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FRESHWATER MANAGEMENT IN CANADA: III. ISSUES AND CHALLENGES

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INTRODUCTION

Global water use, in terms of withdrawals, has increased six-fold in the past 100 years and has almost tripled since 1950. Total withdrawals stood at an estimated 3,800 km^3 per year by 1995.(1) The increase cannot be attributed to population growth alone, because the world's population has only tripled during the same 100-year period. Overuse and poor water management are key contributors to the escalating demand.

Increased global water consumption and inadequate water management are creating many problems, including: lack of access to drinking water in certain countries; polluted and unsafe water; chronic undernourishment of the population in many countries due to a lack of water for agriculture; and destruction of natural habitat as the result of hydroelectric projects. Water planners have responded to increasing demands by introducing new projects, including dams and diversions, and by tapping aquifer water. These options are either running dry or carry economic, political and ecological price tags that make them less attractive. If needs are to be met, a new approach to water management must be developed. Three courses of action are urgently required: 1) considering water as a resource and ensuring that consumers pay the real cost of treating and providing it; 2) developing water conservation programs that help meet increasing water needs without drawing further on natural water sources; and 3) addressing the complex interactions between land, vegetation and water, including the effects of human activities that decrease the sustainability of water supplies.

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(1) William J. Cosgrove and Frank R. Rijsberman, *World Water Vision – Making Water Everybody's Business*, World Water Council, 2000, http://www.worldwatercouncil.org/Vision/cce1f838f03d073dc125688c0063870f.htm.

Canada has more renewable freshwater than most other countries. This abundance is, however, somewhat of an illusion. Sixty percent of Canada's freshwater flows north toward the Arctic, while 90% of our population lives less then 300 kilometres from the American border. Canada must adopt effective management strategies to protect this resource.

This third paper in a series on the management of freshwater in Canada(2) examines current issues and challenges pertaining to water. For Canadians, the most prominent water issues in the coming century will be:

- drinking water quality;
- water pollution;
- water use and conservation;
- bulk water exports;
- renewal of infrastructure; and
- privatization of water.

Most challenges in managing water are related to one or more of the following three areas:

- protecting public health;
- protecting watersheds and ecosystems; and
- ensuring a sustainable water supply for the future, and providing adequate infrastructure for the treatment and delivery of water.

PROTECTION OF PUBLIC HEALTH

The World Health Organization(3) estimates that over 2 million people, mostly children, die annually from diarrheal diseases spread by contaminated drinking water. By

(2) The two previous papers are *Freshwater Management in Canada: I. Jurisdiction*, PRB 04-48E, and *Freshwater Management in Canada: II. Resources, Use and Treatment*, PRB 04-47E, both by François Côté, Parliamentary Information and Research Service, Library of Parliament, Ottawa, 2004.

(3) World Health Organization, *The Right to Water*, Geneva, 2003, http://www.who.int/water_sanitation_health/rightowater/en/.

comparison, Canadians are remarkably safe. However, the tragic events of Walkerton,[4] Ontario, in 2000 and North Battleford, Saskatchewan, in 2001 had long-term impacts both locally[5] and on Canadian society in general, and are reminders of our vulnerability. Canadians have taken safe water for granted.

Major public health threats include waterborne pathogens, arsenic, and disinfection by-products. Of these, the emergence and spread of waterborne pathogens in recent years has received most public attention. This is likely to be a growing problem in Canada and around the world, as increasing human population densities and rapidly expanding and increasingly intensive livestock production cause significant animal and human waste management challenges. In addition, the threats of disease outbreaks are accompanied by growing concerns about pathogens as causative factors in chronic diseases such as ulcers, cancer and heart disease, where infectious agents were not previously suspected of being involved.

A. Waterborne Pathogens

Waterborne pathogens can generate problems for drinking water supplies, recreational waters, and source waters for agriculture and aquaculture. Sources of pathogens include municipal wastewater effluents, urban runoff, agricultural wastes and wildlife. Waterborne disease outbreaks in Canada have been monitored by Health Canada since 1974. From 1974 to 1996, there were over 200 outbreaks of infectious diseases in Canada associated with drinking water.[6]

The main threats in drinking water come from bacteria, protozoa, and viruses. Bacteria (primarily *Salmonella*, *Shigella* and *Campylobacter*) were responsible for 78 drinking-water-related infectious disease outbreaks in Canada between 1974 and 1996.[7] Other species such as *Escherichia coli* can also cause outbreaks. The Walkerton outbreak was found to have

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(4) Ontario Ministry of the Attorney General, *Walkerton Commission of Inquiry Reports*, Toronto, 2002, accessed 20 August 2004, http://www.attorneygeneral.jus.gov.on.ca/english/about/pubs/walkerton/.

(5) Martin Mittelstaedt, "Walkerton ordeal continues for many," *The Globe and Mail* [Toronto], 2 July 2004, http://www.globeandmail.com/servlet/ArticleNews/TPStory/LAC/20040702/HWALKERTON02/TPEnvironment/.

(6) Environment Canada, *Threats to Sources of Drinking Water and Aquatic Ecosystem Health in Canada*, NWRI Scientific Assessment Reports Series No. 1, National Water Research Institute, Burlington, Ontario, 2001, http://www.nwri.ca/threats/threats-eprint.pdf, p. 1.

(7) *Ibid.*

been caused by a particularly harmful strain of this species (strain O157:H7) causing bloody colitis, and potentially kidney failure. *E. coli* belongs to a larger group of common bacteria called faecal coliforms, which originate in the digestive tracts of animals. Ruminant mammals are a natural reservoir for *E. coli* O157:H7. The disease that it causes is primarily a foodborne illness and is a notifiable disease under Canadian law.(8) The infection is usually acquired by eating undercooked, contaminated ground beef. Person-to-person contact in families and in child care centres is an important route of transmission. However, infection can also occur after drinking raw milk, and after swimming in, or drinking, sewage-contaminated water.

Protozoa(9) were responsible for 59 outbreaks of waterborne diseases in Canada between 1974 and 1996. Outbreaks caused by protozoa have tripled since 1990. Most of these outbreaks were caused by *Giardia*, but in 1993 the first reported outbreak caused by *Cryptosporidium* occurred in Canada. Since then, outbreaks of giardiasis and cryptosporidiosis have occurred in all regions of the country. Maybe the best-known outbreak of cryptosporidiosis occurred in North Battleford, Saskatchewan, in 2001.(10) Waterborne *Cryptosporidium* also killed 54 people (mostly HIV-positive and immunodeficient individuals) and made 400,000 sick in Milwaukee in 1993. In 1995, the first outbreak of toxoplasmosis (*Toxoplasma gondii*) linked to a municipal drinking water supply occurred in British Columbia.

Enteric viruses, primarily Norwalk and Hepatitis A, have been identified as the cause of 23 outbreaks. One of those was an outbreak of Hepatitis A on the Île d'Orléans near Quebec City in 1995. The large number of disease outbreaks (43 between 1974 and 1996) caused by unknown agents is also of interest. It is probable that many of these were caused by enteric waterborne viruses.(11)

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(8) Health Canada, *National Notifiable Diseases for 2000*, Ottawa, 2003, http://dsol-smed.hc-sc.gc.ca/dsol-smed/ndis/list_e.html.

(9) A large group of small, usually single-celled microorganisms that are larger and more complex than bacteria. Protozoa include amoebas, and are capable of causing disease.

(10) Justice Robert D. Laing, *Report of the Commission of Inquiry in the matters relating to the safety of the public drinking water in the City of North Battleford, Saskatchewan*, 2002, http://www.northbattlefordwaterinquiry.ca/final/toc.asp.

(11) Environment Canada (2001).

Sustained efforts are being made to understand threats and develop effective means to protect public health by preventing waterborne disease transmission. It is generally accepted that a preventive approach to pathogen pollution is required, in the form of a source water protection program for all major freshwater bodies. In addition, action is being taken to monitor drinking water quality more closely and to improve detection protocols for waterborne pathogens.

One important preventive measure to protect against waterborne disease is the use, by public health authorities, of advisories warning Canadians to boil their water. This can be viewed as a measure of last resort; the number of such advisories may be considered as an indicator of the failure of other preventive measures. The issuance of boil advisories is triggered by conditions such as: deterioration in source water quality; equipment malfunction during treatment and distribution; and other situations where drinking water is or may be responsible for an outbreak of illness.(12) In 1998, there were 3,100 boil water advisory days in municipalities across Canada, compared to 2,492 in 1993 – an increase of 24%. In 1999, 65 First Nations and Inuit communities were under a boil water advisory. Over one-quarter of these communities were under an advisory from six months to a year.(13)

B. Arsenic

Arsenic has long been recognized as a poison, and public concerns about low levels of arsenic found in some municipal water supplies and in some private wells are therefore understandable. Chronic poisoning by arsenic can result in skin problems, damage to the peripheral nervous system, alteration of blood cell functions, and degeneration of the liver and kidneys.

Arsenic is a natural substance widely found in the earth's crust; it may enter lakes, rivers or underground water naturally, when mineral deposits or rocks containing arsenic dissolve. Arsenic may also get into water through the discharge of industrial wastes and by the deposition of arsenic particles in dust or dissolved in rain or snow. Levels of arsenic in Canadian

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(12) Health Canada, *Water Talk: Boil Water Advisories and Boil Water Orders*, 2004, http://www.hc-sc.gc.ca/hecs-sesc/water/factsheets/boil_water.htm.

(13) Statistics Canada, Environment Accounts and Statistics Division, "Fresh water resources in Canada," Featured article, in *Human Activity and the Environment: Annual Statistics 2003*, Cat. No. 16-201-XPE, Ottawa, 2003, p. 22.

drinking water are generally less than 0.005 milligrams per litre (parts per million), although concentrations may be higher in some areas.(14) Elevated levels of arsenic in groundwater near Cold Lake, Alberta, in some southern Saskatchewan rural municipalities, and at Waverley, Nova Scotia, have all been related to natural sources of arsenic in bedrock and in surficial sediments, and secondary redistribution in both ground and surface waters.(15) Health Canada has set a guideline for arsenic levels in drinking water at a maximum of 0.025 milligrams per litre. A water supply found to have an arsenic level above this Canadian Drinking Water Quality Guideline should not be used for drinking or for food preparation. Health Canada considers this guideline to be "an interim measure until an appropriate treatment technology is developed to further reduce arsenic levels in drinking water."(16) There already exists however, water treatment technology capable of reducing arsenic to levels well below this guideline.(17) It is not known whether any municipal drinking water treatment facility in Canada is taking advantage of this technology.

C. Chemical Contamination by Disinfection By-products

While waterborne disease remains an important water quality concern, some of the public attention has shifted to the chronic health effects related to chemical contamination of drinking water. For example, trace amounts of certain synthetic organic substances in drinking water are suspected of causing cancer in humans. One area of particular concern is the effects of long-term exposure to chlorine and fluoride. When chlorine reacts with organic matter present in untreated water, such as leaves and faecal matter, a variety of by-products are formed. Among these are trihalomethanes (THMs), which have been linked to certain kinds of cancer, principally of the colon and bladder. Studies have indicated that very large doses of these chemicals can produce an increased cancer rate in animals. There is some evidence that people are

(14) Health Canada, *Arsenic in Drinking Water*, 2003, http://www.hc-sc.gc.ca/english/iyh/environment/arsenic.html.

(15) Environment Canada (2001).

(16) Health Canada, *Arsenic in Drinking Water* (2003). Furthermore, the U.S. Environmental Protection Agency (EPA) and the World Health Organization have established a Maximum Contaminant Level (MCL) of 10 parts per billion (0.01 milligrams per litre) of arsenic in drinking water. The EPA MCL takes effect in January 2006.

(17) ADI International, *Arsenic Removal*, accessed 4 October 2004, http://www.adi.ca/Water/arsenicRemoval.html.

experiencing an increased rate of certain cancers associated with chlorinated drinking water. For this reason, THM levels have been monitored in the drinking water supply since the 1980s. Health Canada has established an interim guideline for total THMs of 0.1 milligrams per litre (100 ppb).(18) The guidelines for THMs and other chlorination by-products are currently under review by a task group whose work is coordinated by Health Canada. THM formation can be reduced by filtering out as much organic material as possible before the chlorination process.

D. Drinking Water Quality

In 2001, the Sierra Legal Defence Fund (SLDF) published a report entitled *Waterproof: Canada's Drinking Water Report Card*.(19) The SLDF found that most Canadian provinces and territories had inadequate laws to ensure the safety of drinking water. The report graded provinces and territories on how they addressed the most critical factors affecting drinking water: watershed and well field protection; the stringency of water testing practices; water treatment (e.g., filtering and disinfection methods); operator training and certification standards of personnel; and reporting requirements for utility operators and consumers.

The report noted significant variations in how different provinces and territories handled the important task of ensuring that public water supplies were safe for human consumption. In fact, SLDF described the situation as a patchwork approach that could potentially create serious public health risks. Other developed countries, such as the United States, have established enforceable guidelines with which states and districts must comply in order to receive federal funding. In Canada, the *Guidelines for Canadian Drinking Water Quality* are not binding, even though they set fairly stringent limits on a number of potentially harmful microbiological, chemical and radiological contaminants that may be found in community drinking water supplies. The SLDF *Waterproof* report concluded that Alberta, Nova Scotia and Quebec were alone among Canadian provinces and territories in nearly or completely

(18) Federal-Provincial-Territorial Committee on Drinking Water of the Federal-Provincial-Territorial Committee on Environmental and Occupational Health, *Summary of Guidelines for Canadian Drinking Water Quality*, April 2003, http://www.hc-sc.gc.ca/hecs-sesc/water/publications/drinking_water_quality_guidelines/toc.htm.

(19) Randy Christensen and Ben Parfitt, *Waterproof: Canada's Drinking Water Report Card*, Sierra Legal Defence Fund, January 2001, http://www.sierralegal.org/reports/waterproof.pdf.

adopting the *Guidelines for Canadian Drinking Water Quality* as the standard by which their drinking water is assessed.

According to the Commissioner of the Environment and Sustainable Development, the quality of Canada's drinking water is generally good.(20) Nevertheless, following the events in Walkerton and North Battleford, the confidence of the Canadian public has been shaken. A survey undertaken in May 2001 found that 46% of Canadians had serious doubts about the safety of tap water. They wanted, among other things:

- more government transparency;
- development and implementation of quality standards for water at source;
- better management of watersheds; and
- more attention given to the poor condition of drinking water distribution networks, often the cause of contamination problems.

The report by Mr. Justice O'Connor(21) on the contamination of drinking water in Walkerton contained 93 recommendations aimed at ensuring the quality of drinking water is improved. The recommendations concerned, among other things:

- protection of water at source;
- water quality standards and management;
- water treatment;
- water distribution;
- surveillance and control of treatment and distribution;
- operator training;
- testing laboratories; and
- the role of municipalities and the provincial government.

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(20) Commissioner of the Environment and Sustainable Development, *2001 Report*, Chapter 1, Section 3, "Water," http://www.oag-bvg.gc.ca/domino/reports.nsf/html/c101sec3e.html.

(21) Ontario Ministry of the Attorney General, Walkerton Commission of Inquiry Reports, 2002, http://www.attorneygeneral.jus.gov.on.ca/english/about/pubs/walkerton/.

E. The Multi-barrier Approach

The O'Connor report also considered the benefits of a multi-barrier approach,[22] an integrated system of procedures, processes and instruments that collectively prevent or reduce contamination of drinking water from the source to the tap, thus reducing risks to public health. This approach has been supported by Canadian jurisdictions responsible for safe drinking water, by the Canadian Council of Ministers of the Environment, and by the Federal-Provincial-Territorial Committee on Drinking Water.[23]

The multi-barrier approach focuses on three elements:

- source water protection;
- drinking water treatment; and
- drinking water distribution systems.

The second and the third elements include the development of criteria for design, construction and operation of treatment and distribution systems that are designed to optimize all aspects of these processes and maintain the quality of the water throughout the distribution system.[24]

The first element of the multi-barrier approach, source water protection, is often viewed as the most important step in providing safe drinking water. Sources need to be protected from contamination by industrial pollution, farming, ranching, logging, mining, sewage disposal, waste disposal and urban sprawl. Such contamination can occur either in groundwater, the source of drinking water for 30% of the Canadian population, or in surface waters.[25] Drinking water must be safeguarded by protecting the watersheds supplying this water.

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(22) Federal-Provincial-Territorial Committee on Drinking Water of the Federal-Provincial-Territorial Committee on Environmental and Occupational Health, and the Water Quality Task Group of the Canadian Council of Ministers of the Environment, *From Source to Tap: The multi-barrier approach to safe drinking water*, 2002, http://www.hc-sc.gc.ca/hecs-sesc/water/publications/source_to_tap/source_to_tap-toc.htm.

(23) Canadian Council of Ministers of the Environment, *Multi-barrier approach*, Ottawa, 2002, http://www.ccme.ca/sourcetotap/mba.html.

(24) Steve Clarkson, "Water Quality in Canada: An Update," in Simon Fraser University, *Water and the future of life on earth*, Workshop Proceedings, 22-23 May 2002, Chapter 3, http://www.sfu.ca/cstudies/science/water/pdf/Water-Ch03.pdf.

(25) David Boyd, *Unnatural Law: Rethinking Canadian Environment Law and Policy*, UBC Press, Vancouver, 2003, p. 18; and Statistics Canada (2003), p. 25.

PROTECTION OF WATERSHEDS AND ECOSYSTEMS

A. Watershed-based Management

"Don't spit in the well – you may need to drink from it!" says a Russian proverb. Water resource managers must balance the various demands for water use. The use and degradation of water quality in one sector has serious implications for other uses of the resource, resulting in a variety of economic and social conflicts and costs. New approaches to the management of water resources are increasingly watershed-based.

Watershed-based planning takes the natural boundaries of surface and groundwater into consideration. The watershed represents the most logical physical entity for the efficient management of water. However, management based on watersheds often challenges the political structure of our society, with its government-imposed boundaries. Such approaches also require a sustained and open dialogue and collaboration among all resource users. Watershed management focuses on methods to integrate land use with water quantity, water quality, demand, supply and balance for both human and ecosystem use.

Because different stakeholders often have competing interests, there could be as many management plans to negotiate as there are watersheds. This could result in a very large number of plans. There are 23 major river basins in Canada, 8 of which share boundary waters with the United States. Three-quarters of the 23 basins straddle the boundaries of provinces or territories.(26) The province of Quebec, for example, includes an estimated 430 major watersheds, 100 of which drain an area larger than 4,000 km^2. The province has targeted 33 river basins for watershed-based integrated management as defined in its Québec Water Policy.(27) In Ontario, there are a total of 144 tertiary watersheds within 28 secondary watersheds. The three primary watersheds are the Great Lakes-St. Lawrence River, the Hudson Bay Lowlands, and the Nelson River. The Ontario Ministry of the Environment is currently

(26) The smallest river basin is the Okanagan-Similkameen; the largest, the Arctic Coasts and Island, followed by the lower Mackenzie. These rivers drain to one of four water bodies: the Pacific, the Arctic, and the Atlantic oceans and Hudson Bay. In addition, a small area in the southern Prairies drains into the Gulf of Mexico. Streamflow ranges from about 900 m^3 per second for the Rupert River in northern Quebec, to about 9,000 m^3 per second for the Mackenzie River. Each of these drainage areas has its own physical characteristics.

(27) Environnement Québec, *Integrated water management at the watershed level*, Web site, http://www.menv.gouv.qc.ca/eau/bassinversant/index_en.htm.

working with Conservation Ontario to organize watersheds into regions, for the purposes of developing source water protection plans across Ontario's 36 conservation authorities (31 of which cover southern Ontario).(28)

B. Bulk Water Exports

Ecosystems are threatened by such things as water exports, diversions,(29) dams, and reservoirs. Larger-scale phenomena such as climate change also play a significant role in the health of ecosystems.

In recent years, there have been a number of proposals to export large quantities of water from Canada by tanker, pipeline or other means. Such potential bulk removal projects, which presuppose a permanent loss of water, are cause for concern. Because they are considered a non-sustainable use of the resource, the government would like to ban them in the case of major watersheds. Small-scale removals, such as those involved in the production of bottled water, are not included in the definition of bulk removal. The total volume of bottled water exported from Canada in 1998 was approximately 274 million litres, a volume much lower than that of a single, mid-sized ocean tanker carrying water in bulk.

In February 1999, the federal government announced a strategy aimed at banning large-scale removal of water, including water intended for export.(30) The related *Accord for the Prohibition of Bulk Water Removal from Drainage Basins*,(31) a voluntary agreement, was signed by some provinces but not all. At this time, however, all provinces have in place, or are developing, legislation, regulations or policies prohibiting the bulk removal of water.

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(28) Ontario Ministry of the Environment, *White Paper on Watershed-based Source Water Protection Planning*, Toronto, 2004, http://www.ene.gov.on.ca/programs/3585e01.htm.

(29) In Canada, there are 54 interbasin water diversions, diverting an average annual flow of 4,450 m^3 per second, mostly for hydroelectric production purposes. This rate is larger than the mean annual streamflow of the Fraser River in British Columbia.

(30) Environment Canada, *Freshwater website*, "Background information on bulk water removal and water export," Ottawa, accessed 24 August 2004, http://www.ec.gc.ca/water/en/manage/removal/e_backgr.htm. See also David Johansen, *Bulk Water Removals and the NAFTA*, TIPS-20E, Parliamentary Information and Research Service, Library of Parliament, Ottawa, 2003, http://lpintrabp.parl.gc.ca/apps/tips/tips-cont-e.asp?Heading=15&TIP=46.

(31) Canadian Council of Ministers of the Environment, *Accord for the Prohibition of Bulk Water Removal from Drainage Basins*, November 1999, http://www.scics.gc.ca/pdf/accord.pdf.

In 2000, the International Joint Commission (IJC), which administers the boundary waters between Canada and the United States, concluded that the Great Lakes should not offer a vast reservoir for an increasingly thirsty world, and recommended the protection of the integrity of the Great Lakes basin ecosystem. According to the IJC, removals of water from the Great Lakes and St. Lawrence River basin would reduce the resilience of the system and its capacity to cope with unpredictable stresses, such as climate change. While recognizing the efforts made in the past few years, the IJC reiterated the conclusions and recommendations of its 2000 report in a review released in August 2004.(32)

In July 2004, Ontario, Quebec and eight U.S. states agreed on a proposal to protect and improve the Great Lakes water system.(33) The Great Lakes Annex 2001 Implementing Agreements is a two-part arrangement between the Council of Great Lakes Governors and the governments of Ontario and Quebec. Both parts still need final approval. The first part, the Great Lakes Basin Sustainable Water Resources Agreement, is a non-binding arrangement among the states and provinces on water management. The second part, the Great Lakes Basin Water Resources Compact, is binding on the eight Great Lakes governors and would give them the power to decide on diversions of water from the lakes. Enabling legislation by the U.S. Congress would give this compact the force of law. The two Canadian provinces were not involved in that part of the agreement. While the agreements should prevent the export of water from the Great Lakes, some experts estimate that they constitute more of a risk than a protection for the ecosystem.(34) In January 2005, the Government of Canada responded to the proposed Great Lakes Annex 2001 Implementing Agreements and made a submission to the Council of Great Lakes Governors, encouraging the Great Lakes states to provide the same level

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(32) International Joint Commission, *Protection of the Waters of the Great Lakes – Review of the Recommendations in the February 2000 Report*, Ottawa, 31 August 2004, http://www.ijc.org/php/publications/pdf/ID1560.pdf.

(33) Council of Great Lakes Governors, *Great Lakes Basin Sustainable Water Resources Agreement, 2004*, http://www.cglg.org/projects/water/Annex2001Implementing.asp; and Environnement Québec, *Public Consultation: Great Lakes Basin Sustainable Water Resources Agreement, 2004*, http://www.menv.gouv.qc.ca/eau/grandslacs-en/.

(34) Louis-Gilles Francoeur, "Un projet visant à protéger les Grands Lacs inquiète des experts," *Le Devoir* [Montréal], 9 September 2004. See also Ralph Pentland and James Olson, *One Issue, Two Voices: Decision Time: Water Diversion Policy in the Great Lakes Basin*, The Canada Institute, Woodrow Wilson International Center for Scholars, Washington, September 2004.

of protection for water in the Great Lakes-St. Lawrence basin as that already provided by Canada, Ontario and Quebec.(35)

FUTURE WATER SUPPLY AND INFRASTRUCTURE

A. Cost of Infrastructure Renewal

Most Canadians obtain their drinking water from municipal water treatment plants,(36) of which there are approximately 4,000 in Canada. The majority of these facilities are owned and operated by municipal governments. All agricultural and industrial activities, including power generation, also rely on water being delivered and on used water being treated.(37) These processes require an expensive network of pipes, pumping stations, drinking water production plants and wastewater treatment. Collectively, this investment is called "water infrastructure."

The costs of the infrastructure that provides homes, farms and industry with water and sewer services are straining the available municipal financial resources. Many existing treatment facilities are becoming increasingly inadequate: water mains, sewers and treatment plants are aging and gradually deteriorating. Some systems in older cities are over 100 years old. In many communities, this infrastructure is coming to the end of its useful life, leading to an "infrastructure deficit" estimated at between $41 and $90 billion.(38)

In the Speech from the Throne of February 2004, the federal government made a commitment to help Canadian municipalities by providing $7 billion in new funding over 10 years.(39) The money would come from relief from a portion of the GST. This is, however, clearly not enough, and new avenues have to be considered. One possibility is to share the gas

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(35) Government of Canada, News Release, "Federal Government Promotes Strong Protection for Water in the Great Lakes/St. Lawrence Basin," Ottawa, 11 January 2005, http://www.ec.gc.ca/press/2005/050111_n_e.htm.

(36) Statistics Canada (2003), p. 23. A large portion of the population, however, relies on private wells, and a small group relies on alternative water systems. See also http://www.cwwa.ca/legislation/faqs/private.htm.

(37) These activities rely either on municipal systems or their own infrastructure to provide these services.

(38) National Round Table on the Environment and the Economy, *State of the Debate on the Environment and the Economy: Water and Wastewater Services in Canada*, Ottawa, 1996, p. 10, http://www.nrtee-trnee.ca/Publications/PDF/SOD_Water_E.pdf.

(39) Canada, *Speech from the Throne*, 37th Parliament, 3rd Session, 2 February 2004.

tax revenues with municipalities. Another is to modify the way municipalities generate their revenues. In this context and given the challenges ahead, it is significant that as of July 2004 the federal cabinet includes a portfolio for "Infrastructure and Communities."

B. Privatization of Water

"All water flows into the ocean or into the purse of the rich," states a Danish proverb. Large-scale investment in water-related infrastructure will require new and innovative technologies and methods of management. There appears to be a significant market for new technologies, not only in Canada but also for export, where Canadian expertise is already well known. There has been in recent years an increasing number of "Public-Private Partnerships" (PPP) that pair cities and private enterprises for projects involving water management. The city of Moncton is an example: under a 20-year licensing arrangement, a private firm designed, built, financed and now operates a treatment facility serving 100,000 people.(40) Moncton could neither afford to finance the investment out of its municipal resources, nor obtain funding from higher levels of government for a needed water filtration plant, so the city held a competitive bidding process.

Although the advantages for the municipalities are often obvious, PPP and the related issue of water privatization are contentious.(41) The debate is polarized between the views of water either as a commodity or, alternatively, as a public common good. One view promotes full-cost pricing of water, access based on need, and market control of supply management. The other view holds that water should be essentially free, access to it should be a human right, and its management should be controlled by the community.(42)

Other factors also influence the debate. Some stakeholders argue that governments have not been effective in their management of water supplies. Moreover, insufficient funding for renewal and maintenance of the capacity to supply potable water has

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(40) City of Moncton, *Greater Moncton Water Treatment Facility Fact Sheet*, Moncton, accessed 24 August 2004, http://www.moncton.org/search/english/CITYHALL/water/watertreatment.htm.

(41) Peter Cook, Maude Barlow and Sara Ehrhardt, "A debate on water privatization," *Grist Magazine*, July 2004, http://www.gristmagazine.com/soapbox/cook070904.asp.

(42) Karen Bakker, "Water management issues from commons to commodity? Privatizing and commercializing water supply," in Simon Fraser University, *Water and the future of life on earth*, Workshop Proceedings, 22-23 May 2002, Chapter 12, http://www.sfu.ca/cstudies/science/water/pdf/Water-Ch12.pdf.

created a vacuum for private corporations to fill as builders, owners and operators of municipal supply systems. Municipalities enter into agreements with the private sector for the renewal of their water supply infrastructure for four main reasons: to obtain much-needed investment that is unavailable from the public sector because of competing demands for limited public funds; to offload financial risks to the private sector; to increase capital efficiency; and to reduce regulatory conflicts.(43)

Privatization is not common in Canada. Cities such as Vancouver, Kamloops, Winnipeg and Halifax have either cancelled or decided against plans for private firms to design, build, and operate water supply and treatment infrastructure. In Ontario, however, Hamilton privatized its water utility in 1995, Haldimand-Norfolk in 1998, Goderich in 2000, and London in 2001. Privatization is almost commonplace south of the border.(44) According to the Environmental Protection Agency, about half the drinking water utilities in the United States are privately owned, serving about 16% of the population.(45) Elsewhere, England has completely privatized its water and sewage systems since 1989, and private water firms serve almost 80% of the French and 50% of the Spanish populations. Nevertheless, here in Canada as well as worldwide, many still question the ability of corporations to address citizens' concerns regarding access, affordability and accountability of water systems in their communities.

C. The Cost of Clean Water

Water is free; the cost of water is incurred in its treatment, pumping, delivery and pressure, and in treatment of waste. Municipal water rates in Canada are among the lowest in the world. In 1999, Canadians paid on average for water services (public water supply and sewerage treatment) US$0.77 per cubic metre (or about 8 one-hundredths of a cent per litre), while the

(43) Elizabeth Brubaker (Executive Director, Environment Probe), *Public Goals, Private Means: Why the Private Sector is Uniquely Capable of Providing Water and Wastewater Services to Ontario's Municipalities*, Presented to the "Public Goals, Private Means" Research Colloquium, Faculty of Law, University of Toronto, 3 October 2003, http://www.environmentprobe.org/enviroprobe/index.cfm?DSP=content&ContentID=8735.

(44) *Ibid.*

(45) Cook, Barlow and Ehrhardt (2004).

average for 25 OECD countries was US$1.84.[46] In Canada, the price of water varies greatly from province to province and even within provinces. Water rate schedules[47] across the country are extremely diverse, each municipality having its own unique set of rates. In the 470 municipalities included in a 1987 Environment Canada study,[48] over 1,100 individual rate schedules were found.

Two basic pricing systems are employed: flat-rate and volume-rate.[49] Under the flat-rate pricing structure, fixed payments are imposed in particular payment periods, and users obtain unlimited access to water servicing upon payment. Occasionally, municipalities use indirect forms of the flat-rate system, such as additions to property taxes or special assessments. For volume-based rates, water meters determine the amount of water used and water services are priced accordingly. There are several ways in which volume-based rates can be applied: constant unit rate, declining block rate and increasing block rate.

About 55% of Canadians served by municipal water pay in ways that do not promote conservation. A 2001 study of rate structures by Environment Canada showed that in 1999,[50] 43% of the population was under a *flat rate* structure. Another 12% was under a *declining block rate* structure; i.e., the more you use, the less you pay per unit. Only about 45% of the population served was found to be under a rate structure that provided a definite incentive to conserve water: 36% were under a *constant unit rate* structure; and 9% were under an *increasing block rate* structure.

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(46) Data from other countries: United States (US$1.40), Australia (US$1.49), Germany (US$3.47) and Norway (US$5.10). OECD, *Social Issues in the Provision and Pricing of Water Services*, Paris, 2002, p. 75; and David Burke, Luis Leigh and Valerie Sexton, *Municipal Water Pricing, 1991-1999*, Environment Canada, 2001, http://www.ec.gc.ca/water/en/info/pubs/sss/Pricing91-99.pdf. Earlier data from a 1998 survey of OECD countries (*OECD Environmental Data Compendium 2002*, http://www.oecd.org/document/21/0,2340,en_2825_495628_2516565_1_1_1_1,00.html) and Environment Canada indicated that Canadians paid an average price of US$0.31 per cubic metre, while Germans paid the most (US$2.16).

(47) Water rate schedules cover water use as well as sewer charges.

(48) D. M. Tate, *Municipal Water Rates in Canada, 1986 – Current Practices and Prices*, Social Science Series No. 21, Water Planning and Management Branch, Inland Waters Directorate, Environment Canada, Ottawa, 1989, p. v.

(49) Susan McFarlane and Erik Nilsen, *On Tap: Urban Water Issues in Canada*, Canada West Foundation, Calgary, 2003, http://www.gordonfn.org/resfiles/CWFwaterreport.pdf.

(50) Environment Canada, *Freshwater Website*, "Water Efficiency/Conservation: Rates, pricing and public education," 2002, http://www.ec.gc.ca/water/en/manage/effic/e_rates.htm.

Table 1

Types of Rate Structures

Type	Description	% of Population
Flat rates	Customer pays a fixed rate per time period for unlimited access to public water supply.	43%
Volume-based rates		
Declining block rates	Water use is divided into two or more volume ranges or blocks. The rates decline progressively as water use increases.	12%
Constant unit rates	Charges per unit of water use (e.g., cubic metre) are constant through the range of usage.	36%
Increasing block rates	Similar to decreasing block rates except that rates rise progressively as water use increases.	9%

Many experts argue that Canada's water resources are being unnecessarily depleted as a result of the existing pricing structure. The combination of low prices and the widely used flat-rate pricing structure encourages high demand, which in turn creates pressure on the infrastructure. It also discourages increased water-use efficiency and the adoption of conservation approaches and technologies.(51)

There is evidence to suggest that pricing can be used as an effective instrument to manage water demand. Many users, however, are not charged the full cost of water. Progressive volume-based rates, which encourage the conservation of the resource, make use of water meters. Water metering has been shown in recent years to be a powerful tool to promote water-use efficiency. Statistical analysis of the proportion of Canada's population under water metering regimes and the per capita water use for each province and territory indicates that metering results in a 50% reduction in water usage.(52)

(51) Brenda Lucas, *Controlling Our Thirst: Managing Water Demands and Allocations in Canada*, The Walter and Duncan Gordon Foundation, Toronto, June 2004, http://www.gordonfn.ca/resfiles/Controlling_Our_Thirst.doc; and Oliver M. Brandes and Keith Ferguson, *The Future in Every Drop: The benefits, barriers and practice of urban water demand management in Canada*, The POLIS Project on Ecological Governance, University of Victoria, Victoria, 2004, http://www.waterdsm.org/PDF/Drop.pdf.

(52) Statistics Canada (2003); and Ian Campbell, "Toward Integrated Freshwater Policies for Canada's Future," Policy Research Initiative, *Horizons*, Vol. 6, No. 4, March 2004, http://policyresearch.gc.ca/page.asp?pagenm=v6n4_art_02.

In 1994, the Canadian Council of Ministers of the Environment approved a plan to encourage water-use efficiency in municipalities. The plan promoted the introduction of mandatory water metering on all new construction, and a move towards universal metering. Since the plan's introduction, every province and territory in the country has increased the number of its residents connected to water meters. However, still only 57% of Canadian households are metered, while in most OECD countries all households are. In cities such as Vancouver and Montréal, the proportion of metered households is less than 1%.(53)

D. Climate Change and Conflicts Between Water Users

Efforts at improved water-use efficiency should not be limited to municipal use, which accounts for roughly one-tenth of Canadian water withdrawals. Significant conservation efforts are needed in the agricultural, power generation, and industrial sectors. It is noteworthy that irrigation for agricultural production is most intense in regions that are most stressed in terms of available renewable water. The potential for conflict between water users such as expanding cities and agriculture or oil and gas production is greater in those regions. According to most prediction models, this situation will be likely exacerbated by climate change.

The major river basins irrigating the Prairies (North and South Saskatchewan, Nelson, Churchill, and Assiniboine) have their sources in the Rocky Mountains, fed by snow melt and glaciers. Glaciers store in excess of 75% of the world's freshwater, and Canada's terrestrial glaciers contain a volume of water 1.5 times greater (35,000 km^3) than that of the Great Lakes. Glaciers contribute significantly to the supply of freshwater for human consumption in British Columbia and the Prairies. For example, Rocky Mountain glaciers supply up to 10% of the base flow used for irrigation in Western Canada. Glacial stream flow, which peaks in the hot summer months, provides moisture during the driest times of the year. This phenomenon is central to the ecological and economic functioning of the Prairies.

It seems widely accepted that, as a result of global climate change, glaciers are receding worldwide. The consequences in Canada could be dramatic. For example, due in part to glacier retreat in the Rockies, the water supply for Calgary, one of Canada's fastest-growing cities, is shrinking rapidly, to the point where it will soon not meet the demand.

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(53) Boyd (2003), p. 48.

ACCESS TO WATER: A HUMAN RIGHT?

Approximately 1.1 billion people worldwide lack access to clean and safe water sources, and 2.4 billion people lack access to any type of improved sanitation. Some 1.7 million deaths a year worldwide are attributable to unsafe water and to poor sanitation and hygiene, mainly through infectious diarrhea. Most of the deaths (90%) occur in children, and virtually all occur in developing countries.

Recognizing that access to a safe water supply and adequate sanitation are essential to a healthy life, international efforts have focused increasingly on the issue of safe water access. Together with 140 other nations, Canada made a commitment in September 2000 at the UN Millennium Summit(54) to reduce by half the proportion of people without access to safe drinking water by 2015. In addition, efforts have been made to enshrine water as a basic human right.(55) Canada, however, has opposed this principle. Canada's refusal to recognize water as a human right seems to stem from concern about the international obligations that would accompany such recognition, notably the provision of water resources and of financial and technical assistance to help other countries realize their right to water.

Canada's position on this issue has drawn criticism from various non-governmental organizations that have noted the internationally acknowledged link between water and human health. The Universal Declaration of Human Rights of 1948 guarantees all people a right to a standard of living adequate for their health and well-being. The International Covenant on Economic, Social and Cultural Rights,(56) which Canada signed in 1976, recognizes "the right of everyone to an adequate standard of living for himself and his family, including adequate food …" and "the right of everyone to the enjoyment of the highest attainable standard of physical and mental health." In 2000, the Committee on Economic, Social and Cultural Rights of the United Nations Commission on Human Rights (UNCHR), the Covenant's supervisory body, interpreted the right to health as an inclusive right that extends not only to timely and

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(54) United Nations, *Millennium Assembly Website*, accessed 26 August 2004, http://www.un.org/millennium/.

(55) World Health Organization (2003).

(56) High Commissioner for Human Rights, *International Covenant on Economic, Social and Cultural Rights*, entered into force on 3 January 1976, accessed 26 August 2004, http://www.unhchr.ch/html/menu3/b/a_cescr.htm.

appropriate health care, but also to those factors that determine good health. These include access to safe drinking water and adequate sanitation, a sufficient supply of safe food, nutrition and housing, healthy occupational and environmental conditions, and access to health-related education and information. In 2002, the Committee further recognized that water itself was an independent right by issuing a General Comment(57) that stated: "the right to water clearly falls within the category of guarantees essential for securing an adequate standard of living, particularly since it is one of the most fundamental conditions for survival."

CONCLUSION

Water is of vital importance to Canada's environment, economy and population. Canada now faces a water crisis that manifests itself in an increasing number of water-related disease outbreaks, in endangered watersheds and aquatic ecosystems, and in crumbling infrastructure in need of major capital investment for renewal. Governments at various levels have recently undertaken initiatives and consultations with a view to meeting some of these challenges. The multi-barrier approach has emerged as a preferred course of action for several jurisdictions. A major element of this approach is the protection of drinking water at the source – a goal that watershed-based management has the potential to achieve. At this time, most provinces have either a safe drinking water strategy, a water resource management plan based on watersheds, or both.

Two other key challenges in freshwater management are the need to ensure a sustainable water supply for the future and the provision of adequate infrastructure for the treatment and delivery of drinking water. Municipalities, the main owners and operators of water utilities, are looking to the federal government for assistance with the high costs of renewing their infrastructure. If that assistance is not adequate – as seems very likely – then municipalities will be tempted to contract out to the private sector. This issue of water privatization is troubling for many in our society, and will obviously be the subject of major debate in the next few years.

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(57) High Commissioner for Human Rights, Committee on Economic, Social and Cultural Rights, *General Comment no. 15 (2002), The right to water (arts. 11 and 12 of the International Covenant on Economic, Social and Cultural Rights)*, E/C.12/2002/11, Geneva, 26 November 2002, http://www.unhchr.ch/html/menu2/6/gc15.doc.

The water crisis is not only a Canadian problem, but a global one. In fact, given Canada's fortune in terms of freshwater resources, the crisis is much more acute in developing countries in Africa, Asia and South America, where millions of people lack access to unpolluted and safe water. Access to water is reflected in the Millennium Development Goals to which the United Nations agreed in 2000, in events marking 2003 as the International Year of Freshwater, and most recently in a UN recommendation to proclaim 2005-2015 as the International Decade for Action, "Water for Life." Canada continues to participate in these activities, despite its objection to the proposal to recognize access to water as a basic human right.