

Chapter 2

The Hydrological and Policy Contexts for Water in Canada

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Abstract The chapter focuses on the hydrological and policy contexts for water in Canada. Regarding the hydrological context, attention focuses upon available water quantity and quality related to the needs of humans and other living species; and, situations related to floods, droughts, wetlands and permafrost, especially in the context of anticipated climate change. Specific examples highlight the complexity and uncertainty involved. With regard to the policy context, consideration first is given to arrangements for the authority and responsibilities of the federal, provincial, territorial and municipal governments, as well as Indigenous peoples. Other aspects considered are the steady reduction in the federal commitment to, and engagement in, water illustrated by the federal water policy, flood damage reduction program, experimental lakes research area, and the ‘war on science’. A final matter addressed is the concept of water as a basic human right, with attention to evolution of thinking both internationally and within Canada. It is essential to have data, knowledge and appreciation for the hydrological reality across the nation, as well as of actions at various spatial scales to facilitate or limit such understanding. Context for policy is also very important. In particular, it is important to appreciate policy choices for related aspects, such as climate change.

2.1 Introduction

This chapter has two purposes. First, it explores the hydrological context for Canada, with particular attention to water quantity and quality related to the needs of humans and other living species; and related to floods and droughts as well as to wetlands and permafrost. Second, attention turns to the policy context, especially the significance of roles by various levels of government, the steady disengagement of the federal government regarding water, and the issue of water as a basic human right.

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2.2 Hydrological Context

2.2.1 *Water Quantity*

Writing over 35 years ago, Foster and Sewell (1981) suggested that Canadians generally believed that their country enjoys a ‘superabundance’ of water, and observed that such a belief was based more on ‘myth’ than reality. Indeed, given the size of Canada, and its number of major and minor rivers and lakes, it is not surprising that many Canadians believe there is abundant water in their country, notwithstanding that Foster and Sewell identified six regions (Okanagan, Milk, North Saskatchewan, South Saskatchewan, Red-Assiniboine, and southern Ontario) for which current and anticipated future demands either exceeded or were within 20 % of total available monthly flow. As Sprague (2007, p 32) later summarized:

Although Canada has a relatively large supply of water per capita, it does not necessarily have a large supply per region. Most Canadians live in the south of the country, far from some of the larger sources. Certain regions already have water shortages, and climate change could well exacerbate this situation.

Sprague (2007) explained how such a ‘myth of superabundance’ could persist. The main reason, he argued, is that many commentators, and members of the public, do not differentiate between the water in Canadian lakes, approximately 20 % of the amount of all lakes in the world, and the portion of that water which is renewable. He noted that the water in lakes is similar to the sum of all deposits in a bank account, whereas for sustainable use the account holder should only be withdrawing the interest, and leaving the principal intact. In this analogy, if only the interest, or the renewable supply is considered, then Canada has a bit over 6 % of the world’s water supply, placing it in fourth place, after Brazil (1st with 12.4 %) and Russia (2nd with 10 %), and being tied with the same renewable volume (6.4–6.5 %) as Indonesia, the United States, and China (Sprague 2007, p 24).

2.2.2 *Water Use*

Shrubsole and Draper (2007, p 40) reported that annual per capita residential water use in Canada for 2001 was 335 l per day. For 2009, Environment Canada (2011) reported that the average residential water use had lowered to 274 l per person per day, and by 2011, had fallen to an average of 250 l per person per day. Notwithstanding the steady decline in annual average per capita daily residential water use, Canadians continue to be the second highest per capita users in the world, below only the United States. The steady decline has been due to improved technology, and water conservation programs, including a steadily increasing charge for water provided from municipalities to their users with the purpose of the charges being to move towards full cost recovery rather than achieve a profit from water sales.

Regarding variation in per capita residential use across the country, Environment Canada's (2011) data for 2009 showed that Prince Edward Island had the lowest per capita residential use at an average of 189 l, followed by Manitoba at 199 l and Alberta at 209 l. In contrast, the highest per capita residential use was in Newfoundland and Labrador (395 l/person/day), followed by New Brunswick (394), the Territories (390), Quebec (386), British Columbia (353), Nova Scotia (292), Saskatchewan (238), and Ontario (225). In a broader context, in environmental indicators using 1999 data, Canada was ranked 28th out of 29 OECD countries in terms of per capita daily water consumption. The lowest nations at that time were Luxembourg, followed by Denmark and the United Kingdom each tied for second place (Environmental Indicators 2015).

Environment Canada (2013, p 9) also reported that just over 30 % of Canadians depend on groundwater for municipal, domestic and rural use. Based on 1996 data, percentages ranged from 23.1 % in Alberta to 100 % in Prince Edward Island, with two thirds of groundwater users across the country being in rural areas. In terms of municipalities, the Kitchener-Waterloo-Cambridge area in southern Ontario and Fredericton in New Brunswick receive most of their water from aquifers. The users dependent on groundwater vary across the country, with municipalities being the largest users in Ontario, Prince Edward Island, New Brunswick and the Yukon; agriculture for livestock watering in Alberta, Saskatchewan and Manitoba; industry in British Columbia, Quebec, and Northwest Territories; and rural domestic use in Newfoundland and Labrador (Environment Canada 2013).

2.2.3 *Water Quality*

With regard to water use, it should be highlighted that at any given year for the past 5 years there have usually been about 100 communities under a 'boil water' advisory. Such advisories normally occur in relatively small and remote communities, many on First Nations reserves, for which serious challenges exist to provide, operate and maintain safe potable water supply systems. This matter is discussed in more general terms in Sect. 2.3.3 which focuses on 'water as a human right'. However, water quality problems are not confined to remote communities. A dramatic example was the boil water advisory declared for a short time for the 700,000 residents of Winnipeg in late January 2015, due to tests which indicated presence of *E. coli* in the public water system. Other earlier high profile experiences occurred at Walkerton, Ontario in 2000 and in North Battleford, Saskatchewan in 2001. In Walkerton, a community of 5000 people, 2300 became ill and 7 died due to the deadly bacteria *Escherichia coli* 0157:H7, or *E. coli*. in the water supply system (Perkel 2002), and in North Battleford thousands of residents became ill due to exposure to the parasite *cryptosporidium*, both due to malfunctioning water treatment systems. An inquiry following the Walkerton incident led to a recommendation to use a multi-barrier approach to ensure water quality, starting with initiatives to ensure quality of the aquatic ecosystems which become the source of domestic

drinking water (O'Connor 2002a, b). In addition, it was recognized that ongoing provincial government cutbacks in Ontario had reduced monitoring and testing capacity to an extent that users of water systems had become at risk.

Another concern related to water quality is the potential for pollution of ground water due to LUST (leaking underground storage tanks), as well as from other sources such as landfill sites and industrial waste disposal sites. Regarding the issue of LUST, prior to the 1980s most underground storage containers were made from steel, which commonly begin to leak after 15–20 years. Furthermore, in many cases there are not accurate records of where LUSTs are located, and therefore problems do not become apparent until after water pollution is discovered. A pervasive and significant concern is pollution of aquatic systems from non-point sources. Such sources include road salt, manure, chemical pesticides and accidental spills. While point sources (e.g., sewage treatment plants, industrial plants) can and have been addressed systematically, non-point sources of pollution are much more challenging to resolve since so many individual land owners have to become engaged if there is to be progress.

An example highlights the challenge, and potential costs. In early 2015, the Supreme Court of Canada awarded a farmer near Brooke-Alvinston in Lambton County, Ontario, compensation of \$100,000 for damage to his crops due to salt spread on nearby county roads. The farmer had argued that salt spread onto roads adjacent to his farm between 1998 and 2013 had caused significant crop losses and had reduced the overall value of the farm property. Provincial regulations stipulate how quickly and systematically municipalities must remove snow from roads, and municipalities can become liable if a motorist establishes that snow was not removed fast or thoroughly enough, which could lead to an automobile accident. However, regulations do not specify the amount of salt that should be used, nor what are acceptable amounts carried off onto nearby properties or environments. As a result of the Supreme Court decision, municipalities in Ontario have become more vulnerable. This challenge was noted by the president of the Good Roads Association in Ontario, who was quoted as saying the decision by the Supreme Court “sets a dangerous precedent for Ontario municipalities” (Herhalt 2015).

Transboundary waters provide an especially difficult challenge which requires collaboration. For example, the water quality of Lake Winnipeg has been seriously degrading with a primary cause being non-point source pollutants, such as nitrogen and phosphorus from agricultural land, triggering algal blooms. The Lake Winnipeg basin covers over 1 million square kilometers, and includes parts of Alberta, Saskatchewan, Manitoba and Ontario as well as North and South Dakota, Minnesota and Montana. A main contributor of such pollutants to the lake is the Red River which flows through Minnesota and North Dakota before crossing the international boundary into Manitoba. For a solution to be realized, the upstream riparian states need to work collaboratively with Manitoba as the downstream partner. And, of course, Manitoba will receive most of the direct benefits of improved quality in the Lake.

The idea of a Lake Friendly Accord was introduced in June 2013. The Accord's purpose is to facilitate coordination of action for a shared goal to improve water

quality in Lake Winnipeg through reducing nutrient flows into the lake. The Manitoba provincial government began by partnering with local level governments to create a shared goal for reducing nutrient loadings into the south basin of the lake into the waterways, to develop commitments for specific initiatives, and to produce annual reports about the status of plans, actions and accomplishments. The Accord is intended to complement actions underway by the International Joint Commission, the Red River Basin Commission (a non-government organization), and the Prairie Provinces Water Board. Representatives of the Canadian Government, the Government of Manitoba and South Basin Mayors and Reeves signed the Accord on 21 March 2014, and the Red River Basin Commission on 4 September 2014. And, on 20 January 2015, the Commissioner of the Minnesota Pollution Control Agency signed the Accord in Winnipeg, indicating steady progress.

The Great Lakes system also has been under stress related to water quality, with highly visible pollution in Lake Erie during the 1960s leading to commentary that Lake Erie was ‘dying’. Through the International Joint Commission, 43 Areas of Concern were identified in 1987 across the Great Lakes, leading to preparation of Remedial Action Plans for each one. Seventeen of the AOCs are in Canada, with 5 of them bi-national situations. By early 2015, 3 of the AOCs in Canada (Collingwood Harbour 1994; Severn Sound 2003; Wheatley Harbour 2010) and 2 in the USA (Oswego River, New York 2006; Presque Isle Bay, Pennsylvania 2013) had been officially delisted. Furthermore, two other AOCs in Canada (Spanish Harbour and Jackfish Bay) were designated in 1999 and 2011, respectively, as Areas of Concern in Recovery, signalling all remedial actions were judged to have been completed successfully, with time needed for those two AOCs to complete the recovery naturally.

2.2.4 *Flooding*

Up to 200 communities in Canada have experienced significant flooding since records have been kept. Below, examples are provided about major flood events. Caution should be used regarding the damage estimates, as it is not always clear in reports whether ‘damages’ mean total damages, insured damages and/or indirect impacts. The numbers provided below are understood to represent total damages, unless noted otherwise. Furthermore, the amounts reflect the costs at the time of the flooding events, not present values.

Major floods have occurred in the lower Fraser River valley of British Columbia (1948, \$22 million in compensation paid, 16,000 people evacuated from homes), southern Manitoba (1950, nearly \$125 million compensation, 107,000 people evacuated; 1997, about \$300 million, 28,000 people evacuated), related to Hurricane Hazel in Toronto (1954, \$100 million, 4000 left homeless, 81 deaths), Fredericton (1974, no data found), Montreal region (1976, \$30 million in compensation), Winisk, Ontario (1986, entire community destroyed), Saguenay River Valley in Quebec (1996, 10 deaths and \$800 million), Alberta (2005, ‘Flood of Floods’, \$400

million), St. John River in New Brunswick, 2008 (\$50 million), Richelieu River, 2011 (\$40 million), Manitoba and Saskatchewan (2011, \$1 billion and \$360 million, respectively; 2014, no data available, but estimates 'greater than' damages for 2011 and over 920,000 acres unseeded due to inundation), and, Calgary and southern Alberta (2013, \$6 billion, over 100,00 people evacuated) (Dearden and Mitchell 2016, p 394–395).

The traditional way to deal with flooding is to strive to control water flows using dams, dykes and diversion channels (Shrubsole 2016, p 158–159). While such a 'structural approach' does provide protection, it protects against a flood event of a specified return period, such as a 1 in 100 year flood. By definition, there will eventually be a 1 in 200 or 300 year flood, whose waters will overtop structural measures designed for a 1 in 100 year event. Experience has shown that once structural measures are built, the flood-prone land is often perceived to be 'safe', resulting in pressure for development on it. However, eventually a flood event of greater magnitude than the design capacity occurs, causing higher levels of damage because of the new and vulnerable development.

Subsequently, non-structural approaches began to be used in place of or to complement structural approaches. While structural measures are designed to control behaviour of the natural system, non-structural measures intend to modify human behaviour. In that context, non-structural measures include flood plain mapping, flood forecasting and warning systems, land use zoning regulations to restrict development in flood-prone areas, and public information.

To advance the application of a mix of non-structural measures, the federal and provincial governments began a national flood damage reduction program in 1975, with a primary goal to prepare flood-risk maps to identify hazardous areas in communities. The maps were complemented with land use regulations to discourage building in areas subject to flood risk. Over 300 locations were mapped under this program, and the information was available to agencies responsible for floodplain management, as well as to municipalities, developers and home owners. Of course, conditions in a river basin change, meaning that floodplain maps need to be updated to ensure they reflect the flood hazard.

The national flood damage reduction program was ended in 1998, as a cost-saving measure by governments, and by then many of the floodplain maps were seriously outdated. In some provinces, such as Ontario where Conservation Authorities have a lead role related to flood-prone land, work continued to maintain and update the flood-risk maps, but in many other provinces the maps simply became outdated.

2.2.5 *Wetlands*

Wetlands are defined by Environment Canada (2010, p 1) as areas:

submerged or permeated by water – either permanently or temporarily – and are characterized by plants adapted to saturated soil conditions.

Wetlands are usually identified as five kinds: bogs, fens, marshes, shallow water, and swamps. They are particularly valuable because they absorb and reduce the impact of large waves or floods; filter sediments and toxic materials; provide nutrition and habitat for many fish, shellfish, shorebirds, waterfowl and furbearing mammals; provide food products (e.g., wild rice, cranberries, fish, wildfowl), energy (e.g., peat, wood), and building materials (e.g., wood); and, often become valuable recreational destinations for hunting, fishing and birdwatching (Environment Canada 2010, p 1). Indeed, because of these numerous positive characteristics, some wetlands have been designated for protection under international convention.

Canada has about 1.5 million km² of wetlands, about 14 % of the land mass in the country, and also about 25 % of the wetlands in the world. Of the total wetlands in Canada, 37 of them covering about 131,000 km² have been designated as of international importance (Biodivcanada 2014).

However, when European settlers arrived in what was to become Canada, the normal view was that wetlands were a nuisance and should be drained or infilled to facilitate agriculture or other settlement activity. While a systematic national inventory of wetlands in Canada does not exist, it has been estimated that between the early 1800s and 1991 more than 200,000 km² of wetlands had been lost (Biodivcanada 2014, p 2), primarily through drainage to create more agricultural land. The most complete data for wetlands are for the Prairie Provinces and southern Ontario.

While some increases in wetlands have occurred, losses continue primarily due to their conversion to other uses, construction of water level control infrastructure (including hydroelectric dams and reservoirs), and climate change, as well as due to their fragmentation resulting from various types of development, as well from pollution, invasive species, grazing and recreational activity. Biodivcanada (2014, p 2) has noted that wetlands are particularly vulnerable when they are in or adjacent to large urban areas, and it estimated 80–98 % of wetlands once in or adjacent to major urban areas no longer exist. In contrast, at a global scale it estimated wetlands now cover 5–10 % of the Earth's land surface, even though more than 50 % of wetlands have been lost globally.

Climate change is an obvious threat to wetlands. Especially in arid or semi-arid areas, if and as summers become drier and warmer, combined with more extraction of water for irrigation, the probability increases that the basic supply of water for wetlands, whether surface or ground water, will be reduced. As water volumes decline, then concentrations of pollutants, such as naturally occurring salts or human-induced agricultural chemicals and atmospheric pollutants, are likely to rise. Modest changes in temperatures and/or water supply usually significantly affect biota in wetland systems.

In terms of protecting wetlands, various strategies are used. Specific initiatives for coastal wetlands include adding sediment to counterbalance rising sea levels, planting grasses to protect coastal sand dunes from erosion, and building dykes or protective offshore barrier islands. For inland wetlands, planting grasses also is used, as well as artificial control of water levels. For both coastal and inland wetlands, developing and applying protection policies is also needed.

The North American Waterfowl Management Plan (NAWMP) was signed by Canada and the United States in 1986, with the purpose to protect wetlands in North America. The stimulus was a rapid decline in waterfowl populations as a result of removal of or damage to wetlands. Indeed, it has been calculated that the many small wetlands on the prairies of Canada and the US are the most productive habitat for waterfowl at a global scale, supporting between 50 and 88 % of the breeding populations of several species in North America (Biodivcanada 2014). Mexico became a partner in NAWMP during 1993.

The North American Waterfowl Management Plan (2012) was revised in 2012. The new plan noted that NAWMP had conserved and restored 63,000 km² of wetlands, grasslands and other key habitats for ducks, geese and swans in the three countries since 1986. The revised plan has three key goals, one of which is that to achieve waterfowl conservation it is essential to have “Wetlands and restored habitats sufficient to sustain waterfowl populations at desired levels, while providing places to recreate and ecosystem services that benefit society” (p 2), and a key strategy is to achieve “healthy wetland ecosystems that sustain natural functions (e.g., water quality, flood control, carbon storage) that benefits people and wildlife” (p 6).

2.2.6 Drought

Droughts are challenging to define, as unlike floods, it is not always obvious when a drought begins or ends. However, there is general agreement that a drought occurs when lower than normal precipitation leads to sharply reduced water supply, which in turn leads both to reduced moisture in soil and replenishment of surface and groundwater sources. In Canada, regions most susceptible to drought are the three Prairie provinces, as well as the interior of British Columbia. Southern Ontario and Quebec also experience droughts, but generally their droughts are less severe, cover a smaller area, and are shorter in duration than droughts on the Prairies. In contrast, both Atlantic Canada and the Canadian North experience relatively few drought conditions.

Records show significant droughts occurred on the Prairies in the 1890s, 1910s, and from 1929 to 1937. Other droughts occurred there in the late 1950s and early 1960s, 1980s and from 1999 to 2005, with the latter being the worst in 100 years for the Prairies (Chipanski et al. 2006). The drought period during 2001 and 2002 covered almost the entire southern portion of Canada, from British Columbia to Atlantic Canada.

The drought in the 1930s led to establishment of the Prairie Farm Rehabilitation Administration (PFRA) by an Act of Parliament, passed in 1935. The PFRA was created to facilitate technical and financial assistance to farmers in order to allow them to construct small water holding areas, such as dugouts and small dams. In addition, PFRA acquired sub-marginal agricultural land, and, after seeding the land, turned it into community pastures. Initially, PFRA established 16 community pastures, ranging in size from 2430 to 10,120 ha. It presently operates over 80

community pastures, with 75 % being in Saskatchewan. The landowners of the sub-marginal land were assisted in obtaining other property.

In 1959, PFRA initiated the South Saskatchewan River Project, which resulted in the Gardiner and Qu'Appelle Dams, as well as the 225 km long Diefenbaker Lake. Water from this project supplies drinking water to about 50 % of the population in Saskatchewan, and also a significant amount of water for irrigation.

In 2013, as part of its cost-cutting, the federal government terminated funding for the shelterbelt program that had been operated for decades by PFRA, and through which farmers had obtained free seedlings of trees and shrubs to create shelterbelts.

In addition to PFRA, each of the three Prairie provincial governments developed their own programs, and collaborates with the federal government. Generally, the focus has been on adaptation strategies, including soil and water conservation, irrigation, and infrastructure (e.g., wells, reservoirs, pipelines).

2.2.7 *Permafrost*

Permafrost involves ground which remains at or below 0° Celsius for at least 2 years. Permafrost areas can be continuous, discontinuous, in isolated patches, or in alpine systems. Permafrost is often covered by a thin layer of soil that regularly melts and freezes.

It has been estimated that permafrost underlies 50 % of Canada's land mass. Turner (2013) has reported that, in the North, permafrost is mainly continuous and may be several 100 m thick, with temperatures averaging -5 ° C. In contrast, in the South, the permafrost areas are often discontinuous and often only a few metres deep.

Permafrost, similar to other natural systems, is susceptible to modification due to climate change. In that context, the International Panel on Climate Change 5th Assessment Synthesis Report (2014, p 6) stated that:

There is high confidence that permafrost temperatures have increased in most regions since the early 1980s in response to increased surface temperatures and changing snow cover.

Such vulnerability is important, because of inter-connections among permafrost, hydrological processes, soil conditions and vegetation (Smith 2011, p 3).

To elaborate, changes in permafrost environments have implications for both terrestrial and aquatic systems. Related to hydrology, Smith (2011) reminds us that permafrost influences infiltration, surface runoff and aquifer recharge and storage. Furthermore, both frozen ground and the thickness of an active layer of soil influence the hydrologic cycle by affecting evapotranspiration, as well as vegetation succession and growth because of impact on rooting zone depth and soil moisture capacity. In addition, infrastructure on the surface may be damaged when permafrost thaws, as a result of 'thermokarst development'. Such damage can include cracking or breaking of pipelines carrying water, oil or natural gas, and structures built to contain mine tailings and other wastes, as well as buildings, schools and factories.

Furthermore, frozen peatlands retain significant quantities of carbon, and thawing of permafrost can have consequences for capacity to store carbon from greenhouse gas emissions. Finally, changes to permafrost may lead to drier terrestrial conditions, in which shrubs and tundra replace wetlands, with implications for the number and mix of plants, birds and animals.

While relatively small human populations live in the areas underlain by continuous permafrost, the consequences for the hydrological cycle of changing permafrost conditions are significant, especially given the potential for mineral and energy development projects in Canada's North.

2.3 Policy Context

2.3.1 *Role of Different Levels of Government*

As a federal state, in Canada power and authority are shared between the federal and provincial governments. In turn, provincial governments allocate authority to municipal governments. Important for the policy context is the Canada Act, 1982, which distinguishes between proprietary rights and legislative authority regarding natural resources. Proprietary rights, or ownership, are held by provincial governments for all Crown lands and natural resources not specifically held under private ownership, within their jurisdictions. North of 60° latitude, the federal government has proprietary rights to land and resources until territories gain the same status as a province. As a result of devolution of authority in the past decade and a half, however, both the Yukon and Northwest Territories now have more 'provincial-type' powers and responsibilities related to water.

Legislative authority is divided between the federal and provincial governments. Statutory jurisdiction for trade and commerce is held by the federal government, allocating to it significant authority related to interprovincial and export trade of resources, including water. The federal government's legal authority for navigation and shipping, and fisheries, has been used as the basis for federal water pollution regulations, even though water is a provincial responsibility under the Canada Act. Such arrangements inhibit *national approaches* (federal, provincial, and territorial collaboration) to address water issues, given provincial sensitivities about their authority and responsibility under the Canada Act being infringed upon. At the municipal level, responsibility focuses on providing potable water for residents as well as removing and treating wastewater.

Aboriginal people, not all of whom are First Nations, increasingly have argued that they had, and have retained, traditional rights to natural resources, even if treaties had been signed with the federal government. During the 1980s, increasing recognition began by the federal government regarding traditional rights of Aboriginal peoples. Existing and treaty rights were formally recognized in the Canada Act of 1982, which has led to Aboriginal peoples becoming more involved in decisions related to water development projects located on their traditional areas.

The implications of the above arrangements are non-trivial (Pentland and Wood 2013). It often is difficult for one level of government to take a leadership role, or to act unilaterally, as other levels can claim they have shared jurisdiction. Consequently, some governments or leaders avoid taking action, or initiatives, arguing that they do not have sufficient responsibility or authority, and thus others should be acting. And, finally, an obvious need exists for collaborative and cooperative approaches, but often, it seems, nothing or little happens, or it takes an exceedingly long time for initiatives to get started, because of the often difficult negotiations that extend over a lengthy period.

2.3.2 Disengagement by the Federal Government

Engagement in water policy and management by the federal government reached a high point in 1987, when a federal water policy was created (Pearse et al. 1985; Environment Canada 1987). The intent was to clarify goals and actions by the federal government to facilitate efficient and equitable development and use of water through cooperative programs, provision of information, development of expertise, and technology development and transfer. However, by the mid-1990s, the federal government had reduced its engagement related to water (Bruce and Mitchell 1995). The Inland Waters Directorate in Environment Canada was eliminated, and its staff was re-assigned to other divisions. An Interdepartmental Committee on Water also became inactive. As a result, the federal water policy “lost much of its momentum” (Bruce and Mitchell 1995, p 2). Furthermore, funding for the Canada Water Act, 1970 was significantly reduced.

Previously, it was mentioned that the National Flood Damage Reduction Program received less and less funding from the federal government, and stopped being funded in 1998. The federal government has also shown lack of commitment to water in other ways, since that time. For example, in 2012 the federal Conservative government announced it would stop funding the Experimental Lakes Research Area in northwestern Ontario, an area of 58 lakes in which pioneering research had been completed since 1968 on issues such as eutrophication of freshwater lakes due to phosphorus overloading, and the impact of acidification of freshwater systems from acid rain. These two research projects created new and internationally recognized insight and solutions to address the negative impacts from eutrophication and acid rain. Regarding eutrophication, Clancy (2014, p 87) stated that the research:

...led to recommendations that made Canada the first country to ban phosphates from laundry detergents (which accounted for more than half the phosphorus supply in many lakes) and the compulsory removal of phosphates from municipal sewage discharges into lakes.

The experimental lakes continue to function as a research site only because in 2013 the Ontario provincial government committed funding, and the International Institute of Sustainable Development in Winnipeg took over management of the facility.

In the summer of 2012, the Conservative government introduced omnibus Bill C-38, in which it proposed major changes to the Fisheries Act in order to focus attention on a small number of ‘valuable’ freshwater fish species; repealed the Environmental Assessment Act; and, significantly amended the Species at Risk Act as well as the Navigable Waters Protection Act, with the latter having the number of water bodies under the authority of the Act reduced from over 3 million to 169 (Turner 2013, p 27).

The above actions by the federal conservative government, and its insistence that federal researchers should not present research findings at conferences unless approved by the federal government, nor respond to questions from the media about research without a federal government spokesperson present to determine which questions could be answered, led Turner (2013) to conclude that the federal government had engaged in a ‘war on science’. In Turner’s (2013, p 112) view, the role of science was viewed by the federal government as:

...to create economic opportunities for industry, and the purpose of government is to assist in that process in whatever way it can.

Furthermore, he added, at the core of the federal government’s approach was to be ‘willfully blind’, and also to have an:

abiding mistrust of expertise and ... contempt for any kind of science not being applied directly to an economic activity of immediate benefit to Canadian industry and self-evident appeal to Conservative voters.

Thus, the approach of the federal conservative government was to reduce funding for many kinds of environmental research, and to be selective regarding what kind of research is funded and reported publically. In that regard, water per se had not been the target for less funding. However, the federal election in October 2015 resulted in the Liberal party forming the government. Prime Minister Trudeau indicated that science should inform decisions by the federal government, and also that government scientists should have the right to speak out about their research. Thus, a shift in approach at the federal level may occur.

2.3.3 *Water as a Human Right*

By the end of the twentieth century, the global population had grown by a factor of 3 and water consumption by a factor of 6. And, by the middle of the second decade of the twenty-first century, almost 800 million people did not have access to safe potable water, and about 2.6 billion did not have access to adequate sanitation facilities for human waste. Furthermore, about 1.5 million children under 5 years of age died annually from water-related illnesses. Given such reality, an important policy question is whether water should be a basic human right, and, if so, what role should countries such as Canada play in realizing such a goal both domestically and internationally (Matthews et al. 2007; Clancy 2014, p 193–194). In Sect. 2.2.3, it already

was noted that there are communities in Canada that do not have safe and reliable drinking water. Related policy questions are what rights should other living species beyond humans have related to water, and also what rights should future generations have?

In reflecting on the above policy matters, the approach taken by South Africa is instructive. The Constitution of the Republic of South Africa, 1996, Section 27(1) (a) stipulates the right to basic access to food and water, and also the right of the environment to enough water to meet its requirements. More specifically, it is stated that,

The quantity, quality and reliability of water required to maintain the ecological functions on which humans depend shall be reserved so that the human use of water does not individually or cumulatively compromise the long term sustainability of aquatic and associated ecosystems.

Thus, South Africa has explicitly recognized the right to water for both humans and other living species.

At a global scale, the United Nations Human Rights Council considered a proposal for water and sanitation to be recognized as a basic human right three times in the 6 year period 2002–2008. Canada opposed this proposal, along with Russia and the United Kingdom. It appears as if at least four issues influenced Canada's position at the Human Rights Council. First, concern existed related to NAFTA (North American Free Trade Agreement). If Canada supported water as a basic human right, how could it oppose requests from the United States or other countries to have water exported from Canada by pipeline or ship? Second, what would be liability implications related to boil water advisories in Canada? The federal government was not keen to assume liability for inadequate water supply systems in remote northern communities, many of which are Aboriginal communities for which the federal government has responsibility. Third, if water became a basic human right, what other matters might be proposed to become a right? And fourth, related to the first point, what would be implications for national sovereignty, and Canada's right to choose how and when its resources were developed and extracted?

The Universal Declaration of Human Rights, adapted by the UN General Assembly in December 1948, was the first global expression of rights for all human beings. The Declaration in the UN Charter, is binding on all member states, and contains 30 articles. Article 25 states that:

Everyone has the right to standard of living adequate for the health and well-being of himself and of his family, including food, clothing, housing and medical care and necessary social services,...

Striking by omission in Article 25 is the word, 'water'. How could food be included and water be omitted, when conventional wisdom is that a healthy adult in normal weather conditions would live for 3–5 days without water, but for about 3 weeks without food?

At a meeting of the UN General Assembly on 28 July 2010, the following motion was proposed:

....states and international organizations to provide financial resources, build capacity and transfer technology, especially to developing countries, in scaling up efforts to provide safe, clean, accessible and affordable drinking water and sanitation for all.

The motion was passed by a vote of 122 countries in favour, 0 against, and 41 abstentions. Canada was among the countries which abstained. Others abstaining included Australia, Austria, Denmark, Ireland, Israel, Japan, Netherlands, New Zealand, Sweden, Turkey, United Kingdom, and the United States along with Botswana, Ethiopia, Guyana, Kenya, Poland, Republic of Korea, Romania, Slovakia, Trinidad and Tobago, Tanzania, and Zambia. For many abstaining nations, including Canada, the rationale was that the motion was premature, given the UN Human Rights Council was still examining this matter.

Two years later, at the Rio+20 Summit in June 2012, in the final report from the Summit, entitled *The Future We Want: Outcome of the Conference*, the following statement appears in Section 121:

We reaffirm our commitment regarding the human right to safe drinking water and sanitation, to be progressively realized for our population with full respect for national sovereignty.

This statement, along with the vote at the UN General Assembly in 2010, are often cited as evidence that the international community has recognized water as a basic human right. However, careful reading indicates that at the UN General Assembly the nations supported provision of assistance to help, especially for developing countries, to achieve safe and accessible drinking water and sanitation for all. Furthermore, the statement after the Rio+20 Summit was explicit that national sovereignty of nations must be respected, reflecting concern that water-bountiful countries had concerns about other countries pointing to the UN resolution as giving them the right to access to water in another country, a concern identified above as one shared by Canada.

From a policy perspective, an obvious question arises as to what actions the federal and provincial governments will take to respect the 2010 motion and 2012 declaration, given they are binding on all members. Action should be expected at two levels by Canadian governments: (1) to ensure all Canadians have access to safe water and sanitation, and (2) to contribute to support developing nations which require external assistance if the intent of the UN resolution is to be achieved. To date, little has been said by political leaders at federal and provincial levels in Canada as to what will be done.

2.4 Implications

In terms of the hydrological context, there is no doubt that Canada is well endowed with fresh water. However, given where the water flows or is held and where most of the population is concentrated, water of sufficient quantity and quality is not always available for all Canadians. Furthermore, a ‘myth of abundance’ has made it

challenging to get all Canadians to reduce their per capita water use to levels comparable to other developed nations. Water quality also is an issue. In remote areas, especially ones serving Aboriginal peoples, water supply systems are often similar to those found in developing nations, and ongoing boil water advisories exist.

Flooding damages continue, often due to historical development on flood-prone lands. Wetlands continue to be removed, even though Canada has one quarter of all the wetlands in the world. Droughts create major challenges, especially in the southern Prairie Provinces, and the interior of British Columbia. And permafrost areas, which underlie 50 % of the Canadian land area, are susceptible to climate change.

From a policy context, the division of responsibilities and authority among federal, provincial, territorial and municipal governments, and increasingly including First Nations, creates a significant challenge to achieve an integrated, coordinated and collaborative national approach to many water problems. This challenge has been exacerbated as the federal government had steadily reduced its involvement in water matters since the early 1990s. And, the issue of water as a human right should be a real issue for Canada because of inadequate water supply and sanitation systems for some of its communities, and the UN commitment to help developing countries ensure all residents have access to safe potable water for drinking and have capacity to remove human wastes safely. On the issue of water as a human right, both federal and provincial governments have been conspicuously silent.

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