funded healthcare is provided to all with no financial charge. Why? Because that is equitable. When it comes to buying a home, this occurs in the real estate market. Why? Because it is also equitable for homeowners to pay themselves for where they want to live.

When it comes to allocating scarce resources, we have always had to make such choices. Consider life's most fundamental needs — shelter, clothing, and food. Other important needs like transportation can also be considered. All of these are provided through private trades in a free and open market. The market ensures that most everybody gets shelter (an apartment or a mansion), everybody gets clothing (Wal-mart or Harry Rosen), everybody gets food (Kraft Dinner or T-bone), and everybody gets transportation (Ford or Ferrari). Society has deemed that each and every one of these inequities is not intolerable. In fact, they are reasonable. However, going without a necessary cardiac bypass has been deemed intolerable.

Back to water. What is it about water that demands it be provided publicly and freely to everybody without cost? Is it because water is fundamental to survive? Hardly. Try sleeping outside during a deep freeze in southern Alberta with no clothes and an empty stomach. Shelter, clothing, and food are just as necessary — sometimes more so — than water. No, water was always provided free to everybody because Albertans believed there was plenty of it, that it was a public good, and that it could not be allocated through a market. Roads used to fit in the same category. But new digital technology, sophisticated electronic toll collection, and GPS are changing the roads too.

The fact that water is essential to survival does not, by necessity, exempt water from provision through a market *(see Discussion Box 16)*. Neither is water exempted by the fact that markets raise equity concerns. The question here is all about *intolerable* inequity. For too long many of us have bought into a radical line that separates water from other essential resources, and that is illogical and unhelpful. Virtually all basic and fundamental needs are purchased in and provided quite well by markets. So the real question is whether a system of trading in water allocations can be constructed in such a way that all people — both well-off and less well-off — can be provided with a sufficient amount of high quality water to satisfy their most basic and fundamental needs without imposing *intolerable* inequity.

Is it possible? Most likely, yes. It is possible because the very idea of trading through a regulated market or exchange is an inherently flexible instrument. For example, it is entirely possible for a municipality to earn gains from trading that they can pass on to residential, domestic, and household water users. It is possible for municipalities to participate in a trading system for the municipality as a whole, and still exempt or shield a certain amount of basic residential water from the market price if that is deemed necessary.

Discussion Box 16: Emissions "Cap-and-Trade"

There is probably no more important, special, or vital resource than air. Without water, a person might last three days. Without air, the end comes in three minutes.

The US Environmental Protection Agency, through the *Clean Air Act (1990)*, established a market-based allowance system commonly known as the "Acid Rain Program." The program set a decreasing cap on Sulphur Dioxide (SO_2) emissions, which cause acid rain. The goal was to reduce SO_2 to 50% of 1980 levels.

In capping emissions, the program created a "closed" system by allowing only a certain amount of emissions. In other words, the "supply" of air that could be polluted with SO_2 became limited. Air became a "scarce" resource. The program also decreased the cap over time, thus creating a "diminishing" supply of air to pollute as well. Within this closed system, the program allowed for the creation of a market where industry could buy and sell emission credits — purchase the "right" to discharge SO_2. The buying and selling of credits created an opportunity for industry to make profits if they reduced their emissions.

This "cap-and-trade" program has been successful in achieving its goals. Since 1990, SO_2 emissions have fallen dramatically, and according to the *Pacific Research Institute*, acid rain levels in 2007 are 65% lower than 1976. In 1990, total SO_2 emissions were 16.0 million tons. In 2007, total SO_2 emissions were 8.9 million tons, achieving the program's long-term goal well ahead of the 2010 statutory deadline. And, it was markets — "cap-and-trade" — that achieved the goal.

While water is different than air, both are a still a vital resource. If markets can help clean the air, can they help clean the water and even allocate the water? It is certainly worth exploring.

SOURCE:

Environmental Defense Fund. 2009. The Cap and Trade Success Story.

When it comes to allocating scarce resources, there are very real economic and very real environmental boundaries. The economy cannot afford to provide everyone with a huge mansion in which to live. It is not possible. Similarly, the environment cannot afford to provide everyone with as much water as they want. No watershed can sustain that. The drive for equity in the provision of water, at least in southern Alberta, has bumped up against a very real ecological and environmental limit. There is not enough water. To solve the problem, Albertans must find and secure new efficiencies that do not impose intolerable inequity or do violence to Albertans' shared values over this critically important resource.

In considering the concept of tolerable or intolerable inequity, it is also important to understand that the real equity concern about markets does not relate to "basic human needs" — the critical, basic, personal, domestic, or household use of water. It is irrelevant because Albertans spend so very little on this use. For example, even low-income Albertans drink cola. One cubic meter of cola is $700 per m^3 when bought on sale at 25¢ a can.

What is the typical m^3 of water worth? About 50¢. Personal equity and affordability here is not the issue. It may well be an issue in third-world countries like the Sudan, but not in Alberta. No, the fundamental and serious concern with the trading of water allocations in Alberta would involve the economic users of water, and the potential inequities that might arise for them if water — a basic economic input — is allocated through a trading system. Now that might raise a critical equity issue, especially for agriculture. This is the concern that needs to keep our attention.

In response to this concern, Albertans should take note of two things. First, the current allocative system is not at all free from its own inequities and biases, such as senior rights vs. junior rights, and perpetual licences vs. term licences. Markets are not the only "inequitable" water allocator. Second, the issue here may be less about equity itself and more about certain socio-economic choices. For example, a commercially viable fish population might be a more socially and environmentally responsible use of water than irrigating a golf course. But with a water allocation trading system in play, the golf course may win the water because it carries a higher economic value. In the market, the socially responsible choice may not be able to compete.

Is that fair? Is that the right choice for using water? Markets, left to their own devices, cannot answer such questions. Albertans, acting collectively, must answer those questions. And while they are not altogether easy questions to answer, an answer is now very much required. In considering trading, Albertans have to work through the thorny question of how to mesh water efficiency with important social priorities. In answering the question, Albertans need to keep their eye on the critical economic uses of water. Indeed, water can be treated as an economic good without forgetting that it is a basic human need. But in Alberta — unlike underdeveloped or developing countries — that is not the great choice to be made when it comes to trading water allocations.

2. *Trading could subject Canadian water to NAFTA:* There are many who continue to express the fear that trading in water allocations — perhaps even just "pricing" the water — will make water a tradable good under NAFTA. Several things need to be kept in mind. First, water itself will not be what is actually traded, but the allocation. And how that works out will depend on the type of market or trading that occurs. Second, Alberta has little water to trade, and what water it does have is a provincially-owned and managed resource. While Ontario and Quebec might have water to trade, it is difficult to see how trading of allocations in Alberta could or should force Ontario or Quebec to now trade their provincial water resource under NAFTA. Third, the governance of water between the US and Canada may not be specifically exempted under NAFTA, but only because it is already governed by a 100 year old treaty — the *Boundary Water Treaty (1909)*. This

treaty is governed by the *International Joint Commission (IJC)*, and its management of shared waters between Canada and the US is highly regarded the world over. Fourth, the real issue here is likely not NAFTA at all, but the whole matter of bulk water exports to the US. While that is certainly a related concern, it is still somewhat separate. In the end, the NAFTA connection has enough unknowables to make it worthy of research, and is a topic that the Canada West Foundation intends to tackle more fully in a future study. For now, the NAFTA concern should not stop the process of at least exploring the concept of trading allocations.

3. *Trading will swing the door open to bulk water exports:* When it comes to water, Canadians have spent a lot of time worrying about a potential US grab of Canada's water. It is a perennial, if not obsessive, national concern. While it is understandable given the place of water in Canada's history and development, it also amounts to a distraction that works against a sharper focus on improving our water management practices and policies, and takes our collective eyes off the fundamental issues that need to be solved. At least for now, bulk water exports should not be a cause for undo concern. First, Alberta has no huge water sources that it can export, unless inter-basin transfers come into play. And, that is not likely to happen anytime soon. What is more, inter-basin transfers of water are not exactly popular in the US. Canada is a bigger diverter of water than the US, and the US itself has taken a stronger stand here than many governments in Canada. Second, bulk water exports are very expensive. Water is heavy, and it takes a lot of energy to move it. There are lower cost solutions such as small-scale water supply and even desalination. Around the globe, there are some 13,000 desalination plants in operation producing 12 billion gallons (45 million m^3) of freshwater per day (Kranhold 2008). The Ashkelon desalination plant in Israel can provide up to 110 million m^3 of freshwater annually at a relatively low cost of 53¢ per m^3 (Water Technology 2010). The plant in Tampa Bay, currently the largest in the US, does 35 million m^3 per year (Tampa Tribune 2007). Once complete, the Jebel Ali plant in the United Arab Emirates will be the world's largest, producing up to 300 million m^3 per year (National Media Council 2006). Desalination still comes with a hefty price tag, but it is still more economically attractive for coastal cities than bulk water exports, and it ensures that one does not become dependent on a foreign supply of water. Third, the US has embraced — certainly with more passion and commitment than Albertans or Canadians — a water conservation ethic. When water supplies run low, the least expensive and most practical option is to start conserving, and that is exactly what places like Los Angeles, San Diego, and San Francisco are doing (Courtney 2009).
4. *Trading should be the last resort:* Trading goods and services in a market or exchange is certainly not the last resort for most goods and services. Rather, that is the norm. We have just thought about exempting water for so long that it is hard to even imagine if or how trading water allocations might be made to work. Trading

can be tapped to assist with achieving the goals in the *Water for Life Strategy* in many ways. But more important, this sentiment might just be very correct. The rivers in southern Alberta are closed. Enter the last resort.

» **Acceptability:** Active trading in water allocations is currently used in Australia (the Murray-Darling Basin), South Africa, and in many US states including California, Colorado, Utah, Nevada, Oregon, and Arizona. While California often receives a lot of the attention, one of the more active markets is in Colorado, where the rights to tens of thousands of acre feet of water are traded each year through private and voluntary transactions, and the profit goes to those who can conserve the water and sell what they conserve. What is more, trading has been used in many US states primarily to achieve environmental objectives. Would the concept be acceptable to Albertans?

In many ways, Albertans have a "love-hate" relationship with markets, especially world commodity markets for oil, gas, grain, and beef. Markets can reward, but markets can also punish. Currently, many of Alberta's markets are in the punishing mode, with prices for many of the province's important exports in the doldrums. Albertans have always been "price-takers" on world markets, and this has often been seen as one of the province's unique, if not troubling, economic vulnerabilities. Yet, Albertans do participate in markets and are more than intimately familiar with them. This especially holds true for water's biggest users — irrigators — who listen daily to futures reports and make the all-important decision on whether or not it is time to capture the highest price and get last fall's yield into the market. If anything, this relative familiarity should offer some potential traction.

Alberta's limited experience with the trading of water allocations is also instructive. In structuring the current trading system, the province made it a requirement that a water management plan first be put in place that established a sustainability boundary by identifying instream flow needs (IFNs) and water conservation objectives (WCOs). That has been accomplished for the South Saskatchewan River Basin, after which water allocations could be traded. Interestingly, it was the establishment of the IFNs that drew the most controversy. There were those who thought they were much too low, and this prompted significant debate. The trading of water allocations, on the other hand, seemed to slip right under the radar. While the *Cross Irons Mills* water deal has drawn a lot of attention, it has not produced a lot of controversy. It was unique, different, odd, and a little strange, but it did not result in any protest in the mall parking lot.

While there has been little "trouble" with the trading of allocations in Alberta so far, what exists now is very small — more like a pilot project. Trades have been quite informal and participation has been generally limited. It is less clear how Albertans would react to a much bolder trading system — a larger, more enduring, and more vibrant market or regulated exchange. The big concern has to spin around Alberta's

vital agricultural industry — especially irrigation — which is the single largest user of water in Alberta and has also been an important economic backstop given falling prices for oil and gas. Irrigation is the very heart and soul of southern Alberta's rural economy and communities. It is important to recognize, then, that irrigation is not the "problem" with Alberta's water. Rather, irrigation is a fundamental part of the "solution." If that is not recognized up front, any expansion in trading not only swims against some very powerful currents, it is likely DOA.

The productivity of irrigated land is three times that of dryland, and irrigation allows for the cultivation of 130 different crop varieties. Almost two-thirds of all crops grown on southern Alberta's irrigated farmland cannot be grown elsewhere in Alberta or Canada because of the wrong climate conditions or other factors, including moisture deficits (Nicol 2005). There is a total of almost 1.6 million acres under irrigation in Alberta, and while this constitutes only 5% of Alberta's cultivated land base, it yields almost 20% of the province's gross primary agricultural production (Alberta Agriculture and Food 2000). Is irrigation important? Absolutely. And this author knows, having grown up in the town of Vauxhall, AB — smack dab in the middle of the *Bow River Irrigation District (BRID)*.

All of this is more than just a set of interesting facts and figures. There are important social, cultural, and historical aspects to water here that defy a consideration of the acceptability of trading allocations on economic grounds alone. The fact is, trading can, and maybe will, make rural communities feel threatened. Ultimately, social and community acceptance will be the scale that tilts the question either in favour or against, because trading in southern Alberta will by necessity involve and affect irrigators in a big way.

There are four important considerations. First, with the exception of private irrigators, individual irrigators do not own an actual water allocation. Each is granted a share of the irrigation district's allocation — to the extent it can be used given flows in the rivers — based on acreage. In Alberta, it is the irrigation district that actually holds the licence. If it is the water allocations that are to be traded in an expanded market, this obviously raises some important practical questions and considerations in terms of designing a trading system with broad participation.

Second, irrigated agriculture in Alberta has, and will likely continue to be, the largest consumptive user of water. Considering potential pressures on the future global food supply, this fact is not likely to change. If Alberta's agriculture will become even more important and more highly valued as a global food supply source, then there is the very real potential that Alberta irrigators will also be able to compete — and win — in any trading system that allocates water. But, there is no guarantee, either.

Third, it is important to know that the southern Alberta irrigation community itself is quite divided on how best to deal with the issue of water, how much they really have, how they use it, how much they might need or have in the future, and where and how more water efficiencies might be generated. Over the past decades, increases in water use efficiency have been seen right across the irrigation community, and work in the efficiency department continues. But securing efficiencies in water use is not cheap. The cost of a centre pivot for a 160 acre quarter section can run well over $100,000. And, moving from "wheel-move" to "centre pivot" is only the beginning of any serious pursuit in water efficiency or improved agricultural practices.

Furrow diking, laser land leveling, direct seeding, drip irrigation, low energy water application, precision application sprinklers, drop sprinklers, computerized and scheduled application, micro-irrigation systems, and water accounting are all efficiency possibilities. Whether any or all of that is applicable to Alberta is better left to the agricultural community. But the point is, it all costs money — lots of money. Where is the money going to come from? Who is going to pay? Who is capable of making the investment? Who is willing to take the risk?

The irrigation community cannot do it on its own. Even the province of Alberta could not start irrigation on its own. Irrigation only took off with a massive federal investment through the *Prairie Farm Rehabilitation Act (PFRA)*. Under this effort, on-farm water application efficiency moved from 36% in 1965 to 74% in 2000 (Fortin 2009) and water savings and yield increases have also been seen. We all know the benefits of water efficiency, but that does not solve the issue of cost, which runs into multiple billions of dollars. More "crop per drop" sounds good, but getting there in a substantial way is an entirely different matter.

So fourth, and finally, this is where trading might actually come in to help. If irrigators, through significant investments of capital, can generate water savings that they can then sell, they might be able to recoup the cash needed to pay for the investments as a purely commercial and self-financing enterprise. To be sure, everything here hinges on whether the value of the water to be transferred under a trading system is sufficient to carry the costs of the investments. Seen another way, trading might also provide the province with an opportunity to take a financial "claw-back" on any traded allocations that could then be used to compensate investments in water saving improvements on the farm as well. Again, there is no guarantee, and the potential has to be examined and studied carefully. But at the very least, there is potential. In the absence of trading, any investments in water efficiency improvements in the irrigation community carry the prospect of taxpayers footing at least part of the bill. That alone should align our thinking a little bit.

It all seems to make at least some sense. Yet, it is hard to avoid at least some nagging doubts. On the one hand, there is certainly no "basic human right" to expropriate massive amounts of water for an industrial purpose and then reap profits on that activity without paying for the water that is being used, especially if there is someone further down the stream who is willing to pay for that water and put it to a more productive use while lowering the environmental impact. That makes a lot of sense. But what if it is the rural irrigation district and the irrigators that are the ones that lose out? There is something in the heart of every rural Albertan that reacts viscerally to the very idea.

The idea of trading does hold some interesting, if not vitally important, potential to turn water in Alberta around. But any system would need to be properly designed and structured, highly regulated and controlled, and also embedded within a comprehensive water resource management framework that includes a suite of other tools and options as well. There is much work to be done, and Albertans need to get to it. As some commentators have noted, move ahead with caution, but certainly move ahead (Brandes, Nowlan, and Paris 2009).

OPPORTUNITIES

> *"Sustainable water management is among the most significant challenges of the 21st century. In moving forward we will face many challenging decisions on the many aspects of freshwater policy. But we must also contemplate where it is we want to go — the bigger picture."*
>
> — Tony Maas and Lindsay Telfer, Prairie Water Directive, 2007.

It is often said that in Chinese, the word "crisis" is composed of two separate characters with the first representing "danger" and the second representing "opportunity." However, many linguists consider this idea incorrect (Mair 2005). The second character is better translated as "crucial point." While Alberta's water is not in crisis — at least yet — there is certainly a sense that water in Alberta is at a crucial point. And, making the right decisions at this crucial point can certainly offer opportunities. There are at least four that Albertans should consider.

First, the water headaches of the province do provide Albertans the chance to become real leaders when it comes to water resource management. In many ways, Albertans are not leaders right now, and despite all the "happy talk" around water, there is much that can, and indeed must, change. If Albertans can do something "big" on the water front, do it decisively, and do it well, then opportunities abound. Albertans can start driving toward a very attractive water vision that has a lot to offer. Albertans will do more than just protect what they have, but enhance it considerably. In grabbing the mantle of leadership, Albertans will be developing an entirely new export industry, one that can earn dividends from around the world. It is much like the challenge of developing Alberta's oil and gas industry, which took more than just a little effort. Alberta expertise in the form of R&D is now shipped around the world.

Second, and closer to home, solving the water challenge offers Albertans the opportunity to employ water more effectively and more efficiently, and move water up towards higher and more valued economic purposes. The *Water for Life* goal of a 30% increase in water productivity is not a "bad" goal. This is not about "taking anything away." Rather, the goal of productivity and efficiency is the very engine that drives economic growth, rising real incomes, and prosperity. Albertans, in looking to solve the water challenge, should eagerly embrace the challenge for productivity enhancement. It is critical to long-term prosperity and competitiveness.

Third, water is becoming a huge global challenge. Albertans should know, and understand, that water may seriously and dramatically affect a good portion of the world's future food supply. The Australian experience is more than a little sobering. A decade of drought has compromised Australia's agricultural industry, and Australia is just the tip of a much bigger problem that is now coming to bear. In the future, it is entirely possible for water — given its crucial role in irrigated agriculture — to become a more valuable resource than oil is today. Canada is often described as one of the critical "lifeboats" for the world's food supply. And Alberta, which contains the good portion of Canada's most agriculturally productive land and the great majority of her irrigated land, will have to help pilot that lifeboat. But if Albertans are incapable of redesigning water resource management for the future, Alberta could just as easily fall victim as well. At the very least, Alberta may not be counted upon to help the other countries of the world. Failing in this regard not only entails lost opportunity, but a denial of responsibility as well.

Fourth, there is a very real opportunity here for Alberta to counteract what is a growing reputation as an environmental polluter and a producer of "dirty" oil. And in all of that, a waster of water to boot. These are hard things for Albertans to swallow. But it is also up to Albertans themselves to turn that image around. Just like all western Canadians, Albertans have had to meet so many challenges before. For example, in the 1960s and 1970s, a big challenge for Albertans was finding a way to get a barrel out of the oil sands. In the 1980s and 1990s, that problem was resolved. The new challenge was to make the entire process economically viable in the light of a collapse in oil prices. Today, the challenge has become the environmental implications and the need to make the operation more environmentally sustainable, and with it, to lower the impacts on water as well. In Chinese, crisis may not necessarily equal danger and opportunity. But making the right decisions at a "crucial point" can certainly yield the opportunity for a new generation of Alberta pioneers to seize upon the water future of the province.

CONCLUSION: TIME TO ACT

> *In essence, two options lie before us — re-plumbing the prairie rivers and watersheds, or re-thinking human activities and economies. Do we transform our watershed ecosystems or do we transform ourselves?*
>
> — Tony Maas and Lindsay Telfer, Prairie Water Directive, 2007.

Water is a tough public policy issue — perhaps the toughest. It has numerous dimensions, and speaks to history, ownership, and established precedent. Water speaks to lifestyle, recreation, and earning a living. Water is fundamental, special, and essential. Water is emotional, and for some, it has a spiritual mystery as well. The challenge of Alberta's water, then, goes well beyond water stresses and strains. Water reflects wide and deeply held beliefs and convictions that go to the heart of Alberta's shared values.

With the threat of water becoming an increasingly scarce resource in southern Alberta, and numerous other water challenges across the province, it is timely to think about new and innovative mechanisms and instruments that can help manage the supply of water, improve conservation and efficiency, enhance and renew water ecosystems, and allow water to move across Alberta's critical economic sectors. Financial or market-based instruments may be one vital link tying these different goals together, creating opportunity for solving some of Alberta's recurring water headaches.

To be sure, many of Alberta's water challenges reflect a future threat and potential concerns that have yet to arrive, or have yet to make their full presence known. But this is no reason to postpone action.

First, some of the stresses and strains *are* real and they *have* arrived. Over-allocation in the South Saskatchewan River Basin is a clear and present reality. The rivers are closed. If left unaddressed, this headache alone could turn into a much more chronic migraine.

Second, failing to meaningfully address today's water challenges will only serve to complicate and compound any future challenges that may arrive. In other words, there is a set of *converging* difficulties for which Albertans should be preparing. To safeguard the province's water resources, Albertans need to contemplate and accelerate actions now, moving ahead with options for the long-term instead of postponing until circumstances — which may then be out of our control — take over. Albertans have room to manoeuver now. There may be less room to manoeuver in the future.

Third, postponing important decisions on water to some point in the future may force decisions to be made at a time when there is even more pressure on water resources. This is almost certain to result in less effective and thoughtful decisions. What is more, any potential options then may prove more expensive than Albertans can afford, or they may be outside our technological capacity. It is best to find solutions now, before it becomes too difficult, before it becomes too expensive, before serious obstacles arrive, and before unproductive conflicts arise. If that happens, Alberta's historical battle with a limited water supply could be over, and Albertans will have become the losers. Water — or the lack of it — has won the day, and now Alberta's future economic and social development is limited.

Finally, there is more than just a small feeling that Alberta needs to do something big, and do it fast. The challenges are certainly driving intense debate and discussion, and there is already much work going on, from the establishment of the *Alberta Water Research Institute*, *Water for Life* and the *Water for Life Renewal*, to the *Land Use Framework*, the new *Water Act*, and the new *Irrigation Districts Act*. But we are not at all there yet. The water concerns of today and the threats of tomorrow should be the catalyst driving intense creativity, imagination, and innovation. If Albertans make the right choices today, Albertans can avoid hitting the water wall tomorrow.

Albertans should not kid themselves into believing that any of this will be entirely easy or straightforward. But Alberta has always had to struggle with profound questions on how to manage natural resource endowments. Alberta's oil and gas endowment is a case in point, and it offers an interesting parallel. In managing that endowment, Albertans had the choice of pursuing different mechanisms, different approaches, and making different choices. There is a nagging feeling — at least sometimes — that Albertans did not get it quite right, and they have lost out as a result.

Today, much of the energy future in Alberta lies in the oil sands, where the work is tougher, the returns lower, the environmental implications more serious, and the impact on water more dangerous. Once again, everything comes back to water. And when it comes to water, Albertans have to make sure they get things right. Water, in all of its aspects, is just too precious and too special.

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