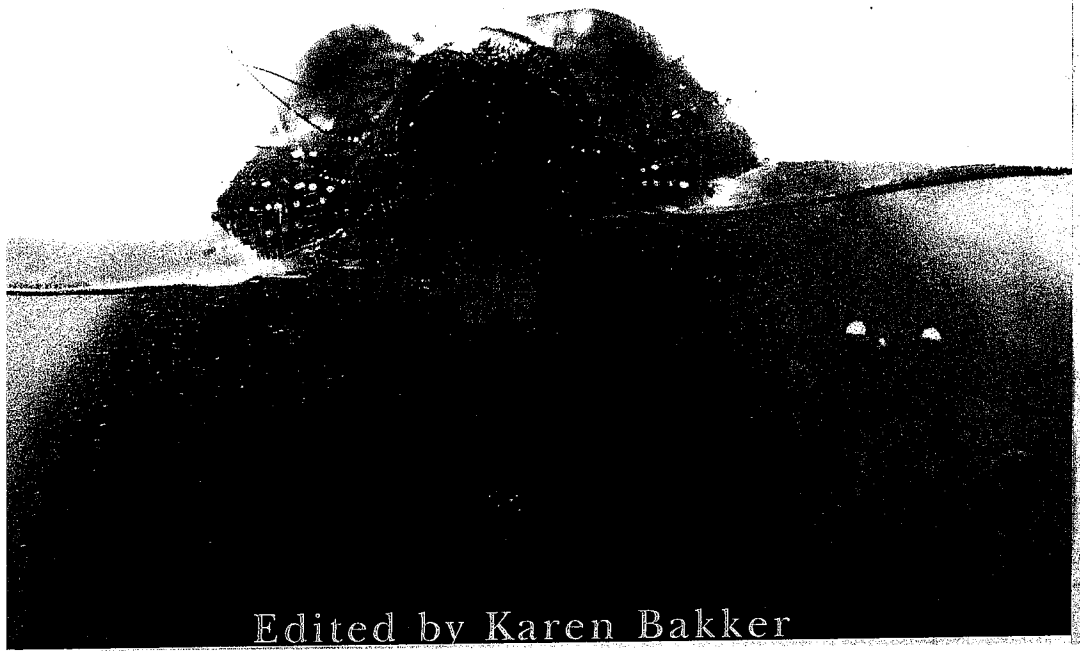
Eau Canada

THE FUTURE OF CANADA'S WATER



Edited by Karen Bakker

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15.
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1
Introduction

Karen Bakker

Canadians' relationship with water is rife with contradictions. We are fiercely protective of our water, yet hugely wasteful with it, using more water per capita than any nation in the world, except the United States (Boyd 2001). Images of pristine water are Canadian icons, yet we are one of the very few developed countries not to have legally enforceable water quality standards (see Appendix 1). Canadians are highly resistant to the notion of exporting water, yet Canada is one of the largest diverters of water in the world for hydropower (Day and Quinn 1992).

These contradictions in our approach to water stem from many sources: a mistaken belief in water's unlimited abundance; an assumption that water resources can be diverted to suit human purposes, with little regard for environmental consequences; our failure to comprehensively address threats to public and environmental health that arise from water contamination, poor environmental monitoring, and a lack of data and enforcement; and an inability to transcend provincial-federal turf wars over resource management. In a recent report on water management by the Senate Standing Committee on Energy, Environment and Natural Resources, the state of water management at the federal level was described as "shocking" (Senate 2005) and "unacceptable," an assessment with which many of the contributors to this volume would agree.

Over the past decade, these contradictions in our approach to water management have become increasingly difficult to sustain, and the "flush-and-forget" mentality that characterized our relationship to water for much of the twentieth century is giving way to increased concern. Canadian news coverage of water issues doubled between 1999 and 2001, and it has remained high since 2001.[1] Well-publicized water contamination incidents in Kashechewan (Ontario), Walkerton (Ontario), and North Battleford (Saskatchewan) have alerted Canadians to public health issues related to water

TABLE 14.1

A spectrum of water management approaches

Policy	Dominant discipline	Range of policy choice	Fundamental question	Planning process	Outcomes
Supply management	Engineering	Low: infrastructure based	How can we find new resources to meet future projected needs for water based on past trends in water use and population growth?	Planners model future growth, extrapolate from historic patterns of consumption, plan for an increase in capacity to meet anticipated future needs, then locate and develop a new source of supply to meet that need.	Construction: dams, pipelines, canals, wells, desalination
Demand management	Economics	Medium: short-term cost-benefit driven	How can we reduce demands for water to conserve the resource, save money, and reduce environmental impacts?	Planners model growth and account for a comprehensive efficiency and conservation program to maximize use of existing infrastructure. Increasing capacity would be a final option as part of a least-cost approach.	Water as an economic good; technical fixes; efficiency gains
Soft Path	Social sciences with physical limits	High: based on self-reflective political processes	How can we deliver the *services* currently provided by water in new ways that recognize the need for long-term "system" changes to achieve social sustainability?	Planners describe a desired sustainable future state (or scenario) based on economic and demographic variables and then "backcast" to devise a feasible and desirable path to that future with sustainability built into the economic, political, and sociocultural choices made along the way.	Ingenuity, new options, habits, and patterns of use

SOURCE: Adapted from Brooks and Wolfe (2004) and Brandes et al. (2005).

pattern of ever-increasing capacity – typically underwritten by governme subsidies that reinforce the belief that water is not a valuable resource – dc little to provide incentives for efficiency, let alone to encourage conservatic Though supply management has given Canadians a wealth of water acce the financial costs of new water supply are almost doubling every deca (Serageldin 1995), and preliminary evidence is that the environmental co are mounting even faster (Postel and Richter 2003). This cycle of use-bui use-build embeds past water habits (and waste) into future planning even the reality of ecological limits becomes apparent.

Demand management offers an alternative approach, which seeks multaneously to save money, conserve water resources, and reduce envirc mental impacts. Demand management has gained recognition in a numb of resource fields, including energy and transportation. With new techno gies and institutions, we can use less water but still achieve the same benef from household, industrial, commercial, and agricultural water use. Lo flow fixtures, drip irrigation, reuse and recycling technologies, consumer ec cation, and pricing and regulatory initiatives can all help to "manage demanc

Developing (and maintaining) new power plants, highways, and pip lines is costly. Avoiding new infrastructure expenditures and reducing cc sumer demand offers real potential. Most water policy experts believe tl cost-effective savings of 20 percent to 50 percent of water use are read achievable (Brandes and Ferguson 2003; Brooks and Peters 1988; Postel 19 Tate 1990; Vickers 2001). Cost effectiveness is often masked because us get water at less (typically much less) than its full cost. As a result, th incentive to improve water use efficiency is limited. Even "full cost accou ing" ignores the non-monetary environmental effects of water supply a disposal. If these costs were taken into account, the cost effectiveness of ei ciency improvements would be even greater.

A recent state-wide study in California profiles a compelling example the potential savings possible with demand management. The Pacific Ins tute (Gleick et al. 2003) reports that total commercial, industrial, residenti and institutional water use could be cost-effectively cut by at least 30 perce using "off-the-shelf" technologies. This improvement can be achieved mc quickly and cleanly than can any new supply project now under conside tion. They emphasize that "the potential for conservation and efficiency i provement in California is so large that even when the expected growth in t state's population and economy is taken into account, no new water-supp dams or reservoirs are needed in the coming decades" (Gleick et al. 2003,

quality (Laing 2002; O'Connor 2002; Parr 2005; Prudham 2004; Woo and Vicente 2003). Reports on increased threats to water quality and quantity from Environment Canada, the National Water Resources Institute, and the Senate have attracted renewed attention to water issues (NWRI 2001; Senate 2005).

At the local level, many communities are engaging in debates over water management. Droughts and floods in different regions are raising concerns about water supply and flood control infrastructure, and about the possible effects of climate change. Responding to the underfunding of public infrastructure, many cities – including Toronto, Montreal, and Vancouver – have recently debated the involvement of private companies in water supply (Bakker and Cameron 2005). Ongoing attempts to export water from Canada – whether by tanker from BC lakes or directly from the Great Lakes – are also generating heated discussion. In many instances, such as during the recent Great Lakes Annex debate (see Chapters 7 and 8), citizens' coalitions and non-governmental organizations are much more active than in the past; indeed, they are often at the forefront of debates.

The contributors to *Eau Canada* explore these debates, focusing on five themes: water governance; transboundary water management; water privatization; pathways to better water management; and changing water worldviews.

Part 1 – Muddy Waters: How Well Are We Governing Canada's Waters?

At the provincial level, water governance and management in Canada have been undergoing a period of rapid change and intense debate over the past decade. Provincial governments have revised legislation and introduced innovations in water management, such as Alberta's water markets, Quebec's new citizen-run participatory "watershed organizations," and Ontario's requirements for full-cost pricing and accounting for water supply infrastructure. Several provinces, including Manitoba, Ontario, and Quebec, have revamped water quality standards and monitoring. Alberta is dramatically delegating citizen participation in water management (Alberta Environment 2003). Manitoba has created a new Ministry of Water Stewardship (the only ministry devoted to water issues in Canada). Leading not-for-profit organizations (Council of Canadians) and environmental think tanks (Canadian Environmental Law Association, Friends of the Earth, Sierra Legal Defence Fund) have launched high-profile water campaigns, as has the country's largest union (Canadian Union of Public Employees). Growing corporate

interest is reflected in the Conference Board of Canada's new Water Research Forum initiative.

This activity is occurring within the context of what many of the contributors to *Eau Canada* portray as a diminished (and in some instances ineffective) federal government focus on water issues over the past two decades. Noting the absence of federal leadership on water policy, as evidenced by

BOX 1.1

CANADIAN RESEARCH ON FRESHWATER PROBLEMS: FROM "BEST IN THE WORLD" TO "DOWN THE DRAIN"?

David Schindler is one of Canada's top water scientists. In 1991, Schindler was awarded the first Stockholm Water Prize, water science's equivalent to the Nobel Prize. Schindler became well known for his groundbreaking work proving the link between water pollution and acid rain. He has warned repeatedly of a freshwater crisis in Canada, criticizing the cavalier attitude of Canadians to fresh water, the failure to deal with water pollution and to safeguard water quality, and the lack of a national water strategy and under-investment in water research on the part of the federal government. According to Schindler:

> In the mid-1960s, many aquatic scientists, myself included, immigrated to Canada because of new and exciting approaches to water research. Large freshwater laboratories were formed by the federal government ... The Experimental Lakes Area (ELA) was formed, becoming one of the few sites in the world where whole-ecosystem experiments could be done to investigate and solve pollutant and fisheries problems. This foresight caused great excitement in the global water science community: Canadian federal freshwater programs were envied throughout the world ... Many Canadian university and provincial programs also became strong ... Best of all, there was excellent interaction between federal, provincial, and university scientists, who worked together with contagious enthusiasm to develop the most powerful freshwater research teams anywhere in the world ... Unfortunately, these programs have been slowly strangled by a shortage of funds, poor salaries and the lack of replacement of departing staff. Politicians have stated the need to balance federal and provincial budgets as an excuse to reduce spending for environmental research and to decrease the size of the civil service ... It is well known that Canada's funds for research are a much smaller proportion of its national budget than in most First World countries. This must change if we are to adequately protect Canadian resources from degradation. (Schindler 2001, 24-25)

the failure to update the federal government's water policy since the last attempt in 1987 (Environment Canada 1987), some prominent Canadian water scientists have voiced concern about the underfunding of water research and the disbanding, in the 1990s, of federal departments devoted to water resources. They argue that this has dramatically reduced Canadians' capacity to assess the state of, and to safeguard, water resources (Box 1.1). As noted by Rob de Loë and Reid Kreutzwiser (Chapter 5), the ensuing fragmentation of water-related activities was so severe that the federal government had to assemble a "Where's Water" team in the mid-1990s to determine whether or not the federal government was meeting its water-related responsibilities.

One reason for the lack of federal attention stems from the division of constitutional responsibility for water between provinces and territories and the federal government. Fisheries, navigation, and international waters are federal responsibilities, yet water resources and water supply are provincial and territorial responsibilities. Water supply is, in turn, usually municipally managed. The fact that water is managed by multiple orders of government further complicates an already complex debate over how best to meet water quality, environmental protection, and public health goals in an era of public sector fiscal constraints. In the context of strained federal-provincial relations and provincial assertions of sovereignty, some stakeholders do not perceive increased federal involvement in water management to be either appropriate or desirable. Yet, this desire for a limited federal role does not resolve the question of responsibility for pan-Canadian or transboundary water issues.

Another reason for the lack of priority accorded to water issues may be, as aquatic scientist John Sprague explores in Chapter 2, a persistent "myth" of water abundance. Sprague argues that this myth is held by a majority of Canadians, and he illustrates his argument with statements made by Canadian politicians and the media. As Sprague demonstrates, the assumption that Canada is significantly more water-abundant than other nations (or the notion that "Canada is to water as Kuwait is to oil") is simply false. We are not the "Kuwait of water": Canada has under 7 percent of the global renewable water supply, and much of that supply flows north to areas relatively remote from population centres in southern Canada. These arguments are backed up by the findings of a recent report of the Senate Standing Committee on Energy, Resources and the Environment, which notes that:

> 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. [But] the fact is that certain regions of Canada, notably in the prairies, face important water challenges. Some parts of the prairies are semi-arid. In certain areas water consumption now matches or possibly exceeds what is renewed every year. (Senate 2005, 1)

Nonetheless, the myth of water abundance remains widespread in the Canadian media and public policy debates, and it is one of the reasons why, Sprague argues, both ground and surface water fail to receive the attention they deserve. Environmental lawyer Linda Nowlan, writing on Canada's approach to groundwater management in Chapter 4, agrees. She documents the relative lack of information about Canada's groundwater resources, despite the fact that one in four Canadians relies on groundwater for drinking water (Nowlan 2005).

As geographers Dan Shrubsole and Dianne Draper point out in their survey of water use and management in Canada (Chapter 3), the myth of water abundance is becoming increasingly difficult to sustain at the local level in many communities. Important and increasing stresses on water sources have been documented by Environment Canada. These stresses, in turn, have significant implications for water users. For example, Shrubsole and Draper report that Environment Canada surveys indicate that approximately 25 percent of municipalities experienced water shortages due to increased consumption, drought, or infrastructure constraints between 1994 and 1999 (Environment Canada 2002).

As subsequent chapters in this book point out, recognition of the stresses on water supply has been one trigger for innovation in water governance and management in Canada over the past decade, particularly at the regional, provincial, and municipal levels (see, for example, de Loë, Kreutzwiser, and Neufeld 2005; Kreutzwiser 1998; Plummer et al. 2005; Sproule-Jones 2002). As discussed in Chapters 4 and 5, enforcement and regulation is one area in which Canada has shown little innovation in comparison to other OECD countries. Canada contrasts dramatically to countries such as the United States and the United Kingdom, where large and well-funded environmental protection agencies (distinct from departments of the environment) fulfill key roles such as enforcement and monitoring. In Canada,

these key tasks often fall to independent, often under-resourced NGOs. Drinking water quality, for example, is not nationally enforced or monitored; the federal government merely sets guidelines – which only a few provinces follow in their entirety (see Appendix 1). In some provinces, the best source for comparative data on water quality is an environmental legal not-for-profit organization, the Sierra Legal Defence Fund, which has produced a well-publicized series of "National Sewage Report Cards" and reports on drinking water quality (SLDF 2001, 2004). In contrast, in countries such as the the United Kingdom or United States, water quality reporting is undertaken by well-resourced public sector watchdogs, backed up by legislation; this results in more comprehensive, reliable, and accessible data for consumers than is the case in Canada.

Moreover, several contributors to this book argue that Canada falls behind other OECD countries in accounting for water quantity and quality. In the US, for example, stream flow and hydrology data are publicly available via the Internet. In Canada, however, data are less widely collected, and the number of hydrometric stations has been dramatically reduced in recent years, thus straining information-gathering capacity and raising concerns that network density in some provinces does not meet international standards (Lilley 2004; Scot, Yuzyk, and Whitney 1999). For example, about half of the hydrometric stations in the Okanagan Basin – the driest watershed in Canada – have been discontinued since 1973; this comes at a time when the need for long-term data is critical, given rapid population growth, development pressures, and the effects of climate change in the Okanagan. As indicated by the experience of the Sierra Legal Defence Fund (Box 4.1, Chapter 4), data collection does not automatically imply easy public access. And the limited data that is produced is not widely available or easily accessible.

The contrast between Canada and other developed countries is significant. In the UK, for example, water quality standards are legally enforced, extensively monitored, and the results published annually in an easily accessible form on the Internet site of the national regulator (Drinking Water Inspectorate); in Canada, water quality is not as systematically monitored, nor are data as easily available. For example, due to funding issues, Health Canada does not inspect water on planes to determine its safety (CESD 2005). As a result, the federal government "cannot assure the millions of Canadian travellers that potable water on aircraft is safe" (ibid.), despite its acknowledged responsibility. In comparison, the US government currently has agreements with the majority of airlines transporting the public and found that,

in 2004, water was contaminated with coliform bacteria in about 15 percent of the aircraft tested (ibid.).

Part 2 – Whose Water? Jurisdictional Fragmentation and Transboundary Management

JURISDICTIONAL FRAGMENTATION

Another persistent problem in Canadian water governance, as discussed by lawyers Owen Saunders and Michael Wenig in Chapter 6, is the jurisdictional fragmentation that characterizes water management. Water legislation is a patchwork of provincial and federal laws, with inconsistencies and gaps in important areas of responsibility and oversight. This is not unusual. Water continually crosses political boundaries as it circulates through the hydrological cycle and invariably raises difficult questions of jurisdiction, in part because water is a multiple-use resource, critical for energy, agriculture, tourism, environmental health, and human water supply.

Delegating these responsibilities to different departments and scales of governance may make sense in theory. Yet, many of the contributors to *Eau Canada* argue that our approach to distributing governance between different jurisdictions has reduced Canada's effectiveness in dealing with challenges to water governance. For example, drinking water guidelines are established through a process that involves federal, provincial, and territorial governments on a joint committee (Federal-Provincial-Territorial Committee on Drinking Water [CDW]), which establishes guidelines for Canadian drinking water quality. Canada's Commissioner of the Environment and Sustainable Development (in the Office of the Auditor General) has audited the process the federal government uses to develop these guidelines and found a "significant backlog" (of approximately ten years) in updating them, despite Health Canada's recommendation that they should take no more than two to three years to develop or review (CESD 2005). The Commissioner found that many known contaminants are not even listed in the guidelines because of the time lag in updating them.

As contributors to this volume conclude, the federal government is "floundering" with respect to water policy (Chapter 12), and "our water protection capabilities are adrift" (Chapter 8). The federal government's performance with respect to water policy was strongly criticized in a 2001 report by the federal Commissioner of the Environment and Sustainable Development (2001). The commissioner's report argued that the federal government was

not doing enough to protect the environment of the Great Lakes and St. Lawrence River Basin. It also noted that the federal government lacked a consistent and clear strategy for water policy in Canada, and voiced concern that the Federal Water Policy had not been updated since 1987. These concerns were reiterated by the commissioner's annual report for 2005 (CESD 2005). The Commissioner commented favourably on the renewed federal interest in water but noted that the future of the Federal Water Policy remained "unclear" and "uncertain" (ibid.). The Senate Standing Committee on Energy, the Environment and Natural Resources also criticized the federal government's failure to collect adequate basic data on Canada's water resources, stating that "this information gap is ... unacceptable [and] stems in large part from the Government of Canada's retreat from water management issues and from funding relevant research" (Senate 2005, 5).

In addition to impacting our management of water quality and resources, jurisdicitonal fragmentation affects policies and politics of transboundary water management and exports. Given the potentially significant consequences for the integrity of Canadian waters, this book devotes a chapter to each of these issues.

Water Exports and Transboundary Management

Are water exports to be feared? In the past, Canadian water experts tended to argue that Canadians spent too much time worrying about the possibility of water exports and not enough time worrying about the damage caused by their own diversions for hydroelectricity (Day and Quinn 1992). As geographer Frédéric Lasserre argues in Chapter 7, the ecological effects of water diversions are significant and generally negative. Fears of water exports also sometimes underestimate the extensive cooperative mechanisms that have evolved to deal with waters shared between Canada and the United States. The most important of these is the International Joint Commission (IJC), a binational panel that oversees the Boundary Waters Treaty (the international agreement governing cooperation over shared watercourses between Canada and the United States). As Ralph Pentland and Adéle Hurley point out in Chapter 8, the Boundary Waters Treaty is regarded internationally as a model of bilateral cooperation over shared water resources, although its adequacy and the commitment of both nations to the treaty is increasingly under question. Finally, the fact that water exports to the United States already occur (although in very small volumes) and that the "floodgates" have not opened as a result has been interpreted as providing reassurance that

Canada and its southern neighbour are able to cooperate over shared waters (Boyd 2003).

Yet, in the past two decades, the situation with respect to transboundary waters has undergone significant change. First, the North American Free Trade Agreement (NAFTA) has affected Canadian ability to control domestic water policy and to pass legislation controlling or prohibiting water exports (Boyd 2003). The question of how to deal with Canadian water ignited fierce controversy during NAFTA negotiations in the 1980s. The federal government maintained that Canadian water (except bottled water) was exempt from NAFTA. Opposition leaders and critics called for a clause that would specifically exclude water from NAFTA. Instead, the Canadian, Mexican, and American governments issued a joint statement in 1993 to the effect that water was excluded from NAFTA (DFAIT 1999). Moreover, Canada's NAFTA Implementation Act explicitly states that nothing in NAFTA applies to water in its natural state.[2] Nonetheless, legal experts continue to debate whether NAFTA applies to water in its natural state and, thus, to bulk water exports. The closed nature of NAFTA tribunals and the lack of transparency in the decision-making process have further contributed to ongoing uncertainty over the legal status of water under NAFTA.

Second, in response to lingering domestic concerns over NAFTA and to public opposition to three controversial water export proposals, federal and provincial governments have passed new legislation banning interbasin transfers. In 1998, an Ontario-based company (Nova Corp) applied for a permit to take water from the Great Lakes and export it to Asia. In the same year, a Newfoundland-based company (McCurdy Group) applied for a permit to export bulk water from Newfoundland's Gisborne Lake. Neither proposal went ahead. A year later, a British-Columbia based company (Snow Cap) was granted a licence to provide water for export to a California-based company (Sun Belt); the licence was subsequently revoked, although Sun Belt threatened to contest the decision under NAFTA's provisions for equal treatment (see Box 8.1). Although these proposals have been dropped, new ones regularly appear, such as the proposal by a local real estate developer to abstract and bottle one millions gallons of water per day from Adams Lake (in BC's Okanagan Basin) for export to the Middle East.

Following the public debate engendered by these proposals, and an IJC study calling for a moratorium on bulk water exports (IJC 2000),[3] the federal government amended the Boundary Waters Treaty Act,[4] banning the abstraction of bulk water from boundary waters that fall under the treaty.[5] Yet this

amendment did not address the issue of exports of non-boundary waters, responsibility for which is claimed by both provincial and federal governments (the former responsible for water resources, but the latter responsible for international trade). Accordingly, the federal government also sought to establish a cross-Canada consensus on water exports and encouraged Canadian provinces to introduce legislation to ban or limit the export of bulk water. All Canadian provinces, except New Brunswick, have passed legislation pertaining to water exports and/or water diversions.

However, as discussed by Frédéric Lasserre in Chapter 7, much of this legislation does not explicitly prohibit water exports but, rather, bans out-of-basin water diversions on environmental grounds. Canadian legislators may have relied on the fact that, with a few important exceptions, most of the major watersheds in Canada fall completely within Canadian territory, banning trans-basin diversions thus implicitly prohibits water exports. As Lasserre notes, the legislative protection accorded to water exports is incomplete: it may not provide protection in the case of transboundary watersheds, and it may be vulnerable to challenge under NAFTA, under which any exemptions must be in proportion to the objective being served. Provincial laws that prohibit out-of-basin diversions may be open to dispute as being disproportionate with regard to environmental protection – particularly as Canada already diverts significant amounts of water from one basin to another.

Increasing unilateralism on the part of the United States is a third important change in transboundary management. The recent case of Devils Lake is illustrative of these changes (Box 8.2 and Chapter 8). The export of polluted waters by the state of North Dakota into Manitoba's Red River system, via a pipeline constructed in the summer of 2005, clearly violates Article IV of the Boundary Waters Treaty, which states that "waters flowing across the boundary shall not be polluted on either side to the injury of health or property on the other side." After pressure from Manitoba's provincial government, the Canadian government asked Washington to join it in referring the Devils Lake case to the IJC, after failing to respond to an earlier request by the US to refer the matter. At the time of writing, the US government has yet to do this. Reasons include the relative decline in the Canadian-American relationship, the power of North Dakota lobbyists in Washington, the commitment of the current White House administration to "states' rights," and increasing American unilateralism on a number of issues (such as softwood lumber). Devils Lake sets a precedent for unilateral action on transboundary

waters on the part of states and provinces – a situation, as several contributors to this volume argue, to which Canada is ill-equipped to respond.[6]

Why would Canada be ill-equipped to deal with these and other governance challenges? As several contributors to this volume argue, at the heart of Canada's inability to exert control over shared water resources is the ongoing "turf war" between federal and provincial politicians over water resources and the resulting federal timidity in exercising its full jurisdiction over water management issues that are, in fact, federal responsibilities. In the case of the debate over bulk water exports in the late 1990s, for example, David Anderson (then federal environment minister) argued that it was beyond the federal government's "jurisdiction to make decisions about provincial resources" (Boyd 2003, 58), even though provinces had repeatedly referred questions over bulk water exports to the federal government's jurisdiction over international trade. As explored in Chapters 7 and 8, this jurisdictional stalemate was evident during the recent debate over "Annex 2001" proposals for a new governance regime allowing bulk water exports by American states bordering the Great Lakes (CGLG 2001).

Part 3 – Blue Gold: Privatization, Water Rights, and Water Markets

Another controversial debate regarding water governance in Canada in recent years has involved the shift toward market-based institutions in water resources and supply management. Historically, water management in Canada has been closely controlled by provincial, territorial, and federal governments. In Canada, as in most industrialized countries, water supply was mobilized during the twentieth century as a strategic resource to support industrialization, urbanization, and agricultural intensification (Bakker 2004). Canada's approach to water management was state-led and emphasized engineering-intensive hydraulic works as a means of satisfying water demands. This "supply-led" approach was based on a desire to provide sufficient quantities of water, where and when needed, such that economic growth could proceed unconstrained. Given high capital costs and long infrastructure lifetimes, public financing was believed to be critical for the development of water supply and resources. Another justification for state involvement was the "public good" characteristics of water: given that water is a partially non-substitutable resource essential for life, and of critical importance to public health, state involvement was thought to be necessary. Accordingly, Canadian

governments financed, built, and managed hydraulic works and water supply infrastructure throughout the country.

Yet, in the past decade in Canada, as elsewhere, the consensus about the need for and nature of state involvement in water supply has broken down (Gleick 2000). This has occurred for many reasons: costly infrastructure investment needs that have outstripped public financing capacity; declining transfers to municipalities from higher levels of government; changing political views on appropriate roles of states and markets in services provision; and increasing support for water conservation and efficiency initiatives, some of which are thought to be more amenable to market-based rather than to state-based regulation (Water Strategy Expert Panel 2005).

As a result, new experiments with market-based water provision and regulation have emerged in Canada. One set of approaches focuses on "commercializing" water management: managing water in line with what are commonly identified as principles and economic instruments associated with the private sector (see, for example, Renzetti and Dupont 1999). Water pricing is a good example (Cantin, Shrubsole, and Aït-Ouyahia 2005). Over the past decade, many Canadian municipalities have begun or have extended the process of metering residential water supply, which implies charging by volumes consumed. As explored in Chapters 13 and 14, various benefits, both economic and environmental, are cited as reasons for metering, which is generally associated with increased efficiency and a reduction in demand for water (National Round Table 1996).

A second, and more controversial, set of approaches to water governance involves the introduction of private companies and private property rights into water supply management (Bakker 2004; Horbulyk 2005). These market-based approaches can be grouped into four distinct categories (which are often confused in public debate): (1) private sector participation in water supply; (2) commercialization of water management; (3) water markets for "raw," or bulk, water (usually for irrigation purposes); and (4) water rights trading. Private sector participation involves private, usually for-profit corporations in the management (and, more rarely in Canada, ownership) of water and wastewater infrastructure. Commercialization is more widespread and less controversial than privatization: it entails the introduction of commercial principles such as profit-seeking and full-cost pricing into water supply management. As documented by Karen Bakker in Chapter 9, several Canadian municipalities have recently signed contracts with private companies for water supply and sewerage management, although most water

supply systems in Canada remain publicly owned and operated. Many more water supply utilities have commercialized operations, adopting a variety of approaches, including the conversion of municipal utilities into publicly owned for-profit corporations (e.g., in Edmonton), the introduction of metering (e.g., in West Vancouver), and market-based pricing mechanisms (e.g., irrigation water in Alberta). Commercialization has occurred in many Canadian provinces; in some cases, such as Ontario, recent legislation requires such commercial approaches to water management as full-cost pricing. As Bakker argues, private sector involvement in water supply is not a panacea: it does not provide cheap financing or solve water governance problems. Bakker recommends that Canadian municipalities need to improve water governance first before considering private sector involvement, keeping in mind the disadvantages as well as the potential advantages of such involvement (Aït-Ouyahia 2006).

This message is reiterated in the examination of water markets and water rights trading in Chapters 10 and 11. Water markets, as discussed by economist Ted Horbulyk (Chapter 10), are relatively new to Canada. Historically, water rights in Canada's Western provinces were associated with land ownership: a water right "attached" to a piece of land could not be exchanged or sold. In water-scarce agricultural areas, the resulting inflexibility in water use (with under-use of water on some farms and shortages of water on others) led, in the late 1990s, to proposals to create water markets in Alberta. In other jurisdictions, as explained by lawyers Randy Christensen and Anastasia Lintner in Chapter 11, although water markets have not been created, governments are creating new ways for users to exchange or trade water rights. Christensen and Lintner examine Canadian and international examples (including Chile and California) and argue that Canadian water governance is not strong enough to allow for widespread markets or water rights trading. They suggest that potential positive outcomes of market mechanisms would be severely hampered by Canada's fragmented jurisdiction, weak regulatory structures, a lack of basic data on water resources, and poor accountability mechanisms. Canada, in other words, needs to improve water governance before it begins experimenting with some of the potential benefits that some market-based mechanisms might offer.

Part 4 – Waterwise: Pathways to Better Water Management

How could we manage water more wisely? This section of *Eau Canada* documents innovative water governance approaches that are being applied in

Canada and that many water experts argue should form the core of a "new water paradigm" (Gleick 2000). In Chapter 12, lawyers Paul Muldoon and Theresa McClenaghan argue that the provincial-federal "turf wars" – and the resulting stalemate in water policy at the national level – should be addressed through a new governance framework that enables provincial and federal levels of government to work together to streamline and enforce existing water legislation. In Chapter 14, political ecologist Oliver Brandes, natural resources economist David Brooks, and lawyer and environmental activist Michael M'Gonigle make the case for a sustainable approach to water management, an approach based on conservation as part of a broader strategy for maintaining environmental health and preserving ecosystem functions.

This strategy of "ecological governance" begins with emphasizing reductions in water demand (to conserve resources, save money, and reduce environmental impacts), with the long-term goal of "soft path" management. This soft path requires a new form of water governance – one that focuses on sustainability, breaks the link between increasing water consumption and economic growth, and radically changes our water use and disposal practices by focusing on the delivery of *services* rather than water.

As economist Steven Renzetti argues in Chapter 13, a key component of this new approach to water management is water pricing. Pricing, according to Renzetti, should balance four criteria: efficiency, fairness, economic equity, and sustainability. Getting the prices "right" should help to encourage efficient water allocation, improve water quality, provide adequate revenues to water suppliers, and encourage innovation and conservation (although in practice it may not always be possible to balance these goals). However, there are significant barriers to "getting the prices right," and better pricing cannot solve more fundamental questions about governance and sustainability (Brandes et al. 2005). How, then, are we to adjudicate between different goals and strike the right balance? The final section of *Eau Canada* attempts to answer this question.

Part 5 – Water Worldviews: Politics, Culture, and Ethics

The final three chapters turn to questions of new water worldviews and their implications for water management. In Chapter 15, lawyer Ardith Walkem documents the increasing legal recognition that Canadian courts have granted to Aboriginal water rights. This has implications, she argues, well beyond water rights and Aboriginal land claims: there is a strong case for integrating

Aboriginal water management norms and ethics into Canadian resource management practices as a matter of environmental justice. The implications would be far-reaching not only for Aboriginal peoples' water sources and water rights but also for the ethical bases of water management practices in Canada.

Changing our water worldviews is, however, far from an easy task. As political scientist Andrew Biro explores in Chapter 16, our ethical bases for water management practices are deeply rooted in Canadian culture: images of pristine, or "natural," water are central to concepts of Canadian identity, which are often implicitly defined against the "modern hydrologically engineered (nature-dominating, imperialist) society to the south." These characterizations, however, break down upon closer inspection. As geographer Frédéric Lasserre demonstrates in Chapter 7, Canada is a much larger diverter of water than is the United States: in the search for hydropower we have, in fact, dammed and diverted more water per capita than has almost any other nation in the world. Nonetheless, the "myth of water abundance" persists, in part, Biro argues, because of its fit with the Canadian national imaginary: "Northern, vast and open, rugged, wild and, of course, cold and wet" (Chapter 16).

Walkem's and Biro's arguments contain important parallels to the call for a "new water ethic," which is articulated by geographers Bruce Mitchell and Cushla Matthews and political scientist Bob Gibson in Chapter 17. In this final chapter of the book, the authors survey emerging approaches to water management in Canada and internationally, and they note that several new (and sometimes controversial) principles and goals are increasingly being advocated (and, in some cases, adopted) around the world. These include ecosystem integrity, source protection, user participation, efficiency and conservation, precautionary management, and legal rights – for both humans and the environment. As the authors point out, these approaches are not always consistent, nor are they always equally applicable. Rather, they point to a new underlying approach to water governance and management that acknowledges the limits of the conventional approach (i.e., hierarchal management) and emphasizes the need for dialogue regarding how we govern not only our relationships with one another but also with the ecologies within which we live. In other words, we need to move away from the "environmental management" of resources and toward the "ecological governance" of human-water relationships, managing *ourselves* as well as the environment.

The Focus of *Eau Canada*

This book focuses on two aspects of our relationship with water: water governance and water management. The difference between the two is subtle, but important. Simply put, "water governance" refers to the decision-making process we follow, whereas "water management" refers to the operational approaches we adopt. Governance refers to how we make decisions and who gets to decide; management refers to the models, principles, and information we use to make those decisions. Obviously, the two are interrelated; however, management is often the focus of debate, whereas governance is often overlooked.

The premise of this book is that Canadian water governance and management are at a crossroads. There is increasing recognition of systemic weaknesses in our approach to water governance, and increased debate regarding necessary reforms to our water management models. This has, in turn, lent new urgency to calls to reform our approach to governance and has also led to a period of fascinating experimentation with new approaches to management.

Eau Canada analyzes some of these weaknesses, challenges, and innovations. Specifically, the book documents recent changes in water governance and management in Canada; analyzes current challenges in Canadian water governance; and explores the different solutions being advocated by different Canadian water experts. This focus will, of necessity, exclude (or acknowledge only in passing) equally important debates in related fields, such as aquatic science and engineering. This is unfortunate insofar as most experts working on water issues – including the majority of contributors to this book – would likely agree that an integrated approach, although difficult, is absolutely necessary given that water is a multipurpose resource that is essential for life, transcending jurisdictional and geopolitical boundaries and linking complex social and technical systems. Accordingly, an appendix with suggestions for further reading has been included (see Appendix 2).

Significant changes are going to be made to water governance and management in Canada over the next decade. One of the premises of this book is that informed public input is essential to good policy outcomes. Accordingly, the goal of this book is to introduce these issues to the broader Canadian public in the hope that people will continue to engage with, and build upon, the ideas and debates presented here. Our water is too important to do otherwise.

NOTES

1 A search of the Canadian Business and Current Affairs (CBCA) database was conducted on 30 August 2005. CBCA indexes articles published in and about Canada, taken from more than 1,500 popular and scholarly publications, including newspapers, magazines, and academic journals. News coverage of the keyword "water supply" was surveyed for the period 1987-2005.

2 North American Free Trade Implementation Act, S.C. 1993, c. 44, s. 7. The relevant clause states that nothing in the act (except Article 302) applies to water, where water is defined as natural surface and ground water in liquid, gaseous, or solid state, but does not include water packaged as a beverage or in tanks. Article 302 refers to the progressive elimination of tariffs (customs duties) between NAFTA signatories.

3 The IJC report stated that Canada and the United States "should not permit any new proposal for removal of water from the Great Lakes Basin to proceed unless the proponent can demonstrate that the removal not endanger the integrity of the ecosystem."

4 Bill C-15, An Act to Amend the International Boundary Treaty Act, S.C. 2001, 40.

5 Bill C-15 specifically "(a) prohibits the bulk removal of boundary waters from the water basins in which they are located; (b) requires persons to obtain licences from the Minister of Foreign Affairs for water-related projects in boundary or transboundary waters that would affect the natural level or flow of waters on the United States side of the border; and (c) provides clear sanctions and penalties for violation."

6 The proposed North Dakota Garrison Diversion (also known as the Red River Supply Project) is an example. Amendments by the US Congress to the Garrison Reformulation Act in 2000 removed the previous requirement for consultations with Canada, strongly opposed by the Manitoba and Canadian governments (Manitoba Water Stewardship 2006).

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PART 1

Muddy Waters: How Well Are We Governing Canada's Waters?

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Canada has just over 6 percent of global annual renewable water supply. Despite this, rumours persist that it is water-rich.

2
Great Wet North? Canada's Myth of Water Abundance

John B. Sprague

The news media and most Canadians are convinced that our country is exceptionally rich in water. We often see statements such as "we have more than a fifth of the world's freshwater supply," or "one-quarter of world supply." Certainly, it is easy to go along with this idea when standing beside one of the Great Lakes or when flying over the north with thousands of little lakes down below. But sometimes the statements become excessively optimistic. West Coast Environmental Law, a group in British Columbia that is usually well informed, exemplifies this optimism in a publication that stated that "Canada has one of the most abundant supplies of fresh water in the world, exceeding the volume of US water resources by a factor of 10" (Shrybman 1999). This might be the greatest over-estimate on record, and there is no apparent set of data that would justify "a factor of 10."

Volume vs. Renewable Supply

The common overestimation of Canada's water supply is probably derived from the volume of fresh water sitting in all Canadian lakes, which is about 20 percent of the water in all of the world's lakes (Environment Canada 2005). Of course, the water sitting in a lake is totally different from the *renewable supply*. The renewable supply is what falls from the sky and runs off in rivers, often passing through lakes as it moves to the sea. Some goes underground, replenishing aquifers that can be tapped by wells. These flows are renewed every year and count as the *water supply*.

This renewable fresh water can be defined as "salt-free water that is fully replaced in any given year through rain and snow that falls on continents and islands and flows through rivers and streams to the sea" (WRI 2003). This definition includes groundwater because an aquifer that gains water from seeping rainfall, beyond its equilibrium, will drain off its excess water

by means of springs, which run into streams. The definition excludes water that is evaporated or transpired from vegetation. To use a financial analogy, the water sitting in lakes and aquifers is comparable to a capital resource of money that can be spent only once. The rivers running out of the lakes would represent interest and dividends that could be used every year for an indefinite time.

For a more homespun analogy, it doesn't matter if my back yard has a swimming pool full of water and my neighbour's yard has only a barrel. If the taps in my house dribble, but the neighbour's taps gush, then it is the neighbour who has the good supply of water. The size of the swimming pool is of no consequence; if I start using the water in my pool for laundry and watering the garden, I will have a dry pool in a few months, along with my dribbling taps. The giant lakes in North America are comparable: we can use them to boat and fish and swim, but if we start consuming their standing water, we will eventually dry them up. Recent complaints about low levels in the Great Lakes indicate why lowering of water levels is not an option.

Indeed, lake storage capacity is not as big as might be thought. The total volume of water resident in all the freshwater lakes of the world is only equal to about two years' worth of runoff in the world's rivers (Environment Canada 2005). Exactly the same principles and consequences apply to underground aquifers, if we deplete them faster than nature renews them. In other words, this would deplete the "capital" in our "bank account" of stored water.

Canada: Third to Sixth in Renewable Supply

Canada appears to have lots of water, but this is because of a topography that creates a few large lakes and many shallow, small lakes, along with a cool climate and low evaporation of the water. In fact, our share of the world's renewable water supply is relatively modest. Recent data put us in third place (barely) among all nations. This estimate comes from the World Resources Institute, a quarter-century-old environmental research institute and think tank based in Washington, DC (WRI 2003, 2005).

The two countries with the largest renewable water supplies are Brazil, with 12.4 percent of the world's renewable supply, and Russia, with 10 percent. Below that, Canada is in a virtual four-way tie with Indonesia, the United States, and China, each with about 6.5 to 6.4 percent. Next down the

TABLE 2.1

Internal renewable water resources for the ten countries with the largest water supplies

	Supply (km^3 per year)	Percentage of world supply
Brazil	5,418	12.4
Russian Federation	4,313	10.0
Canada	2,850	6.5
Indonesia	2,838	6.5
United States	2,818	6.4
People's Republic of China	2,812	6.4
Colombia	2,112	4.8
Peru	1,616	3.7
India	1,261	2.9
Democratic Republic of Congo	900	2.1
World total	43,773	

SOURCE: WRI (2005).

list, from about 5 percent to 2 percent, are Columbia, Peru, India, and the Democratic Republic of Congo, respectively (Table 2.1).

The numerical estimates in Table 2.1 are intended to represent the surface water flows and groundwater recharge that originate within a given country. In other words, the numbers signify the amount of precipitation falling within a country's borders. Water flowing into the country from a neighbour is not included, nor is water that flows out, evaporates, or transpires.[1] Canada's annual renewable volume of fresh water seems large, at about 2,850 cubic kilometres, but that is only 6.5 percent of the world total of almost 43,800 cubic kilometres.

There is another factor to consider if one is assessing Canada's water supply, particularly with reference to the United States. The two countries are almost identical in total renewable water supply. However, about 60 percent of Canada's water flows north to arctic or subarctic regions (Environment Canada 2005). That water is largely unavailable for use in the southern part of the country, where most people live, work, and farm. Accordingly, the supply in southern Canada is only about 2.6 percent of the world supply. This is the number that should spring to the minds of Canadians when they contemplate the country's water resources. Notably, the figure is tenfold lower than the frequently used and mythical "one-quarter of the world supply."

This accurate assessment of Canada's available water supply might well influence thoughts about sharing Canadian water with neighbours (Chapter 8, this volume). The total US supply is more than twice the amount available in the populated areas of Canada. Even excluding the Alaskan part of US supply, the 48 contiguous mainland states receive 57 percent of the national supply, or about 3.7 percent of world supply, and, thus, more than southern Canada!

In other words, the United States and Canada have similar amounts of easily accessible fresh water for human uses. This contradicts the public statements often made about Canada's water. In media and policy reports, emphasis is usually placed upon the perceived abundance of Canadian water, and precise figures for the United States are rarely mentioned. It must be admitted that southern Canada's share of 2.6 percent of world water supply is a comfortable amount, particularly when taking into account our relatively small population; our per capita availability is well above the global average. Nonetheless, water availability in both absolute and relative terms, is less than is usually supposed.[2]

Continuing Misconception

The difference between standing volume and water supply is obvious with a moment's thought, so it is rather surprising that, over the decades, inflated estimates of Canadian water supply have continued to be published in magazines and newsletters. Examples of this are:

- "Canada contains as much as 25 per cent of the global supply of fresh water" (*Maclean's* 1985).
- "Canada is blessed with at least one-fifth of the world's supply of fresh water. We're the envy of other countries" (Pollution Probe 1987).
- "one fifth of the world's freshwater supply is located in Canada" (CUPE 1999).
- "with 20 per cent of the world's fresh water, resource-rich Canada ... " (Kirshner 1999).

Even national newspapers are not immune. In editorials and feature articles, Toronto's *Globe and Mail* has reported that:

- "Canada has lots and lots of water" (*Globe and Mail* 1999).

- "Canada is home to roughly 40 per cent of the Earth's store" of fresh water (Mitchell 2000).
- "Canada, blessed with the world's largest freshwater supply ..." (Mitchell 2001).

It seems to be nearly impossible to put an end to this myth, even though the correct technical information has long been available. In the 1970s, for example, Dr. A.T. Prince, director of Inland Waters for the Canadian Department of the Environment, said that "the water supply in Canada is ... about average for the area of the country as compared to other parts of the world" (Bocking 1972). Dr. Frank Quinn of the same department pointed out the difference between water stored in lakes and the actual usable runoff, which he estimated "as just 6 percent of the world's runoff" (ibid.). That agrees closely with the most recent estimate given above. The Canada Water Year Book of 1975, based on measurements taken at that time, gave 9 percent as Canada's share of the world's river flow (Environment Canada 1975). A few years later, Foster and Sewell (1981) published an excellent book, the second chapter of which is entitled "The Myth of Superabundance." They gave Environment Canada's 9 percent estimate and followed it with a tabulation of all the regional river flows, along with a comparison showing that the United States had a total river flow that was only slightly lower than Canada's. In 1985, *Maclean's* published a letter that I wrote, pointing out the fallacy of their above-mentioned article. Today, the website of Environment Canada (2005) continues to distinguish very clearly between static volumes of lakes and renewable supply. The website assigns Canada 7 percent of the world's runoff, which is in keeping with the estimate used here.

Although this technical information has been available for decades, we see from the quotations above that the myth of abundance has a life of its own and continues to be repeated from one writer or broadcaster to another.[3] Recently, there has been some indication that the message is finally getting through to the popular press. An article in *Maclean's* (Maich 2005) was quite perceptive and used the correct numbers: "This country boasts more than 20 per cent of the world's fresh water, and the flow of rain, spring water and snowmelt that courses through our waterways represents seven per cent of the planet's renewable water supply." However, even though these are the right numbers, they are framed by the familiar – and misleading – theme of abundance in statements such as, "Canada is a country of unbelievable water wealth" and "Canada, the most water-rich nation on the planet." Hence, the

Maclean's article reaffirmed Canada's myth of water abundance, ignoring Brazil and Russia (who have more water than Canada) and overlooking the fact that the continental United States has a greater proportion of the global water supply than does southern Canada. The *Maclean's* message, in keeping with the myth, was that water could be exported to the United States for financial gain.

Social and Political Implications

Inflated perceptions of Canada's water supply are problematic because many Canadians continue to think that they are in a surplus situation regarding water. This is evident in a public opinion poll published by *Maclean's* (2003), which was conducted at the time a new prime minister was taking office. People were asked how acceptable they considered each of eight options for improving relations with the United States. The option of allowing the export of fresh water was acceptable to 42 percent of respondents. ("Very acceptable" = 11 percent, "somewhat acceptable" = 31 percent, "not too acceptable" = 18 percent, "not at all acceptable" = 38 percent, and "don't know" = 3 percent.) The degree of acceptability for this option ranked between the 61 percent approval for common continental laws for immigration and border crossing, and the 33 percent approval for sending troops to Iraq. The opinions are open to many interpretations, but almost half of the people believed the country had water to spare.

Public perception and media misinformation are bound to influence political decisions, and some government leaders have evoked the myth of superabundance in their statements:

- David Anderson, then minister of the environment: "Although Canada has the world's largest supply of fresh water ..." (Anderson 1999)
- Raymond Chrétien, Canada's ambassador to the United States at the time, made the following statements to the annual meeting of New England governors and eastern Canadian premiers in Rockport, Maine: "Between Canada and the United States, water is bound to emerge in the new millennium as one of the four or five biggest issues we will have to deal with." Chrétien told the governors and premiers that "the demands of U.S. society are bound to increase. We have in Canada 20 per cent of the world reserves of fresh water. Together, our two countries manage 40 per cent of the world's reserves in fresh water. We're bound to have difficulties in the years to come" (Chrétien 1999).

It is not clear what Mr. Chrétien meant by "world reserves." However, any implication by a Canadian government official that such numbers represent a usable supply of water can only make the country more vulnerable to proposals for transfers. Any credence given to such inflated estimates impinges upon all aspects of regulation and negotiation. A more realistic value – 2.6 percent of world supply – casts an entirely different light on thoughts about available flows, sharing among jurisdictions, and diversions.

There is no question that Canadian demands for water will increase with time. If nothing else, a presumed population increase will have that effect. About 30 percent of Canadians depend on groundwater for their household supplies (Rutherford 2004), and this groundwater needs to be recharged from the surface. Northcote and Hartman (2004) point out that an expanding human population results in major increases in logging and other forms of deforestation, which, in turn, reduces or profoundly changes the seasonal flows of rivers, with a concomitant decrease in fish and their habitat. Climate change is predicted to affect the distribution and/or regularity of precipitation, and this would likely increase demand for irrigation. In the face of all these potential needs for water, it is essential that we take a realistic view of Canadian water resources and their future role.

It is distressing to hear incorrect statements from Canadian leaders, especially since government technical experts know the real situation (as noted above). However, there is some hope. Recently, representatives of Ontario and Quebec have demonstrated that they clearly understand the difference between renewable supply and standing water. Their statements about the removal of water from the Great Lakes were made in terms of the time that would be needed for inflows to replenish these lakes – that is, they were made in terms of water *supply*. These statements came during discussions with US states about water diversions (the so-called Great Lakes Annex Agreement; see Chapters 7 and 8, this volume).

Ecological Implications of Diversions

In addition to its sociopolitical influences, the myth of abundance has probably encouraged a cavalier attitude toward the use and manipulation of

water within Canada and reduced the concern for environmental side-effects. There have been small and large diversions of water flow, often for generating power (Chapter 7, this volume; Quinn et al. 2004). Historically, human needs have received most attention, as is documented in much of this book, with ecological consequences being ignored or put aside as a secondary consideration. However, it is imperative that we take ecological effects into account as well as social effects.

It is all too easy to destabilize the balance of natural habitats. Diversion of a river's natural flow always carries some ecological penalty and can create major upsets, both downstream and upstream. Even water that "is just pouring into the sea," as it is sometimes put, is not wasted. It maintains the reduced salinities in estuaries, which are major areas of natural production on coastlines.

The effects of changed and regulated streamflow on species of Pacific salmon were examined for eighty-one case histories by Burt and Mundie (1986). Of the sixty-three histories that provided known outcomes, three-quarters showed decreased populations of salmon or complete disappearance. Most cases of damage (60 percent) were associated with decreases in flow. Other important side effects of flow manipulation were blockage of habitat, sedimentation, fluctuating flows, and change in water temperatures. In the remaining one-quarter of the case histories, there was little effect on salmon populations or an increase in numbers. Most (73 percent) of these "good" outcomes were associated with only slight changes in flows or else increased flows in the system – that is, diversions elsewhere brought more water into the system.

One of the more spectacular diversions in Canada occurred in tributaries of the upper Fraser River in British Columbia. Forty percent of the water from the Nechako River was turned around to flow into a sixteen-kilometre tunnel in order to generate electricity for smelting aluminum. The major changes in flow regime and the associated history of salmon populations have been documented in detail by Hartman (1996) and Day and Quinn (1992).

Even without diversion, a mere change in the regime of seasonal flow can lead to a spectrum of ecological impacts – a spectrum that is outlined by Prowse, Wrona, and Power (2004). A powerful example is the Peace-Athabasca delta in Alberta, the largest boreal delta in the world. It was once a paradise for 400,000 migrating or breeding waterfowl and a treasure house for local trappers and fishermen. When British Columbia constructed the Bennett Dam in 1967, more than 900 kilometres upstream on the Peace River, there were

extreme changes in seasonal patterns of runoff; in particular, there was a big decrease in the normally heavy spring runoff. The result was ecological chaos in the delta, as it dried out due to lack of springtime flooding (Townsend 1975; Prowse and Conly 1996). As the dam filled, 38 percent of the water area in the delta disappeared, and 500 square kilometres of mudflats were exposed (Alberta Environment 1996). In 1971, a weir was built in the delta in an attempt to imitate seasonal flooding, and this showed some signs of success. Unfortunately, the weir washed out in 1973, hasty repairs raised it too high, and flooding continued for the following summer and winter. An attempt to breach the weir the following spring was not successful, and the result was severe flooding. Bison were floating around on ice-pans during spring break-up, and it is thought that about 1,000 of them drowned. Marooned trappers had to be rescued by aircraft. Since then, the weir has gone, the delta continues to be in a drying phase, and parts of it are becoming covered in trees. The cause is thought to be a combination of the changes in flow regime, normal climate oscillations, and global warming, particularly changes in ice cover because of warmer winters. All of these have probably acted on this community, which, like all deltas, is in a dynamic state of natural stress (Timoney 2002). It is not known what the status of the delta would be had a natural flow regime prevailed.

Conclusion

Most Canadians seem to believe that Canada has approximately one-quarter of the world's supply of fresh water. This misconception apparently arises from confusion between standing water, which fills the country's many lakes, and renewable supply, which is represented by each year's rain- and snowfall. It is the amount of that precipitation that governs river flow and groundwater recharge.

In fact, Canada's renewable supply is about 6.5 percent of the world supply. There is a four-way tie among Canada, Indonesia, the United States, and China for the size of water supply, and all of these countries rank far behind Brazil and Russia.

The misconception surrounding water supply has deep implications for government decisions, as a number of political representatives have made statements indicating that they buy into the notion of mythical abundance. A misplaced belief that Canada has an excess of water will likely lead to decisions that will be detrimental to the country throughout future decades.

Although Canada has a relatively large supply of water per capita, it does not necessarily have a large supply per region. Most Canadians live in the south of the country, far from some of the larger sources. Certain regions already have water shortages, and climate change could well exacerbate this situation. As is outlined in Chapter 3, ongoing developments are likely to further constrain the water supply. No decision on water use or diversion should be based on a misapprehension of the national or local supply. In particular, it must be realized that Canada's nearest neighbour, the United States, has a supply of water that equals ours.

The myth of abundance has no doubt also contributed to a thoughtless disregard for the environmental consequences of manipulating rivers. There have been large and small diversions of water, some of them causing major destruction of natural habitat and species. Even dams that merely distort the seasonal pattern of flow have caused problems (e.g., ecological chaos in Alberta's Peace-Athabasca delta).

Thus, there must be a continued campaign to get Canadians to abandon the myth of water abundance and to adopt a realistic view of their water supply. Otherwise, we will make policy decisions on the basis of misinformation, and this cannot help but have serious ecological, economic, and political consequences.

ACKNOWLEDGMENT

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NOTES

1 Values are taken from the data table "Freshwater Resources 2005" (WRI 2005). WRI took most of the data from AQUASTAT, an online database that is maintained and frequently updated by the Food and Agriculture Organization of the UN (FAO 2003). In turn, AQUASTAT shows a collection from diverse national and international yearbooks, surveys, and project documents. Critical evaluation and judgment were needed in the compilation, and WRI cautions that the values are approximate estimates. I asked the water experts of WRI about changes in successive publications, and they replied that adjustments of the database occur all the time with improved gathering of information. Water supplies and water flows are difficult to assess at the best of times, and information from some regions is far from perfect. FAO and WRI experts adopt the most recent sets of data that they consider reliable, on the assumption that information is improving. If the tabulation were to include the quantities of water reserved for upstream and downstream countries, by treaty or other agreement, then the United States would edge slightly ahead of Canada in water supply (WRI 2005). However, the comparison in this chapter deals only with the "within-border" natural supply.

2 Moreover, discussions about water export often overlook how Canada's limited water resources might be used creatively within the country. General A.G.L. McNaughton addressed the topic as long ago as 1965. A wartime leader, he became chairman of the Canadian Section, International Joint Commission on Boundary Waters (as did Adèle Hurley, an author in this volume). On 4 October 1965, McNaughton said to the Montreal Canadian Club: "All of our water can be translated into growth somewhere. Let it take place in Canada" (Anon 1965).

3 The day after the appearance of the *Globe and Mail* item listed above (February 1999), the paper published my letter to the editor, which pointed out the misconception inherent in the myth of abundance. That did not stop the *Globe* from reprinting the myth in feature articles in 2000 and 2001. (It did not publish my letters, which were written in response to those two articles.) If the author of those feature articles had conducted a simple computer search of the *Globe and Mail* archives they would have found my original letter and, consequently, might have presented a realistic portrayal of water supply.

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