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WATER: TOMORROW'S STRATEGIC ISSUE

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INTRODUCTION

At the dawn of the 21st century, half of the Earth's supply of available fresh water[1] is used to meet human needs, which increased spectacularly over the past century. All indications are that human consumption is not about to change soon, that world demand will continue to grow, and that it will become critical in the near future.

Canadians live in a country that is plentifully endowed with water, and it ranks near the top in terms of renewable fresh water. In spite of this abundance, Canada knows that it will have to adopt effective management strategies to protect this valuable resource.

The purpose of this report is to determine how well prepared Canada is to face an impending water crisis and its vision of how the resource ought to be managed. The first two sections briefly describe the situation for Canada and the world. The next section gives an overview of the Canadian water use management framework and the steps it has taken in this area. The final section deals with Canada's vision of water management against the backdrop of international issues.

A GLOBAL PROBLEM: BETTER WATER MANAGEMENT

The amount of water used for human needs has doubled in the past 35 years. Estimates show that it has increased sixfold in the past 100 years,[2] and the increase cannot be attributed to population growth alone, because the world's population has only tripled during the same period.

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(1) Definitions of various water terms are given in the Glossary (see Appendix 1). For a brief version of this report, see Christine Labelle, *Water Management in Canada: Related Issues*, TIPS-37E, Parliamentary Research Branch, Library of Parliament, 30 November 2000.

(2) William J. Cosgrove and Frank R. Rijsberman, *World Water Vision – Making Water Everybody's Business*, World Water Council, 2000.

This increased use – combined with inadequate water management – is the source of a host of problems, including:

- lack of access to drinking water in some countries;
- pollution and dirty water;
- chronic undernourishment caused by water shortages for agriculture; and
- the destruction of natural habitats for hydro-electric projects.(3)

At the moment, the available fresh water in the world (including surface water and groundwater) is approximately 40,000 km^3 per year.(4) In 1995, estimated water consumption, whether diverted or pumped for human use, was 3,800 km^3 (approximately 10%). Of this volume, 2,000 km^3 are for direct consumption, with the rest discharged into the environment after being used for a variety of purposes.(5)

According to analyses carried out in 1995 by the World Water Council (WWC), if world policies remain unchanged and current upward economic trends continue as forecast, the need for water will increase considerably by 2025.(6) Water consumption might then reach somewhere between 4,300 and 5,200 km^3 and lead to water stress at the world level, particularly in Africa, Asia and Latin America. Furthermore, in view of world demographic growth, the average annual volume of water available per inhabitant will decrease from today's figure of 6,600 m^3 to 4,800 m^3 in 2025.(7)

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(3) This has also led to positive results for people and the environment, for example, the creation of water treatment systems (see Appendix 3).

(4) The report prepared for the World Water Council by Cosgrove and Rijsberman (2000) refers to "blue water" and "green water." Blue water, which includes surface water and groundwater, is the main source of water for human purposes and the subject of water resources management. Green water corresponds to rain water and is the main source of supply for natural ecosystems and agriculture that does not rely on irrigation (it produces 60% of the world's food).

(5) Generally speaking, the quality of discharged water has been seriously altered. Industrial applications use the most water, double what is consumed for domestic purposes. In these contexts, water is used primarily as a cooling agent in generating electricity.

(6) The variation depends in part on any expansion in irrigation for agricultural purposes. See Cosgrove and Rijsberman (2000), p. xxi.

(7) *Ibid.*

Part of the problem stems from the fact that not all available water resources are accessible or usable.(8) Indeed, much of the water is located in areas that are inaccessible and thinly populated, particularly some of Canada's Northern regions, Alaska and the Amazon basin. Furthermore, many tropical river basins only contain large quantities of water for short periods of the year.

On the other hand, problems related to managing the use of water may explain why these resources are less plentiful elsewhere in the world, particularly in the temperate river basins of many Northern countries. Intensive human use – in addition to the consumption involved in such use – pollutes both surface and subterranean water resources, making quality water harder to find.

In short, the results and analyses published by the WWC make it absolutely clear that there is already a world water crisis. It stems not so much from a shortage, but from poor management, and millions of people are currently suffering as a result. The Council feels that it has become urgent to adopt sustainable water resource management and food production policies. It therefore advocates five major measures that would make it possible to introduce such a management system by 2025:

- getting all stakeholders involved in integrated water management;
- placing tariffs on all water services based on total costs;
- increasing government funding for research and innovation;
- strengthening of cooperation for international river basins; and
- massively increasing investment in water.

These measures should contribute to achieving a variety of objectives, including:

- conservation of aquatic ecosystems;
- enhanced production and access to food on a planetary scale; and
- further empowerment of communities for the management of drinking water.

(8) See Cosgrove and Rijsberman (2000).

THREATS TO WATER RESOURCES IN CANADA

A. Fresh Water – An Abundant Resource

Canada has one of the world's largest supplies of fresh water.(9) It has 9% of the world's renewable fresh water (it actually has 20% of the world's fresh water, but only part of the reserve is accessible, with the rest consisting of inaccessible or fossil water(10)).

Canada's renewable fresh water reserve consists of:

- primarily groundwater, the volume of which is 37 times greater than the volume of water in this country's lakes and rivers;
- lakes and water courses, which make up almost 8% of Canadian territory, and wetlands, which account for 16%; and
- snow and ice, which are two major sources.

Because Canada is so big and some parts of the country are inaccessible, 90% of the population has access to only 40% of the water.

B. Fresh Water – Massive Consumption

Canadians use an average of 326 litres of water per person per day, making this country one of the world's biggest consumers of drinking water.

The chart prepared by Environment Canada and shown in Appendix 2 illustrates various aspects of water use by area of activity in Canada.

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(9) Brazil is first with 18% of the world reserve, followed by Canada and China (9%) and the United States (8%). *Environment Canada, A Primer on Fresh Water*, website, October 2000, http://www.ec.gc.ca/water/en/info/pubs/e_pubs.htm.

(10) Fossil water is a vestige of the ice sheets that covered the Earth during the Pleistocene era. See Environment Canada, *A Primer on Fresh Water*, October 2000.

Users other than the transportation and tourism sectors consumed 57.9 billion cubic metres of water[11] in 1991, broken down as follows:

- thermoelectricity (63%);
- manufacturing (16%);
- municipal networks (11%, excluding rural areas);
- agriculture (9%); and
- mining (1%).

Even though the supply of drinking water does not, at first glance, seem to be a problem for Canadians, 17% of municipalities with a watermains system experienced supply problems in 1994. Increased consumption has a direct effect on the volume of wastewater that must be treated and increases the cost of both supplying and treating (see Appendix 3) water.

C. Degradation of Aquatic Ecosystems

Human activity is one of the biggest threats to fresh water. All areas of industrial activity have a real impact on aquatic ecosystems. For example:

- thermoelectric power generation often leads to the discharge of coolant water into the environment at temperatures that are higher than normal for the surrounding ecosystems;
- effluents produced by the manufacturing and mining industries and discharged into the natural environment usually display chemical, physical or biological characteristics different from those of the water before it was used, even after treatment;
- agricultural activities are responsible for the eutrophication of many watercourses and for the presence of pesticides in aquatic environments; and
- municipalities must manage wastewater and runoff water, which modify the receiving aquatic environment if they are not properly treated first.

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(11) Of that volume:

- more than 12.8 billion cubic metres are recirculated in various industrial sectors;
- 4.3 billion cubic metres are consumed – in other words, use leads to the water evaporating or being incorporated into products or organisms – and no longer available for other purposes;
- more than 40.4 billion cubic metres are returned to the environment after being used and become available again (Source: Environment Canada, *Water Use in Canada in 1991*, website, October 2000).

Some of the major changes caused to the aquatic environment by human activity are:

- alteration of natural shorelines by urban and agricultural development;
- destruction of peat bogs and other wetlands as a result of the regulation of water levels;
- impact of commercial fishing, primarily as a result of dredging of the ocean floor;
- acidification of lakes caused by the emission of acid-producing substances into the atmosphere; and
- organic and chemical contamination of water as a result of industrial, agricultural and municipal activities.

These factors not only lead to habitat loss and a decrease in biodiversity, but also contribute to a build-up of toxins in the food chain and to a decline in the quality of water prior to treatment.

Even though approximately 90% of the water used in Canada returns to the environment, the loss – mainly attributable to evaporation during use – has an impact on aquatic ecosystems, particularly in areas that are susceptible to drought.

Consequently, many problems persist; action to prevent pollution and achieve efficiency gains is becoming ever more vital and pressing.

D. Climate Change

Debate continues on planetary climate change, concerning both whether it exists and its possible effects.[12] Some computer models can develop scenarios, particularly for the possible impact on water and various water-related activities.

The conclusions vary considerably. For example, experts at the National Oceanic and Atmospheric Administration (NOAA) in the United States and at Environment Canada believe that global warming will lower water levels in the Great Lakes by a metre or more over the next 50 years. On the other hand, scientists from the U.S. National Assessment on the Potential Consequences of Climate Variability and Change think it *possible* that there could be

(12) See Tim Williams and Jean-Luc Bourdages, *Global Warming and the Willingness to Reduce Greenhouse Gases*, TIPS-39E, Parliamentary Research Branch, Library of Parliament, 1 December 2000.

either a slight increase *or* a decrease in lake levels.(13) Despite the high degree of continuing uncertainty about the extent of the observed changes, analyses of circulation in the Earth's atmosphere would appear to indicate that warming will change global precipitation patterns.

The International Joint Commission (IJC) – whose mandate is to govern relations between Canada and the United States with respect to boundary waters – believes that a decline in water levels could occur as a result of climatic change. For the Great Lakes, any drop in water level could have a number of consequences, including:

- reduced hydroelectricity production;
- increased shipping costs;
- a need to modify some urban infrastructures near shorelines;
- an increase in damage caused by recreational activities, sport fishing and deep draft marine traffic to and from Montreal; and
- reduced fresh-water flow into the St. Lawrence estuary and the Gulf of St. Lawrence.

In short, lower water levels could have a major economic, social and environmental impact on the entire Great Lakes region.

E. Poor Understanding of Groundwater

Most groundwater is derived from rainfall infiltration into the ground, at rates that vary with porosity.(14) Water from the water table, which is the main Canadian source of fresh water, meets the needs of over 7.9 million people or about 26% of the population.(15)

Consumption varies from province to province. For example, groundwater accounts for only about 20% of the drinking water consumed by Quebeckers.(16) However, in other provinces and territories, its use is more significant: the entire population of Prince Edward Island and 60% of the people in New Brunswick and the Yukon rely on groundwater to meet their drinking water needs. It is worth noting that these regions face shortages more often than regions that can use surface water.

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(13) International Joint Commission, *Final Report on the Protection of the Water in the Great Lakes*, submitted to the governments of Canada and the United States of America, 22 February 2000.

(14) Normand Grondin, "Les eaux souterraines : ce qu'il faut savoir", *Québec Science*, September 1997.

(15) Environment Canada, *Almost 8 Million Canadians Depend on Groundwater*, water website, March 2000, http://www.ec.gc.ca/water/.

(16) Stéphane Gagné, "Les eaux souterraines : une ressource convoitée", *Le Devoir*, 6 December 1997, p. F6.

In recent years, the abundance of groundwater has led some entrepreneurs to consider using it for major commercial projects, such as bottling it for export.(17) Projects of this kind are controversial and widely debated, partly because of a current lack of understanding of the water table.

In a report issued in February 2000, the IJC described the Canadian and Great Lakes groundwater system. According to the Commission:

- the role of the water table in supporting ecosystems is not well understood;
- data on consumption and bulk removals of groundwater are incomplete;
- some estimates – including the effects of changes in land use and population growth on the availability and quality of groundwater – are incomplete;
- information about the direct removal of groundwater and natural supply areas is insufficient; and
- mapping is inadequate, and accurate mapping is essential for sound management of any removal of either groundwater or surface water, because the two systems are linked.

F. Bulk Removals of Water

"Bulk removal" means the removal and transportation of large quantities of water away from its original basin by means of man-made resources (canals, boats, tanker ships, pipelines).(18) The term does not necessarily mean that water is transported outside its province or country of origin (exported). Likewise, it does not include small-scale removal (small portable containers).

Bulk removal projects presuppose that the water removed will be lost permanently from the basin concerned. Furthermore, such projects may involve the diversion of watercourses and the construction of dams that are likely to take a toll in the form of huge social costs. Some possible problems include:

- flooding or drying up of land;
- degradation of the natural or urban environment;
- forced expropriations;

(17) International Joint Commission (2000).

(18) Environment Canada, "General Information on Bulk Removal and Export of Water", *The Green Lane*, August 2000. See also David Johansen, *Bulk Water Removals and the NAFTA*, TIPS-20E, Parliamentary Research Branch, Library of Parliament, 4 February 2001.

- social upheaval; and
- the disappearance of ways of life or even whole communities.

Bulk removal of water is accordingly considered to be a non-sustainable use of the resource and that is why the Government of Canada wants to ban such removals from major drainage basins.(19)

The aim of Bill C-15, An Act to amend the International Boundary Waters Treaty Act, which was tabled in the House of Commons on 22 November 1999 by the Minister of Foreign Affairs, was to protect cross-border waters from extensive water removals. In particular, the bill was intended to clarify the existing Act and to make the implementation of the 1909 *Treaty relating to Boundary Waters and Questions arising along the Boundary between Canada and the United States* (commonly called the *International Boundary Waters Treaty*) more effective by:

- prohibiting the damming and transfer of boundary waters from their water basin;
- requiring that activities resulting in changes to the natural flow or level of water on the U.S. side of the border have a licence issued by the Minister of Foreign Affairs; and
- providing for specific penalties and punishments for offences – a ban on damming boundary waters would apply primarily to the Great Lakes, but would also affect other boundary waters, including part of the St. Lawrence, the St. Croix River, the upper waters of the St-Jean River, and Lake of the Woods.

Although Bill C-15 died on the *Order Paper* with the calling of the federal election on 22 October 2000, a similar bill (C-6) was introduced on 5 February 2001 at the beginning of the 37th Parliament.(20)

The IJC – which in 2000 issued a report on the subject at the request of Canada and the United States in the context of the federal bulk-water removal strategy – believes that governments ought not to authorize bulk removal of water from the Great Lakes unless the proponent can demonstrate that there will be no impact on the ecosystems. Again according to

(19) Department of Foreign Affairs and International Trade, *Implementation of a Strategy to Prevent the Bulk Removal of Water from Canada, Including Water for Export*, News release, 10 February 1999.

(20) See David Johansen, *Bill C-6: An Act to amend the International Boundary Waters Treaty Act*, Legislative Summary LS-383E, Parliamentary Research Branch, Library of Parliament, 12 February 2001.

the IJC, this approach would satisfy Canada's trade obligations. Governments in fact have sovereignty over the management of water in its natural state and are not bound by trade agreements.(21)

Lastly, the Canadian Council of Ministers of the Environment also holds the view that the extraction of water from the main drainage basins should be prohibited for the near future.

GOVERNMENT MANAGEMENT OF WATER IN CANADA

A. Federal and Provincial Responsibilities

The question of what action ought to be taken to protect water is inseparable from that of the respective responsibilities of the federal and provincial governments for the management of this natural resource. Under the *Constitution Act, 1982*.(22)

- The federal government has jurisdiction over some aspects of water such as:
  - fishing and navigation on the high seas and in domestic waters;
  - waters located on federal lands, in the territories and on Indian reserves as well as cross-border waters; and
  - the implementation of international treaties signed on Canada's behalf.

  It can also make laws for the peace, order and good government of Canada.
- The provinces have jurisdiction over the operation, conservation and management of ground and surface water. This means that they are responsible for handling projects involving regulation of the flow and use of water and for enacting legislation governing water supply, pollution, and thermal and hydro-electric power. As municipal governments come under the provinces, they may be delegated almost all the jurisdiction conferred on the provinces by the Constitution, including the powers relating to regulations governing water purification,

(21) Department of Foreign Affairs and International Trade, "Canada Welcomes with Satisfaction the Report of the International Joint Commission on Protecting the Water of the Great Lakes", Department's website, 15 March 2000, http://198.103.104.118/minpub/Publication.asp?FileSpec=/Min_Pub_Docs/103094.htm.

(22) See Report of the Standing Committee on the Environment, *The Environment and the Constitution*, House of Commons of Canada, March 1992.

sewers or the protection of riverbanks, shorelines and flood plains. Regulations of this kind have a considerable impact on the quality of aquatic ecosystems.

- Some activities fall under both federal and provincial jurisdiction, such as activities related to border or cross-border waters, and activities related to agriculture or health when a major national water problem arises.

B. Canadian Water Legislation

The obligations arising from the above-mentioned responsibilities have given rise to numerous statutes that make it possible for Canada to manage water in certain areas. Noteworthy statutes include the following Acts:

- *Navigable Waters Protection Act*;
- *Fisheries Act*;
- *Canadian Environmental Assessment Act*;
- *Canadian Environmental Protection Act*;
- *Yukon Waters Act*;
- *Northwest Territories Waters Act*;
- *Arctic Waters Pollution Prevention Act*;
- *Canada Shipping Act*;
- *Dominion Water Power Act*;
- *International River Improvement Act*; and
- *Canada Water Act.*

However, there is no single federal statute governing all aspects of water resources in Canada, and most of the above-listed statutes deal with specific sectors.(23)

The *Canada Water Act*,(24) which enables the federal government to play a leadership role in fresh water management, was enacted in 1970, the year before the Department of the Environment was established (1971). It provides for consultation between the federal and

(23) International Joint Commission (2000).

(24) Environment Canada, *Canada Water Act* – Annual Report 1998-1999.

provincial governments on any issue relating to water resources and includes provision for the application of unilateral federal measures in the event of cross-border problems.

Projects arising out of this process are currently under way, including:

- the Flood Damage Reduction Program;
- several programs to regulate, restore and control water resources; and
- preliminary studies on sustainable development of water resources.

Bilateral agreements have been signed for all of these programs. The agreements set out a number of things, including the contribution to be made by each level of government in terms of funding and the provision of information and expertise. The 1998-1999 annual report on water resources includes the recent agreements for these programs. By implementing the *Canada Water Act*, Canada is encouraging an approach that focuses on partnership between the various levels of government and the private sector.

The Federal Water Policy(25) was drafted by various levels of government in 1987, with a view to improving water management. Through this policy, the federal government is working to protect and improve the quality of water resources while encouraging prudent and effective water management and use. The policy also deals with the importance of raising public awareness of the need for rational daily use of water. Five strategies were put in place as a result of the policy. These five strategies correspond to action plans that define the government's supporting role and make it possible for the partners (federal agencies, other levels of government, industry) to deal with specific situations and challenges in this area.

In addition to the Canadian legislative and administrative tools described above, two sets of recommendations deserve mention: those on the quality of Canada's water published by the Canadian Council of Ministers of the Environment in 1987; and those on drinking water quality in Canada developed by Health Canada in 1989.

(25) Environment Canada, *Federal Water Policy*, 1987.

C. International Cooperation

The Canada-U.S. border passes through many watercourses and all the Great Lakes,[26] except one. The International Joint Commission (IJC) which was established under the *International Boundary Waters Treaty* of 1909, and which has six members – three appointed by the President of the United States and three by the Canadian Cabinet on the advice of the Prime Minister – is the agency assigned responsibility for governing relations between Canada and the United States with respect to boundary waters. It established bilateral councils to facilitate investigation, control and monitoring under the Treaty.

The IJC reviews applications for approval of projects relating to boundary and cross-boundary waters and may regulate the operation of such projects. It helps both countries to protect the environment in border areas, including enforcement of the *Great Lakes Water Quality Agreement* of 1972, and keeps the governments informed about new risks that might lead to disputes between the two countries.

Canada is also a participant in a number of global initiatives. For example, it produced a joint report on water management in North America in partnership with the United States and Mexico. This report stems from the *Global Water Vision* initiative established in 1998 by the World Water Council (WWC) to achieve international consensus on the implementation of a management plan to deal with the current water crisis.

Since 1998, individuals and organizations have joined in discussions organized by the WWC with professionals and stakeholders. Sectoral and regional consultations were held and regional reports were issued. These reports – including the one prepared by Canada, the United States and Mexico entitled *North America* – led to the drafting of the comprehensive report entitled *World Water Vision – Making Water Everybody's Business.*[27] In addition to providing an overview of the world situation with respect to water management, this report sets forward solutions intended to provide access to drinking water for people by means of management plans that will guarantee the integrity of aquatic ecosystems.

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(26) The Great Lakes and St. Lawrence Basin contain one-fifth of the Earth's fresh water resources.

(27) Cosgrove and Rijsberman (2000).

D. Other Water Initiatives

For 12 years now, initiatives have been developed within Canada to deal with the problems described above. These initiatives, which focus on ecosystems, take into account not only environmental but also economic and social concerns.[28] They are the product of partnerships between the federal and provincial or territorial governments and often require the cooperation of individuals, communities, Aboriginal peoples and private enterprise.

Canadian Water-Related Measures

International Strategies for Action	
Agreements	
1952	St. Lawrence Seaway project
1972, 1978	Great Lakes Water Quality Agreement (revised in 1989)
1989	Agreement on water supply and flood protection in the Souris River basin
Treaties and Agreements	
1909	Treaty relating to boundary waters and questions arising along the boundary between Canada and the United States (International Joint Commission)
1925	Lake of the Woods Agreement and Protocol
1941	Rainy Lake Agreement
1950	Treaty concerning the diversion of the Niagara River
1961-1964	Columbia River Treaty (1961) and Protocol (1964)
1984	Treaty concerning the Skagit River and Ross Lake and Seven Mile Reservoir on the Pend d'Oreille River
Federal and Provincial Strategies	
1970	The *Canada Water Act* creates a consultation process between the federal and the provincial governments on any question relating to water resources.
1987	The *Federal Water Policy* enables the government to protect and improve the quality of water resources while encouraging prudent and effective management and use of water.

Source: Websites of the International Joint Commission, the Commissioner for the Environment and Sustainable Development, and Environment Canada, June 2000.

(28) Environment Canada, *Ecosystem-based Initiatives*, information paper.

For example, the ecosystems-based approach was used to develop the St. Lawrence Action Plan of 1988, which is now in its third phase. The program has three objectives:

- clean up the St. Lawrence ecosystem;
- restore the health of the communities; and
- make the river accessible.

The past 12 years of work have led to major successes: a 96% reduction in high-priority industrial discharges, the creation of the Saguenay Marine Park, an increase in the beluga whale population, the protection of 12,000 hectares of wildlife habitat, and the creation of ten community groups for action (priority intervention zones committees – ZIPs) along the St. Lawrence. Over the next few years, Phase III of the St. Lawrence Action Plan will be concentrating on preventive action in the following areas: biodiversity, agriculture, industry and shipping. Community organizations will play an active role in projects to clean up the St. Lawrence ecosystem.

The following table lists a number of current major initiatives that favour an ecosystem-based approach and whose aim is to revitalize aquatic ecosystems from coast to coast.

Canadian Aquatic Ecosystem Initiatives

Since 1988	*St. Lawrence Action Plan Vision 2000* (SLV 2000)
Since 1989	*Great Lakes 2000* (GL 2000)
Since 1991	Northern River Basins Study/Northern Rivers Ecosystem Initiative
Since 1991	Atlantic Coastal Action Program (ACAP)
Completed in 1998	*Fraser River Action Plan* (FRAP)
Since 1998	Georgia Basin Ecosystem Initiative (GBEI)
To come	Northern Ecosystem Initiative

Source: Environment Canada website, June 2000.

THE FUTURE OF WATER: CANADA'S VISION

In view of the current problems – including more frequent periods of drought in the Western provinces; the quality of drinking water, which is sometimes unsatisfactory in certain regions; and increasing demands for water exports – Canadian governments believe that improving the water management system has become urgent. In this, they agree with the World Water Council, which argues that it is important to manage the world water crisis by taking action to improve management of the resource by 2025.(29)

Water has been a concern to Canada since 1909, and its management structure is very highly developed. Many obstacles have been overcome thus far, but others need to be seriously examined. For example, the Great Lakes, the Fraser River and the St. Lawrence River, where many efforts to clean up these bodies of water have already been implemented, need further work in the medium and longer term to eliminate toxic pollution from farming, and from urban and industrial pollution. In addition, Canada's water resources are overused (given that the largest part of the population has access to only 40% of fresh water), which will lead to the spending of billions of dollars in supply infrastructure and wastewater treatment.(30)

Many initiatives are based on action advocated by the WWC, including the following:

- that Environment Canada base its ecosystems projects on the principle of integrated water management;
- that the WWC work to continually strengthen partnerships within trans-border basins; and
- that Canada be involved in international debate with a view to working on cooperative global management.

Most governments in this country want to continue to work towards improving Canadian water resource management. Environment Canada, which is constantly developing integrated management tools, promotes cooperation among governments and strives at all times to meet sustainable development objectives. The Department therefore promotes projects such as community or voluntary measures, basic research and more technical solutions (e.g., installation of meters).

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(29) See earlier section entitled A GLOBAL PROBLEM: BETTER WATER MANAGEMENT.

(30) Canada Mortgage and Housing Corporation, *The Ecological City: Canada's Overview*, Federation of Canadian Municipalities, May 1995.

In a report on the health of the country's water prepared in 2000 by Agriculture and Agri-Food Canada, the Department emphasized the importance of creating management tools that would make it possible to use groundwater in a sustainable manner. According to research by the Department, the consequences of drought in Western Canada will worsen as a result of parameters such as climate change or population growth, urbanization and water demand.(31)

Quebec's Bureau d'audiences publiques sur l'environnement [Environmental Public Hearings Board], or BAPE, which conducted hearings on water in 1999, concluded in a report published in 2000 that current management of water and aquatic environments is spread among too many sectors, poorly integrated and insufficiently concerned with the environment. According to BAPE, it is urgent to:

> move to integrated management that is better harmonized at the government level, combine the functions of protection and enhancement, and specifically target individual drainage basins. Moreover, immediate action can and must be taken, and it needs to be consistent with future policies.(32)

Among other things, BAPE recommends:

- a draft groundwater protection policy;
- the establishment of a committee with a mandate to put in place the management of individual drainage basins;
- a major review of agricultural clean-up programs; and
- creation of a system of payments for removals and discharges of water.

Lastly, Canada's work with the United States and Mexico(33) has led it to conclude that a pan-North American approach to water will require intersectoral and cross-border cooperation at all levels.

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(31) Agriculture and Agri-Food Canada, *The Health of Water – Toward Sustainable Agriculture in Canada*, 2000.

(32) BAPE, "L'eau, ressource à protéger, à partager et à mettre en valeur", extract from general findings, website, June 2000.

(33) "World Water Vision: North America", website, June 2000, http://www.watervision.org.

However, one thing is certain: participation by an informed public will have to be the starting point for action by governments and management organizations in the public and private sectors. The greatest challenge will be to integrate water management at all levels – from the ordinary individual user to the bodies responsible for administering major water basins – and to ensure that everyone participates in the decision-making process. In this way, all parts of society will have a role to play in a genuinely integrated Canadian water management system.

APPENDIX 1

GLOSSARY

Consumed water:
(1) Water used in such a way that it evaporates.
(2) Water incorporated into products or organisms and thus no longer available for other purposes.

Extracted water: Water diverted from a watercourse or pumped from ground water for human use.

Fresh water: Water generally containing less than 1,000 mg/L of dissolved solids such as salts, metals, nutritional elements, etc.

Groundwater: Reserves of water stored below the earth's surface (normally in aquifers), often the source of springs and wells.

Renewable water: Water is regarded as an inexhaustible or renewable resource, because human activities do not affect the biosphere's total water reserves, even though the length of water's life cycle varies depending on where it is found and the use that is made of it. However, to be useful, water must be of a certain quality and physically available. It is therefore also regarded as a scarce resource and sometimes even as non-renewable, especially because of a life cycle that can be extremely long.

Surface water: Any water naturally in free contact with the atmosphere (water courses, lakes, reservoirs, retention ponds, the sea, estuaries, etc.) The term also covers springs, wells and other collectors directly influenced by surface water.

Used water: Resources drawn from surface and groundwater for human use. A portion of this water is discharged into the environment after use and so becomes available again.

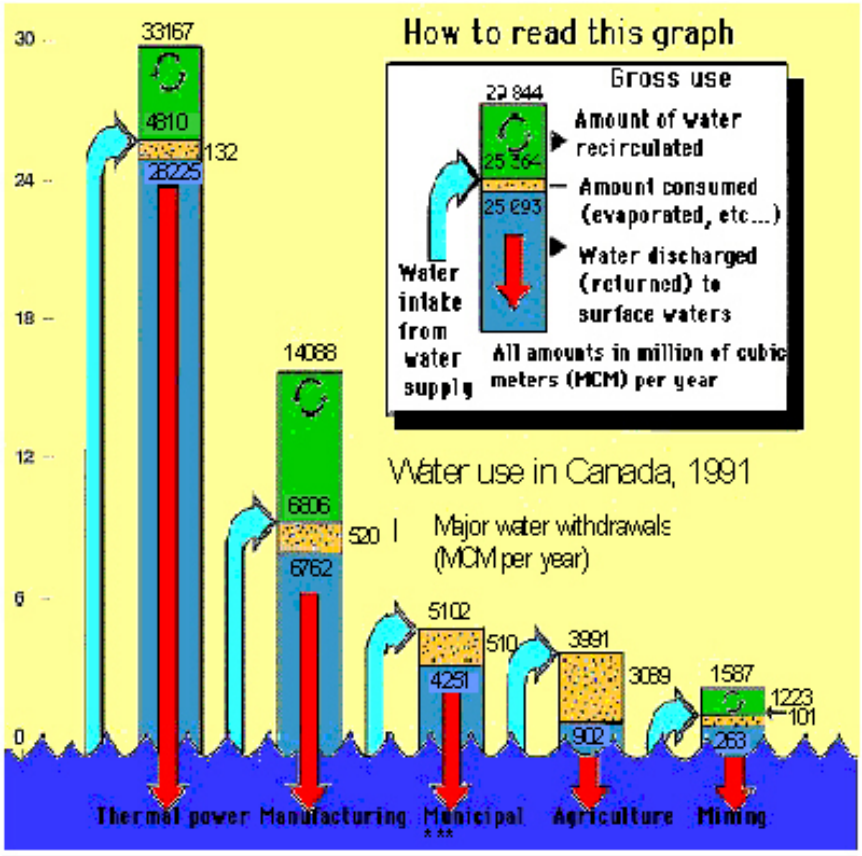
Wastewater treatment system: Conduits, pumping stations, force mains and all other infrastructures and installations used to gather wastewater and transport it to a given point for treatment or discharge.

Water management: The study, planning and oversight of water resources and the application of quantitative and qualitative development and monitoring techniques designed to ensure the multiple and long-term use of the various forms of the water resource.

Water quality: Term used to describe the chemical, physical and biological characteristics of water relative to a given use.

APPENDIX 2

WATER USE IN CANADA



* Municipal data exclude water supplied to industry.
** Municipal data include estimates for rural residential water use.
Notes: 1) Intake + Recirculation = Gross Use
2) Intake - Discharge = Consumption (except in the municipal sector, where consumption has been estimated at 510 or 10% of intake).
3) Municipal consumption is an uncertain figure, but has been estimated. However, the difference between intake and discharge is not consumption, but non-metered sewage. If this non-metered sewage (including rainfall) was known, then the municipalities would be "net producers" of water, not consumers.
4) Data for some sectors have been extrapolated and rounded.

Source: Environment Canada water use surveys and studies.

Source: Environment Canada, *The Green Lane*, November 2000.

APPENDIX 3

WATER TREATMENT IN CANADA

Drinking water

To prevent diseases caused by water-borne pathogens, drinking water is disinfected in one of three ways: chlorination, ultraviolet light, and ozonization.

Chlorination is the most commonly used technique because it is effective in killing fecal coliforms and other bacteria and other micro-organisms. Ultraviolet disinfection, in which light energy is used to destroy pathogens, is an alternative to chlorination. Water ozonization is also used in Canada. Ozone and ultraviolet light are effective, but they disinfect water only temporarily, whereas chlorine continues to disinfect water as it moves through the distribution system.

Wastewater

In Canada, wastewater is:

- treated before being returned to the environment (approximately 20 million Canadians have wastewater treatment service); or

- discharged directly into the aquatic environment without any type of treatment.

Wastewater can be treated in one or more of the following ways:

- *Primary treatment*: After undergoing preliminary treatment to remove grit and solid material, wastewater goes through a completely physical process that separates solid matter from liquid. Floating, oily and greasy material is removed from the effluent, and the resulting sludge can be disposed of in a number of ways. If the effluent is not treated further, it is simply returned to the environment. Generally, primary treatment without chemicals reduces biochemical oxygen demand (BOD) by 25% to 40% and removes between 40% and 60% of solid matter in suspension.(1)

- *Secondary treatment*: Secondary treatment, also known as biological treatment, may follow primary treatment. The process consists of introducing micro-organisms into the pool containing the liquid effluent and giving them enough oxygen to survive so that they can feed on the organic matter. This technique considerably reduces the quantity of solid matter in wastewater. The resulting sludge is treated further or returned for additional biological treatment. Secondary treatment reduces BOD by 85% to 95% and eliminates up to 99% of coliforms.

- *Tertiary treatment*: Tertiary treatment involves the use of technologies that supplement other treatments; the choice of supplementary technologies depends on the characteristics of the wastewater being treated. Additional filters may be added, such as carbon filters or other specialized filters that remove metals, chemicals and other types of contaminants. In

(1) Sierra Legal Defense Fund, *The National Sewage Report Card – Rating the treatment methods and discharges of 20 Canadian cities*, June 1994.

addition to further reducing the amount of suspended matter and BOD, tertiary treatment helps eliminate such substances as phosphorous and nitrogen or ammonia.

Chlorine is sometimes used in the last stage of wastewater treatment, just before the water is discharged into the aquatic environment.

Primary treatment is used in British Columbia, while the Prairie provinces favour secondary treatment. Ontario has opted for tertiary treatment. All three types are used in Quebec to varying degrees, although tertiary treatment is less common. In the Atlantic provinces, half the population is served by sewer systems which discharge untreated wastewater directly into estuary or coastal waters that are considered unable to properly dilute the material.