Environment Canada Environnement Canada

Canada Water Act

Combined Annual Reports

for April 2006 to March 2007
and April 2007 to March 2008

Canada

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Print version
En1-20/2008E
978-1-100-14555-6

PDF version
En1-20/2008E-PDF
978-1-100-14556-3

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CONTENTS

PREFACE

The *Canada Water Act*, proclaimed on September 30, 1970, provides the framework for co-operation with provinces and territories in the conservation, development and use of Canada's water resources. Section 38 requires that a report on the operations under the Act be laid before Parliament after the end of each fiscal year. This report, comprising the 34th and 35th annual reports, covers progress on these activities from April 1, 2006, to March 31, 2008.

The report describes a wide range of federal activities conducted under the authority of the Act, including participation in federal–provincial/territorial agreements and undertakings, significant water research and a public information program. A map depicting Canada's major drainage areas and drainage flows is provided in Figure 1.

Provisions of the *Canada Water Act*

The following is a summary of the major provisions of the Act:

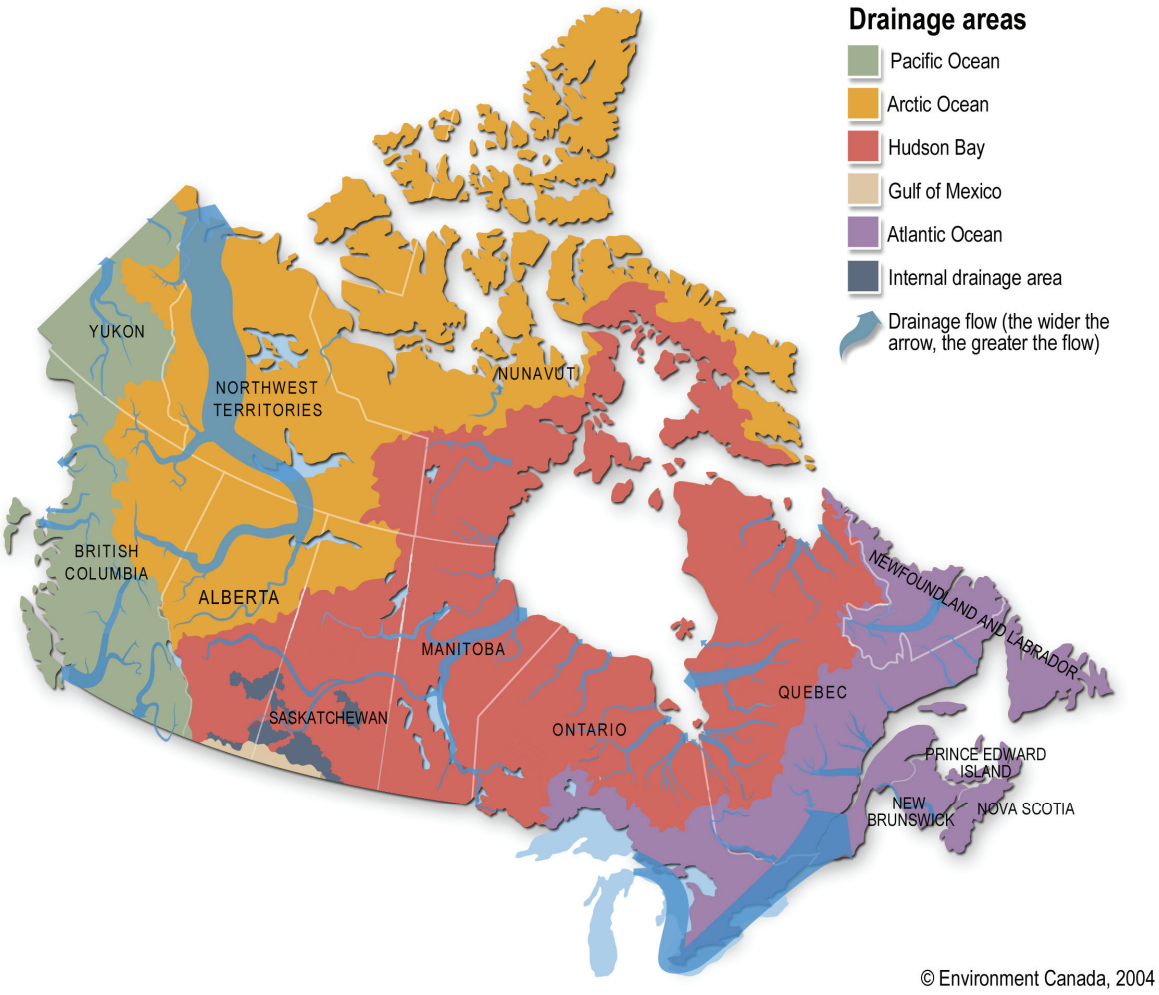
Part I, section 4, provides for the establishment of federal–provincial consultative arrangements for water resource matters. **Sections 5, 6 and 8** provide the vehicle for co-operative agreements with the provinces to develop and implement plans for the management of water resources. **Section 7** enables the Minister, directly or in co-operation with any provincial government, institution or person, to conduct research, collect data and establish inventories associated with water resources.

Part II provides for federal–provincial management agreements where water quality has become a matter of urgent national concern. It permits the joint establishment and use of federal or provincial incorporated agencies to plan and implement approved water quality management programs. The application of alternative co-operative approaches and programs has resulted in **Part II** never having been used.

Part III, which provided for regulating the concentration of nutrients in cleaning agents and water conditioners, was incorporated into the *Canadian Environmental Protection Act* in 1988 and later into sections 116–119 (Part VII, Division I) of the *Canadian Environmental Protection Act, 1999* (CEPA 1999), which came into force on March 31, 2000. (See the CEPA 1999 annual report to Parliament, at www.ec.gc.ca/CEPARegistry/gene_info.)

Part IV contains provisions for the general administration of the Act, including annual reporting to Parliament. In addition, **Part IV** provides for inspection and enforcement, allows the Minister to establish advisory committees, and permits the Minister, either directly or in co-operation with any government, institution or person, to undertake public information programs.

Figure 1. Major Drainage Areas and Drainage Flows in Canada



COMPREHENSIVE WATER RESOURCE MANAGEMENT
(Part I of the *Canada Water Act*)

1. Federal–Provincial/Territorial Programs

This section describes federal, provincial and territorial collaboration on data collection and use, inter-jurisdictional boards and ecosystem initiatives.

1.1 Data collection and use

1.1.1 Collection of water quantity data

Background

Hydrometric agreements have been administered as co-operative endeavours between most provincial/territorial governments and the federal government since 1975. These agreements provide for the collection, analysis, interpretation and dissemination of water quantity data to meet a wide range of needs in the hydrology community.

Under the Partnership Renewal Process initiative, government partners have been reviewing the 1975 bilateral agreements in order to determine how best to update and revise them. Efforts under this process continued throughout 2006–2008. By the end of the two reporting periods, four bilateral agreements were finalized between Canada and four provinces: Manitoba, Alberta, Quebec and Ontario.

The concept of co-management, fundamental to the success of the revised agreements, was discussed at a national administrators table, comprised of the administrators of the provincial and territorial agreements, in October 2007. A significant outcome of joint federal–provincial/territorial co-operation was the development of a performance measurement working group.

Progress to March 31, 2007

Progress continued in updating and revising bilateral hydrometric agreements. In 2006, the agreements with Quebec and Alberta were finalized.

Thirty-eight new stations were added to Canada's hydrometric network. This comprised 3 stations in northern Saskatchewan; 10 sites commissioned and built in northern Alberta; 8 new stations in the Mackenzie River Valley along the proposed pipeline corridor and within the Delta; and 17 new stations on Baffin Island for the network serving the Northwest Territories and Nunavut. The eight Mackenzie Valley and Delta stations were the result of funding received under the International Polar Year initiative and other initiatives, and the Baffin Island resources were provided by hydro-electric interests related to the exploration of potential sources of clean energy.

An Environment Canada stakeholder workshop on monitoring, data sharing and information management, held in Yellowknife, elicited new feedback on northern monitoring requirements. Feedback from the workshop revealed a need to evaluate northern hydrometric resources in the context of future northern development. The significance of the new stations for understanding the hydrology of the North and its role in the production of alternative sources of clean energy is crucial. A number of stations have been developed as a direct result of the needs identified at this meeting.

Work continued on revitalizing the hydrometric Memorandum of Understanding between the Canadian hydrometric program and the United States Geological Survey. The scope of the Memorandum was expanded to encompass the broad area of earth sciences.

Staff were trained and certified in the use of new hydrometric technologies. New hydrometric technologies, such as hydro-acoustic technology and acoustic Doppler, have necessitated the training and certification of staff in the operational aspects of these technologies. In particular, training and accreditation of field staff using an acoustic Doppler current profiler was ongoing throughout 2006–2007. Also ongoing were the expansion and refinement of a repository of core documents detailing program structure and management practices.

Progress continued on the development of the hydrometric workstation. The hydrometric workstation is a highly anticipated tool that will manage the hydrometric program's entire data

production process. Work during 2006–2007 focused on fine-tuning the hydrometric workstation's structure and increasing its functionality. The selection and application of off-the-shelf supporting software for the hydrometric workstation is the next step towards operationalization. Also, improvements to the HYDEX metadata management tool supporting life-cycle-management functionality were made during 2006–2007. Both of these tools provide means to optimize real-time data services in order to accommodate the need of an ever-expanding user community for information in an increasingly timely manner.

Progress to March 31, 2008

Efforts under the Partnership Renewal Process continued in 2007–2008. In 2007, agreements with Ontario and Manitoba were finalized. A Memorandum of Understanding on environmental co-operation between the Government of Canada and the Atlantic provinces is expected to be developed. It will include, as an annexed item, the hydrometric agreements with the provinces.

The hydrological network was expanded and plans for further expansion were announced. The Government of British Columbia announced funding for meteorological and hydrological network expansion, specifically as it relates to the ability to detect changes in weather and water patterns due to climate change. There was significant network expansion in Newfoundland and Labrador in 2007–2008: 10 new stations were commissioned. Additions to the network of hydrometric stations in the Prairie and Northern Region of Environment Canada included two new stations in the Arctic Islands (supported by funding received under the International Polar Year).

Environment Canada held a stakeholder workshop on monitoring, data sharing and information management in Winnipeg. Feedback from the workshop revealed a need to provide stakeholders with better access to and dissemination of basic hydrologic data and information pertaining to the national hydrometric program's current network status. An additional stakeholder meeting, an awareness forum on water resources, was held in Yellowknife for the Aboriginal community in the North. Feedback on the workshop's value was very positive. Plans were made for future stakeholder meetings in Alberta and Atlantic Canada.

Progress continued on the re-scoping of the Memorandum of Understanding between the Canadian hydrometric program and the United States Geological Survey to support an earth sciences agenda. By the end of the reporting period, the new agreement was drafted and was reviewed by the Parties.

ISO 9001 certification of the hydrometric program was undertaken.

Progress continued on the development of the hydrometric workstation. The procurement process for the hydrometric workstation (hardware and software) commenced during 2007–2008.

1.1.2 Water use and supply projects

Okanagan Basin Water Supply and Demand Project

This project is a partnership between the Government of British Columbia and the Okanagan Basin Water Board. The British Columbia Ministry of Environment is the lead agency, operating in collaboration with the Board, the provincial Ministry of Agriculture and Lands, and the Ministry of Community and Rural Development. Federal agencies involved in the project include Environment Canada, Agriculture and Agri-Food Canada, and Fisheries and Oceans Canada. Contributions to the project have also been received from the Okanagan Nation Alliance, The University of British Columbia (Okanagan), Simon Fraser University, the British Columbia Agriculture Council, the Water Supply Association of British Columbia, and the Planning Association of British Columbia.

The first phase of the project (2004–2005) focused on identification of data sources and gathering of data, including Environment Canada climate data and hydrological data from stations in the Okanagan Basin. Data were stored in a customized database (OkWater database). During 2006, the Department was involved in planning the second phase, with a primary focus on assessment of the balance of water (including groundwater) inflows and on extraction and losses from the basin, for an overall water budget estimation.

The $2-million second phase of the project was initiated in 2007. During the reporting years, the Okanagan Basin Water Supply and Demand Project maintained the goal of estimating

present and future water needs to inform water management and planning decisions in the rapidly developing, semi-arid Okanagan Basin of British Columbia. The assessment made use of available data on hydrology, climate, land use, water use, water diversion, groundwater, population trends and other relevant factors. Assessment of potential climate change impacts on water use and availability, and in-stream flow needs were also considered.

From 2007 to 2008, Environment Canada participated in a pilot water-balance study for the southern portion of the Okanagan Basin. The Department also provided modelled estimates of lake evaporation and analysis of climate data, to support analysis of the surface hydrology and the groundwater.

Canada–Ontario Water Use and Supply Project

Background

In the fall of 2000, Canada and Ontario initiated a joint federal–provincial water use and supply project for the Great Lakes Basin. The primary objectives were to

- gain baseline information on water supply (surface and groundwater source and abundance), water use and demand at a sub-basin level;
- make projections for the future and consider the impacts of climate change; and
- improve our understanding of the diversity of water resource conditions in the Great Lakes Basin and the sensitivities of the system to future demands and climate change.

Environment Canada and the Ontario Ministry of Natural Resources co-led the project. The project management team included members from those two agencies, as well as from the Ontario Ministry of the Environment; the Ontario Ministry of Agriculture, Food and Rural Affairs; Conservation Ontario; and Fisheries and Oceans Canada. Three technical working groups (water use, water supply and ecological requirements) conducted the work.

Progress to March 31, 2007

Efforts continued on a work-share basis to assess conditions of water supply, water use and ecological water requirements on a watershed basis in the Great Lakes Basin.

The Ecological Requirements Working Group finalized a report on a study that examined the sensitivity of wetland resources to decreased water availability as a result of climate change. In addition, further testing was done to determine how site-specific ecological monitoring information could be used to describe water requirements on a larger watershed scale.

The Water Supply Working Group continued efforts to characterize watersheds based on available historical stream-flow monitoring data. Various map layers were prepared for consideration and underwent review and assessment. Further testing and analysis of the base flow index results (i.e. base flow / total stream flow) were also undertaken to support assessment of groundwater resources within the study area.

The Project Management Team began the process of establishing a set of summary map layers that could be made available online. In addition, a report summarizing project highlights and results was initiated.

Progress to March 31, 2008

During 2007–2008, a variety of tasks under the Canada–Ontario Water Use and Supply Project were undertaken on a work-share basis. The Water Supply Working Group developed map layers characterizing watersheds in the study area based on the watersheds' estimated groundwater recharge and estimated base-flow recession characteristics (a measure of groundwater conditions within the watersheds).

The Project Management Team made a set of map layers available online. The map layers were developed by the working groups and were made available for review (www.on.ec.gc.ca/orise/orise.html?Lang=e; category: water quantity; subcategory: Ontario Great Lakes and St. Lawrence Basin). The available maps supported reporting for the Water Use and Supply Project and contributed to the fulfillment of commitments under the Canada–Ontario Agreement Respecting the Great Lakes Basin Ecosystem. The Project Management Team also prepared a summary report and initiated work to finalize it.

Two priorities during the 2007–2008 reporting year were the review of the activities of the Canada–Ontario Water Use and Supply Project, and an assessment of the future direction of the project. To support the review, a workshop entitled "Water availability and use in the Ontario Great Lakes Basin: Understanding science and information requirements in support of improved water quantity management" was held. The workshop's primary objective was to consider current management needs for information on water availability in the Great Lakes Basin.

1.1.3 Water quality monitoring agreements

Background

Beginning in the early 1980s, agreements were negotiated between the federal government and several provinces and territories, including British Columbia (1985), Manitoba (1988), New Brunswick (1988), Newfoundland (1986) and Prince Edward Island (1989).

The agreement with New Brunswick was revised in 1995 when the provincial government undertook to collect, analyze and manage the data for the water quality monitoring program. The agreement with Prince Edward Island was incorporated into the Canada–Prince Edward Island Water Annex in 1996, which expired in 1999 and was replaced with the Canada–Prince Edward Island Memorandum of Agreement on Water, signed in May 2001. Water quality monitoring continued under this new agreement.

The agreement with Quebec was terminated in 1995 because activities were similar to those in the St. Lawrence Action Plan. In the context of the 2005–2010 Canada–Quebec agreement, the St. Lawrence Action Plan included a specific Annex for State of the St. Lawrence River Monitoring.

Progress to March 31, 2007

British Columbia and the Yukon

Under the Canada–British Columbia Water Quality Monitoring Agreement, Environment Canada and the provincial Ministry of Environment jointly conducted biweekly or monthly water quality monitoring at 42 river sites in British Columbia. Approximately half of these were transboundary (on significant tributaries to transboundary waterways) or of other federal importance. The current network includes two stations that were added, thanks to additional resources from federal Water Quality Indicator funds and matching provincial resources. This expansion of the network has improved spatial representation of water quality in the province.

The report *British Columbia and Yukon Territory Water Quality Report (2001–2004) – An Application of the Canadian Water Quality Index* was released in March 2007 (www.llbc.leg.bc.ca/public/Pubdocs/bcdocs/414921/BC_Yukon_WaterQualityRpt.pdf). This report gives a site-specific presentation of water quality index ratings for each station in British Columbia and the Yukon, along with summary information on each site. Data collected for the program are reported on Environment Canada's website (www.waterquality.ec.gc.ca/EN/home.htm). In addition, assessment reports were produced by the Province for eight monitoring sites.

Co-operative arrangements to test groundwater quality at wells continued, with a total of 12 monitoring wells sampled on an annual basis with the British Columbia Ministry of the Environment. This forms part of a larger Environment Canada groundwater monitoring program in the transboundary Abbotsford–Sumas aquifer. Environment Canada monitored water quality at an additional seven stream and/or river sites in British Columbia and seven in the Yukon. Many of these sites are in national parks and were monitored in co-operation with the Parks Canada Agency. Four Yukon sites had been added in 2005–2006 with Water Quality Indicator funding and were sampled in co-operation with the Yukon territorial government (Environment Yukon). The water quality web project, which was developed as a pilot in 2002–2003 in co-operation with the Canadian Information System for the Environment, continued to evolve with support from Georgia Basin Action Plan funding. The above-noted website provided access to water quality data and associated information. In 2006–2007, station-level data and a water quality glossary were added to the website.

Manitoba

The Canada–Manitoba Water Quality Monitoring Agreement has been in place since 1989, and continues to be supported as a mechanism for identifying sites of common interest and enabling data sharing. Interprovincial sites that are

identified in this agreement are also operated by Environment Canada in support of the Master Agreement on Apportionment, and decisions on monitoring needs are discussed through the Prairie Provinces Water Board's Committee on Water Quality, which comprises representatives from both Environment Canada and Manitoba.

During 2007–2008, there was an announcement that a new agreement with regard to Lake Winnipeg was to be negotiated. This fed into discussions about reviewing the Canada–Manitoba Water Quality Monitoring Agreement, as did the existing overlap with other water quality monitoring activities in the province. The administration and committee structure aspects of the agreement were dealt with through these other arrangements, such that operational decisions for many of the sites were included as part of either the Prairie Provinces Water Board or the International Red River Basin Board. For example, during 2006–2007, the Red River at Emerson water quality station, which is located on the international boundary with the United States, continued to provide real-time information via satellite. Decisions on the operations at this site were discussed through the International Red River Basin Board, which has representation from both Environment Canada and the Manitoba Government, rather than the Canada–Manitoba Agreement.

Atlantic provinces

Bilateral annual meetings were held by representatives for the Canada–New Brunswick, Canada–Prince Edward Island, and Canada–Newfoundland and Labrador water quality agreements to discuss and review the previous year's accomplishments, and plan and prioritize workloads for cost-shared and work-shared projects. Data from most sites were used to report on federal waters or contribute to a national report under the Canadian Environmental Sustainability Indicators program led by Environment Canada (www.ec.gc.ca/indicateurs-indicators/Default.asp?lang=En&n=2102636F-1).

In New Brunswick, 10 long-term federally designated and 36 provincially designated surface-water-quality stations continued to be monitored under the federal–provincial agreement. Twenty-eight of these stations were used to report on freshwater quality in the 2007 Canadian Environmental Sustainability Indicators report. Three real-time water quality stations were added on international rivers: two on the St. Croix River at Milltown and Forest City, and one on the Saint-John River at Tracey Mills on the Big Presqu'ile River. Also, biological monitoring, using the Canadian Aquatic Biomonitoring Network standards, was undertaken at 20 sites in New Brunswick.

In Newfoundland and Labrador, 80 water quality sites were sampled under the federal–provincial agreement. Twenty-three of these stations were used to report on freshwater quality in the 2007 Canadian Environmental Sustainability Indicators report. In addition, 10 real-time automated water quality stations were deployed under a work- and cost-shared federal–provincial-private partnership.

In Nova Scotia, although no official water quality agreement exists between the federal government and the Province, a network of 24 water quality monitoring stations, monitored six to eight times a year, was set up by Environment Canada throughout the province after the 2007 Canadian Environmental Sustainability Indicators report identified gaps in the province. Two real-time water quality stations were added to the existing network of provincial real-time water quality stations. The first station was added on the Little Sackville River and the second was set up in the upper reaches of the Annapolis River. In addition, benthic sampling occurred at eight sites in Nova Scotia.

In Prince Edward Island, a total of 28 water quality monitoring sites were sampled during 2006–2007, including 14 freshwater river sites, 4 groundwater well sites, and 10 estuarine or marine sites. Of the 14 river sites, 5 were co-located at Water Survey of Canada hydrometric stations thereby providing integrated water quantity and quality data. Data were used to report on freshwater quality in the 2007 Canadian Environmental Sustainability Indicators report. Water quality monitoring results were made available to the public through the provincial and RésEau websites (www.gov.pe.ca/envengfor/index.php3?number=77980&lang- and www.environmentandresources.gc.ca/reseau).

Progress to March 31, 2008

British Columbia and Yukon

Water quality was sampled biweekly or monthly at 42 stream and river sites in British Columbia by Environment Canada and the provincial

Ministry of Environment for the Canada–British Columbia Water Quality Monitoring Agreement. Approximately half of these were transboundary (on significant tributaries to transboundary waterways) or of other federal importance (e.g. the United Nations Global Environment Monitoring System sites at www.gemswater.org).

A new site in the Fraser River Estuary was added. This station is monitored using a water quality monitoring and surveillance buoy developed for the estuary. The buoy measured real-time water quality and collected grab samples of water to measure a wider range of contaminants. The real-time data, as well as a webcam photo from the site, were displayed hourly on a website that also displayed data and information on all water quality monitoring stations under the agreement, as well as other stations operated by Environment Canada in British Columbia and the Yukon (www.waterquality.ec.gc.ca/EN/home.htm and www.waterquality.ec.gc.ca/waterqualityweb/realtimeindex.aspx). Assessment reports for the Agreement were produced by the Province for three monitoring sites in British Columbia.

Co-operative arrangements to test groundwater quality at wells continued where cost-effective. During the reporting period, Environment Canada monitored water quality at an additional 7 stream and/or river sites in British Columbia and at 10 sites in the Yukon. Most of these sites are in national parks and were monitored in co-operation with the Parks Canada Agency. Four of the Yukon sites were added in 2005–2006, and three in 2007–2008, with Water Quality Indicator funding; five of these are sampled in co-operation with the Yukon government (Environment Yukon), and two are sampled in partnership with the Vuntut Gwitchin First Nation in Old Crow. The water quality web project, which was established as a pilot in 2002–2003, included the following developments in 2007–2008: the design of a station web page, the addition of supporting descriptive information, and the introduction of real-time data display for the Fraser River Estuary buoy (www.waterquality.ec.gc.ca/EN/home.htm).

Manitoba

Water quality sampling continued at nine sites identified as part of the Canada–Manitoba Water Quality Monitoring Agreement. Interprovincial sites that are identified in this agreement are also operated by Environment Canada in support of the Master Agreement on Apportionment. The water quality station on the Red River at Emerson supports the International Red River Basin Board. The Red River at Emerson site, which is located on the international boundary with the United States, continued to provide real-time information via satellite.

Discussions were underway with the Province to re-establish a joint sampling program on the Red River at Selkirk to allow for interoperable comparisons between field and laboratory protocols. In addition, and as part of the announcement of the Lake Winnipeg Basin Initiative, which is part of the federal government's Action Plan on Clean Water, discussions were initiated with the Province of Manitoba on a Canada–Manitoba Agreement with respect to Lake Winnipeg.

Atlantic provinces

Bilateral annual meetings were held by representatives of the Canada–New Brunswick, Canada–Prince Edward Island, and Canada–Newfoundland and Labrador water quality agreements to discuss and review the previous year's accomplishments and to plan and prioritize workload for cost-shared and work-shared projects. Data from most sites were used to report on federal waters or contribute to a national report under the Canadian Environmental Sustainability Indicators program. The 2007 and 2008 Canadian Environmental Sustainability Indicators reports use monitoring data from 2003–2005 and 2004–2006, respectively.

In New Brunswick, 10 long-term surface water quality stations continued to be monitored under the federal–provincial agreement. These stations and 35 provincial stations were used to report on freshwater quality in the 2008 Canadian Environmental Sustainability Indicators report. Another real-time water quality station was added on the international Saint-John River at Tinker Dam on the Aroostook River, bringing the total number of real-time stations to four on the New Brunswick–Maine–Quebec international and interprovincial rivers. A joint project was initiated to enhance the availability of New Brunswick water quality data using the Internet, hosted on a provincial server. Most sites are used to report on federal waters or contribute to a national report under the Canadian Environmental Sustainability

Indicators program. Benthic sampling was also conducted at 15 sites in New Brunswick.

In Newfoundland and Labrador, 79 water quality sites continued to be sampled under the federal–provincial agreement. Twenty of these stations were used to report on freshwater quality in the 2008 Canadian Environmental Sustainability Indicators report. One real-time water quality station continued to be operated and calibrated in partnership with the First Nations band and the Province of Newfoundland and Labrador, in order to help with the operation of the drinking water plant. Another six real-time water quality stations were installed in a federal–provincial–private partnership that now has a total of 16 real-time water quality stations. Benthic sampling was conducted at 30 sites in Newfoundland and Labrador.

After the 2007 Canadian Environmental Sustainability Indicators report identified gaps in some parts of Nova Scotia, 24 stations continued to be monitored, although no official water quality agreement existed between Canada and the Province. Other stations (six lake stations under the Acid Rain Program and two river stations by the Parks Canada Agency) provided the data used to report on freshwater quality in the 2008 Canadian Environmental Sustainability Indicators report. A total of eight real-time water quality stations monitoring pH, turbidity, conductivity, temperature and dissolved oxygen in real time continue to be operated. Benthic sampling was conducted at 30 sites in Nova Scotia.

In Prince Edward Island, a total of 28 water quality monitoring sites were sampled during the 2007–2008, including 14 freshwater river sites, 4 groundwater well sites, and 10 estuarine or marine sites. Of the 14 river sites, 5 were co-located at Water Survey of Canada hydrometric stations thereby providing integrated water quantity and quality data. Data were used to report on freshwater quality in the 2008 Canadian Environmental Sustainability Indicators report. Water quality monitoring results were made available to the public through the provincial and RésEau websites. Benthic sampling was conducted at 20 sites in Prince Edward Island.

The Parks Canada Agency collaborated on benthic sampling at over half the 42 national parks. Water quality monitoring results were made available to the public through the provincial and RésEau websites (http://map.ns.ec.gc.ca/reseau/en/).

1.1.4 Canadian Environmental Sustainability Indicators

Background

Since 2005, the Government of Canada has published the Canadian Environmental Sustainability Indicators annual report, which provides indicators on the state of air and water quality, as well as greenhouse gas emissions. Its freshwater quality indicator uses the Water Quality Index endorsed by the Canadian Council of Ministers of the Environment as a means to summarize the status of surface freshwater quality. Quality is assessed by examining the extent to which Water Quality Guidelines for the Protection of Aquatic Life (plants, invertebrates and fish) are being met at selected lake and river monitoring sites throughout Canada.

The Canadian Environmental Sustainability Indicators reports are posted on Environment Canada's website (www.environmentandresources.gc.ca/default.asp?lang=En&n=2102636F-1).

Progress to March 31, 2007

In the 2006 Canadian Environmental Sustainability Indicators report, the freshwater quality indicator was the basis for reporting the quality of surface freshwater at selected monitoring sites across the country, including the Great Lakes and northern Canada. The following are highlights from the report:

- Freshwater quality ratings (Table 1) at 340 selected monitoring sites measured across southern Canada over three years (2002 to 2006) were rated as "good" or "excellent" at 44 percent of the sites, "fair" at 34 percent, and "marginal" or "poor" at 22 percent.
- Freshwater quality at 30 sites across northern Canada measured over the same three years was rated as "good" or "excellent" at 67 percent of the sites, "fair" at 20 percent, and "marginal" or "poor" at 13 percent.
- Freshwater quality measured on a rotational basis in 2004 and 2005 in the Great Lakes was rated as "good" or "excellent" for Lake Superior, Lake Huron, Georgian Bay and

eastern Lake Erie; “fair” for central Lake Erie; and “marginal” for western Lake Erie and Lake Ontario.

Table 1. Interpretation of Water Quality Index Ratings

Rating	Interpretation
Excellent (95.0 to 100.0)	Water quality measurements **never** or **very rarely** exceed water quality guidelines.
Good (80.0 to 94.9)	Measurements **rarely** exceed water quality guidelines and, usually, by a narrow margin.
Fair (65.0 to 79.9)	Measurements **sometimes** exceed water quality guidelines and, possibly, by a wide margin.
Marginal (45.0 to 64.9)	Measurements **often** exceed water quality guidelines and/or by a considerable margin.
Poor (0 to 44.9)	Measurements **usually** exceed water quality guidelines and/or by a considerable margin.

Progress to March 31, 2008

Based on data collected from 2003 to 2005, the 2007 Canadian Environmental Sustainability Indicators report indicated the following:

- The freshwater quality for the 359 monitoring sites in southern Canada had a rating of “good” or “excellent” at 44 percent of the sites, “fair” at 33 percent, and “marginal” or “poor” at 23 percent.
- Freshwater quality measured at 36 monitoring sites in northern Canada was rated as “good” or “excellent” at 56 percent of the sites, “fair” at 31 percent, and “marginal” or “poor” at 14 percent.
- Phosphorus, a nutrient mainly derived from human activities and a key driver of the Water Quality Index, is a major concern for surface freshwater quality in Canada. Phosphorus levels in southern Canada exceeded limits set under the water quality guidelines for aquatic life over half the time at 127 of 344 monitoring sites.

1.2 Inter-jurisdictional boards

1.2.1 Ottawa River Regulation Planning Board

Background

In 1983, Canada, Quebec and Ontario concluded an Agreement Respecting Ottawa River Basin Regulation. Under its terms, a board was constituted to plan and recommend regulation criteria for the 13 principal reservoirs of the basin, taking into account flood protection, hydro-electric power production and other interests. Supported by a Regulating Committee and a Secretariat, the Ottawa River Regulation Planning Board endeavoured to ensure that the integrated management of the reservoirs provided protection against flooding along the Ottawa River and its tributaries, and along its channels in the Montréal region.

Progress to March 31, 2007

Three meetings of the Board were held in Ontario and Quebec during 2006–2007. Board members considered routine items such as current and planned projects along the Ottawa River, operation of the Regulating Committee and its annual report, Secretariat operations, and correspondence and communications from organizations and the public. The Board completed the annual report for the previous fiscal year and delivered it in the fall of 2006 to the Ministers responsible for the Agreement.

The magnitude of the spring peak flow for 2006, as measured at the outlet of the basin at Carillion, was approximately the mean annual flood flow for the period of record. Snow surveys across the watershed in March indicated an average snow/water equivalent. The snowmelt began early with a relatively rapid rise in stream flows at the beginning of the freshet. The threshold for minor flooding was reached at three locations along the mainstem: Lake Coulonge, Chats Lake and the Britannia Beach area of the Ottawa River in Ottawa. The flood damage level was not quite reached in the Montréal area of Lac des Deux Montagnes.

Progress to March 31, 2008

During 2007–2008, the Board convened three meetings in Quebec and Ontario. Issues dealt with by the Board included customary business such as a review of Ottawa River projects (both

ongoing and planned), operation of the Regulating Committee and its annual report, Secretariat operations, and correspondence and communications from organizations and the public.

Two member agencies of the Board, the Ontario Ministry of Natural Resources and Ontario Power Generation, reported that they had established a Public Liaison Group for the reach of the Ottawa River from Mattawa to Arnprior. The Group's objective is to facilitate communication with the public regarding flow and water level management. The Board supported in principle the formation of the Group. The Board also agreed to participate in meetings of the Group, as required to inform Board activities.

For the winter of 2007, the snow cover and precipitation were well below normal. The snow/water equivalents measured during March snow surveys showed water equivalents also well below the average. This late winter information presaged a spring freshet that contained a low volume of runoff and below-average peak flows. No incidents of flooding were reported in the basin. The precipitation deficit continued during the summer and fall with low water levels reported along the river and in the Montréal region.

1.2.2 Prairie Provinces Water Board

Background

In 1969, Canada, Alberta, Manitoba and Saskatchewan signed the Master Agreement on Apportionment, which provides for the equitable apportionment of eastward-flowing prairie rivers and the consideration of water quality problems. Schedules A and B of the Agreement provide general principles to apportion water between the provinces. Lodge and Battle creeks in southwestern Saskatchewan are apportioned under Article 6, Schedule A of the Master Agreement, and the 1921 Order of the International Joint Commission, under the terms of the 1909 Canada–United States Boundary Waters Treaty. Under Schedule C, the Prairie Provinces Water Board was reconstituted to administer the provisions of the Master Agreement. Schedule E specifies acceptable water quality objectives in each river reach along the interprovincial boundaries, and further defines the duties of the Board with respect to its water quality mandate.

Progress to March 31, 2007

During 2006–2007, apportionment requirements were met on all eastward-flowing prairie streams that fell under the Master Agreement on Apportionment. Board Water Quality Objectives were adhered to, on average, 94 percent of the time in 2006–2007.

In 2006–2007, the Board and its standing committees for hydrology, water quality and groundwater held at least one meeting, in addition to conference calls. The Board approved a water quality monitoring program for 2007. In addition to reviewing and approving the Prairie Provinces Water Board hydrometric and meteorological monitoring stations list for 2007, the Board continued work on a review of the natural flow computation computer programs.

Various studies were undertaken related to the current and future hydrology of eastward-flowing prairie streams, including the impact of irrigation on streamflows.

Efforts to better understand the nature and extent of interprovincial aquifers continued, including preparation of a draft Conceptual Aquifer Management Framework study and a review of aquifer sustainable yield concepts.

The Board continued to exchange information on issues of common interest, including the Highgate Dam proposal on the North Saskatchewan River, Shellmouth Dam on the Assiniboine River, a Water Management Plan for the South Saskatchewan River Basin in Alberta, a Special Areas Water Supply Project in Alberta, water quality in Lake Winnipeg and flooding on Fishing Lake in Saskatchewan.

Member agencies were informed about Board activities through distribution of Board and committee minutes, quarterly reports and an annual report. As well, the chair and executive director met with Saskatchewan's Minister of the Environment and Saskatchewan Watershed Authority staff in December 2006 to discuss the Board.

Progress to March 31, 2008

During 2007–2008, apportionment requirements were met on all eastward-flowing prairie streams that fall under the Master Agreement on Apportionment. In 2007, water quality objectives

were adhered to, on average, 95 percent of the time.

In 2007–2008, the Board and its standing committees for hydrology, water quality, and groundwater held at least one meeting, in addition to conference calls. The Board approved its water quality monitoring program for 2008 and work was initiated on a five-year work plan for the Board. The hydrometric and meteorological monitoring stations list for 2008–2009 was reviewed and approved, and work continued on a review of natural flow computation software programs.

A draft groundwater contingency plan was prepared, a conceptual aquifer management framework study was completed, and initial consideration was given to development of a groundwater schedule to the Master Agreement on Apportionment.

Work continued on the development of nutrient objectives as part of a comprehensive review of water quality objectives.

The Board continued to exchange information on issues of common interest, including a proposal concerning Highgate Dam on the North Saskatchewan River, Shellmouth Dam on the Assiniboine River, a water management plan for the South Saskatchewan River Basin in Alberta, a special areas water supply project in Alberta, water quality in Lake Winnipeg, and flooding on Fishing Lake in Saskatchewan.

Member agencies were informed about Board activities though distribution of Board and committee minutes, quarterly reports and an annual report. As well, a joint meeting of the Board and the Prairie Provinces Water Board Ministers was held on April 20, 2007, in Regina.

1.2.3 Mackenzie River Basin Board

Background

The governments of Canada, British Columbia, Alberta, Saskatchewan, the Northwest Territories and the Yukon completed the signing of the Mackenzie River Basin Transboundary Waters Master Agreement in July 1997. The Master Agreement endorses the principle of managing water resources for future generations in a manner consistent with the maintenance of the ecological integrity of the aquatic ecosystem, with special provisions for the involvement of Aboriginal people. It provides for early and effective consultation on potential developments and activities in the basin that could affect the integrity of the aquatic ecosystem. It also provides a basis for administrative processes, policies and principles to guide development and implementation of seven sets of bilateral water management agreements for water passing between adjacent jurisdictions in the basin.

The Mackenzie River Basin Board administers the Master Agreement. Its 13 appointed members represent all Parties: Canada, British Columbia, Alberta, Saskatchewan, the Northwest Territories and the Yukon. Environment Canada, Indian and Northern Affairs Canada, and Health Canada each have one representative, and the five jurisdictions of the basin each have two: a representative of the provincial or territorial water management agency, and an Aboriginal board member nominated by Aboriginal organizations.

Under the Master Agreement, Environment Canada is responsible for managing the expenditures of the Board, which are cost-shared equally by the Parties. Shareable costs include, for example, the staffing and operation of a Secretariat office in Fort Smith, Northwest Territories (which is near the centre of the Mackenzie River Basin) to support the Board at the working level. An executive director of the Secretariat, hired by Environment Canada's Prairie and Northern Region, plans, organizes and manages Board operations.

The Board's website provides public information about water in the basin, including downloadable news items, maps and reports. However, the currency of information on the site suffered during 2007–2008, due to site maintenance problems (www.mrbb.ca).

Progress to March 31, 2007

The Board met once during the year, in October 2006 in Yellowknife. The main items of business included finalizing a strategic plan for the Board, deciding on a focus for the 2009 *State of the Aquatic Ecosystem Report*, setting requirements for a basin hydrology model to support future bilateral agreements, improving the use of traditional knowledge in Board activities, and discussing public concerns about water management issues in the Basin. Budgetary implications of initiatives to address these issues,

and the Board's need for prior notification of activities within the jurisdictions, were also discussed.

During the summer and fall of 2006, the Athabasca, Peace and Slave rivers experienced extremely low flow conditions. Drought is likely to have been the major factor behind the low levels, and public interest was high. Concerns were expressed by residents of the sub-basins and downstream in the Northwest Territories about possible links between low water levels, climate change, and impacts of upstream water withdrawals and storage. Water withdrawals and storage by oil sands projects, hydro-power reservoirs, other industrial projects, and large municipalities are of concern.

The Board's strategic plan was released in the winter of 2006. The strategy targeted action on six basin-wide transboundary issues over the next five years: improving overall knowledge of the basin, incorporating traditional ecological knowledge into Board activities, responding to climate change, understanding contaminants in drinking water and country foods, protecting aquatic ecosystem biodiversity and developing a watershed approach.

The Board's outreach activities included communication of key messages from the *2003 State of the Aquatic Ecosystem Report* to the general public, participation on the Oil Sands Multi-stakeholder Committee, a presentation on responsibilities and activities to the Joint Review Panel for the Mackenzie Gas Project, and participation in initial meetings of a new "Keepers of the Water" forum established by Aboriginal, community and environmental interest groups in western Canada, as well as in two government standing committees.

The Board's technical committee established three sub-committees during 2006–2007:

- a hydrology sub-committee, which completed an assessment of work required to develop an integrated flow simulation model for the Peace, Athabasca, Slave, and mainstem Mackenzie rivers, and submitted a proposal for development of an initial model;
- a water quality protocols and standards sub-committee, which began to evaluate jurisdictional differences in water quality monitoring; and
- an information sub-committee, which compiled a list of information relevant to the Board and proposed options for its library and referral services.

Progress was achieved towards bilateral water management agreements:

- British Columbia–Alberta: Discussions continued periodically throughout the year. Joint working groups gathered information under the auspices of the 2005 Memorandum of Understanding on negotiations, and their findings were presented at a workshop in January 2007.
- Alberta–Northwest Territories: A draft Memorandum of Understanding on negotiations was completed and forwarded to the Government of the Northwest Territories for a legal assessment.
- Northwest Territories–Yukon: Parties to the only completed Mackenzie River Basin Board bilateral agreement met once in the summer of 2006.

Parties for the other potential bilateral agreements awaited progress on the two sets of negotiations noted above.

A traditional knowledge workshop was held in October 2006 to address concerns about the Board's lack of progress on initiatives in this area. The workshop resulted in identification of steps that the Board could take to incorporate traditional Aboriginal knowledge into its activities. The Board acknowledged that it needs to do more work in this area.

The *State of the Aquatic Ecosystem Report* steering committee identified priority issues, and an initial outline for the 2009 report with the goal of addressing areas for improvement. The Board reached a consensus that additional resources would be needed on an ongoing basis to deliver on key activities prescribed in the Master Agreement, including Board and Secretariat operations, improved consultation with Aboriginal peoples and use of traditional knowledge, cyclical tasks such as the preparation of *State of the Aquatic Ecosystem* reports every five years, and new initiatives such as the basin hydrology model.

Progress to March 31, 2008

The Board met three times during the year: April 2007 in Whitehorse, November 2007 in Yellowknife and February 2008 in Edmonton. The main items of business included:

- relocation of the Secretariat office to another location in Fort Smith;
- work undertaken by the Canadian Council of Ministers of the Environment on national water quality issues closely related to the Board's needs;
- the focus for the 2009 *State of the Aquatic Ecosystem Report*;
- completion of the Mackenzie River Basin hydrology model;
- contents of a business plan submission to Ministers in the Board's jurisdictions seeking additional resources for the Board for new high-priority activities;
- prior notification of basin activities within jurisdictions; and
- setting July 2008 in Edmonton as the target date for a meeting to present information to Ministers on proposed new Board activities.

Development of the Mackenzie Basin hydrology model was largely completed during the year, a collaborative $157,000 effort by the University of Alberta, University of Waterloo and Environment Canada. Existing model components for the Peace and Athabasca rivers and the Peace–Athabasca Delta were combined, and new modules were developed and added for the Slave River, Great Slave Lake and lower mainstem Mackenzie River. Further development, testing, evaluation and model documentation for future users (the Board and its component jurisdictions) was planned for fiscal year 2008–2009.

Decisions were made on the focus for the 2009 *State of the Aquatic Ecosystem Report* based on the 2003 report, the Board's 2006 strategic plan and the Board's discussions. The 2009 report will focus on the evaluation of potential impacts from continuing oil sands and hydro-power development; climate change; and the incorporation of traditional knowledge into the Report, Board activities, and water management processes of jurisdictions in the basin. Planned work on water quality protocols and standards for the Board was postponed, pending completion of a similar national project being undertaken by the Canadian Council of Ministers of the Environment to see whether the Council's document could simply be adopted, or revised as required, to meet the Board's needs.

At each Board meeting via "agency reports," as required to comply with prior notification clauses in the Master Agreement, jurisdictions reported on internal water management and developments affecting waters. Initiatives newly completed or under development in 2007 and early 2008 by the jurisdictions included *Living Water Smart: British Columbia's Water Plan*, the *Saskatchewan Water Authority's State of the Watershed Report*, and the *Northern Voices, Northern Waters: Towards a Water Resources Strategy for the N.W.T.* discussion paper.

Progress was achieved on the bilateral water management agreements:

- British Columbia–Alberta: Discussions continued, with monthly meetings on technical matters through much of the year. A consultant was jointly hired to facilitate discussions and produce a Joint Background Document.
- Alberta–Northwest Territories: Parties began collecting background information to support negotiations. The Northwest Territories initiated development of a water resource management strategy, in collaboration with various interest groups via a series of workshops. One use of the strategy would be to guide the Government of the Northwest Territories on appropriate objectives for negotiations.
- Northwest Territories–Yukon: Parties met twice in 2007–2008 as required under the completed bilateral agreement. They reviewed other obligations and informed each other of activities that have impacts on transboundary waters.

Parties for the other potential bilateral agreements awaited progress on the two sets of negotiations noted above.

1.3 Ecosystem initiatives: watershed and water-related activities

Through the application of an ecosystem approach, the objective of Environment Canada's ecosystem initiatives is to attain the highest level of environmental quality within targeted

ecosystems as a means to enhance the health and safety of Canadians, preserve and enhance natural resources, and optimize economic competitiveness.

Ecosystem initiatives achieve measurable results by relying on aligned and co-ordinated efforts, collaborative governance mechanisms, integrated science and monitoring, community involvement, the sharing of information and experiences, and informed decision making.

1.3.1 Atlantic Coastal Action Program

Background

The Atlantic Coastal Action Program (ACAP) is a collaborative watershed-based community initiative that has been building partnerships, increasing capacity and achieving environmental results through an ecosystem-based management approach since 1991 (http://atlantic-web1.ns.ec.gc.ca/community/acap/default.asp?lang=En&n=085FF7FC-1). During the two reporting periods, ACAP used community-based leadership to address environmental and sustainable development issues for ecosystems in watersheds and coastal areas throughout Atlantic Canada. There were 16 ACAP organizations as well as 3 other ecosystem initiatives in the four Atlantic provinces. Environment Canada contributed funding, technical and scientific expertise, and direct staff support for four broad categories of projects relevant to the *Canada Water Act*: clean water, atmospheric depositions, toxics and natural habitat.

Progress to March 31, 2007

ACAP Cape Breton implemented an integrated monitoring program that used existing sampling protocols to monitor terrestrial, freshwater and brackish ecosystems. This program was useful for providing information to federal, provincial and local authorities responsible for environmental protection and nature conservation. The Canadian Aquatic Biomonitoring Network protocol was used to monitor the health of three freshwater ecosystems in differing conditions within the Cape Breton Regional Municipality. An Estuarine Health Assessment Program developed by ACAP Cape Breton and other groups was used to monitor the health of six brackish ecosystems in eastern Cape Breton.

The Humber Arm Environmental Association studied the surface currents in the Humber Arm. With an increase in marine traffic in the arm, information on surface currents was crucial for predicting the spread of a potential spill or discharge and for the assessment of the potential pathways of harmful substances and organisms. By learning more about how contaminants may move during a catastrophic event, the local community became more prepared to protect and preserve this important resource.

ACAP Saint John achieved its primary and founding mandate of uniting the community in support of the Saint John Harbour cleanup. ACAP Saint John was one of the key stimuli behind the announced tri-level government funding announcement of $80 million on March 16, 2007.

Over the previous two years, the Southeast Environmental Association Ltd. conducted a monitoring program to gain a better understanding of the overall health of the Montague estuary, which suffers from nutrient enrichment, causing excessive amounts of sea lettuce to grow and depriving the water of much-needed oxygen. Preliminary results showed a correlation between nutrient concentrations and land use such as agricultural or residential use, and between nutrient concentrations and the type of ecosystem, such as wetland or forest ecosystems.

Progress to March 31, 2008

In southeastern Nova Scotia, the LaHave River watershed provides a diversity of habitats for freshwater and anadromous fish, and a variety of plants and other wild species. Tourism, forestry, farming and fishing are common activities throughout the LaHave system. To ensure the watershed's health and continued sustainable use by future generations, the Bluenose Coastal Action Foundation spearheaded the LaHave Water Rescue Project. The project's main goal is to address environmental impacts on the LaHave system by providing a long-term record of the river's health and educating the local community about the watershed.

In the Annapolis Valley, Nova Scotia, the Clean Annapolis River Project continued its Ecosystem Assessment Initiative. Water and shell stock sampling allowed for the conditional opening of approximately 200 hectares of a clam-harvesting area around Goat Island in the Annapolis Basin. This is an important local clam harvesting area, which was historically accessible to independent,

commercial clam harvesters. The opening of this area allowed approximately 70 local clam harvesters to benefit economically from the commercial harvest of soft-shell clams.

Northeast Avalon is one of the fastest-growing, most urbanized regions in Newfoundland and Labrador, but has not had new water- or land-use plans in 30 years. The Northeast Avalon ACAP organization worked towards the development of a plan. This involved water monitoring, scientific investigation, and a thorough analysis of the water-use and land-use plans for northeast Avalon. Residents and stakeholders were consulted at public workshops to gather information towards building a more relevant, environmentally sensitive plan for the region.

In Prince Edward Island, Environment Canada scientists and the Bedeque Bay Environmental Management Association investigated whether the concentrated flows from pesticide sprayers in potato fields compromised the ability of "buffers" to prevent contamination. Preliminary water chemistry results suggested that treating sprayer track rows with mulch may be one way to reduce the risk of runoff posed by these rows, especially the runoff of nitrates into freshwater or estuarine systems close to land.

The Southern Gulf of St. Lawrence Coalition on Sustainability joined the community aquatic monitoring program, which saw 21 community groups from across the southern Gulf of St. Lawrence participate in activities such as counting fish, determining the richness and diversity of fish species, and sampling for dissolved oxygen, nutrients and temperature to determine water quality. The program increased understanding of the state of ecological health of estuaries in the southern Gulf, which supported informed decision-making with respect to restoration action plans.

1.3.2 St. Lawrence Plan

Background

Launched in 1988, the St. Lawrence Plan is a Canada–Quebec ecosystem initiative to protect, preserve and restore the St. Lawrence River ecosystem. This five-year plan, renewed three times since 1988, has achieved concrete results through concerted efforts by federal and provincial departments, supported by the private sector, universities, research centres, ZIP (*Zone d'intervention prioritaire* [priority intervention zone]) committees, non-governmental organizations and riverside communities. Efforts are focused on the St. Lawrence River and its major tributaries, from Lake Saint-François at the Quebec–Ontario border to the eastern end of the Gulf of St. Lawrence.

The 2005–2010 Canada–Quebec Agreement was signed in November 2005. This fourth phase of the Plan continued the collaborative implementation of measures to conserve, protect and restore the ecosystem, and recover its uses. The fourth phase also initiated the implementation of a new governance mechanism to achieve integrated management of the St. Lawrence (www.planstlaurent.qc.ca/sl_bm/interventions_g/psl/phase_IV/fondements/gestion_e.html).

Progress to March 31, 2007

In June 2006, agreement was reached to begin implementing integrated management of the St. Lawrence by creating a provisional St. Lawrence Committee comprising members of the Agreement Management Committee. A support team comprising professionals from the ministère du Développement durable, de l'Environnement et des Parcs du Québec, as well as Environment Canada was created to help set up the provisional committee and, more generally, to support the implementation of integrated management of the St. Lawrence. At the first provisional St. Lawrence Committee meeting on March 16, 2007, information was pooled on the approach and actions selected for implementing integrated management, the Committee's mandate and operating rules were clarified, and discussion took place on the subsequent steps for establishing a permanent St. Lawrence Committee and the St. Lawrence roundtables (www.strategiessl.qc.ca/english.html).

The Committee for the Environmental Planning and Assessment of Dredging provided technical support for contaminated-aquatic-site remediation projects. At the mouth of the Saint-Louis River, 16 000 cubic metres of contaminated sediment was dredged in 2006 and placed in a containment cell.

The Committee for the Environmental Planning and Assessment of Dredging established a

planning registry of dredging activities, updated the legislative framework for managing sediments in Quebec and helped to develop a common approach to evaluating losses of fish habitat due to dredging.

At the public event “Rendez-vous St. Lawrence 2006,” held in Nicolet, the most recent results of the Canada–Quebec State of the St. Lawrence Monitoring Program were distributed. Some 200 participants from community organizations, municipalities, the scientific community, and the federal and provincial governments received the latest findings on the state of the River, discussed environmental issues related to the St. Lawrence and learned about the participation of non-governmental organizations in the monitoring of this major aquatic ecosystem.

The State of the St. Lawrence Monitoring Program found that the physico-chemical quality of the water in the St. Lawrence declined between 1995–2001 and 2003–2005. The main cause appeared to be increased turbidity and phosphorus in the water, combined with increased flow in the St. Lawrence between 2001 and 2005. Sediment quality in Lake Saint-Pierre had improved greatly since the 1970s, and mercury and PCB levels had fallen by more than 90 percent. The area around the Sorel archipelago was still vulnerable to accumulation of contaminated sediments.

Wetland loss along the St. Lawrence had stabilized, or even reversed. However, certain sectors in the Montréal area and at Lake Saint-Pierre presented a negative portrait because of a net loss of wetland area.

Sampling campaigns and analyses were conducted to fulfill Environment Canada’s monitoring responsibilities under the Canada–Quebec State of the St. Lawrence Monitoring Program. These activities centred on water and sediment quality, riverbank erosion, wetlands, invasive plants, Northern Gannet *Morus bassanus* foraging, benthic communities, recreational uses of Lake Saint-Pierre and land use patterns. Remote sensing technology was used for the land use component under an agreement with the Canadian Space Agency.

Six bilingual fact sheets drawing on the updated state of the St. Lawrence environmental indicators were posted on the St. Lawrence Action Plan website. The latest findings on the chemical integrity of the waters of the St. Lawrence were presented at the State of the Lakes Ecosystem Conference in 2006 (www.planstlaurent.qc.ca/sl_obs/sesl/publications/fiches_indicateurs/fiches_e.html).

Improvements were made to online access to sediment geochemistry data for the St. Lawrence, and to the management of data and information generated through water quality and aquatic ecosystem monitoring activities in Quebec.

Governmental and non-governmental partners and collaborators continued to play an active and productive role in reporting on the state of the St. Lawrence, with the members of this network participating by chairing the State of the St. Lawrence Monitoring Program Committee, serving on the Management Committee of the Canada–Quebec Agreement on the St. Lawrence Action Plan for Sustainable Development 2005–2010, and working closely with the co-ordination committees, such as those dealing with ecological integrity, community involvement, access to riverbanks and navigation.

Environment Canada identified priority habitats of bird populations potentially at risk, and set conservation priorities for areas in the St. Lawrence Plain region. A database was constructed, along with a methodology for identifying nationally significant wetlands in the St. Lawrence Lowlands. Launched in early 2007, the *Atlas of Bank Restoration Sites of the St. Lawrence River* (www.planstlaurent.qc.ca/archives/articles/2007/20070216_atlas_e.html) contains information necessary for restoring stretches of riverbank that have been degraded by human activities. Activities continued on the artificial reproduction and stocking of Copper Redhorse and Striped Bass.

Various projects conducted by St. Lawrence Plan partners have effectively reduced the impact of agricultural activities. Environment Canada chose to focus research on the improved use of pesticides by farming activities. Several projects were aimed at monitoring water quality at the mouth of certain tributaries of the St. Lawrence, such as the Yamaska River. In the Baie-Saint-François sector, the pesticide concentrations in air, water and soil were quantified to determine the sources and modes of transport, with the

ultimate goal of introducing and promoting practices to limit the presence of pesticides in the environment. Digital simulators were used to assess the effectiveness of various pesticide-use practices and to help select those that have the least impact on the environment.

The departments that are partners in the St. Lawrence Plan, including Environment Canada, have provided ongoing technical and scientific support to community organizations involved. Among other things, the project provided access to expert advice on specific projects, enabled a scientist to attend a conference, and permitted the transfer of georeferenced data.

During 2006–2007, the Community Interaction funding program enabled 19 projects to be implemented, 9 of which were carried out by ZIP committees and related to the environmental remedial action plans for their respective areas (www.planstlaurent.qc.ca/centre_ref/programmes/pic/accueil_e.html).

Environment Canada's Biosphère has created and led various projects for young people. These include observation/environmental action projects such as Mouille et grouille (action on water woes), which teaches children about erosion and sedimentation issues related to the St. Lawrence and other rivers, and encourages children to suggest and implement environmental protection measures in their community.

Also launched in 2006–2007 was the community intervention project on the shores of the St. Lawrence River, referred to as the "CEGEP project." This is a joint project to raise awareness among college students about the issues affecting the St. Lawrence, and encourage the development of tangible projects for the conservation or enhancement of this ecosystem. It includes a key partnership component involving regional stakeholders.

The St. Lawrence Global Observatory program is designed to offer integrated, rapid and transparent access to data and information from a network of federal and provincial departments, universities and other organizations in order to support sustainable management of the St. Lawrence ecosystem. The Observatory's steering committee, composed for the most part of member organizations of the extended Agreement Management Committee, completed the 2006–2009 business plan and presented it to the community of organizations interested in the program.

Progress to March 31, 2008

As specified in the Canada–Quebec Agreement on the St. Lawrence, the requisite government approvals were obtained to implement integrated management of the St. Lawrence and to secure the commitment of non-governmental partners. A steering committee was set up to submit requests for government approval.

In the summer of 2007, dredging of 4500 cubic metres of contaminated sediment was carried out in sector 103 of the Port of Montréal. These sediments were to be dried and disposed of before 2010. Aquatic and terrestrial revegetation work was carried out at the site in the summer of 2007.

For the Port of Gaspé (Sandy Beach), remediation options were examined and a project was selected. Follow-up on these remediation projects has enabled identification of the elements of a standardized approach for contaminated site remediation in order to begin a process that would lead to the selection of other contaminated aquatic sites for assessment.

The revision of the criteria for assessing sediment quality was completed and the final report published at the beginning of 2008 (www.planstlaurent.qc.ca/centre_ref/publications/diverses/Qualite_criteres_sediments_e.pdf).

The Friends of the St. Lawrence Valley developed a presentation on the environmental advantages of marine transportation, as well as its limitations and challenges. The Sustainable Navigation Strategy and Quebec Marine Transportation Policy were the subject matter of the presentations. The presentation was given in a dozen port cities (Baie-Comeau, Sept-Îles, Valleyfield, Québec, Sorel-Tracy, Rimouski, Matane, Gaspé, Saguenay, Montréal, Trois-Rivières and Bécancour) between September 2007 and May 2008. The presentations drew a total of almost 300 people representing approximately 200 different organizations. Local media attended all of the sessions and the participants appreciated the documentation provided.

A number of initiatives were launched to improve the water and sediment indicators and encourage community participation. The fact sheets on water and biological resource components were updated, and other fact sheets were drafted on the following topics: monitoring of sediment contamination (mercury and phosphorus) in Lake Saint-Louis, riverbank erosion, land use, organic toxic substances at the mouths of the Yamaska and Richelieu rivers, and benthic invertebrates in Lake Saint-Pierre (www.qc.ec.gc.ca/csl/pgr/pgr002_e.html).

Environment Canada continued monitoring under the State of the St. Lawrence Monitoring Program and increased the spatial coverage. New substances were added to the list of parameters analyzed. Monitoring of riverbank erosion was extended to the river proper, and polybrominated diphenyl ethers, tributyltins, and pharmaceuticals and personal care products were included in the parameters related to water and sediment quality.

Scientific findings from the State of the St. Lawrence Monitoring Program were distributed at various meetings, including the 14th Annual International Conference on the St. Lawrence River Ecosystem, the Society of Wetland Scientists annual meeting, and the annual conference of the Association francophone pour le savoir. In addition, environmental indicators for the St. Lawrence were updated, with a view to the preparation of fact sheets as specified in the schedule of dissemination of results for the State of the St. Lawrence Monitoring Program posted on the St. Lawrence Action Plan website.

Changes observed in the state of the St. Lawrence were documented as part of drafting the preliminary version of the *Overview of the State of the St. Lawrence River*, a process that included all the partners involved in implementing the Canada–Quebec State of the St. Lawrence Monitoring Program (www.slv2000.qc.ca/plan_action/phase3/biodiversite/suivi_ecosysteme/portrait_a.htm).

Support was provided for community efforts to monitor invasive plant species by providing communities with data collection guidelines. Training sessions were provided to ZIP committees, among other groups, on the monitoring of invasive plant species and riverbank erosion. In addition, scientific and technical support was provided to assist monitoring efforts related to recreational uses of Lake Saint-Pierre. Non-technical information on the results of the State of the St. Lawrence Monitoring Program was disseminated to non-governmental organizations through the use of a special booth during the training sessions.

The water quality database was expanded, further improved and made more accessible to facilitate its use, as well as data collection, related to the health of the river.

The approach in the area of ecological integrity was modified to harmonize the different measures and emphasize complementarity. Work proceeded on developing a portrait of the protected areas in Quebec in co-operation with conservation organizations. The goal is to pool the databases maintained by the different levels of government and non-governmental organizations and identify gaps.

Agriculture-related projects continued in 2007-2008. Environment Canada also contributed to the National Agri-Environmental Standards Initiative related to pesticides. Several pesticide monitoring projects were carried out, for example in the Yamaska River and at the mouth of major tributaries of the St. Lawrence, such as the Richelieu River. In addition, a study was carried out to determine the inputs of sediments, nutrients and agricultural contaminants that have occurred in Lavallière Bay over the years. As well, many wildlife-related projects were implemented to address issues such as the development of watercourses in agricultural areas, and monitoring of wildlife habitats, water quality at spawning sites and indicator species.

A meeting of the constituent assembly of the St. Lawrence Global Observatory was held on October 25, 2007, and the new Board of Directors was established. Seven universities, three federal departments, three associated organizations and four observers from the Government of Quebec were in attendance (http://ogsl.ca/en.html).

During 2007–2008, 18 projects were implemented under the Community Interaction funding program, including 15 projects established by ZIP committees related to environmental remedial action for their respective areas. A considerable decline was observed in the number of projects submitted and funded

(www.planstlaurent.qc.ca/centre_ref/programmes/pic/accueil_e.html).

Work continued on education programs for young people under the CEGEP community project on the shores of the St. Lawrence River, initiated in 2006–2007. A pilot phase was carried out at La Pocatière CEGEP.

1.3.3 Great Lakes Program

Background

The federal Great Lakes Program, a partnership involving seven federal departments and one federal agency, has the goals of a healthy environment, healthy citizens and sustainable communities. The Program significantly bolsters Canada's work to protect and restore the Great Lakes Basin ecosystem, particularly in combination with Environment Canada's Great Lakes Basin Ecosystem Initiative.

Federal partner departments' activities were integrated with those of Ontario through the 2002 Canada–Ontario Agreement Respecting the Great Lakes Basin Ecosystem, and more recently through the 2007 Canada–Ontario Agreement Respecting the Great Lakes Basin Ecosystem. The Agreement outlines how the two governments will co-operate and co-ordinate their work to restore, protect and conserve the ecosystem. It builds on the actions taken through previous agreements and focuses priorities for future actions, and contributes to meeting Canada's obligations under the Canada–United States Great Lakes Water Quality Agreement.

Signatories to the Agreement include seven federal departments and agencies (Agriculture and Agri-Food Canada, Environment Canada, Fisheries and Oceans Canada, Health Canada, Natural Resources Canada, the Parks Canada Agency, and Transport Canada) and three Ontario ministries (Environment, Natural Resources, and Agriculture, Food and Rural Affairs).

Progress to March 31, 2007

Monitoring of Great Lakes Areas of Concern continued in 2006–2007. A characterization of St. Marys River sediment was undertaken in response to binational concerns. The levels of *Escherichia coli* (E. coli), nutrients, metals, petroleum hydrocarbons and other organic contaminants were assessed and reported. Analysis was conducted of sediments in the Thunder Bay harbour and at Peninsula Harbour (on the north shore of Lake Superior) to delineate the most contaminated areas of the harbours in support of Environment Canada's sediment remediation program. Preliminary work was carried out in Blackbird Creek (Jackfish Bay Area of Concern) to determine the level of contamination in sediments, as part of the delisting process for this Area of Concern.

Environment Canada continued to conduct monitoring programs throughout the Great Lakes to meet identified needs under the Canada–Ontario Agreement Respecting the Great Lakes Basin Ecosystem, specifically the identified needs of the Lakewide Management Plan working groups, the Remedial Action Plan teams and the Binational Toxics Strategy. These monitoring programs included the

- Great Lakes Open Lakes Surveillance Program (focusing on lakes Superior and Ontario in 2006–2007), which provides status and trends information for water quality, reports on compliance with established guidelines, and serves to identify new and emerging issues;
- Great Lakes Fish Contaminants Surveillance Program, which measures and reports on trends in legacy and emerging contaminants within top predator and forage fish species in the four Great Lakes that border Canada (this program was recently transferred from Fisheries and Oceans Canada to Environment Canada);
- Connecting Channels monitoring programs in the St. Clair, Detroit, Niagara and St. Lawrence rivers, to measure and report on trends in inputs/outputs from the connecting channels to the lakes, and to measure the success of implemented remedial measures in these Areas of Concern; and
- Integrated Atmospheric Deposition Network, a binational program with the U.S. Environmental Protection Agency to report on spatial and temporal trends in concentrations and loadings of priority toxic chemicals to the Great Lakes.

The Great Lakes Cooperative Monitoring Initiative (piloted in 2003) works to address key information needs. The needs are identified by

the Lakewide Management Plan working groups. The initiative supports new monitoring of, and research into, one Great Lake at a time, on an annual rotational cycle endorsed by a Binational Executive Committee. In 2006, the binational focus was on Lake Superior. The expertise and participation of agency staff and academia was sought in designing a program to address that focus. The majority of projects initiated by Environment Canada in 2005 (while the United States focused on Lake Michigan) continued into 2006. Samples were collected from air, water, lake and tributary sediments, fish and organisms lower in the food chain than fish. The samples were analyzed for a wide range of organic compounds, including new and emerging chemicals, thus allowing scientists to look at concentrations from the same time period in the sampled media. Investigators also had the opportunity to better understand the impact of invasive species on organisms at lower trophic levels. A herptile (amphibian and reptile) monitoring pilot study, initiated in the Lake Superior Basin in 2005, continued in 2006.

Updates on the Great Lakes Lakewide Management Plan were released in April 2006 for lakes Superior, Huron, Erie and Ontario. Plan implementation was facilitated with partners during the 2002–2007 time frame on the restoration, conservation and protection of habitat as well as native species restoration, and to support locally based harmful pollutant reductions, such as implementation of the Zero Discharge Demonstration Program for Lake Superior and implementation of local action plans for priority watersheds in Lake Erie (Grand River, Thames River, Rondeau Bay, and the Huron–Erie Corridor).

To improve scientific understanding of the fate and effects of harmful pollutants and the causes of ecological impairments for each lake, partner agencies researched and reported the latest scientific understanding on a lake-by-lake basis through a number of networks and mechanisms, including the 2006 biennial State of the Great Lakes Conference and the 2006 Lake Erie Millennium Network Conference.

Progress to March 31, 2008

A new Canada–Ontario Agreement Respecting the Great Lakes Basin Ecosystem was signed on June 25, 2007.

Monitoring continued on the Great Lakes Areas of Concern. In 2007–2008, there were sediment assessments in selected Areas of Concern (Hamilton Harbour, Cornwall, Jackfish Bay, Toronto Harbour, Nipigon Harbour and the Spanish River) to determine concentrations of new and emerging (newly recognized) contaminants, specifically brominated flame retardants and perfluorinated compounds. Both classes of compounds are a priority under Canada's Chemicals Management Plan. Toronto Harbour was further sampled to assess benthic community health, including nutrient, metal and organic contaminant concentrations. The sediment assessment in the St. Marys River continued with an evaluation of E. coli levels at sites not characterized in 2006. Work proceeded in the Turkey Creek PCB trackdown study in collaboration with the Ontario Ministry of the Environment. Sediment remediation in the creek has been carried out by Environment Canada as a direct result of this study.

Environment Canada continued to conduct monitoring programs throughout the Great Lakes in response to Annex 2 of the new Canada–Ontario Agreement Respecting the Great Lakes Basin Ecosystem.

In 2007, the binational focus in the area of co-operative monitoring was on Lake Huron to address two main issues. The first identified need was to better understand the decline of organisms below fish in the food chain and the impact of this decline on fish populations. This multiple-agency initiative involved numerous cruises on various small and large vessels to collect samples from the part of the food web comprising plankton up to small prey fish. Protocols were standardized prior to the start of the program to ensure data comparability. The second identified need was for improved chemical (trace organic) characterization of the lake. Samples were collected in various media and analyzed for numerous organic compounds, including new and emerging chemicals. Sediment cores were taken at key sites and analyzed for dioxins and furans. As part of the Cooperative Monitoring Agreement, participating scientists agreed to present their findings in a special session at the 2009 International Association for Great Lakes Research conference.

To improve scientific understanding of the fate and effects of harmful pollutants and the causes

of ecological impairments for each lake, partner agencies researched and reported the latest scientific understanding on a lake-by-lake basis through a number of networks and mechanisms, including the 2007 binational conference, Making a Great Lake Superior.

1.3.4 Northern Ecosystem Initiative

Background

The Northern Ecosystem Initiative was launched in 1998 and renewed for a second five-year mandate in 2003. It supported partnership-based efforts to improve the understanding of impacts of and adaptation of ecosystems to climate change, investigations of local contaminant concerns, improved management of resource-use activities, and the development of a northern monitoring network in support of status and trend reporting. The initiative supported projects that addressed science- and capacity-building needs throughout the Canadian North, including the Yukon, the Northwest Territories, Nunavut, the lowlands of northern Manitoba and Ontario, northern Quebec and Labrador.

The initiative is guided by the principle of sustainable development and follows an interdisciplinary scientific approach that also seeks to promote the use of local and traditional knowledge systems in combination with Western scientific knowledge and methodologies.

Progress to March 31, 2007

Several water-related projects were funded by the Northern Ecosystem Initiative in 2006–2007. The Labrador Wetlands and Highway Wetland Project looked at the impact that a double land corridor (Trans-Labrador Highway) would have on water quality and quantity, and migratory bird populations. Progress to March 31, 2007, included a hydrological assessment of the area using satellite imagery, water sampling in survey blocks and the collection of three sets of data for water quality. Water chemistry showed clear waters: a conductivity of 8–13 µS/cm, low turbidity, and pH between 5.6 and 6.8 units.

The Northern Ecological Monitoring Community of Practice and Provision of Ecosystem Status and Trends Information project focused on the Yukon, the Northwest Territories, Nunavut, northern Manitoba and Labrador. This project involved the printing of 200 English and 25 French northern-water-quality manuals for distribution among government agencies, research institutes and northern community organizations to improve the understanding of ecological change in northern Canada by promoting, co-ordinating and communicating the results of long-term ecological monitoring.

A study on the impacts of changes to northern lakes' water and energy budgets (Great Bear Lake, Northwest Territories) involved the merging of scientific and traditional knowledge; local traditional knowledge was used to validate regional results. Regional knowledge of the fluxes of heat and air, and water flow enhanced the understanding of the local patterns of wind, ice, snow and stream discharge. Investigators learned that Great Bear Lake is dimictic: it freezes and goes through two stratifications and two temperature mixing cycles each year.

A project on the sensitivities of high-latitude lakes to climatic and development disturbances in the Beaufort–Delta region, Northwest Territories, included establishment of survey sites that represent Canada's first co-ordinated response to recommendations made by the Arctic Climate Impact Study regarding the need for circumpolar observatories to research and monitor the effects of climate change on aquatic ecosystems. Preliminary analyses indicated a significant difference in macrophyte biomass between lakes with and without permafrost slumping.

A pilot project was undertaken in two Inuit communities in Labrador on drinking water quality and climate change. This involved the merging of scientific and traditional knowledge. Progress to the end of March 2007 included scoping of key water issues in Nunatsiavut communities through a workshop, a literature review, a microbiological analysis and community interviews.

Dose-response curves and thresholds were applied on a landscape scale for northern waters in the Yukon and Nahanni region of the Northwest Territories. The goal of this project was to improve the understanding of cumulative effects thresholds for northern waters and develop tools for management to ensure the sustainability of freshwater in the North. Results demonstrated that it is possible to have a larger-scale model for evaluating relationships between

land uses and indicators of aquatic health in Northern Canada west of the continental divide.

Progress to March 31, 2008

A study was undertaken to determine the concentration and form of mercury in coal deposits and sediments in the Mackenzie River in the Northwest Territories, and evaluate their contribution to the mercury impact on the ecosystem. By the end of March 2008, a solid baseline had been established from which to continue long-term monitoring of the ecosystem. Lake-fed tributaries have shown a significant correlation between organic matter and mercury. Some samples collected from the coal bed near Tulita exceeded the average levels of mercury found in world coals by up to 25 times.

A project continued in two Inuit communities in Labrador on drinking water quality and climate change. This project involved the merging of scientific and traditional knowledge. Feedback from community members indicated more algae and insects due to increasingly still water, and a general increase in the overall temperature of the water, which encourages bacterial growth. More than 50 years of historical data revealed an increase in air temperatures and fluctuations of precipitation levels.

1.3.5 Georgia Basin Action Plan

Background

The Georgia Basin Action Plan (2003–2008) was a multi-partnered initiative whose participants worked to improve the state of the environment in the Georgia Basin region in southwestern British Columbia. The action plan built on work undertaken by its predecessor, the Georgia Basin Ecosystem Initiative (1998–2003).

The Plan was based on the guiding principles of accountability, ecosystem approach, pollution prevention, science-based decision making, and sustainability. Its governing partners were the British Columbia Ministry of Environment, Coast Salish, Fisheries and Oceans Canada, and the Parks Canada Agency. As the Plan drew to a close, its legacy of more integrated partnerships to better manage environmental, social and economic actions in the Georgia Basin continued.

Progress to March 31, 2007

Surface water monitoring continued at 13 sites in the Georgia Basin area, 6 of which were added to the federal–provincial water quality network in British Columbia through the Action Plan. Water quality in the estuary and in tributaries of the lower Fraser River was also sampled in a surveillance project assessing emerging contaminants in the lower Fraser River.

The Canadian Aquatic Biomonitoring Network approach continued to be implemented and expanded in the region to assess aquatic ecosystem health. This approach is based on assessing the structure of stream benthic communities. In 2006, 36 sites were sampled; 18 of these were at water quality monitoring sites. This sampling was expanded to the Okanagan Basin and to national parks in British Columbia. An online training framework for implementation of this approach was developed in collaboration with the University of Canberra and the University of New Brunswick, Canadian Rivers Institute. Adoption of the approach was promoted through training workshops, presentations and advice to interested groups.

Studies continued on the transport and fate of PCBs and polybrominated diphenyl ethers in the Strait of Georgia. Because these contaminants are now at high concentrations in marine mammals (whales and seals), an assessment was undertaken of the relative contributions of the suspected sources of these contaminants to the Strait. The studies are being conducted mainly through agreements developed with Simon Fraser University, the Greater Vancouver and Capital (Victoria) Regional Districts, Fisheries and Oceans Canada and the British Columbia Ministry of Environment. Environment Canada organized a technical session focused on the Strait of Georgia work at the March 2007 Georgia Basin–Puget Sound Research Conference in Vancouver.

The Georgia Basin Action Plan supported the *Fraser Valley Soil Nutrient Study (2005)*, a multi-stakeholder study published in February 2007, to determine the nitrogen, phosphorus and potassium status of agricultural soils in the Lower Fraser Valley. Nutrient surpluses pose environmental risks because agricultural runoff and groundwater contamination are significant sources of pollutants in the Georgia Basin. This study created a baseline data set to monitor the effectiveness of activities

under the national Agricultural Policy Framework, including the Canada–British Columbia Environmental Farm Plan Program. Approximately one third of farms were in the high to very high environmental risk class for residual nitrate nitrogen. Eighty percent of fields were in the high to very high environmental risk class for phosphorus in the 0–15 cm depth. Forty-seven percent of fields were in the high to very high Kelowna extractable potassium classes (an agronomic test) in the 0–15 cm depth (www.agf.gov.bc.ca/resmgmt/EnviroFarmPlanning/FV_SoilNutrientStudy/_FVSNS-CombinedReport_Feb28_2007_for_Release.pdf).

Work was undertaken on the environmental impacts of emerging chemicals of concern in municipal wastewater effluent. The Georgia Basin Action Plan supported Environment Canada's Pacific and Yukon Laboratory for Environmental Testing in its study of the interaction between salmonid gene transcript expression and exposure to emerging chemicals of concern (endocrine-disrupting substances, pharmaceuticals and personal care products) in municipal wastewater effluent. The study concluded that endocrine, metabolic and immune gene transcripts were most affected by exposure to municipal wastewater effluent. Gene expression changes were often seen within one day of exposure and some were maintained after eight days of depuration (removal of impurities). The study's results helped with the incorporation of molecular indicators into municipal wastewater effluent monitoring and management programs.

To increase understanding of the health of the Georgia Basin–Puget Sound ecosystem, the Georgia Basin Action Plan and the U.S. Environmental Protection Agency co-led a bi-national team to track and report on transboundary indicators (www.epa.gov/region10/psgb/indicators). According to the indicators for the years covered (1989–2004) by the report, of the 16 freshwater sites measured, five had "excellent" water quality, five were "good," three were "fair," two were "marginal," and one was "poor" (www.epa.gov/region10/psgb/indicators/freshwater_quality/media/pdf/Stream%20and%20Lake%20Quality%20Technical%20Background%20Document.pdf). Ratings are based upon the Canadian Council of Ministers of the Environment's Water Quality Index (www.ccme.ca/ourwork/water.html?category_id=102):

- Sites with an "excellent" rating were Fraser River: Main Stem; Fraser River: Sturgeon Bank; Long Lake; Middle Quinsam Lake; Upper Quinsam River.
- Sites with a "good" rating were Fraser River: Kanaka Creek Mouth; Fraser River: North Arm; Oyster River; Little Oyster River; Woodhus Lake.
- Sites with a "fair" rating were Fraser River: Middle Arm; Cowichan River; Koksilah River.
- Sites with a "marginal" rating included Holland Creek; Stocking Lake.
- Site with a "poor" rating was Tsolum River.

Water quality at five locations on the Fraser River was monitored and two were rated "excellent," two "good," and one "fair." The indicator based on closures of shellfish-growing areas provides information on nearshore water quality. From 1989 to 2004, the number of growing areas closed to commercial shellfish harvesting rose 64 percent. This increase is attributable more to expanded monitoring than degradation of water quality. In 2004, 58 percent of British Columbia closures were located in the Georgia Basin.

The Marine Water Quality Indicator provided information on the relative vulnerability of marine waters to water quality problems, such as excessive algal blooms and low dissolved oxygen levels. From 1999 to 2004, 13 water quality stations were monitored seasonally, with most showing strong, persistent stratification from the Fraser River's freshwater influence. Stations located in strong, tidally induced mixing areas, such as Boundary Pass, Rosario Strait and the northern end of the Strait of Georgia, showed moderate, infrequent stratification.

To monitor groundwater quality, and determine the extent and trend of nitrate contamination, Environment Canada operates and maintains a network of monitoring wells in the transboundary Abbotsford–Sumas aquifer. Monthly groundwater samples were taken from 23 of these monitoring wells and annual samples from 53 monitoring wells for analysis of a range of water quality parameters including nitrate. Nitrate levels in large parts of this aquifer were above Canadian Drinking Water Guideline levels, largely attributable to non-point sources (www.ecoinfo.ec.gc.ca/env_ind/region/nitrate/nitrate_e.cfm).

A survey of privately owned/operated water supply wells in the Canadian portion of the Abbotsford–Sumas aquifer was reported on in 2007, indicating that approximately 40 percent of the sampled wells were above the Canadian Drinking Water Quality Guidelines for nitrate, which is 10 milligrams of nitrogen per litre (mg N/L). Nitrate concentrations in over 60 percent of the sampled wells were above 3 mg N/L, indicating widespread input from anthropogenic sources. Overall nitrate concentrations ranged from non-detectable (<0.02 mg N/L) to a high of 78.4 mg N/L (www.waterquality.ec.gc.ca/EN/navigation/publications/Publications/2004Nitrate/toc.html).

Environment Canada continued to work with other agencies and stakeholders to mitigate nitrate contamination of the aquifer, and participated in a meeting of the Abbotsford–Sumas Aquifer International Task Force, along with British Columbia and Washington State counterparts.

Progress to March 31, 2008

Water quality monitoring continued at 13 sites in the Georgia Basin area.

The Canadian Aquatic Biomonitoring Network approach continued to be implemented for stream-condition assessment. Twelve sites in the Georgia Basin area, as well as 12 within the upstream Fraser Basin, were sampled for the Canadian Aquatic Biomonitoring Network. In addition, 31 other sites in the Okanagan and Columbia River watersheds were sampled, as well as 25 sites in Yukon, as part of the International Polar Year Yukon Survey project. Implementation of the Canadian Aquatic Biomonitoring Network is expanding across the country and setting the basis for aquatic ecosystem condition assessment. This approach is based on assessing the structure of stream benthic communities. Canadian Aquatic Biomonitoring Network training, presentations and advice were provided to various interested groups and agencies.

Research studies continued on toxic substances, specifically the transport and fate of PCBs and polybrominated flame retardants in the Strait of Georgia.

The Georgia Basin Action Plan and the British Columbia Ministry of the Environment implemented five new monitoring stations to measure water quality trends in four Georgia Basin watersheds. This provides enhanced water quality reporting for the Georgia Basin Water Quality Index (www.waterquality.ec.gc.ca/EN/Home/GBAP/GBAP_monitoring.htm).

Sites were chosen to assess impacts on water quality from a variety of anthropogenic activities, including forestry, urbanization and the 2010 Olympics. Data is assessed using the Canadian Council of Ministers of the Environment's Water Quality Index. Information will also be used in Canadian Environmental Sustainability Indicators reports.

The Georgia Basin Action Plan continued to help fund a real-time buoy water quality monitoring in the Fraser Estuary.

Total PCB and polybrominated diphenyl ether loadings continued to be identified through mass balance estimates. This project investigated the sources, pathways and fates of these substances in the Strait of Georgia. The mass-balance model assessed the contribution of various sources of both substances to levels observed in marine mammals, birds and fish in the Georgia Basin, and formed a strong base for developing models for other chemical contaminants. An initial estimate suggested total PCB and polybrominated diphenyl ether loadings of 19 and 53 kg/year, respectively. Wastewater treatment plants contributed approximately 50 percent of the polybrominated diphenyl ethers and approximately 18 percent of the PCBs, reinforcing the emergence of polybrominated diphenyl ethers as a threat to marine food webs. Atmospheric transport and deposition accounted for 35–50 percent of the loading.

The Water Balance Model's companion publication, *Beyond the Guidebook: Context for Rainwater Management and Green Infrastructure in British Columbia* (www.waterbucket.ca/rm/sites/wbcrm/documents/media/37.pdf) was released, advancing implementation of green infrastructure policies and practices throughout British Columbia. The Water Balance Model is an Internet-based scenario modelling tool that promotes a watershed-based approach to urban storm water management (http://beta.waterbalance.ca/index.asp).

The Georgia Basin Contaminant Loading Project was undertaken. Specifically, Environment Canada implemented a new monitoring approach to increase the accuracy of contaminant loading estimates from the Fraser River to the Strait of Georgia. This study looked at PCBs, polybrominated diphenyl ethers, polycyclic aromatic hydrocarbons, nonylphenols, pesticides and sterols. The project overcame sampling complications in freshwater quality monitoring caused by tidal recirculation of water and associated contaminants.

The Green Shores project was undertaken (www.greenshores.ca). It provides planning, design and construction professionals with tools to minimize their projects' environmental impacts on shorelines. Green Shores also offers a voluntary assessment and certification process for shore developments, similar to the Leadership in Environmental and Energy Design certification system for buildings.

To monitor groundwater quality and determine the extent and trend in nitrate contamination, Environment Canada operated and maintained a network of monitoring wells in the transboundary Abbotsford–Sumas aquifer. Monthly groundwater samples were taken from 30 of these wells, in addition to a wider annual sampling event of 60 wells, for analysis and assessment of a range of water quality parameters including nitrate. This represents a slight increase over the previous year due to the installation of several new monitoring wells in the aquifer (www.ecoinfo.ec.gc.ca/env_ind/region/nitrate/nitrate_e.cfm).

Environment Canada continued to implement, in partnership with other federal, provincial and municipal agencies, projects to educate the public on groundwater stewardship, and provide relevant data and information to partner agencies and other groups. The Department helped organize a science forum on the Abbotsford–Sumas aquifer in April 2007, bringing together a wide range of scientists from various disciplines, government agencies, and academic institutions in Canada and the United States. They presented research findings related to the aquifer and identified issues, knowledge gaps and actions towards achieving reduced nitrate concentrations.

Environment Canada, through collaboration with and the support of researchers at Simon Fraser University, concluded the second phase of development of a numerical model that will be used to assess the environmental impacts of land use practices and land management strategies. Phase One comprised the development and verification of a groundwater flow model and Phase Two comprised a contaminant transport model that provided simulations of non-point source nitrate transport in the aquifer. Due to the inherent challenges associated with non-point source groundwater contaminant transport modelling, additional field investigation work and transport model verification was under consideration during the reporting period.

Environment Canada continued to work with other agencies and stakeholders to mitigate nitrate contamination of the Abbotsford–Sumas aquifer, and improve understanding of the distribution and trends of nitrate contamination in the aquifer and related causative factors. Another forum was being developed to follow up on the Abbotsford–Sumas Aquifer Science Forum, with a focus on stakeholder engagement and dialogue.

2. Water Research

This section describes selected research activities conducted by the Water Science and Technology Directorate, the St. Lawrence Centre, and the Pacific Environmental Science Centre; and other research highlights.

2.1 Water Science and Technology Directorate

Background

The Water Science and Technology Directorate at Environment Canada led initiatives across the country to protect and sustain Canada's aquatic ecosystems, aquatic biodiversity, and the quality and quantity of Canadian water resources. During the two reporting periods, the Directorate collaborated with partners from governments, universities and the private sector to confront Canadian and global freshwater problems, and restore damaged sediments, lakes, rivers, groundwater and wetlands. A primary goal was to make timely water science information available to science users, providing the targeted research

results needed by environmental policy makers and managers to address environmental problems.

Progress to March 31, 2007

Perfluorinated compounds such as perfluorooctanesulfonic acid and perfluorooctanoic acid, as well as synthetic musks, alkyl phosphate and chlorinated paraffin flame retardants, were identified in the Great Lakes for the first time. Work will continue to determine whether these compounds are persistent in the environment, the source of the compounds and their potential to bioaccumulate in living organisms.

The occurrence and fate of the antimicrobial triclosan were determined in sewage treatment plant sludge samples and Lake Ontario. The presence of this compound could affect the function and diversity of natural microbial benthic communities in and around effluents, thus affecting the resilience of ecosystems. Further research will help in the understanding of these impacts.

The effects of organic contaminants, including various pharmaceuticals, personal care products and biotechnology products, such as genetically modified organisms, were studied in Canadian aquatic environments. A method for tracking the source of proteins and DNA from Bt-transgenic corn in the environment was developed and published. Researchers documented horizontal gene transfer of transgenic strands of DNA from corn to aquatic bacteria and ultimately to freshwater mussels near corn-growing areas. Researchers further developed a genetic technique to identify and distinguish live and dead DNA from bacteria in order to assess the importance of commercial bacterial products in natural ecosystems.These results will permit us to better understand and assess the cumulative effects of pollution of biological origin on ecosystems, and their complex fate.

Mixtures of pesticides and mixtures of inorganic metals were assessed for toxicity to aquatic invertebrates and fish. The acute and chronic toxicity of arsenic, cobalt, chromium and manganese to a water amphipod was assessed in relation to exposure and bioaccumulation in sediments. All of these metals were toxic to varying degrees, but acted in a cumulative and sometimes multiplicative fashion when tested in combination, highlighting the need to consider whole-system contamination in ecosystems to fully understand the consequences of human activities.

Studies of fish health in Great Lakes Areas of Concern continued to aid in assessment of these sites for continued remediation and eventual delisting of several Canadian Areas of Concern.

The National Environmental Effects Monitoring Office is co-ordinating a National Investigation of Cause project (in collaboration with industry and three universities), which is studying the effects of pulp and paper mill effluents on fish reproduction. Important changes in fecundity and production of offspring were observed in areas affected by effluents.

Scientists also assessed pesticide runoff from agricultural areas following light and heavy rains. The studies were conducted in areas where fish kills from agricultural activities have been noted in the past. These studies confirmed that the current use of 10-metre buffer zones along streams, which are required for gently sloped fields (i.e. < 5 percent slope), was not sufficient for the protection of aquatic life from pesticide runoff: 15–20 metres of buffer zone would be preferable. Buffer zones are areas along streams that are left in a natural state in an effort to absorb and retain runoff during rain events.

New methodologies were developed:

- New test bioassays and methods were developed for fish, invertebrates and complex algal/bacterial/microbial microcosms.
- New methods for the chemical detection in the environment of emerging compounds, such as certain pharmaceuticals and personal care products, were developed and applied to Canadian aquatic environments.
- Development and testing of new microbial source-tracking methods identified bird fecal droppings, rather than sewage treatment plant effluents, as the primary source of the E. coli that caused beach closures.

In the area of modelling, Environment Canada participated in a joint Canada–United States technical review of the computer models used to help define phosphorus load abatement for

Annex 3 in the Great Lakes Water Quality Agreement. The main finding was that while post-audit model results confirmed observed trends for the past 30 years in open waters, improvements to understanding near-shore processes and modelling were required. Efforts were initiated to implement the recommended improvements in monitoring and research programs.

To reduce pollution from combined sewer overflow, research studies were conducted regarding characteristics and treatability of combined sewer overflows. These studies, done in collaboration with several municipalities in the Great Lakes region, resulted in refinement of a high-rate treatment process based on chemical additions. This process was adopted by the City of Toronto for retrofitting an older combined sewer overflow storage facility in North Toronto. The retrofitted facility will store and treat combined sewer overflows and provide a much improved level of service with respect to both the hydraulic capacity and the level of treatment. Similar applications in other Great Lakes municipalities were examined in an effort to improve conditions in those Areas of Concern with combined sewer overflow pollution.

Efforts were undertaken with respect to controlling the release of pharmaceuticals and personal care products into the environment through one of the most important management strategies: advanced municipal wastewater treatment. The occurrences of such substances in Canadian municipal wastewater, and the attenuation of their concentrations by various treatment processes, are of great interest in assessing this management strategy. Research results on the occurrence of pharmaceuticals and personal care products in Ontario wastewaters and their reductions by treatment were published and shared with colleagues in this field. Future studies will deal with additional contaminants addressed under the Government of Canada's Chemicals Management Plan.

Source water protection was studied as a way to improve the taste and odour of drinking water. Environment Canada is one of the major contributors to the science behind developing drinking water intake protection zones in the Great Lakes. The Department's National Water Research Institute researchers worked with partner agencies to compile and interpret long-term data, and provided guidance to the Government of Ontario on implementing Ontario's *Clean Water Act*. Institute studies provided information on nutrients and physical processes and, for the first time, showed the importance of monitoring pathogens near drinking water intakes in Lake Ontario. Institute studies also showed the current uncertainties in models that were being used, and provided extensive data sets and guidance to partners to heighten confidence in the results. Research on this issue will continue at various locations throughout the Great Lakes.

Toward reducing nutrient impacts on the environment (Lake Winnipeg), researchers from Environment Canada have, as part of the Lake Winnipeg Basin Initiative, been assessing the level of impairment, hydrological and physical regimes, and nutrient sources and sinks to develop models leading to a successful restoration and management strategy for Lake Winnipeg. Basic water quality parameters, sediment cores, biota and physical limnology were measured in the Red River and Lake Winnipeg. A study on phosphorus source tracking was also initiated in Lake Winnipeg to determine variability of phosphorus over time and space. Preliminary results show significant spatial variability in the phosphorus fingerprint, particularly in the north basin of Lake Winnipeg.

Progress to March 31, 2008

New results show that perfluorinated compounds, such as perfluorooctanesulfonic acid and perfluorooctanoic acid, are present in relatively important quantities in the Lake Ontario food web and in rivers across Canada. The impacts of these substances will continue to be assessed.

Studies of the antimicrobial triclocarban focused on its occurrence and fate in samples of sewage treatment plant sludge, as well as in the open waters of Lake Ontario. Triclocarban is a substance with anti-bacterial and anti-fungal properties that is used in disinfectants, soaps and other household products, and can act as an endocrine disruptor. This raises some concerns due to the 45 years it has been used in personal care products and the current surge in popularity of its use in anti-bacterial products.

The fractionation of mercury isotopes in Lake Ontario sediments was demonstrated for the first time, pointing to the possibility of using the

natural mercury isotopes to characterize sources of mercury in the environment.

Research characterized components in Athabasca tar sands mixtures, including naphthenic acids, process chemicals, gas condensates, heavy oils and other hydrocarbon mixtures. This will allow Environment Canada researchers to better identify the substances that can potentially leach from the tar sands to natural aquatic ecosystems, better understand the substances responsible for any toxicological effects and identify ways to reduce their impacts on the environment.

Studies on fish from lakes in the Canadian Shield were completed. Researchers examined spatial and temporal trends of persistent organic contaminants (including new contaminants such as brominated flame retardants and perfluorinated chemicals) and mercury in fish, and the bioaccumulation of these substances in food webs. Results indicate an increase in concentration of these contaminants, which is correlated with human activity, and a concurrent reduction in concentration once the chemicals are no longer in use.

Studies investigated the deposition of fluorinated and brominated chemicals in Arctic ice caps and their presence in high Arctic lake waters. This research is necessary to understand the world-wide movement of contaminants via the atmosphere and ocean circulatory gyres, the source of contamination from other continents and the impact of management actions. Results indicate that many persistent organic contaminants are decreasing in the Arctic as a result of regulatory efforts but many more are increasing, especially those in world-wide use, production and emission, such as mercury.

Canadian environments that were contaminated with mixtures of compounds (pulp mill effluents, municipal wastewater effluents) and sediments contaminated with metals and polycyclic aromatic hydrocarbons were assessed for effects in fish, invertebrates and algal/microbial systems. The findings were linked to effects in the receiving ecosystem.

New tests, bioassays and methods (including genomics techniques) for fish, invertebrates and complex algal/bacterial/microbial microcosms were developed and applied.

A source-tracking study found that sewage contamination at an Ottawa beach was mostly associated with rain events and sewage sources on the Ontario (rather than the Quebec) side of the Ottawa River.

Multivariate statistical techniques were used to reveal relationships between fish health measures and measured chemical contaminants in fish from Canadian Great Lakes' Areas of Concern.

To protect streams from pesticide runoff, 20-metre buffer zones were recommended to the Government of Prince Edward Island, which recently updated its buffer legislation and extended the minimum buffer requirement to 15 metres.

Models linking non-point source pollution in runoff from agricultural sources to streams and other models of water quality near the shores of lakes were developed for selected watersheds in the Great Lakes Basin and other regions. The models used two different sets of data and scenarios developed for land use management and biodiversity management. The first set was developed under the National Agri-Environmental Standards Initiative; the second was developed for the Lake Ontario Drinking Water Protection Project under the 2007 Canada–Ontario Agreement Respecting the Great Lakes Basin Ecosystem. These new models allowed users to make integrated assessments of whether all water quality standards were being met and provided solutions to reducing loadings to Lake Ontario.

Efforts were undertaken with respect to controlling urban stormwater pollution at the source. Source controls represent a promising strategy for controlling the pollution transported by urban stormwater. One such control is the cleaning of streets by modern sweeping equipment using powerful vacuum action, which can pick up micron-sized particles and remove them from the street surface before they are washed away by rainwater. Environment Canada conducted a field study of street sweeping effectiveness in improving street runoff quality in Toronto in collaboration with several municipal departments. Study results indicated that sweeping did provide significant environmental benefits, but mostly in areas with high sediment accumulations. The planning of enhanced street sweeping requires cost-benefit analyses. This

information and other research results were shared with Canadian researchers and practitioners in three knowledge-transfer workshops organized in Vancouver, Calgary and Toronto in collaboration with the Canadian Water Network.

An invited review paper was prepared on the detection, characterization and activities of nanoparticles. The expanding use of nanotechnology in manufacturing various products has resulted in an increasing release of nanoparticles into the environment. As environmental effects of such particles are insufficiently known and require further study, the review paper was undertaken as a first step in this process.

Efforts were undertaken with respect to reducing nutrient impacts on the environment, specifically in Lake of the Woods—a large, extremely complex international water body shared by Ontario, Manitoba and Minnesota. Prior to 2007–2008, there had been concerns regarding water quality, including the presence of toxic cyanobacteria blooms in some parts of the lake. An initial Environment Canada assessment and modelling exercise identified gaps in key knowledge about the Winnipeg Basin. As part of a larger initiative to assess and remediate water quality in the Basin, Environment Canada, in partnership with provincial and state agencies, initiated a nutrient assessment plan addressing these data gaps, and implemented a three-year field study and detailed modelling of the lake.

In 2008, Environment Canada launched the Lake Simcoe Clean-Up Fund initiative, designed to protect and preserve Lake Simcoe by helping decrease phosphorus inputs to the lake, and restoring fish and wildlife populations. The program was launched with a call for proposals for Round 1 issued on February 25, 2008, for 2008–2009. A federal–provincial technical review committee was formed and project review criteria were established. Projects requesting $6.6 million in contributions were received in Round 1.

2.2 St. Lawrence Centre

Background

The St. Lawrence Centre has carried out major studies on the state of the St. Lawrence River ecosystem, including water quality monitoring and a mass balance study of chemical contaminants. During the two reporting periods, the Centre focused on evaluation of urban effluents, understanding the impact of environmental stress on biodiversity in the St. Lawrence River and long-term monitoring of the state of the river.

Progress to March 31, 2007

The occurrence and fate of pharmaceutical antidepressants were studied in sewage treatment plant sludge and in the St. Lawrence River, and several papers were published. Pharmaceutical substances, such as clofibric acid, carbanazepine, diclofenac, ibuprofen and naproxen, were found in the Montréal physically and chemically primary-treated effluent. Biological treatment of the effluent resulted in reductions in the order of 50 percent of their original concentrations, but did not eliminate them. The level of success of their elimination was linked to the complexity of their molecular structure and their polarity.

A new disinfection process for municipal wastewater demonstrated a reduction in overall contaminant loadings. However, the process also proved to induce oxidative stress on aquatic organisms. Although the new treatment system reduces the overall level of effects, it does not eliminate them.

Changes in the forms of metals, known as metal speciation, as found in complex effluent mixtures, were shown to create problems with the disinfection of primary-treated municipal effluents. Further work will help understand the speciation process in complex effluents, and identify the best method for capturing and eliminating metals from effluent.

Researchers characterized controlling environmental factors for the growth of blue-green algae in the St. Lawrence River. It was shown that environmental disturbances associated with human activities, and particularly enrichment of water from agricultural and effluent runoff, was a primary cause of elevated phosphorus levels and the resulting algal/cyanobacterial blooms. Elimination of phosphorus from the water did reduce but did not eliminate the incidence of blooms. Research is ongoing to determine the factors involved in the appearance of toxins in blooms.

Investigators examined the cumulative effects of parasites and municipal effluents in fluvial ecosystems. The presence of parasites is a good surrogate for research on food webs and trophic structure. The absence or presence of certain species is an indicator of stress and/or the lack of intermediate hosts that are required to complete the life cycle of parasites. As such, our studies indicate that parasites are present and diverse in healthy ecosystems, contrary to popular belief. Scientists have observed indications of high stress in aquatic organisms exposed to effluent dispersion plumes in the St. Lawrence River, downstream of effluent from Montréal.

Cumulative impacts of hydrology and human activities on water quality were assessed in the St. Lawrence River. Studies demonstrate that hydrological cycles close to natural levels are associated with optimal faunal and floral diversity and complexity, indicative of healthy ecosystems. The reduced variation in water levels and flows in the St. Lawrence River has adversely affected this delicate balance. Results were published in a synthesis of information gathered over several decades of research.

The fractionation of surrogate nanomaterials in natural waters demonstrated different exposure routes for aquatic organisms. The size of the nanoparticles, their propensity for aggregation, and their polarity were all factors in how nanoparticles behaved, from penetration of cell membranes by the smallest particles to reactions within organs or bioaccumulation in tissues. Further work is required to assess the hazards of exposure of aquatic organisms to nanoparticles.

Progress to March 31, 2008

The occurrence and fate of the pharmaceutical anti-infectives were studied in sewage treatment plant sludge and the St. Lawrence River. These substances were found to be present in small but significant concentrations. Assessing the impacts of these contaminants on the environment and human health will require a better understanding of the chemical and physical transformations occurring at the treatment plant and in the receiving environment.

Increased metal bioavailability was documented following municipal wastewater disinfection processes using ozonation.

A suite of nine nanoparticles was evaluated in sediments for their toxicity and mode of action in aquatic organisms. Several were highly toxic to single-celled algae and hydra, and moderately toxic to daphnia and other higher organisms. These compounds may represent a potential threat to benthic life.

Researchers increased their understanding of mercury exchanges under winter conditions, both in fluvial ecosystems and under snow cover in northern Quebec. Results indicate that the mercury cycle, speciation and transport are dependent on atmospheric conditions. The work on the relationship between available mercury, methyl mercury and the inert forms in association with environmental variables is continuing.

Studies measured cumulative effects of parasites and pesticides, and the atmospheric deposition of pesticides in the agricultural watershed of the Yamaska River. The studies indicate that the combined effect of parasites (an indicator of ecosystem health) and pesticides, as well as their interactions, result in a highly stressed river ecosystem and could be used to monitor environmental conditions from a biological effects perspective.

The effectiveness and potential toxicological impacts of promising chemical-treatment technologies for ballast water in cold conditions were investigated. It was demonstrated that ballast water treatment is effective when given the time. However, cold conditions slow tremendously the reaction process and could adversely affect the effectiveness of treatment under normal operating conditions. This was the first study to demonstrate the effectiveness of ballast treatments in eliminating unwanted invasive and exotic species in a realistic setting (full-scale ballast in an active vessel in cold Canadian waters).

The nutrient nitrate was reported to increase the growth of cyanobacteria in fluvial ecosystems, such as the St. Lawrence River.

2.3 Pacific Environmental Science Centre

Background

Since 2003, Environment Canada's Pacific Environmental Science Centre has conducted a number of studies on the toxicology and chemistry of freshwater and marine water in the

Georgia Basin. As projects under the Georgia Basin Action Plan, these studies have focused on emerging environmental concerns about water, such as endocrine-disruptor effects on aquatic organisms as a result of exposure to varying concentrations of municipal, agricultural and industrial effluents.

Progress to March 31, 2007

A focus of these studies has been the emerging toxicological issue of endocrine-disruptor effects on fish as a result of exposure to low-level concentrations of pharmaceuticals and personal care products in water bodies. Effluents and receiving waters continued to be tested to measure biological genetic effects on fish using the state-of-science gene microarray technology (genomics). Chemical-analysis profiling to determine concentrations of acid-based drugs, antibiotics, estrogenic compounds, and fragrance compounds has always been conducted in parallel with the assessment of biological response endpoints. Results from these studies will determine whether receiving water concentrations of effluent are capable of causing genomic level effects in fish. Resulting chemical changes, as either a reduction or an increase in enzyme activity, can be used as an indicator or predictor of deleterious effects in living organisms exposed to contaminants or other stressors. The ongoing studies are conducted in co-operation with the Capital Regional District of Victoria and the Greater Vancouver Regional District. The genomic analysis of the various tissues continued. Preliminary gene array data have been shared with Capital Regional District of Victoria and the Greater Vancouver Regional District.

The Pacific Environmental Science Centre laboratory continued working with the University of Victoria to study molecular effects of effluents on thyroid hormone action in amphibians. This work was supported by a Natural Sciences and Engineering Research Council strategic grant.

Bacterial source tracking in marine and freshwater systems was conducted using a DNA-based method. Samples from freshwater and marine water in British Columbia were tested to identify sources of fecal contamination. This unique water quality tool helps pollution abatement managers within Environment Canada's Marine Water Quality Monitoring Program, the British Columbia Ministry of Environment, First Nations, the Capital Regional District in Victoria, the Nova Scotia Department of Environment, the Department of Fisheries and Oceans in Newfoundland and Labrador and several regional health authorities to determine sources of fecal contamination. The results were submitted to the principal investigator at the University of Victoria, and the Pacific Environmental Science Centre offered this source tracking as a routine parameter.

Validation of the turbidity correction in a rapid assessment approach for development of site-specific water quality guidelines continued for a second year. The site-specific guidelines are used in the calculation of the Canadian Council of Ministers of the Environment's Water Quality Index, which is used for national reporting of water quality in the Canadian Environmental Sustainability Indicators reports. The Index is calculated by comparing concentrations of key water quality parameters to guidelines for the protection of aquatic life. It is problematic to compare ambient water quality against Canadian Council of Ministers of the Environment guidelines, particularly for metals, in locations having seasonal high suspended sediment loads. This problem is due to measurements of particulate metals in the sample, which, although not of toxicological importance, will cause samples to exceed guideline levels. An adjustment technique for such sites has been developed, but the degree of protection afforded by the method required some testing. As a result, researchers used water from the Sumas River and laboratory well water from the Pacific Environmental Science Centre, and spiked each with dissolved copper concentrations corresponding to Canadian Council of Ministers of the Environment, British Columbia Ministry of Environment and federal site-specific water quality criteria concentrations. Acute and chronic freshwater toxicological tests were conducted on a variety of test species at concentration levels above and below these values. Analytical chemistry was also conducted in tandem with the bioassays. During 2005–2006, the target element used in this work was copper. In 2006–2007, the same suite of toxicity tests were applied to dissolved chromium.

Progress to March 31, 2008

Work undertaken during 2007–2008 continued in each area.

Validation of the turbidity correction in a rapid assessment approach for development of site-specific water quality guidelines continued for a third year. This project addressed the degree of protection afforded to aquatic biota after adjustment of site-specific guidelines using a turbidity correction technique. In the fall of 2007, a company was contracted to write the project report, which was completed in March 2008.

2.4 Other research highlights

Environment Canada conducted many water-related investigations in addition to the research undertaken by the primary research Directorate and the major research institutes. Interdisciplinary studies or projects are often fostered in partnership with educational institutions, or the institutes or agencies of other governments and federal departments.

This section highlights examples of water research activities not reported elsewhere in the report. Although not comprehensive, the selections are representative of some of the activities being undertaken.

2.4.1 Hydro-meteorological modelling and prediction

Background

Science makes extensive use of models as predictive tools for the physical world. For several years, researchers at Environment Canada and elsewhere have made use of atmospheric and weather data, and hydrologic data collected under the hydrometric agreements as input for both day-to-day operational forecasting models and hydrologic models, respectively. More recently, research has focused on linking large-scale climate models with smaller, regional-scale atmospheric and hydrologic models to help bridge the gap between research and operations, and demonstrate how regional hydro-meteorological modelling and ensemble forecasting systems can help improve weather prediction and water resources management.

Progress to March 31, 2007

Efforts were undertaken to improve the understanding of interactions between the atmosphere and land surface. Environment Canada's Atmospheric and Science Technology Directorate and Meteorological Service of Canada worked together on coupled hydro-meteorological modelling and prediction to improve the understanding of interactions between the atmosphere and land surface. This was supported by joint work among Environment Canada's Recherche en Prévision Numérique, Hydro-meteorology and Arctic Laboratory, Laboratory for Severe Weather Meteorology, and National Water Research Institute. Work is also under way on a new system to support operational hydro-meteorological prediction. The purpose of the new system (called Modélisation Environnementale – Surface et Hydrologie) is to perform numerical experiments. Based on the Global Environmental Multiscale model, it has the capability of running land-surface models.

Work was undertaken to develop a program that assesses water availability in the South Saskatchewan River Basin using a suite of coupled hydro-meteorological models (funded by the National Agri-Environmental Standards Initiative). The water availability sub-component focused on the development and testing of a framework to predict available water supplies, including precipitation, snowmelt, soil moisture and surface water availability, in agriculturally dominated watersheds at the scale of the current Numerical Weather Prediction system, which is 15 kilometres. Modélisation Environnementale – Surface et Hydrologie will also be tested on research basins by various university researchers taking part in the Improving Processes and Parameterization for Prediction in Cold Regions research network funded by the Canadian Foundation for Climate and Atmospheric Sciences. The modelling system has also been established as part of the Drought Research Initiative, which is a parallel research program focused on drought prediction.

Work continued on hydrological ensemble prediction, in support of improved water management. Modélisation Environnementale – Surface et Hydrologie also supported the international Hydrological Ensemble Prediction Experiment Great Lakes testbed project, which aimed to demonstrate the value of hydrological ensemble prediction in supporting water management. This testbed project started in 2006, with the goals of developing and verifying a hydrological ensemble prediction system on the Great Lakes Basin and St. Lawrence River

upstream of Montréal, providing forecasts to water managers of individual sub-watersheds and improving management of the Great Lakes, in particular in the Montréal archipelago.

Progress to March 31, 2008

There was a continuation of the work done in 2006–2007 to improve the understanding of interactions between the atmosphere and land surface.

There was also a continuation of the work described above to develop a program that assesses water availability in the South Saskatchewan River Basin using a suite of coupled hydro-meteorological models. In addition, a first version of Modélisation Environnementale – Surface et Hydrologie was made available on the Internet through Environment Canada's Hydro-meteorology and Arctic Laboratory. A draft National Agri-Environmental Standards Initiative methodology for water balance indicators in an agriculture-dominated watershed was completed.

As well, there was a continuation of the work described above on hydrological ensemble prediction in support of improved water management. In addition, funding was obtained from the International Upper Great Lakes Study set up by the International Joint Commission to speed up development and testing of the system.

2.4.2 The State of the Strait Conference

Background

The State of the Strait Conference is a Canada–United States conference held approximately every two years, bringing together government managers, researchers, students, members of environmental and conservation organizations, corporations, planning organizations, communities and concerned citizens to assess ecosystem status and provide advice to improve research, monitoring and management programs for the Detroit River and western Lake Erie. The Conference alternates locations between Canada and the United States, and a report is issued following the Conference.

Progress to March 31, 2007

The 2006 Conference was held in Flat Rock, Michigan, and focused on status and trends of key indicators. A final report was completed and released in early 2007 (www.uwindsor.ca/softs).

Progress to March 31, 2008

A comprehensive and integrative assessment of the 2006 results was completed and accepted for publication in a scientific journal (www.ncbi.nlm.nih.gov/pubmed/18850284).

2.4.3 National Agri-Environmental Standards Initiative

Background

The National Agri-Environmental Standards Initiative is a four-year program (2004–2008) led by Environment Canada in partnership with Agriculture and Agri-Food Canada under their Agricultural Policy Framework. The initiative develops two types of science-based agri-environmental performance standards:

- ideal performance standards, which specify the desired environmental state needed to maintain ecosystem health; and
- achievable performance standards, which specify environmental conditions that can realistically be achieved using currently available and recommended beneficial management practices.

These standards provide benchmarks of environmental quality, which can be used to develop and promote the adoption of beneficial agricultural management systems and practices that help reduce environmental risks. These benchmarks could also be used to measure progress towards identified environmental outcomes. The standards have been designed specifically for agriculture, with the understanding that they will be used in the context of a working landscape where zero risk is not the ultimate goal.

The development of agri-environmental performance standards was carried out under four themes (air, biodiversity, pesticides and water), and involves science-based assessments of environmental risk and the determination of

desired environmental quality. Work relevant to the *Canada Water Act* was carried out under the pesticide and water themes.

Progress to March 31, 2007

Research toward the development of water ideal performance standards (nutrients, sediments and instream flow needs) included water sampling activities to validate prototype standards and develop cause-effect relationships between agricultural activity and aquatic ecological impacts. In addition, a field program was launched to collect data for validation of standards and assess the need for regional variability in standards. During 2006–2007, approximately 75 streams across Canada were regularly sampled. Activities in support of development of these standards focused on several key agricultural regions.

Work on the pathogens standards focused on sampling four watersheds across Canada (South Nation River, Ontario; Bras d'Henri, Quebec; Oldman River, Alberta; and Sumas River, British Columbia) for sediment-related properties to be used within a national standard for pathogens. In order to understand the potential for sediments as a transport medium for pathogens, a numerical model (MOBED) was developed for the South Nation River. This calibration made it possible to use modelled sediment loads with sediment-associated pathogen concentrations to predict the delivery of pathogens to environmentally sensitive areas.

Work in the South Saskatchewan River Basin supported the development of the water availability standard through a series of water balance indicators (precipitation, evapotranspiration, runoff, soil moisture and snow-water equivalent).

International approaches were reviewed and protocols were developed for the derivation of impact-based ideal performance standards on an individual basis, on a commodity basis and in mixtures for water. Compound-specific ideal performance standards (acute and chronic) were completed for priority pesticides.

Modelling was carried out in collaboration with Agriculture and Agri-Food Canada on the environmental condition that can be achieved through the implementation of beneficial management practices at the watershed-scale for nutrients and sediments at Black Brook, New Brunswick, and Raisin River, Ontario.

Demonstration projects at four watersheds (British Columbia, Ontario, Quebec and Prince Edward Island) were undertaken to establish baseline concentrations of pesticide runoff at each watershed. Work was coordinated with the Pesticide Science Fund and Agriculture and Agri-Food Canada. Information gathered through this project was used to further the development and verification of pesticide achievable performance standards at these sites and pesticide ideal performance standards. Two pesticide achievable performance standards were developed for one watershed (Chaudière River, Quebec).

The 2007 Annual National Agri-Environmental Standards Initiative Technical Series, containing 54 reports, was published. These reports represent a summary of all research activity carried out under the initiative during 2006–2007.

Progress to March 31, 2008

The 2007–2008 year was the final research year for the National Agri-Environmental Standards Initiative. As such, activities focused on finalizing the standards and delivering final products to Agriculture and Agri-Food Canada. Final synthesis reports were completed and were subject to an intensive peer-review by external scientists.

Field sampling, laboratory tests and other research towards the development of water (nutrients, sediments, pathogens, instream flow needs and water availability) and pesticide (priority pesticides) standards were completed in early 2008.

Modelling of the achievable performance standards for nutrients and sediments at Raisin River, Ontario, and Black Brook, New Brunswick, was completed. Three achievable performance standards for pesticides were developed for an additional four watersheds (Yamaska, Quebec; South Nation, Ontario; Wilmot/Dunk, Prince Edward Island; and Salmon River, British Columbia).

Demonstration projects to establish baseline concentrations describing pesticide runoff at four watersheds (British Columbia, Ontario, Quebec

and Prince Edward Island) were completed. Results show detectable concentrations of some pesticides in these watersheds.

International approaches were reviewed and protocols developed for the derivation of impact-based ideal performance standards on an individual basis, on a commodity-basis and in mixtures for water. Compound-specific ideal performance standards (acute and chronic) were completed for priority pesticides, for a total of 20 pesticides over the life of the program.

The 2008 Annual National Agri-Environmental Standards Initiative Technical Series, containing 66 reports, was published. Work continued on reports for inclusion in the final Annual Technical Series, which will collate research findings and final standards development work.

2.4.4 Metal Mining Environmental Effects Monitoring Program

Progress to March 31, 2008

The first National Assessment of Environmental Effects Monitoring data for metal mining effluents was published in 2007 by Environment Canada. This assessment found a tendency toward inhibitory effects on fish and benthic invertebrates at a national scale. Decreases in liver condition and size for fish as well as significant changes in benthic invertebrate community structure were found in environments receiving metal mining effluents. In contrast, mercury concentrations in tissues of fish taken downstream of sources of metal mining effluents were low or not significantly different from concentrations in control fish. Further work is needed to confirm these effects, determine the extent and magnitude, and investigate the cause.

2.4.5 Municipal Water and Wastewater Survey

Background

The Municipal Water and Wastewater Survey is a Canada-wide survey of municipalities that collects, and makes available to the public, data on water sources, water use, water conservation, wastewater treatment level and water and wastewater pricing. It covers more than 80 percent of the Canadian population. The survey, which has been conducted every two to three years since the 1980s, provides a valuable basis for informed decision making for sustainable water management across Canada. Environment Canada uses the collected data on water use and pricing to produce key reports, one on municipal water use and another on municipal water pricing. The reports summarize key findings and are available on the Environment Canada Freshwater website (www.ec.gc.ca/water).

Progress to March 31, 2007

The 2007 Municipal Water Use Report provides information from the 2004 survey on water sources, overall and per-capita water use, sectoral water use, metering, wastewater flows, wastewater treatment level, and number of people on water and wastewater systems. A report highlight is that average per capita residential water use was the second-lowest in more than a decade at 329 litres per day.

Progress to March 31, 2008

The 2008 Municipal Water Pricing Report provides information from the 2004 survey on water and wastewater pricing, pricing structure, metering and water conservation measures. Findings included that a gradual trend toward municipal water metering continued and that water pricing rates had become more conducive to efficient use of water.

PUBLIC INFORMATION PROGRAM

(Under Part IV General of the *Canada Water Act*)

1. Freshwater Website

The Freshwater website (www.ec.gc.ca/water) continued to provide basic information on a wide range of water-related topics, comprehensive educational materials (e.g. water fact sheets, including *A Primer on Fresh Water*, *Explore Water with Holly Heron*, and *Let's Not Take Water for Granted – A Resource Guide*), and the full text of key water publications (e.g. the *Federal Water Policy*, the *Canada Water Act* annual reports, and reports on water use and pricing). In addition, the links to other governmental and non-governmental sites across the country continued to be regularly updated and expanded, as did the calendar of water-related conferences and events.

The site was heavily used (averaging over 110 000 visits each month) and was often referenced on other websites and in print material produced by other agencies.

2. Water Survey of Canada Website

The Water Survey of Canada (www.wsc.ec.gc.ca) of Environment Canada is the federal agency responsible for the collection, interpretation and dissemination of standardized water quantity data and information in Canada. During both reporting periods, the Survey continued its operations on behalf of most provinces and all territories, under federal–provincial and federal-territorial agreements. In Quebec, the Province collects water quantity data under a similar agreement.

Each year, Environment Canada produces a national HYDAT CD-ROM, which contains the updated water quantity data archive for all Water Survey of Canada data. This includes streamflow, water level and sediment data (daily and monthly means, and instantaneous values) for more than 2500 active and 5500 discontinued hydrometric monitoring stations across Canada. The HYDAT CD-ROM can be downloaded from the Water Survey of Canada website (www.wsc.ec.gc.ca/products/main_e.cfm?cname=products_e.cfm). Alternatively, users can access selected data from the online archive using an interactive query tool.

Data from two thirds of the active hydrometric network are reported in near real-time. Water levels for these stations are presented graphically within hours of their measurement on the Water Survey of Canada website (http://scitech.pyr.ec.gc.ca/waterweb/formnav.asp?lang=0).

Eventually, both water level and stream flow data will be available for most stations in near real-time.

3. Environment Canada's Biosphère

Background

Environment Canada's Biosphère (http://biosphere.ec.gc.ca) has a mission to raise awareness among young people, their families and the general public about environmental issues related to water resources, climate change and sustainable development of the St. Lawrence River and Great Lakes ecosystem. As an environment museum, the Biosphère offers exhibits, guided tours and dynamic activities that involve exploring and learning about major environmental issues related to water, climate change, responsible consumption, sustainable development, environmental technologies and biodiversity. It is also a national centre for expertise in environmental education and engagement, and offers educational activities and training for a variety of client groups Canada-wide, particularly schools. The Biosphère works to help Canadians, including young people, adopt responsible consumption habits in order to conserve the natural environment.

Progress to March 31, 2007

At the end of 2006–2007, the Biosphère billed itself as a museum devoted to the environment. During the year, nearly 60 000 people, including 25 000 young people, visited the museum's exhibits or participated in its educational activities. A pilot video-conferencing project also provided the means to reach some 3500 students across Canada.

The Biosphère continues to offer "Moving Giant: The Great Lakes–St. Lawrence Ecosystem," "Water Wonders!" and other permanent exhibits. Two photography exhibits related to water were added, specifically the "Rétrospective 2001–2005 de l'Escale Nautique" and "The St. Lawrence River," as a spinoff from photography contests involving recreational boating enthusiasts and St. Lawrence River lovers. The summer program, which had the theme "River Fanatics," drew large numbers of visitors and families. Two films featuring spectacular imagery, *L'eau, source de vie* (*Water: Source of Life*) and *Les beautés du Saint-Laurent* (*Beauty of the St. Lawrence*) along with a multimedia presentation entitled "Keeping Current on the St. Lawrence," were available for viewing year-round and helped to raise public awareness.

Progress to March 31, 2008

In 2007–2008, more than 100 000 people, including nearly 50 600 young people (more than double the number of the previous year), visited the exhibits or participated in educational activities. This substantial increase in clientele is attributable to new programs for the general public, expanded use of video-conferencing for school groups and presentations given in schools across the country.

In addition, 4400 young Canadians have made a commitment to protect their watercourse under the Adopt a River program, thanks to an expanded network of co-ordinators trained in five provinces. Environmental training sessions were also given to employees in Environment Canada, the Parks Canada Agency, other departments and non-governmental organizations in various Canadian cities to help them promote environmentally friendly practices and hone their skills. Presentation of the permanent exhibits "Moving Giant" and "Water Wonders!" continued in 2007–2008. Two new biodiversity activities were added during the year: "RESPECT: in the heart of the boreal forest" consists of an outdoor exhibit of huge photographs of the Canadian boreal forest ecosystem and drew 300 000 visitors; the "Man and His World" multimedia presentation helped to raise public awareness about biodiversity in Canada. The Biosphère also purchased two wind turbines and a solar house to use in demonstrations of green technologies.

4. RésEau – Building Canadian Water Connections

Background

RésEau is a Government of Canada online demonstration initiative that focuses on water information (http://map.ns.ec.gc.ca/reseau/en/). The RésEau prototype was launched in March 2006. Water data are now accessible online through one portal that includes a selection of federal government monitoring programs for water quality and quantity, as well as programs on groundwater availability, groundwater contamination, water use, and water and human health (disease outbreaks). In addition, data have been made available from a network of 16 partner groups, including provinces, non-governmental organizations, community groups and high schools.

The RésEau portal provides pre-defined maps for general users, as well as search and query functions that create dynamic maps in real time for more advanced users. A Know Your Watershed module allows Canadians to easily discover which watershed they live in and find customized watershed profiles to learn more about water-related activities in their area.

Progress to March 31, 2007

The RésEau portal was updated with more modern, cutting-edge technologies, and some structural changes to improve its usability. Additionally, there were updates made to the multi-jurisdictional community of participants.

Due to the acceptance of the RésEau model of sharing water-related data and information, a second implementation of the model has been undertaken. Led and supported by Environment Canada, a portal was developed for the Okanagan Basin. This portal adhered to the RésEau principles of sharing water-related data and information, and was applied on a local basin scale where the resource was under significant stress. This portal was launched on March 31, 2007.

Progress to March 31, 2008

Development began on another iteration of the RésEau data-sharing model, this one for the Lake

Winnipeg basin. It was recognized that water in this basin was under significant stress and a large-scale, multi-year remediation plan was put in place. This plan included implementation of a portal to support and enable the sharing of data and information related to the Lake Winnipeg basin. The portal, which was to be rolled out over the course of the Lake Winnipeg Basin Initiative, was in the early stages of development during the 2007–2008 reporting year.

5. Canadian Digital Drainage Area Framework

A partnership between Environment Canada, Statistics Canada, Natural Resources Canada, and Agriculture and Agri-Food Canada was initiated in 2001 to develop the Canadian Digital Drainage Area Framework (www.geogratis.cgdi.gc.ca/clf/en). The Framework is a spatial database comprising several layers of hydrological features, including rivers, lakes, and watershed boundaries, and is designed to support water-related research and analysis.

The Framework was released online in June 2003, the result of nearly three years of federal collaboration as well as consultation with several provincial agencies. This national framework is a welcome tool for the planning, analysis and management of environmental monitoring networks and is an excellent means of reporting data, information and knowledge about watersheds at regional, national and continental scales. The data can be easily imported into standard geographic information systems. The Framework is maintained by Natural Resources Canada.

6. Pacific and Yukon Region

Environment Canada continued to encourage environmental stewardship among the public by informing them of emerging environmental issues, ecological connections in the environment, and positive human impacts through stewardship programs.

The Interactive Pollution Model website provides a do-it-yourself guide for building an interactive pollution model of a community (www.pyr.ec.gc.ca/EN/IPM).

The Pacific and Yukon Water Quality Monitoring and Surveillance Program website provides access to federal–provincial/territorial water quality data, guidelines, reports, publications, links to stewardship programs and resources for designing a water quality monitoring program (http://waterquality.ec.gc.ca/EN/home.htm).

Training workshops regarding Environment Canada's Canadian Aquatic Biomonitoring Network have been delivered in the Pacific and Yukon Region since 2003 to a wide audience to encourage the use of standardized protocols for the collection and analysis of data for stream bio-assessment (http://cabin.cciw.ca/application/welcome.asp?Lang=en).

APPENDIX A: Agreements

The following *Canada Water Act* agreements were ongoing during the 2006–2007 and 2007–2008 reporting periods.

Apportionment and Monitoring Programs

- Agreements on water quantity surveys with all provinces, and with Indian and Northern Affairs Canada for the territories
- Canada–Quebec Protocol on Administrative Arrangements under the Canada–Quebec Agreement on Hydrometric and Sedimentological Networks in Quebec
- Master Agreement on Water Apportionment in the Prairie Provinces (Prairie Provinces Water Board)
- Water quality monitoring agreements with British Columbia, Newfoundland and Labrador, New Brunswick, and Manitoba
- Canada–Prince Edward Island Memorandum of Agreement on Water
- Agreement Respecting Ottawa River Basin Regulation

Please note that on behalf of the federal government the 2007 Canada–Ontario Agreement Respecting the Great Lakes Basin Ecosystem was made pursuant to the *Canadian Environmental Protection Act, 1999* and the Canada–Quebec Agreement pertaining to the St. Lawrence (2005–2010) was made pursuant to the *Department of Environment Act* and the *Department of Fisheries and Oceans Act*.

Water Management Programs

- Mackenzie River Basin Transboundary Waters Master Agreement

APPENDIX B: For More Information

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