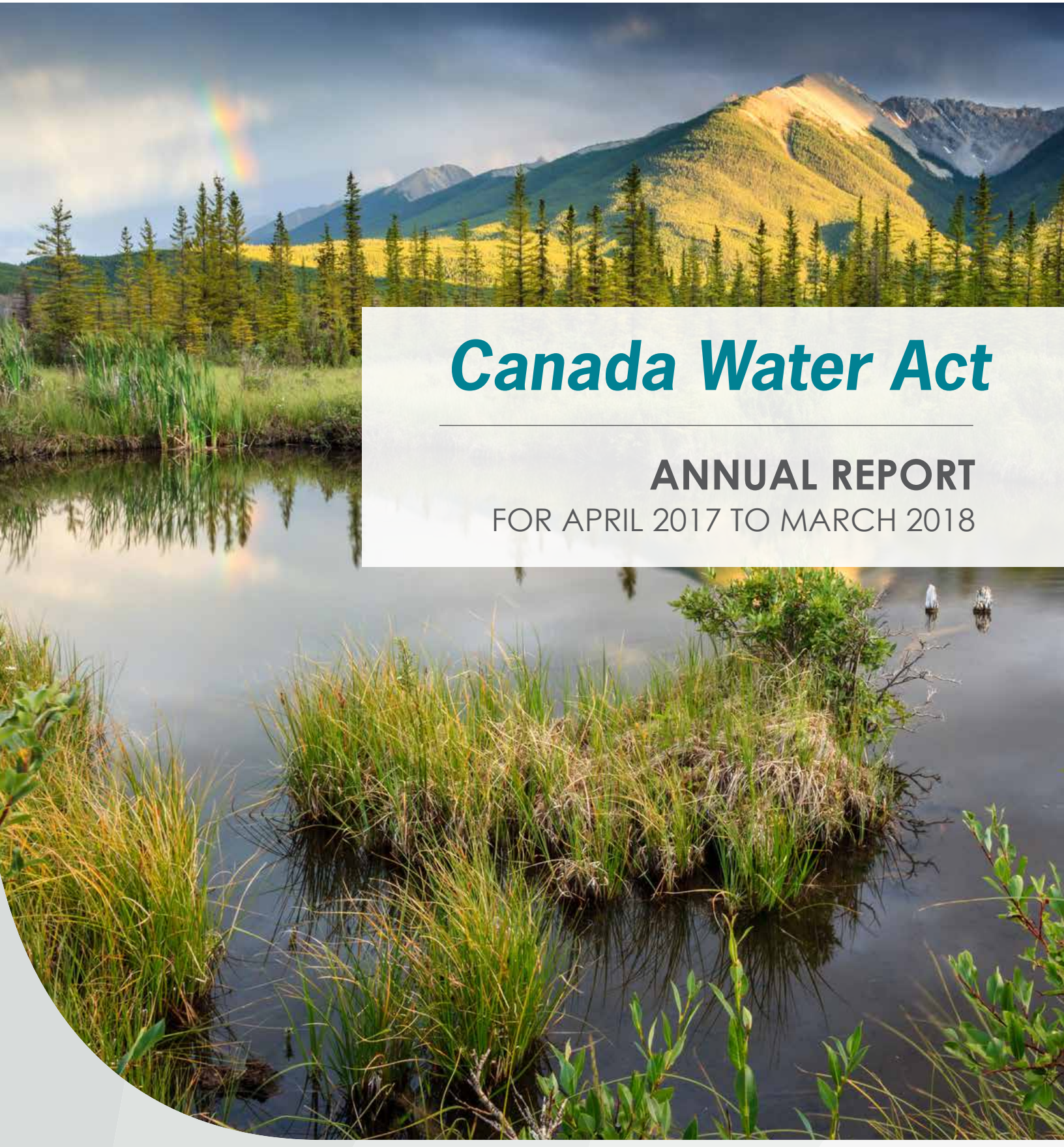
Environment and Climate Change Canada
Environnement et Changement climatique Canada



Canada Water Act

ANNUAL REPORT

FOR APRIL 2017 TO MARCH 2018

Canada

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1. INTRODUCTION

The *Canada Water Act* (CWA), administered by the Minister of Environment and Climate Change provides an enabling framework for collaboration among federal, provincial and territorial governments in matters relating to water resources. Each level of government has a different role related to the management of water resources. Joint projects involve the regulation, apportionment, monitoring or surveying of water resources, and the planning and implementation of programs relating to the conservation, development and utilization of water resources. As well, there are many areas of shared responsibility.

Section 38 of the Act requires that a report on operations under the Act be laid before Parliament as soon as possible after the end of each fiscal year. This annual report covers progress on these activities from April 1, 2017, to March 31, 2018.

THE FOLLOWING IS A SUMMARY OF THE MAJOR PROVISIONS OF THE ACT:

Part I, Section 4, provides for the establishment of federal-provincial/territorial arrangements for the establishment of intergovernmental committees or other bodies in relation to water resource management. **Sections 5, 6 and 8** provide the vehicle for cooperative agreements with the provinces and territories to develop and implement comprehensive water resource management programs. **Section 7** enables the Minister, either directly or in cooperation with any provincial/territorial government, institution or person, to conduct research, collect data and establish inventories associated with water resources.

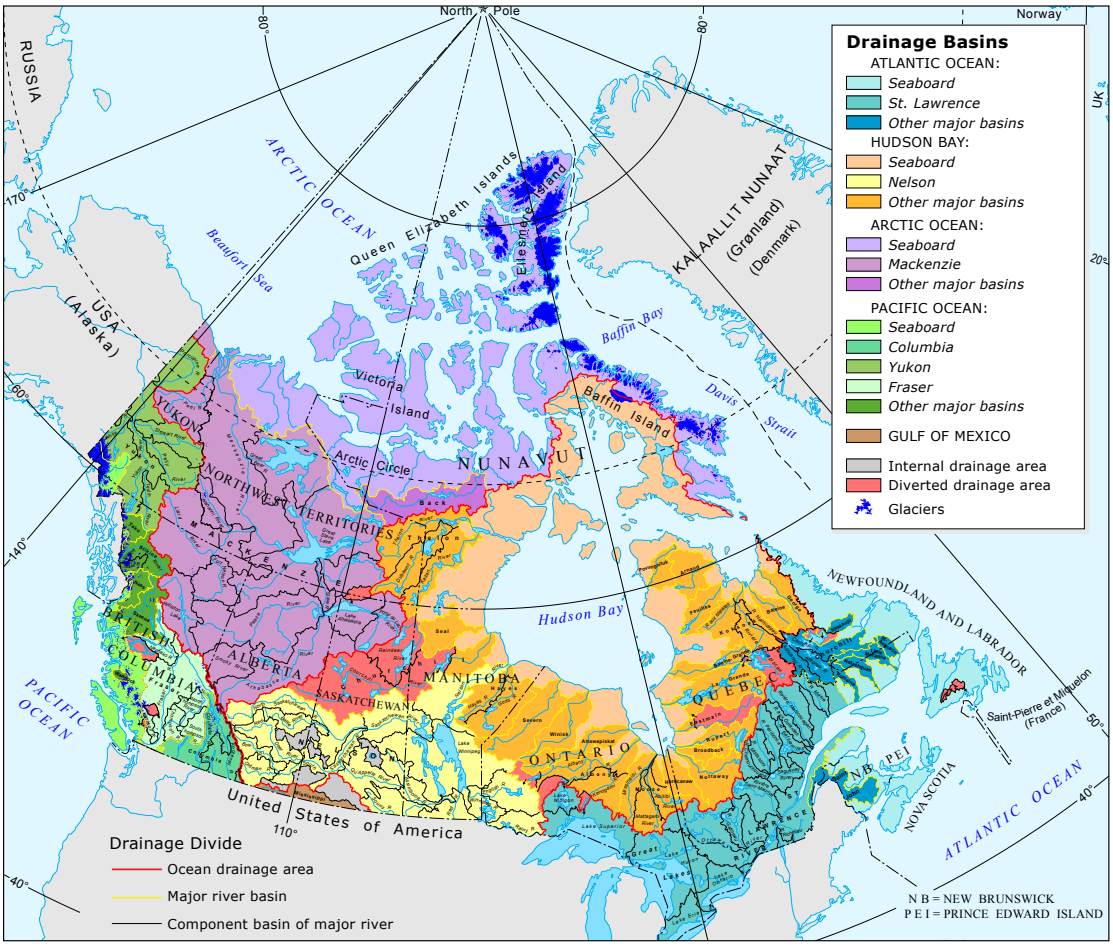
Part II provides authority for the establishment of federal-provincial/territorial management agreements where water quality has become a matter of urgent national concern. It also allows the Minister to name an existing corporation that is an agent of Her Majesty or that performs a function or duty on the Federal Government's behalf to plan and implement approved water quality management programs. The application of alternative cooperative 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, is now part of the *Canadian Environmental Protection Act, 1999,* (See the *Canadian Environmental Protection Act, 1999* annual reports to Parliament, available at www.ec.gc.ca/lcpe-cepa/default.asp?lang=En&n=64AAFDF1-1.)

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 cooperation with any government, institution or person, to undertake public information programs.

This report describes a wide range of federal operations conducted under the authority of the Act, including participation in federal-provincial/territorial agreements and arrangements, significant water monitoring and research, and public information programs. It also includes work done under the Act to safeguard the water quality and quantity of Canada's watersheds. The map in Figure 1 depicts Canada's major drainage areas and drainage flows.

Figure 1: Drainage areas in Canada



Canadian provinces and territories have the majority of responsibility over areas of water management and protection. Most of these governments delegate some authority to municipalities, in particular drinking water treatment and distribution, and wastewater treatment operations in urban areas. In certain cases, local authorities responsible for a particular area or river basin take on some water-resource management functions when requested by government.

The federal government has responsibility for managing water on federal lands (e.g., national parks), federal facilities (e.g., office buildings, laboratories, penitentiaries, military bases), Indigenous lands and in Nunavut. The federal government also has jurisdiction to make laws in relation to fisheries and navigation, both of which play a role in water management.

Formal bilateral hydrometric agreements between most provincial/territorial governments and the federal government provide for the collection, analysis, interpretation and dissemination of water quantity data. These agreements have been administered cooperatively since 1975 and, with the exception of Newfoundland and Labrador, New Brunswick and Saskatchewan, have been renewed since 2008.

CWA agreements that were ongoing during 2017-2018, included the following.

Agreements related to apportionment and monitoring programs:

- *Hydrometric agreements with nine provinces, Yukon and Northwest Territories, and with Indian and Northern Affairs Canada for Nunavut*
- *Master Agreement on Apportionment in the Prairie Provinces (Prairie Provinces Water Board)*
- *Water quality monitoring agreements with British Columbia, Newfoundland and Labrador, New Brunswick, Manitoba, and Quebec*
- *Canada–Prince Edward Island Memorandum of Agreement on Water*
- *Agreement Respecting Ottawa River Basin Regulation*

Arrangements and agreements related to water management, intergovernmental cooperation or programs:

- *Mackenzie River Basin Transboundary Waters Master Agreement*
- *Canada–Manitoba Memorandum of Understanding Respecting Lake Winnipeg and the Lake Winnipeg Basin*

Agreements for specific water programs require participating governments to specify the amount of funding each will pay and the information and expertise they will provide, in agreed ratios. For ongoing activities such as the hydrometric monitoring agreements with each provincial and territorial government, cost-sharing is in accordance with each party's need for the data. For study and planning agreements, generally the federal government and the specific provincial or territorial government each assume half of the costs. The planning studies encompass interprovincial, international or other water basins where federal interests are important. Implementation of planning recommendations also occurs on a federal, provincial/territorial and federal-provincial/territorial basis. Cost-sharing for infrastructure often includes a contribution from local governments.

The sections below describe federal, provincial and territorial collaboration in the following areas:

- data collection and use;
- inter-jurisdictional water boards; and
- partnership-based ecosystem approaches.

2. DATA COLLECTION AND USE

2.1 WATER QUANTITY MONITORING

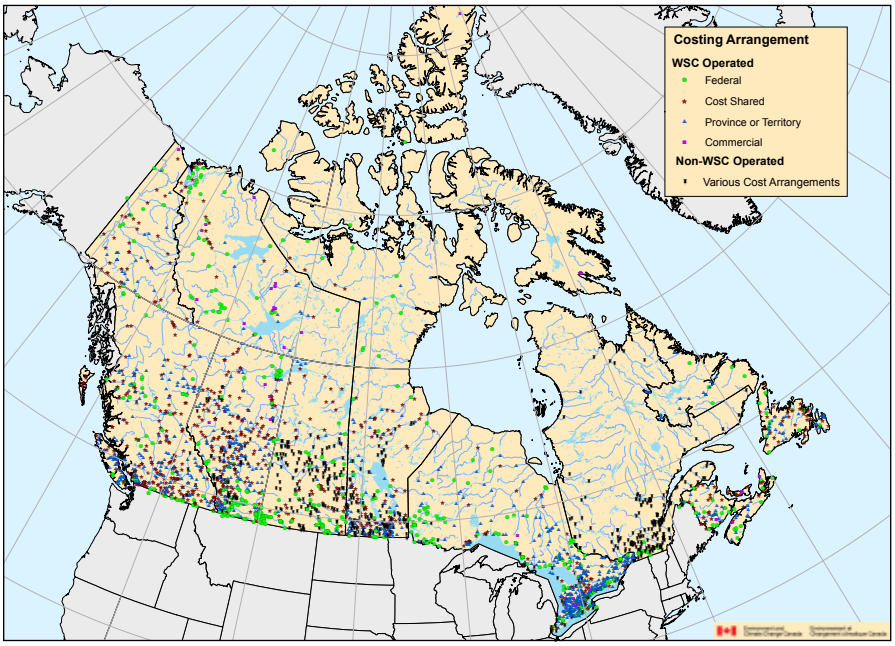
The National Hydrometric Program (NHP)[1] is responsible for providing critical hydrometric data, information, and knowledge that Canadians and their institutions need to make informed water management decisions to protect and provide stewardship of fresh water in Canada. These data are available on Environment and Climate Change Canada's (ECCC) Wateroffice website[2]. The Water Survey of Canada, which is part of ECCC's National Hydrological Service (NHS), is the federal partner and primary operator of the NHP network in Canada.

The NHP is co-managed by the National Administrators Table (NAT) and the NHP Coordinators' Committee, both consisting of members responsible for the administration of hydrometric monitoring agreements in each province or territory and one national administrator designated by Canada. Both groups met regularly throughout 2017-2018 to discuss program issues. Regular input from both groups and an annual survey by NAT provide valuable input on program operations, documentation and dissemination practices, and available training resources for the NHP.

2.1.1 National monitoring network

During 2017-2018, the national monitoring network of the NHP in Canada consisted of 2828 hydrometric monitoring stations (see Figure 2 and Table 1). During this period, ECCC operated 2193 of these hydrometric stations. Out of the ECCC-operated stations, 1144 were fully or partially federally funded. The remaining stations were operated by ECCC on behalf of provincial and territorial governments or a third-party interest, and cost-sharing was based on specific needs and requirements (see Table 1). In Quebec, the Ministry of Sustainable Development, Environment and the Fight against Climate Change operated 227 stations, some funded in whole or in part by the Government of Canada.

Figure 2: National Hydrometric Monitoring Network



[1] http://ec.gc.ca/default.asp?lang=En&n=11A9E7E5-1&news=402EA08D-E487-4068-B7A9-50657071D381
[2] https://wateroffice.ec.gc.ca/index_e.html

Table 1: Stations within the National Hydrometric Monitoring Network

	ECCC-OPERATED (BY COST ARRANGEMENT)					
PROVINCE/ TERRITORY[a]	FEDERAL	COST-SHARED[B]	PROVINCE/ TERRITORY	THIRD PARTY	NON-ECCC-OPERATED (VARIOUS COST ARRANGEMENTS)	TOTAL BY PROVINCE OR TERRITORY
Alta.	77	157	160	33	54	481
B.C.	47	180	212	1	7	447
Man.	22	85	109	2	178	396
N.B.	17	15	20	0	0	52
N.L.	16	32	64	0	0	112
N.S.	11	6	13	0	0	30
N.W.T.	46	23	19	10	0	98
Nun.	14	4	5	2	0	25
Ont.	125	69	337	10	43	584
P.E.I.	0	5	1	3	0	9
Que.	16	0	0	0	227	243
Sask.	91	51	13	0	126	281
Y.T.	10	25	35	0	0	70
Total	492	652	988	61	635	2 828

[a] Hydrometric monitoring stations located within the boundaries of each province, no matter which office operates them.

[b] Cost-shared stations are those that are partially funded by the federal government, provincial/ territorial governments, and third parties. The cost-share ratio varies by station.

Note: The network also includes a small number of designated International Gauging Stations located in the United States that are not included here as they support International Joint Commission activities not covered under the CWA.

There were no significant changes to the size of the national hydrometric network, although the network did undergo a number of adjustments, including the following:

Yukon

- Network expansion as part of the Yukon Water Strategy and Action Plan was completed in 2017.
- One station operated in Northern British Columbia, at the request of Yukon Energy, was discontinued in 2017 upon agreement of both parties.
- Yukon Government staff operated nine gauges in Northern British Columbia for operational efficiencies.
- Due to the 2016 river piracy event, where the Slims River, which drains into Kluane Lake, had its flow diverted as a result of the retreat of the Kaskawulsh Glacier[3], Kluane Lake (gauged), experienced the lowest water levels on record.

[3] The event was documented by Shugar, et.al. in the Journal of Nature Geoscience 10,370–375(2017) doi:10.1038/ngeo2932

Northwest Territories

- Five new stations were added to the NWT network in 2017–2018:
  - Anderson River near Lac Maunoir,
  - Lockhart River above Outram Lake,
  - Dubawnt River above Dubawnt Lake,
  - Thelon River at the Outlet of Double Barrel Lake,
  - Whitefish River near the mouth.
- NWT government staff operated stations in Northeastern British Columbia (Petitot River) and Northeastern Alberta (several stations within the Peace-Athabasca Delta) for operational efficiencies.
- Reconnaissance for seven new territorially funded stations is ongoing, while funding and land tenure approvals are pending.

Nunavut

- Twenty-four hydrometric stations were operational in 2017-2018 within Nunavut. ECCC operates all stations in Nunavut, in accordance with the established cost-share agreement.
- One station, Mecham River near Resolute, was discontinued in 2017-2018 by agreement of both parties.
- Operational funds are apportioned in accordance with specific cost-share arrangement between ECCC, Crown - Indigenous Relations and Northern Affairs Canada, Parks Canada Agency and the City of Iqaluit.

British Columbia

- Four stations were added to the network in 2017-2018:
  - Quinsam River at Diversion Headpond,
  - Kiskatinaw River Below Borden Creek,
  - Keogh River Near Port Hardy,
  - Bridge River Below Lajoie Dam.
- Alces River at 22nd Base Line station was discontinued.
- Thirty hydrometric stations were modernized in 2017-2018, with a focus to improve real-time reporting and update monitoring technology. A total of 391 of the 447 stations (88%) of the hydrometric network now report in real-time.

Alberta

- One hydrometric station (Waterton River at Waterton Park) was destroyed by a wildfire in Waterton National Park and rebuilt shortly afterwards.
- Twenty-four gauging stations were upgraded to Water Survey standards and added to the Oil Sands Monitoring network as commercial stations. While nine proposed bank-operated cableway installations were planned, none were completed due to delays in the land use dispositions.

www.nature.com/ngeo/journal/v10/n5/full/ngeo2932.html.

- Procurement of hydroacoustic instrumentation included the upgrade of two in-situ hydroacoustic units, and a third additional unit brought online, in support of the Bow River Irrigation District, Western Irrigation District and Eastern Irrigation District.
- Operations continued to be suspended at 89 of 91 manned cableways in Alberta pending an operational review and engineering inspection. Issues were found at Berland River near the mouth, so that station was also suspended. The North Saskatchewan River at Whirlpool Point site was repaired and put back in service. St. Mary River at International Boundary continued to remain in service.
- Whirling disease[4] was discovered in Banff National Park in 2016, initially affecting the Bow basin. As more test results became available, the decontamination protocol for invasive species expanded from 41 hydrometric stations to include all 413 hydrometric stations in the province.

Saskatchewan

- North Saskatchewan River at Prince Albert and Saskatchewan River at the Forks stations transmitted photos of the river by satellite.
- Construction changes included:
  - the decommissioning of six stations, with five of them having wells and three having manned cableways;
  - Two stations were relocated to tilt mast cabinets on concrete slabs; and
  - A Mark II bank-operated cableway was installed at one station.
- Surveys were completed on Qu'Appelle River below the Craven Dam station to produce cross sections of the river and determine the size of an erosion hole downstream of the station to assist with river geometry restoration.
- Life cycle management of 12 data loggers, 10 pressure transducers, 2 vehicles, 1 ADCP, and 4 FlowTrackers was completed.

Manitoba

- Three stations experienced infrastructure impacts from flooding: Little Churchill River above Recluse Lake; Gauer River below Thorsteinson Lake and Churchill River below Fidler Lake. Emergency gauges were deployed for these stations and proved effective.
- Southern Manitoba also experienced high water and ice jam flooding in 2017, with six all-time high measurements made throughout Southern Manitoba.
- Two bank-operated cableways were lost, one due to ice and the other to bank failure.
- The Red River Floodway and Portage Diversion were in operation and two communities had partial closures of their ring dikes.
- Manitoba now operates Carrot River station near Turnberry, Saskatchewan for operational efficiencies.
- In fall 2017, preparation began for a large decommission project to remove all infrastructure at inactive sites, locked out manned cableways, and well stations.

[4] Whirling disease is an infectious disease of finfish. The causal agent of whirling disease is not a risk to human health.

All stations in Northern Manitoba experienced very high flow in 2017, with at least seven all-time high water measurements recorded. On June 7, a record high measurement was made at Churchill River below Fidler Lake: the crew measured 3,240 cm compared to the old record of 2,400 cm in 2005.

In Southern Manitoba, approximately 240 municipal roads and highways were closed due to water on roads, 330 people were evacuated with the most from Long Plain and Pequis First Nations. Four First Nations and sixteen Rural Municipalities declared local states of emergencies.

Ontario

- Two stations were relocated with some overlap in operations: White River below White Lake became White River above Oskabukuta River, and Beckett's Creek at Beckett's Creek became Becketts Creek near Cumberland Estates.
- Reconnaissance was completed for two new gauging stations on the Ottawa River main channel in Ottawa, and on the Montreal River at Latchford.
- Four new stations were installed: Stooping River above the mouth, Whitefish River near Stanley, Larches Creek near Elmira, and Ottawa River at Thorne.

Quebec

- In Quebec, 227 stations are run by the provincial government and data are provided to the NHP database. An additional 17 stations are run by ECCC in Quebec to address federal data requirements.

Atlantic Region

- No major changes to the network in New Brunswick occurred in 2017–2018. Two stations listed as "commercial" paid for by the New Brunswick Department of Transportation (not a NHP partner) were closed in 2017-2018.
- No major changes to the network in Nova Scotia occurred in 2017–2018.
- In Prince Edward Island, one commercial station was converted to a provincial station in 2017-2018.
- In Newfoundland and Labrador, seven new provincial stations were installed and one provincial station was closed in 2017-2018.

2.1.2 Technology development

Hydrometric Instrumentation and Data Collection

The NHP continued investment in new field technologies, including hydroacoustic equipment and advanced deployment platforms, such as bank-operated cableway systems and remote control boats, as manned cableways across the country are being decommissioned. There was also new investments in equipment for index velocity sites (sites where discharge is derived from both velocity and water level instead of water level alone).

The NHP is exploring the possibility of using non-contact techniques for both water level and flow monitoring, as well as testing radar sensors and video analysis techniques. Work continued on refining current standard operating procedures and methods, and adopting new ones to ensure measurement techniques provide accurate and reliable data, while maintaining and improving safe work practices.

Surface Water from Space project

While the Surface Water from Space project ended in 2016, the work was used in a 2017–2018 Radarsat Constellation Mission project to help identify the extent of open water.

Data dissemination

Phase 1 of the Hydrometric Data Management Integration and Renewal (HyDMIR) project was partially completed in 2016-2017, which migrated the real-time database to a more efficient and robust infrastructure in Dorval, QC. Phase 2 was launched immediately after Phase 1 to renew the Hydex (metadata) interface.

In April 2017, the Wateroffice delivered a new web service to facilitate the ability of provincial and territorial partners to download data automatically. This was run in parallel with the old web and email service to cover the flooding season of 2017. In September 2017, the old web service and email service were decommissioned along with the legacy infrastructure in Vancouver, B.C.

After-hours support was provided during the 2017 spring freshet to ensure real-time hydrometric data were available 24/7 during high water periods, such as the record-breaking peak flows on the Ottawa River.

The offline historical databases were released four times over the year: April, July, October 2017, and January 2018.

2.1.3 Program Development

Quality Assurance

Following a series of external audits of hydrometric offices, processes and the management system, in early 2018 the NHP's Quality Management System (QMS) was re-certified under the International Organization for Standardization's new ISO 9001:2015 standard, as part of the broader Meteorological Service of Canada certificate. This achievement comes as the QMS is in the eleventh year, after a fourth recertification audit, and is valid for a 3-year period. ECCC also completed a "Fundamental Review" of the Quality Management System in 2017-2018, the outcomes of which include a redesign of the QMS process with an approach based on LEAN principles that will be implemented in 2018.

Updating of the Water Survey of Canada's Standard Operating Procedures (SOPs) continued in 2017-2018, in an effort to keep pace with changes in technology in the operational program. A much-needed upgrade was done to the hydrometric field manual on levelling, which was previously published in 1984. This new SOP outlines the methods used by the Water Survey of Canada for all levelling activities, including the assessment of benchmark and gauge stability and guidance on how levelling should be performed in all conditions.

Hydrometric science and development

In 2017–2018, ECCC continued to be heavily involved with the University of Saskatchewan, University of Waterloo, Wilfrid Laurier University and McMaster University through the Global Water Futures Program. This program explores ways to improve hydrometric program delivery through innovative technology such as drones and cameras.

Collaboration on hydrology modelling to improve the ability of the NHS to predict flows as part of its federal water management obligations was continued. ECCC has also continued collaborations with university colleagues in Quebec (L'Institut national de la recherche scientifique) in operationalizing hydrodynamic and ecohydraulic models in rivers of federal significance.

ECCC continued collaboration on the development of space-based monitoring technologies for hydrological monitoring in Canada with the Canadian Space Agency (CSA), the National Aeronautics and Space Administration (NASA), the University of Sherbrooke, the University of California, Los Angeles and other organizations in the United States. Work focused on the Surface Water Ocean Topography (SWOT) hydrology mission, scheduled for launch by NASA in 2021. This past year, the Canadian team, led through the NHS, tested appropriate ground-based and aerial infrastructure in various environments at key locations in Canada. NASA's Jet Propulsion Laboratory conducted a series of successful flights of the AirSWOT system over selected sites in Canada. Data for regions around the North Saskatchewan River, the Peace-Athabasca Delta and near the Mackenzie Delta were collected during the summer of 2017.

ECCC, in cooperation with the University of Manitoba, University of Victoria, and InnoTech Alberta, continued to support the national pilot project for an operational isotope network, in conjunction with the hydrometric network, which is similar to the existing isotope-hydrometric network in the United States. The goal is to demonstrate the value of systematic collection of river discharge, in tandem with analysis for oxygen-18 (18O) and deuterium (2H) across Canada.

Outreach

National Hydrologic Services support openness and interoperability of information and data access across various systems. NHS, working with ECCC's Geospatial Web Service team, launched a project to make historical hydrometric data available in Open Geospacial Consortium compliant standards. The plan is to release more water quantity resource information, including station metadata and near real-time data.

2.2 WATER QUALITY MONITORING

2.2.1 Freshwater quality monitoring

Freshwater quality monitoring has been a core program function of ECCC since the Department's inception in the early 1970s. The Department's monitoring and surveillance activities are critical for assessing and reporting on water quality status and trends, and for fulfilling many federal domestic and international commitments and legislative obligations. Much of the Department's monitoring is carried out through federal-provincial/territorial agreements, ensuring cost-effective and non-duplicative program delivery.

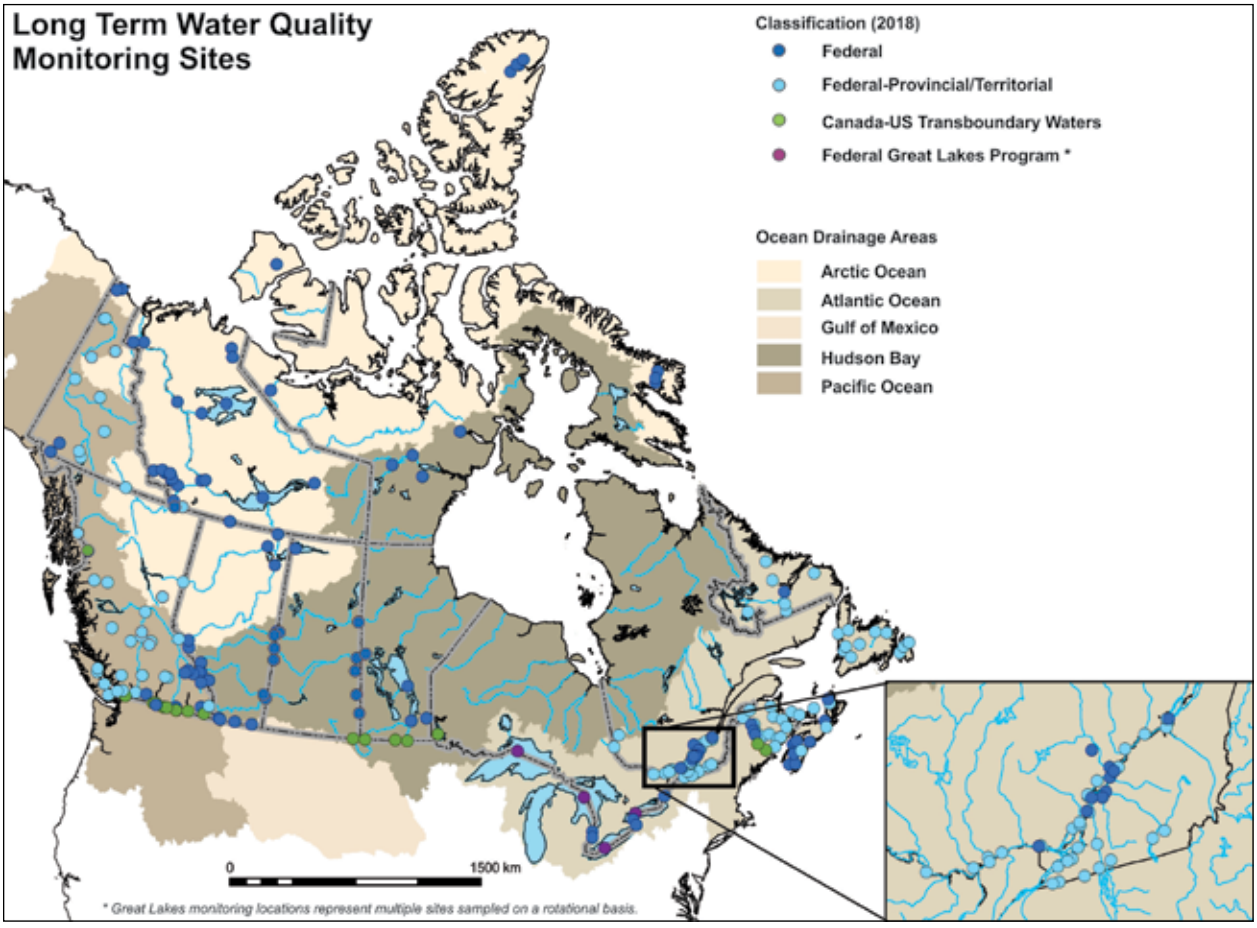
The objectives of the federal-provincial/territorial water quality monitoring agreements are to:

- achieve a long-term commitment for the acquisition of water quality data;
- obtain comparable, scientifically sound water quality data that are reliable to inform water resource management; and
- disseminate timely information on water quality to the public, government agencies, industry and the scientific community.

Data are available at https://open.canada.ca/data/en/dataset/67b44816-9764-4609-ace1-68dc1764e9ea. Data are also used to support the freshwater quality indicator in the Canadian Environmental Sustainability Indicators (see section 3).

The long-term freshwater quality monitoring network consists of federal, federal-provincial and federal-territorial sampling sites across Canada (see Figure 3). Water quality samples are routinely collected at these sites for physical and chemical water quality parameters such as temperature, pH, alkalinity, turbidity, major ions, nutrients and metals. Pesticides and additional parameters of concern are also monitored where site-specific water quality issues exist.

Figure 3: Long-term water quality monitoring sites



Since 2010, ECCC has adopted the Risk Based Adaptive Management Framework (RBAMF) to optimize its monitoring activities. The RBAMF is defined through a set of pillars that guide its various components. These pillars include defining monitoring responsibilities, identifying risks to water quality at monitoring sites and across Canada's drainage basins, optimizing monitoring operations, and ensuring data quality and data access, which improves reporting outcomes. Program activities are framed by health and safety, to ensure workplace field safety and to provide a culture of excellence to continually deliver through clear goals, priorities, team collaboration, and increased efficiencies.

In 2017-2018, a series of national scale networks was developed (including Large Rivers, Large Lakes Priority, Transboundary Rivers, Reference, and High Stress) from existing long-term monitoring sites (Figure 3) and include a set of specific national monitoring objectives. As such, each network aims to improve comparability of monitoring data to more effectively report on water quality issues on a national scale.

ECCC's Freshwater Quality Monitoring Program is aligned with Canada's major watersheds (Arctic/Athabasca, Pacific, Hudson Bay and Atlantic watersheds). This program promotes robust water resource management across Canada.

For more information, please consult the ECCC Freshwater Quality Monitoring and Surveillance website[5].

Arctic/Athabasca Watershed

ECCC continued to monitor 48 sites within the Arctic Watershed and across the North: 22 in the Northwest Territories, 14 in Nunavut, 2 in Yukon and 10 in northern Alberta. The majority of these sites are operated in cooperation with Parks Canada and include eight national parks (Auyittuq, Quttinirpaaq, Ukkusiksalik, Aulavik, Ivvavik, Tuktut Nogait, Nahanni and Wood Buffalo National Parks). Many of these sites are co-located with ECCC's gauge stations.

Ten stations in northern Alberta and one in the Northwest Territories are monitored under the Oil Sands Monitoring Program in partnership with Alberta Environment and Parks. The monitoring work done under this plan is designed to track the cumulative effects of oil sands development in air, water, wildlife and biodiversity, which in turn can help inform governments and industry decision-making processes.

Many of the High Arctic sites are considered relatively pristine and, over time, provide an important baseline and reference for comparison with respect to long-range transport of atmospheric pollutants to high-latitude areas, as well as for any potential future influences from human activities in the North. ECCC also operates water quality sites on major rivers in the North, some of which are associated with transboundary basins (e.g., Mackenzie River, Slave River, Liard River) or are significant northern watersheds (e.g., Coppermine River, Thelon River, Great Bear Lake/River). Additional northern rivers are also monitored in the Yukon (see Pacific Watershed section, below).

Pacific Watershed

Monitoring is conducted in the Pacific Watershed (which includes parts of British Columbia and Yukon) under the *Canada–British Columbia Water Quality Monitoring Agreement*[6] and under operational schedules agreed with the Yukon Government.

[5] www.canada.ca/en/environment-climate-change/services/freshwater-quality-monitoring.html

[6] www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/monitoring-water-quality/west-coast-wq-docs/wq_cowichan-koksilah-assessment.pdf

In British Columbia, ECCC conducts joint monitoring with the provincial Ministry of Environment at 41 river sites (including one automated site). Water monitoring activities are negotiated annually and are documented in the *Canada British—Columbia Water Quality Monitoring Agreement* Business Plan (2017-2018).

In the Yukon, 13 sites were monitored on rivers in collaboration with Environment Yukon including one automated site.

The Canada–British Columbia automated monitoring site located in the Fraser River Estuary is a monitoring buoy platform providing real-time water quality, meteorological, and grab-sample data to the public on ECCC's Freshwater Quality Monitoring and Surveillance website. In addition, ECCC in collaboration with the Department of Fisheries and Oceans, the Okanagan First Nation Alliance and the British Columbia Ministry of Environment, deployed a real-time water quality monitoring buoy in Osoyoos Lake in 2017. Data generated from these automated sites are used to identify important trends and emerging water quality issues from urban, agricultural and industrial activities in the lower Fraser and Okanagan Basins.

In 2017–2018, ECCC, in cooperation with the Parks Canada Agency, operated five long-term water quality monitoring sites in the Glacier, Yoho and Kootenay National Parks in British Columbia and Kluane National Park in Yukon. These sites are relatively pristine and provide important reference information for comparison with sites influenced by human activities. Many of these sites are also located in key areas for assessing climate change.

Hudson Bay Watershed Monitoring

As part of the national long-term monitoring network and in support of the *Prairie Provinces Water Board Master Agreement on Apportionment*, ECCC monitors 12 sites along the main rivers crossing between the Alberta, Saskatchewan and Manitoba provincial boundaries. This work supports annual reporting on water quality objectives for nutrient, metal, major ion and pesticide parameters established by Canada, Alberta, Saskatchewan and Manitoba [7]. The water quality data and information obtained is also used to support the Lake Winnipeg Basin Program. Water quality data are routinely shared with partners and collaborators involved in the Lake Winnipeg Research Consortium, including the Province of Manitoba, other federal departments, universities and institutes working on Lake Winnipeg.

ECCC continued to work with Manitoba Sustainable Development under the Science Subsidiary Arrangement made pursuant to the *Canada-Manitoba Memorandum of Understanding Respecting Lake Winnipeg and the Lake Winnipeg Basin*. The agreement, signed in 2012, supports the development of science-related data, indicators and nutrient targets. Other key transboundary monitoring sites are located on the Red, Pembina, Winnipeg and Souris Rivers and on the Milk River–St. Mary River system. The Red and Souris Rivers, in particular, have encountered many water quality issues over time (nutrients, metals, pesticides, salinity). Water quality and water quantity issues on these rivers are addressed formally through the International Red River Board[8] and International Souris River Board[9] under the International Joint Commission (IJC). Regular monitoring updates were provided to these boards and to a number of institutional partners in 2017-2018.

[7] www.ppwb.ca
[8] https://ijc.org/en/rrb
[9] www.ijc.org/en/srb

All of the transboundary rivers in the watershed are monitored regularly (8 to 12 times per year). During the 2017-2018 open water season, the Red River was monitored more intensively (biweekly to weekly) to address concerns related to increased continuing water releases from Devils Lake (North Dakota) crossing the Canadian border, and to improve the nutrient loading estimates for Lake Winnipeg. Additionally, ECCC also operates an automated station on the Red River at Emerson, Manitoba, as a real-time alert system in the context of transboundary flooding and water quality monitoring. Real-time data were used to assess water quality changes due to increased Devils Lake water releases. In addition, the Red River was also monitored for a suite of current use pesticides, including neonicotinoids, carbamates (fungicide) and sulfonyl urea (herbicide) to assess transboundary contamination.

As an international and interprovincial transboundary waterway, Lake of the Woods is relatively unique in the number of jurisdictions and international organizations, such as the IJC, that have a role to play for successful environmental management. Local and national concerns with noxious and potentially toxic cyanobacteria (blue-green algae) blooms and declining water quality in Lake of the Woods prompted ECCC to address the science needs around this issue. As part of the international effort, ECCC has intensified science and monitoring efforts in the watershed that, in addition to baseline monitoring, includes more directed research efforts on algae, nutrient mechanisms, modelling and remote sensing.

In addition, under a Memoranda of Understanding with Parks Canada, sites in Banff, Jasper, and Waterton National Parks are sampled by ECCC. These sites provide water quality information to Parks Canada and are used as reference sites as part of ECCC's long-term water quality monitoring program.

Atlantic Watershed

In the Atlantic Watershed, federal-provincial water quality monitoring is supported through:

- *Canada–Quebec Water Quality Agreement,*
- *Canada–New Brunswick Water Quality Monitoring Agreement,*
- *Canada–Newfoundland and Labrador Water Quality Monitoring Agreement,*
- *Canada–Prince Edward Island Memorandum of Agreement on Water,*
- *Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health*, and
- *Canada-US Great Lakes Water Quality Agreement.*

Monitoring results generated by ECCC contribute to indicators assessing the status of the Great Lakes ecosystem for toxic chemicals in water, sediments and fish as well as indicators on the status of nutrients, water quality and algae.

In 2017-2018, sediment, water, and fish from the Great Lakes ecosystem were collected for analysis of nutrients, major ions, and toxic chemicals supporting Canada's commitments in the *Great Lakes Water Quality Agreement* between Canada and the United States. These data were used in a comprehensive study of nutrient concentrations and loadings in the connecting channels from

Lake Huron to Lake Erie to further the assessment of performance measures that have been implemented to reduce total phosphorus loadings to the Great Lakes. In June 2017, the most recent version of the triennial *State of the Great Lakes Report*[10] was released.

The *Canada–Québec Water Quality Monitoring Agreement* was renewed in 2017 and covers 39 sites in the transboundary St. Lawrence River and its tributaries. In addition to the sites covered by this Agreement, ECCC operated 10 additional federal sites (including two automated) in the St. Lawrence River Basin. The sites were sampled monthly in 2017-2018 for physical parameters and nutrients, in addition to metals, pesticides and polybrominated diphenyl ethers (PBDEs) at some of them.

Under the *Canada–New Brunswick Water Quality Agreement* during 2017-2018, 10 federal-provincial sites were monitored. The sites are located on international and interprovincial transboundary rivers or their tributaries in the Saint John River (Wolastoq River) and Restigouche River watersheds. Four real-time automated sites in the Saint John River (Wolastoq River) watershed were also maintained by ECCC at the borders of the transboundary Big Presquisle River, Aroostook River and Meduxnekeag River and in the main channel at Evandale.

The International St. Croix River Watershed Board[11], under the IJC, plays an important role in managing water levels, water quality and fisheries between Maine and New Brunswick. The Board works collaboratively with stakeholders within the watershed by preventing and resolving disputes. ECCC monitored water levels at seven stations in the watershed and real-time (automated) water quality at two stations and provided input to the Board's 2017 annual report[12] to the IJC.

In 2017-2018, eleven sites were monitored under the *Canada–Prince Edward Island Memorandum of Agreement*. One real-time (automated) site was operated on the Wilmot River. In addition, pesticide surveillance was conducted during the growing season. The sites are distributed across the province, with data available on the Government of Prince Edward Island's website.[13]

In 2017-2018, ECCC managed 13 federal sites (including two automated sites) in Nova Scotia in support of the Canadian Environmental Sustainability Indicator pertaining to water quality. Nova Scotia Environment provided support on data collection. The sites are located across the province and cover major watersheds within the Maritime Major Drainage Area, including those flowing into the Bay of Fundy.

In Newfoundland and Labrador, 72 sites across the major drainage areas were sampled 4–8 times in 2017-2018. Data and station information from the sites are available on the Newfoundland and Labrador Water Resources website.[14]

2.2.2 Biological monitoring

In addition to the physical-chemical water quality monitoring detailed above, ECCC also undertakes biological monitoring using benthic macroinvertebrates to assess the health of aquatic ecosystems.

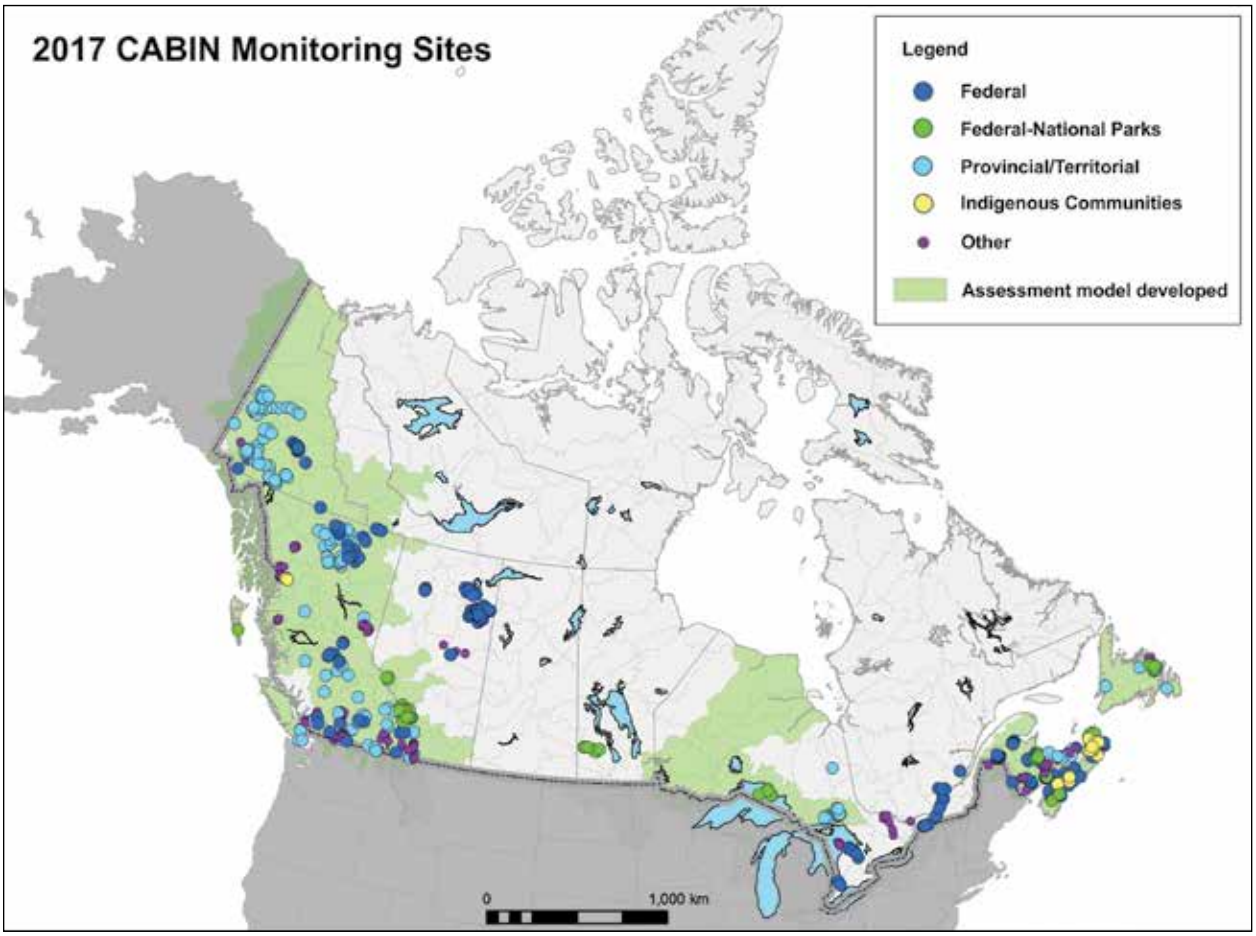
The Canadian Aquatic Biomonitoring Network (CABIN) is a component of the Freshwater Quality Monitoring Program for assessing the biological condition of freshwater ecosystems in Canada using standardized data collection and analysis methods[15]. This component, based on decades of research and development in many countries, has been adopted by multiple organizations across Canada.

[10] https://binational.net/2017/06/19/sogl-edgl-2017
[11] www.ijc.org/en/scrwb
[12] www.ijc.org/en/scrwb/annual-report-2017
[13] www.princeedwardisland.ca
[14] http://maps.gov.nl.ca/water
[15] www.canada.ca/en/environment-climate-change/services/canadian-aquatic-biomonitoring-network.html

The success of CABIN results from collaboration and data sharing. It is led by ECCC's National CABIN Team, which provides online data management, assessment tools and models, field and laboratory analysis protocols, certification and training, and ecological research and development. Network partners share their observations within the national database. CABIN partners include federal, provincial and territorial government departments, industry, academia, Indigenous communities, and non-governmental organizations such as community watershed groups. A CABIN Science Team, consisting of ECCC and external scientists with expertise in large-scale ecological monitoring, provides science advice and recommendations.

Since the early development of the CABIN monitoring strategy in the 1980s, data have been collected in over 10,000 locations across the country. In 2017-2018, data were collected at 921 sites in several sub-basins across the country by ECCC and its collaborators (see Figure 4).

Figure 4: CABIN monitoring sites



Pacific Watershed

In British Columbia, CABIN monitoring is jointly conducted under the *Canada–British Columbia Water Quality Monitoring Agreement*. Under this agreement, ECCC and the provincial Ministry of Environment collaborate on data collection for reference model maintenance and development and site assessment.

The eleven reference models available to all CABIN users to conduct biological assessments in watersheds in British Columbia and Yukon were developed collaboratively by federal, provincial and territorial agencies (i.e., Department of Fisheries and Oceans, the Canadian Coast Guard, Parks Canada, British Columbia Ministry of Environment, and Government of Yukon). Models are available for the Yukon River Basin, Fraser River/Georgia Basin, Skagit River Basin, Okanagan Basin, B.C. Central/North Coast, Northeastern B.C. and Rocky Mountains national parks models. In 2017-2018, ECCC collected CABIN data from 62 stream and river sites: 43 sites for reference model maintenance and development, and 19 sites for assessment of biological condition co-located at long-term physical-chemical monitoring sites.

Arctic/Athabasca Watershed

In the Athabasca watershed, under the Joint Canada–Alberta Implementation Plan for the Oil Sands, CABIN sampling was conducted at 55 sites in the tributaries of the Lower Athabasca River. The program also included biomonitoring sampling at 10 sites with five replicates in the mainstream of the Athabasca River using a modified CABIN approach for large rivers. Sampling sites in the Lower Athabasca River and its tributaries range from within the active oil sands development area (potentially impacted sites) to outside the development area as well as beyond any natural exposure of the bituminous geologic formations in the region (reference sites). In 2017-18, CABIN sampling was also conducted in tributaries of the Peace River (three sites) as part of an expanded oil sands biomonitoring program that includes the Peace River Oil Sands area.

Hudson Bay Watershed

In 2017-2018, ECCC revisited five sampling sites in southern Ontario as part of a comparative study with Ontario Ministry of Environment and Climate. CABIN sampling was also conducted by ECCC in the Great Lakes using the CABIN Open Water protocol. Five reference sites for the Great Lakes Reference Study were sampled, as well as 12 sites in the Cornwall Area of Concern (AOC).

Atlantic Watershed

In the Atlantic Watershed, 188 stream and river sites were monitored by ECCC and its certified partners in 2017-2018: 173 in the Atlantic Provinces (134 by ECCC and other federal departments or parks; and 39 by non-federal partners) and 15 in Québec (10 in the St. Lawrence River and 5 in the Mauricie National Park), using CABIN sampling protocols. This work supported federal-provincial water quality monitoring agreements with New Brunswick, Newfoundland and Labrador, and Prince Edward Island. The monitoring allowed partners to conduct assessments in transboundary watersheds (Saint John River [Wolastoq River], St. Lawrence River) and federal lands (i.e., national parks, Indigenous communities, and the Meaford and Gagetown Canadian Forces Bases).

Monitoring data collected also informed the Canadian Environmental Sustainability Indicators Freshwater Quality Indicator. Research in the use of new techniques for assessing the suitability of aquatic habitat to support aquatic life, based on DNA collection was also conducted as part of a collaborative project with the Genomic Research and Development Initiative. In 2017, 70 sites were sampled in the Atlantic Provinces and DNA was sequenced.

2.2.3 Marine water quality monitoring

The Canadian Shellfish Sanitation Program (CSSP) is a federal program administered jointly pursuant to a Memorandum of Understanding (MOU) between the Canadian Food Inspection Agency, ECCC, and the Department of Fisheries and Oceans (DFO).

The CSSP objective is to provide reasonable assurance that molluscan shellfish are safe for consumption by controlling the harvesting of all molluscs (e.g., oysters, mussels, clams, scallops) within the tidal waters of Canada. The mutual concerns of Canada and the United States to protect the public from the consumption of contaminated bivalve molluscs led to the Canada-US Bilateral Agreement on Shellfish Sanitation on April 30, 1948 dealing with sanitary practices in the shellfish industries of both countries. This Agreement remains in effect and to maintain open trade, Canada is subject to periodic audits by the US Food and Drug Administration.

In 2017–2018, 496 shellfish growing areas were monitored in Canada (Atlantic: 245, BC: 136, QC: 115). Marine water sampling was undertaken through a combination of delivery methods in different portions of each province, including internal ECCC resources, outsourcing to private-sector contractors, federal-provincial water monitoring agreements and voluntary agreements with First Nations and stakeholders. Analyses for fecal coliform and salinity content determination were performed in ISO 17025-accredited laboratories. Across Canada, 26,474 marine water samples (Atlantic: 16,141, BC: 6,491, QC: 3,842) were collected at 6,811 stations (Atlantic: 3,512, BC: 2,074, QC: 1,225).

In addition to marine water quality determinations, sanitary shoreline investigations of point and non-point pollution sources were performed in 298 shellfish growing areas (Atlantic: 114, BC: 124, QC: 60). Related to waste water treatment plant assessments, 16 (Atlantic: 8, BC: 6, QC: 2) wastewater systems were evaluated or re-evaluated. In addition, 2,940 (Atlantic: 653, BC: 2,200, QC: 87) environmental emergency events were reviewed and significant incidents were assessed to determine the need for emergency harvest area closures.

For more information about the Canadian Shellfish Sanitation Program, please consult the Canadian Food Inspection Agency website.[16]

2.3 HYDRO-METEOROLOGICAL MODELLING AND PREDICTION

For several years, researchers and scientists at ECCC and many partner organizations have used atmospheric and weather data as input for day-to-day operational forecasting models, and hydrologic data collected under the hydrometric agreements as input for hydrologic models. These models demonstrate how regional hydro-meteorological modelling can help improve water resources management.

ECCC continued to contribute internationally through its leadership as the Canadian hydrological advisor to the World Meteorological Organization's Commission for Hydrology. This entails providing input and advice to the Commission on all matters related to hydrometric monitoring and hydro-meteorology. Specifically, the Department contributed expertise toward the development of techniques for uncertainty analysis in hydrometric measurements and on basic systems.

The Department continues to lead the Arctic Hydrological Cycle Observing System (HYCOS) initiative, which focuses on assessing freshwater fluxes into the Arctic Ocean. In 2017–2018, a draft web-portal[17] was created to display streamflow and other data for all hydrometric stations in the Arctic-HYCOS network and allow filtering and downloading of the data according to extended metadata criteria (much of the data are also available online via the Global Runoff Data Centre.[18] Work on summarizing and recommending international standards for collection of lake and river ice and water

[16] www.inspection.gc.ca/food/food-specific-requirements-and-guidance/fish/canadian-shellfish-sanitation-program/eng/1527251566006/1527251566942?chap=2
[17] http://arctic-hycos.net/Arctic-HYCOS/Home.html
[18] www.bafg.de/GRDC

temperature observations continued in 2017-2018. The Arctic-HYCOS project steering committee will convene again in November 2018 to wrap up the initial work plan items of creating the network list and the web-portal, and will determine more advanced work to be done on customizing the database and increasing the availability of real-time discharge, temperature, and ice data available to the public.

Great Lakes

In 2017–2018, ECCC continued to improve methods for coupled hydro-meteorological modelling and prediction under an expanded environmental prediction framework. The model enables an improved understanding of interactions between the atmosphere and land surface, and supports improved water management in the region. ECCC is collaborating with the U.S. Army Corps of Engineers, the National Oceanographic and Atmospheric Administration (NOAA), and the U.S. Geological Survey to operationalize various modelling systems for historical analysis of the water balance in the upper Great Lakes. After years of development by NOAA, in consultation with ECCC, a statistical model is now run every month using input from ECCC-MSC and other Canadian and U.S. agencies that determines the most likely values for the water balance components. It is expected that this technique will increase our understanding of the hydrological functions and improve forecasting of Great Lakes water levels.

Under the Coordinating Committee on Great Lakes Basic Hydraulic and Hydrologic Data, flow measurements and computation techniques for the St. Clair and Detroit Rivers continued to be updated to improve water balance accounting.

Hydrological and modelling experts in ECCC continued to develop models to estimate possible scenarios of river flow through forecasting. The operational forecast model is used by provincial flood forecasting agencies and testing of the model in the Great Lakes continued as researchers strive to develop a 10-day model. A pilot project was also started in 2017 to provide forecasted flows to Water Survey of Canada staff. The forecasted flows are expected to provide advance information for efficient planning of Water Survey of Canada fieldwork to capture important data for high flow events.

St. Lawrence River

Activities under the St. Lawrence Action Plan's numerical environmental predictions working group continued in 2017–2018. The main activities of the group were:

- modelling and assimilation of surface data covering the watersheds of St. Lawrence River tributaries;
- hydrological modelling and routing of waters entering via the watersheds of St. Lawrence tributaries;
- two-dimensional hydrodynamic modelling of the St. Lawrence River including lac Saint-François, lac des Deux-Montagnes, lac Saint-Louis, the LaPrairie Basin, rivière des Mille-Îles, rivière des Prairies, and the Sainte-Anne and Vaudreuil channels; and
- modelling of the dynamics of the major St. Lawrence River ecosystems.

These activities are done through the federal-provincial collaboration under the St. Lawrence Action Plan, and they support the main priorities of the plan (biodiversity, water quality and uses).

Other activities

ECCC provided support to many IJC water boards, committees and special studies in 2017–2018. This included establishing plans for special studies and development, testing and implementation of hydrologic and ecosystem models, and an adaptive management framework for the on-going review of lake regulation plans. ECCC continued to support IJC's Lake Ontario St. Lawrence River Plan 2014, which is designed to provide for more natural variations of water levels of Lake Ontario and the St. Lawrence River to restore ecosystem health. This year implementation was marked by an unforeseeable and exceptional period of record rainfall and other weather challenges that resulted in record-high water levels and associated flooding and erosion around Lake Ontario and much of the St. Lawrence River. ECCC provided considerable support interdepartmentally and to other federal, provincial and local partners throughout the extreme water level event, providing daily water level briefings as well as ensuring effective communications to the public.

ECCC's data and knowledge of the hydrology of the Great Lakes allowed them to play a key role in providing information to the Province of Ontario, Conservation Authorities, Municipalities and the public in 2017-2018 on Great Lake water levels. The record setting high levels seen on Lake Ontario in May 2017, along with relatively high water levels on all the other Great Lakes, created interest for more information on current and future water levels and the management of shorelines around the Great Lakes. ECCC provided information sessions and participated in planning meetings of interested governments and groups across the Great Lakes basin to aid in their management efforts.

ECCC, in collaboration with U.S. Army Corps of Engineers, Detroit District, has built an Integrated Ecosystem Response Model for the St. Marys River rapids. The bi-dimensional Ecohydraulic model is being used to improve the spawning success of several fish species that use the swift water of the rapids for reproduction. This prototype will be extended to the entire St. Marys River.

ECCC continued to play a lead role in the Lake Champlain-Richelieu River Study, examining the cause of and possible mitigation measures to flooding issues in the Lake Champlain-Richelieu river basin.

3. CANADIAN ENVIRONMENTAL SUSTAINABILITY INDICATORS

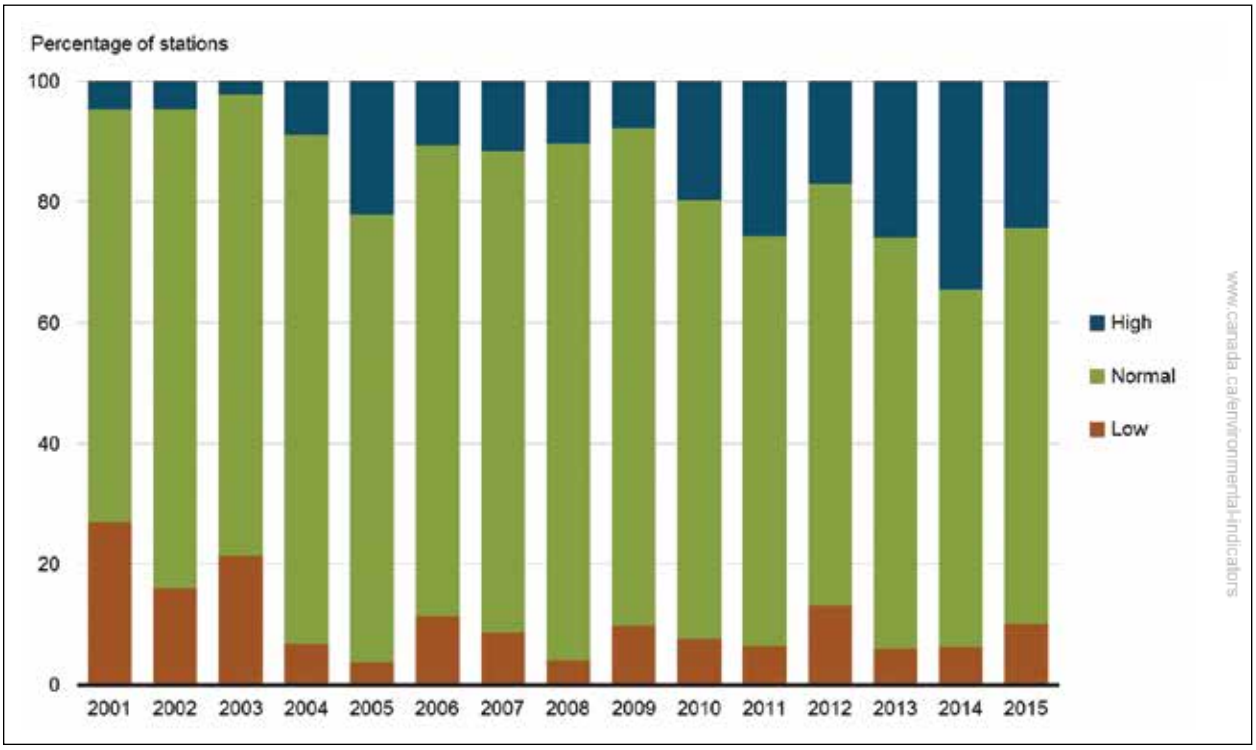
The Canadian Environmental Sustainability Indicators (CESI)[19] program reports on the status and trends of key environmental issues. Indicators cover air quality, climate change, water quality and quantity, and wildlife and habitat.

Water quantity

The most recent national water quantity indicator provides a summary of trends in water quantity in rivers across Canada from 2001 to 2015 (Figure 5). At the drainage and monitoring station level, the indicators provide an illustration of whether water flows were low, normal, or high from 2001 to 2015.

- From 2001 to 2015, most Canadian rivers had normal water quantity.
- Since 2010, there has been an increase in sites with a higher-than-normal quantity.
- The percentage of stations with a lower-than-normal quantity has declined since 2001.

Figure 5: Water quantity at monitoring stations, Canada, 2001 to 2015



[19] canada.ca/environmental-indicators

Water quality

The program's water quality indicator provides an overall measure of the ability of rivers to support aquatic life (plants, invertebrates and fish) at selected monitoring sites across Canada. The water quality indicator is calculated using the water quality index, endorsed by the Canadian Council of Ministers of the Environment, to summarize the status of surface freshwater quality in Canada. This indicator reflects the extent to which water quality guidelines for the protection of aquatic life are being met at selected river monitoring sites throughout Canada. Water quality at a monitoring station is considered excellent when substances in a river are very rarely measured above their guidelines. Conversely, water quality is rated poor when measurements are usually above their guidelines, sometimes by a wide margin.

WATER QUALITY CATEGORIES

Excellent = Water quality is protected with a virtual absence of threat of impairment; conditions are very close to natural or pristine levels.

Good = Water quality is protected with only a minor degree of threat or impairment; conditions rarely depart from natural or desirable levels.

Fair = Water quality is usually protected but occasionally threatened or impaired; conditions sometimes depart from natural or desirable levels.

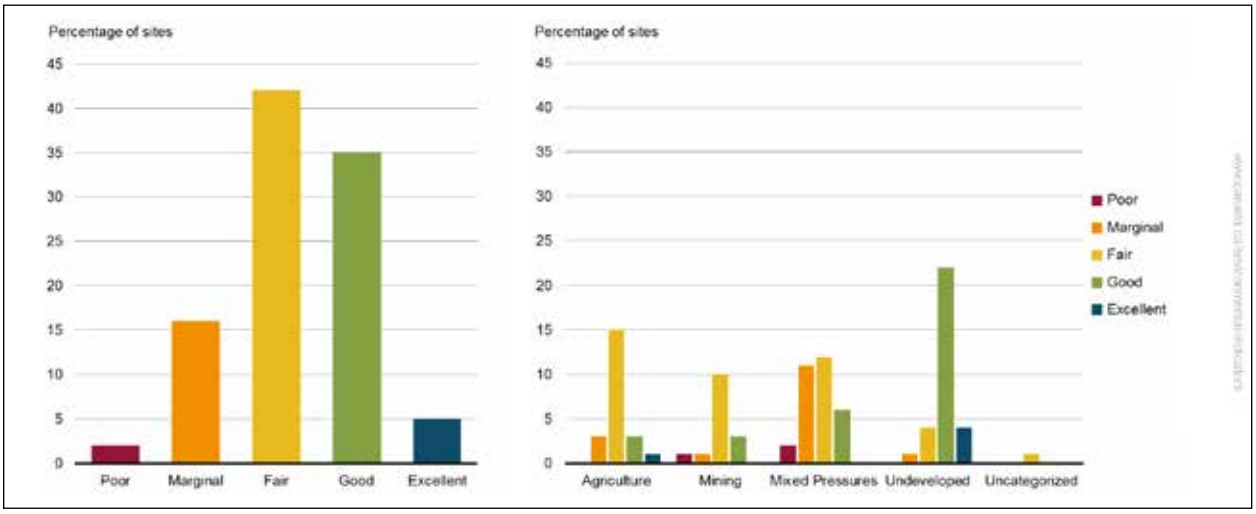
Marginal = Water quality is frequently threatened or impaired; conditions often depart from natural or desirable levels.

Poor = Water quality is almost always threatened or impaired; conditions usually depart from natural or desired levels.

The latest water quality indicator released in January 2018 is based on data collected from 2002 to 2016 at 322 water monitoring stations across Canada and reflecting the diversity of watersheds in the country. The data were assembled from 21 federal, provincial, territorial and joint water quality monitoring programs. The national water quality indicator was calculated using a core national network of 178 river sites, selected to be representative of surface freshwater quality across southern Canada where human pressure is most intense (Figure 6a).

Water quality measured at these river sites across Canada was rated as excellent at 9 sites, good at 63 sites, fair at 74 sites, marginal at 28 sites, and poor at 4 sites. Water quality tends to be worse where there is agriculture, mining, or a combination of these with cities (mixed pressures) (Figure 6b).

Figures 6a and 6b: National freshwater quality indicator for the 2014 to 2016 period, Canada



Note: Water quality was evaluated at 178 sites across southern Canada using the Canadian Council of Ministers of the Environment's Water Quality Index. Two sites have not had their land use categorized because they are close to the Canada-United States border or the ocean. They have not been included in the land use indicator.

Source: Data assembled by ECCC from federal, provincial, territorial and joint water quality monitoring programs. Population, mining and land cover statistics for each site's drainage area were provided by Statistics Canada.

Overall, water quality has not changed at a majority of sites across southern Canada between 2002 and 2016. Out of the 178 core sites, there was improvement in water quality at 10% of sites, deterioration at 9%, and no change in water quality at 81% of the sites (Figure 7).

Figure 7: Trends in National water quality indicator change from 2002 to 2016, Canada

Note: The trend in water quality between the first year that data were reported for each site and 2016 was calculated at 178 sites across southern Canada. A uniform set of water quality guidelines and parameters were used through time at each site for the trend analysis. A Mann-Kendall test was used to assess whether there was a statistically significant increasing or decreasing trend in the annual guideline deviation ratios at a site.

Source: Data assembled by Environment and Climate Change Canada from federal, provincial and joint water quality monitoring programs.

Other water indicators can be found online[20]

[20] canada.ca/environmental-indicators

4. RESEARCH

4.1 RESEARCH ON THE IMPACTS OF CLIMATE CHANGE ON AQUATIC SYSTEMS

In 2017–2018, ECCC undertook a number of activities to quantify and predict local, regional and national sensitivities of hydrological regimes and aquatic ecosystems to climate change, including:

- collection of testbed data to assist in the development of next generation climate-permafrost-hydrology models;
- collaboration with universities and provincial and territorial agencies to build components of a pan-Canadian network capable of determining the impacts of permafrost thawing on water resources;
- examination of the effects of permafrost degradation on fluvial sediment dynamics;
- examination of the linkage between terrestrial flow pathways and sediment sources with changes in moisture content/condition (permafrost thaw, rainfall);
- assessment of current ability to simulate and predict large riverine and water chemistry input to the Arctic Ocean;
- maintenance of energy flux sites at fixed locations and with partners by enhanced mobile platforms with new mounted observation systems;
- quantifying the impacts on river and lake ice phenology[21] in northern regions;
- evaluating changes in peak runoff events to the Arctic Ocean;
- research at the Baker Creek Research Catchment to evaluate the impact of permafrost degradation on water cycling and chemistry in the subarctic Canadian Shield;
- contributing to a national assessment of past trends and projected future changes to several freshwater availability indicators across Canada;
- assessing projected future drought/water availability across Canada using the Standardized Precipitation Evapotranspiration Index derived from output using the Coupled Model Intercomparison Project Phase 5[22] climate scenario data;
- assessing climate variability and change on prairie wetlands and hydrology, including resultant impacts on the water quality in the Prairie's watershed; and
- assessing the vulnerability of western Canadian watersheds reliant on water from mountain headwaters to increasing drought risk and diminishing snow packs in collaboration with international and national academic organizations.

[21] Phenology: the study of cyclic and seasonal natural phenomena, especially in relation to climate and plant and animal life.
[22] Coupled Model Intercomparison Project Phase 5 is meant to provide a framework for coordinated climate change experiments.

5. INTER-JURISDICTIONAL WATER BOARDS

Inter-jurisdictional water boards have been established to focus on specific water issues that have implications for more than one province or territory. Domestic inter-jurisdictional boards include the Ottawa River Regulation Planning Board (ORRPB), Prairie Provinces Water Board (PPWB), Mackenzie River Basin Board (MRBB), and the Lake of the Woods Control Board (LWCB). The 2017-2018 activities of each are described below.

There are also many international transboundary and inter-jurisdictional water boards in which Canada participates, most of which are led by the IJC. IJC work is not covered under the CWA; ECCC's progress towards work plans is reported internally under the *Environment and Climate Change Canada–International Joint Commission Memorandum of Understanding*.

5.1 MACKENZIE RIVER BASIN BOARD

The governments of Canada, British Columbia, Alberta, Saskatchewan, the Northwest Territories and Yukon signed the *Mackenzie River Basin Transboundary Waters Master Agreement* in July 1997. The Master Agreement states that the waters of the Mackenzie River Basin should be managed to preserve the ecological integrity of the aquatic ecosystem and to facilitate reasonable, equitable and sustainable use of this resource for present and future generations. The Master Agreement provides for early and effective consultation on potential developments and activities in the basin that could affect the integrity of the aquatic ecosystem and contains provisions for seven bilateral agreements between adjacent jurisdictions in the basin.

The Mackenzie River Basin Board (MRBB)[23] represents all parties to the Master Agreement and administers the provisions of the Master Agreement. Federal members include representatives from ECCC and Indigenous and Northern Affairs Canada. Health Canada also participates, providing support and expertise on human health issues. Ten members represent the three provinces and two territories in the basin, including an appointee from each provincial and territorial water management agency, and an Indigenous board member representing Indigenous peoples in each of the five jurisdictions.

Under the Master Agreement, ECCC is responsible for managing the expenditures of the MRBB, which are cost-shared equally by the parties. Cost-shared expenditures include the staffing and operation of the Secretariat office to provide working-level support for the Board. The Secretariat has an executive director hired by ECCC and who is responsible for planning, directing and managing Board operations.

[23] www.mrbb.ca

Key activities and accomplishments in 2017-2018 include:

- The MRBB monitored the implementation of bilateral water management agreements that have been signed between Alberta and Northwest Territories, British Columbia and Northwest Territories, and British Columbia and Yukon.
- The MRBB monitored the progress of bilateral water management negotiations between British Columbia and Alberta, Alberta and Saskatchewan and Northwest Territories and Saskatchewan.
- The MRBB State of the Aquatic Ecosystem Committee and the Traditional Knowledge and Strengthening Partnerships Steering Committee worked jointly to advance the next *Mackenzie River Basin State of the Aquatic Ecosystem Report*. This report will describe the state of the aquatic ecosystem via the use of indicators and will give equal weight to western science and Traditional Knowledge.

5.2 PRAIRIE PROVINCES WATER BOARD

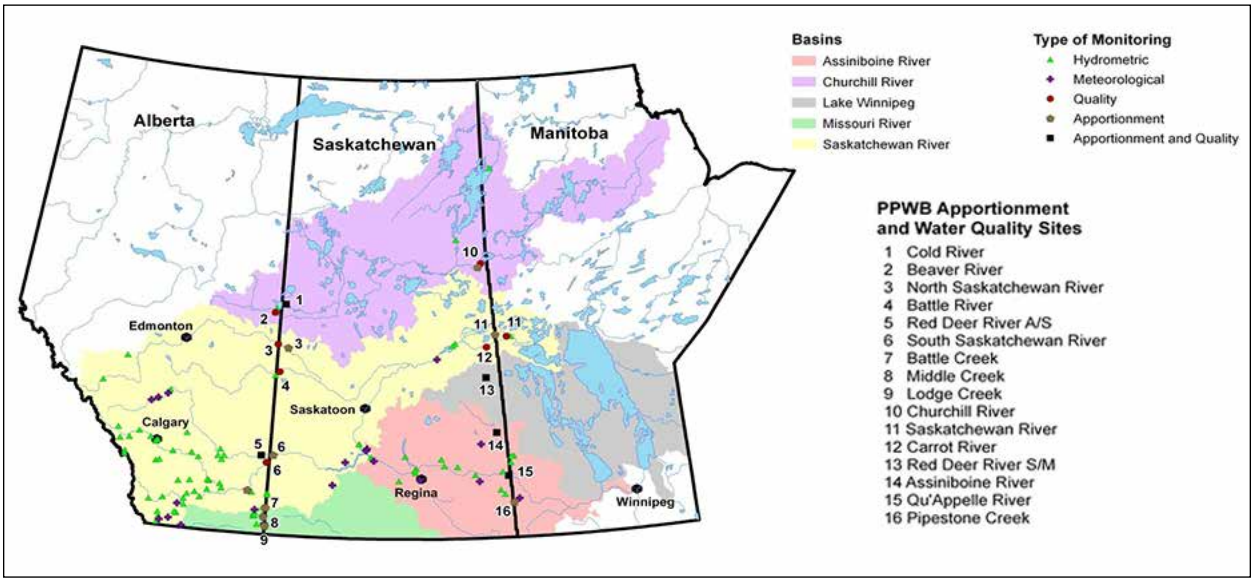
Recognizing that water use within one province may impact another province, and because federal and provincial governments have shared responsibility for water, the governments of Canada, Alberta, Saskatchewan and Manitoba signed the *Master Agreement on Apportionment* (MAA) in October 1969. The purpose of this agreement is to apportion water between the provinces of Alberta, Saskatchewan and Manitoba, and to protect surface water quality and transboundary aquifers. The MAA also provides for cooperation among governments with respect to transboundary water management and for the establishment of the Prairie Provinces Water Board (PPWB) to administer the Agreement[24].

The overarching deliverable for the PPWB is to report on the achievement of the terms of the MAA. The MAA provides for an equitable sharing of available waters for all eastward-flowing streams, including lakes that cross provincial boundaries. The Schedules to the Agreement describe the role of the PPWB and stipulate the amount and quality of water that shall pass from Alberta to Saskatchewan and from Saskatchewan to Manitoba.

In support of the MAA, Environment and Climate Change Canada monitors stream flows, water quality and meteorological conditions on eastward-flowing streams on the provincial borders (see Figure 8). The PPWB computes apportionable flows based on the natural flow on a river as if that river had never been affected by human activity. Excursions (i.e. deviations) to the MAA water quality objectives are calculated annually.

[24] www.ppwb.ca

Figure 8: PPWB water quantity and quality monitoring stations and basins for 2017



Activities and accomplishments of the PPWB in 2017-2018 include:

- Apportionment requirements were reviewed and determined to have been met in the calendar year of 2016 on all eastward flowing prairie streams.
- A project to review apportionment methods is continuing. A review of the Saskatchewan River Basin at the Saskatchewan/Manitoba boundary was completed in 2017. This basin review study looked at all aspects of the apportionable flow calculation and presented options for improvements. The Qu'Appelle River Basin (Saskatchewan-Manitoba boundary) is also undergoing a review.
- The PPWB Committee on Hydrology is working to develop criteria to support how the PPWB determines which transboundary basins are subject to apportionment monitoring, and the frequency of that monitoring. Basins will be evaluated using a classification system.
- Work continued on the development of a proposed schedule to the MAA related to transboundary aquifers. The objective of the schedule will be to establish a cooperative framework for effective and efficient management and sustainable use of groundwater and aquifer systems by the Parties of the MAA.
- The PPWB approved the 2016 Water Quality Excursion Report. The overall adherence to Interprovincial Water Quality Objectives was very high with an average of 96.5% in 2016, such that water quality continues to be protected. The adherence rate was based on the comparison of 5,298 water quality results to water quality objectives.

- In October 2017, the PPWB approved the 2018 water quality monitoring program. The most significant change to the monitoring program from the previous year is the addition of monitoring for *chlorophyll a* to measure algal productivity at all transboundary sites.
    - The PPWB has committed to reviewing the water quality objectives every five years. The revised objectives from the last review were adopted in 2015. The focus of the next water quality review will be on outstanding issues from the last comprehensive review. Objectives were not established for a number of parameters because, at that time, the use of protective objectives was not appropriate and/or there was insufficient information to support development of site specific objectives.
- The PPWB Committee on Flow Forecasting was formed and is currently working on a number of items including a spring runoff harmonization-mapping project.
- The PPWB continued to exchange information on issues of common interest, including water quality issues related to Lake Winnipeg, Saskatchewan–Manitoba drainage issues, Carrot River Sediment issues, and invasive species.
- The PPWB and each of its four standing committees on hydrology, flow forecasting, water quality and groundwater held at least one face-to-face meeting and additional conference calls.

5.3 LAKE OF THE WOODS CONTROL BOARD

The Lake of the Woods Control Board[25] (LWCB) does not fall under the CWA, but it is included in this report to provide a more complete picture of federal-provincial water management in Canada. The LWCB is a board consisting of four members, each with an alternate, who represent Canada (one member), Ontario (two members) and Manitoba (one member). Appointments are made by orders in council of the appropriate government, and each appointee must be a professional engineer.

The LWCB, established in 1919, is responsible for the regulation of levels in Lake of the Woods and Lac Seul and flows in the Winnipeg and English Rivers, downstream from these lakes to their junction. In addition, when the level of Lac Seul exceeds certain specified levels, the LWCB controls the diversion of water from Lake St. Joseph (Albany system) into Lac Seul.

The LWCB's authority is defined by concurrent Canada–Ontario–Manitoba legislation (*Lake of the Woods Control Board Act*; 1921, 1922, 1958) and is further mandated by a Canada–U.S. treaty (Convention and Protocol for Regulating the Level of the Lake of the Woods, 1925), since Lake of the Woods is a transboundary body of water. This treaty also created a second board, the International Lake of the Woods Control Board (ILWCB). Although Lake of the Woods is normally regulated solely by the LWCB, the outflow from the lake is subject to the approval of the ILWCB whenever the level of the lake rises above or falls below certain levels specified in the treaty.

The LWCB maintains a full-time Secretariat that monitors conditions in the basin, provides information and analysis, and recommends regulating strategies or specific outflows. It also implements the LWCB's operating strategy, conducts studies and maintains communications with basin users.

In 2017, conditions in the Winnipeg River basin allowed the LWCB to maintain Lake of the Woods and Lac Seul within their normal operating ranges, balancing lake levels with flow conditions on the Winnipeg and English Rivers. The lakes under the LWCB's authority were maintained within the water level limits established under the Canada-United States treaty and federal and provincial legislation.

[25] www.lwcb.ca

The LWCB held two meetings in 2017 with resource advisors and special interest group representatives in Kenora, Ontario. These meetings resulted in the adoption of seasonal operating strategies employed by the LWCB Secretariat in daily operations.

The LWCB continued its regular engagement activities, hosting a booth at the Lake of the Woods District Property Owners Association's annual Cottage Show in Winnipeg in May and public open house in Kenora in June. Other outreach activities included media interviews and phone calls and email interaction with the public. The 2016 LWCB Annual Report was published in May 2017[26].

5.4 OTTAWA RIVER REGULATION PLANNING BOARD

In 1983, Canada, Quebec and Ontario concluded the *Agreement Respecting Ottawa River Basin Regulation*. Under its terms, the Ottawa River Regulation Planning Board[27] (the Planning Board) was constituted to ensure the integrated management of the flows from the 13 principal reservoirs of the basin in order to minimize damage from floods and droughts along the Ottawa River and in the Montreal region, while maintaining beneficial water uses within the watershed. Under the 1983 Agreement, the governments also established two other entities that report to the Planning Board, namely the Ottawa River Regulating Committee (the Regulating Committee) and the Ottawa River Regulation Secretariat (the Secretariat), which act respectively as the operational arm and working arm of the Planning Board.

The 2017 spring freshet was exceptional for its record-breaking peak flows, the highest in over 100 years on the Ottawa River. This exceptional spring flood can be attributed to various factors, but it was mainly due to unusually heavy rainfall amounts received in April and May when melting snow had already saturated the ground and swollen waterways, combined with a rare sequence of strong depressions that affected the unregulated part of the basin. The freshet was characterized by two peaks: the first on April 20, when water levels along some river portions exceeded levels last seen in 1998, and a stronger peak following two back-to-back storms in early May that caused water levels to exceed those reached in 1974 and 1976.

Flood reduction measures are undertaken annually in preparation for the spring runoff. Typically this involves emptying the principal reservoirs during the winter period with reservoirs being at their lowest levels before the spring snow melt begins. This available storage volume is then used as the spring melt progresses to reduce downstream flows. Throughout the 2017 spring flood, the Regulating Committee, which is made up of representatives from all the major dam owners in the system, held 54 conference calls to perform integrated management of the system, wherein the observed and forecast hydrological conditions are analyzed and a regulation strategy to maximize the use of the available storage volume is developed.

Except for years when there is little snow and precipitation, it is not possible to hold back the entire spring runoff volume in the reservoirs since runoff during spring flooding generally exceeds their capacity to store water. However, using integrated management, the Regulating Committee can develop a regulation strategy to achieve maximum peak flow reductions downstream, at the right time, while maintaining safe and secure conditions for the public and dam structures. Because it is located at the outlet of the Ottawa River basin, the Carillon dam is the best location to see the cumulative reduction in flow realized by the integrated management of the 13 principal reservoirs. It is estimated that flows during the flooding peak were reduced by approximately 20% at the

[26] https://lwcb.ca/permpdf/2016LWCBAnnualReport.pdf
[27] www.ottawariver.ca

Carillon dam. Without this reduction in the river flow, the water levels for Lac des Deux Montagnes would have been approximately 90 cm higher. Similarly, reservoir management reduced peak levels for the full length of the river and its tributaries situated downstream of the principal reservoirs.

Apart from ensuring the integrated management of the system, the Planning Board also ensures that the hydrological forecasts that are produced for this management are made available to government agencies that are involved in issuing flood-related messages and the deployment of emergency measures. This includes providing hydrological forecasts to the Great Lakes – St. Lawrence Regulation Office given that the flow of the Ottawa River can have a considerable effect on the flows of the St. Lawrence River in the vicinity of the Montreal archipelago.

The Planning Board uses its website[28] as the main tool for issuing hydrological forecasts to the public. The website was utilized extensively with close to 400,000 page views during the 2017 spring flood period. An automated toll-free telephone service was also available and received close to 3,000 calls. The Regulating Committee also issued three press releases in 2017, on April 5, April 18 and April 28. Given the forecast of potentially unprecedented flooding in early May, for the first time since it was created, the Regulating Committee issued a table with the forecast peak levels and the date on which peak levels were expected for nine flood prone areas in the basin. The forecast tables were a useful tool to prepare for the anticipated flooding, providing forecast levels and timing for the May 6 to 8 peaks as much as five days in advance. Added to all this, numerous interviews were granted to the media along with participation on multiple conference calls with provincial and municipal authorities responsible for responding to the flooding.

Following the 2017 spring flood, the Planning Board engaged with responsible authorities in Ontario and Quebec to review its communications efficiency and efficacy. In addition, members of the Planning Board and Regulating Committee and staff of the Secretariat attended or organized nearly 30 meetings to provide information to the general public or responsible authorities.

[28] http://ottawariver.ca

6. ECOSYSTEM-BASED APPROACHES TO WATER QUALITY MANAGEMENT

This section describes a number of key cooperation-based ecosystem approaches through which ECCC works to ensure that Canadians have access to clean, safe and healthy water, and that the country's water resources are used wisely, both economically and ecologically. While these initiatives are not formalized under the Act, they do contribute to the objectives of the Act through their contribution to improving the management of water resources in Canada.

ECCC's Ecosystem Initiatives are cooperative, place-based programs designed to deliver environmental results in targeted ecosystems. The objective of the Ecosystem Initiatives is to enhance or maintain ecosystem sustainability by addressing a range of local or regional environmental challenges through partnership-based work. Local activities are coordinated by ECCC and undertaken in collaboration with a range of local partners and stakeholders that may include other federal departments, provinces and territories, regional, municipal and local governments, Indigenous peoples, federal and state governments in the United States, businesses, non-governmental and community organizations, and colleges and universities.

6.1 LAKE WINNIPEG BASIN PROGRAM

The Lake Winnipeg Basin Initiative[29] (LWBI) was the Government of Canada's response to addressing water quality issues in Lake Winnipeg. The LWBI aimed to engage citizens, scientists, and domestic and international partners in actions to restore the ecological health of Lake Winnipeg, reduce nutrient pollution and improve water quality.

In 2017-2018, Lake Winnipeg continued to experience large and frequent algal blooms due to high nutrient levels from multiple transboundary sources, including agriculture, industry, municipal wastewater and surface run-off. Through the Lake Winnipeg Basin Program (LWBP), ECCC continued to conduct and support research, and incorporated a targeted approach for nutrient reducing actions, while introducing financial support for collaborative efforts throughout the basin and enhanced Indigenous engagement on freshwater issues.

Nutrient Reduction Actions

Through the LWBP Science Plan, ECCC conducts research on the response in Lake Winnipeg to nutrient reduction action in the basin, the impact of climate variability on nutrient loading to Lake Winnipeg, and the impact of zebra mussels on nutrient cycling and the food web. The LWBP also supports the Lake Winnipeg Research Consortium[30], the in-lake science platform of Lake Winnipeg, and the Canadian Watershed Information Network[31], a web-based open access data and information network. Through application-based funding, the LWBP supports targeted stakeholder delivered projects, in key geographic areas within the Lake Winnipeg Basin that demonstrate an effective means of reducing phosphorus loading and increasing public knowledge and engagement. ECCC continued to collaborate with regional stakeholders through the *Canada-Manitoba Memorandum of Understanding Respecting Lake Winnipeg and the Lake Winnipeg Basin* (MOU) to develop and report on lake indicators, as well as planning to publish a *State of the Lake* report starting in 2018 and every five years thereafter.

[29] www.canada.ca/en/environment-climate-change/services/water-overview/comprehensive-approach-clean/lake-winnipeg/reports-publications/basin-initiative.html
[30] www.lakewinnipegresearch.org
[31] https://lwbin.cc.umanitoba.ca/canwin/?cn-reloaded=1

Collaborative Governance

The LWBP brings an increased focus to stakeholder engagement, including Indigenous Peoples, by encouraging and strengthening collaborative efforts to protect fresh water throughout the Lake Winnipeg Basin. An adaptive management framework for the Lake Winnipeg Basin is being developed through collaboration efforts under the MOU.

Indigenous Engagement

The water quality in Lake Winnipeg and its basin affects the cultural, social, spiritual, and economic well-being of First Nation and Métis peoples. The LWBP supports opportunities to build capacity and increase engagement of First Nation and Métis governments, organizations and communities on Lake Winnipeg basin water quality issues, including the incorporation of traditional knowledge in discussions on the ecosystem health of Lake Winnipeg.

Some key highlights from 2017–2018:

- An engagement session was hosted to seek input on program design including targeted approaches for nutrient reducing actions and approaches to enhance collaboration throughout the basin. A *What We Heard* report was prepared and shared with participants.
- ECCC's LWBP Science Plan was fully implemented.
- Agreements with three other federal and provincial governmental departments were implemented to support geo-mapping projects.
- Contribution agreements were signed with five non-governmental organizations to support research, information sharing, Indigenous engagement, and collaboration.
- The application-based component of the Lake Winnipeg Basin Program was launched under the departmental-wide proposal call to apply for Grants and Contributions funding.
- The MOU is in place until September 2020. The MOU facilitates a cooperative and coordinated approach in efforts to understand and protect the water quality and ecological health of Lake Winnipeg and its basin.

Scientific projects in 2017–2018 focused on:

- Evaluating the effectiveness of federal funding in reducing nutrient additions to local tributaries by conducting watershed based research and modelling, and evaluating the performance of best management practices and their effect on nutrient loading in response to hydrologic and climatic controls;
- Demonstrating progress in reducing nutrients reaching the lake by undertaking water quality and biotic monitoring to track spatial and temporal flux of nutrients transported from the watershed to the lake; and
- Demonstrating progress in establishing ecologically sustainable nutrient balance in the lake by developing new models and addressing critical knowledge gaps in lake nutrient dynamics relative to changes in nutrient loads and recently invaded zebra mussels to Lake Winnipeg. ECCC is also developing satellite earth observation tools for detecting and reporting on the extent and severity of algal blooms on Lake Winnipeg.

6.2 GREAT LAKES PROTECTION INITIATIVE

The Great Lakes Protection Initiative[32], which received an additional $44.84 million over five years (2017 to 2022), is ECCC's primary program targeting federal priorities in the Great Lakes. Through the Initiative, ECCC combines science and action to address the most significant threats to Great Lakes water quality and ecosystem health. Its current priorities for action include:

- Working with others to protect the Great Lakes
- Restoring water quality and ecosystem health in Great Lakes Areas of Concern
- Preventing toxic and nuisance algae
- Improving the health of coastal wetlands
- Identifying at-risk nearshore waters
- Reducing releases of harmful chemicals
- Engaging Indigenous Peoples in addressing Great Lakes issues
- Engaging the public through citizen science

Freshwater management of the Great Lakes is shared with other Canadian federal departments and other governments. To coordinate efforts on water management, restoration and protection, ECCC works in close collaboration with other implicated federal departments, the governments of the United States and Ontario, Indigenous Peoples and many other organizations, groups and individuals[33]. This is accomplished through leading and coordinating implementation of the 2012 *Canada–U.S. Great Lakes Water Quality Agreement* (GLWQA) and the *2014 Canada–Ontario Agreement on Great Lakes Water Quality and Ecosystem Health* (COA). The GLWQA establishes long-term objectives for Canada and the United States for restoring and protecting the Great Lakes, while the COA provides the governments of Canada and Ontario with a shared short-term (five-year) plan for achieving GLWQA commitments.

Key actions completed for the reporting period include:

- Pursuant to the GLWQA, the Governments of Canada and the United States finalized the Great Lakes Nearshore Framework, which is a systematic, integrated and collective approach for assessing the nearshore health of the Great Lakes and identifying and communicating cumulative impacts and stresses. Through implementation of the Nearshore Framework, Canada will provide the first comprehensive assessment of Canadian nearshore waters of the Great Lakes; share information from the assessment; identify areas that would benefit from protection, restoration or prevention activities; and identify causes of impairment and threats. In 2017–2018, a full Canadian assessment was completed for Lake Erie, Lake St. Clair and the St. Clair and Detroit Rivers.
- The Governments of Canada and the U.S. completed development of the Lakewide Action and Management Plan (LAMP) for Lake Huron. The LAMP provides an assessment of the state of the lake and priorities for action.

[32] www.canada.ca/en/environment-climate-change/services/great-lakes-protection/funding.html
[33] www.canada.ca/en/environment-climate-change/services/great-lakes-protection.html

- In 2017-2018, ECCC initiated a new program to assess and enhance the resilience of Great Lakes coastal wetlands. This program will assess the vulnerability of coastal wetlands to projected climate change and other stressors; identify best approaches to increase wetland resilience; and work with others to develop priorities for action.

- To address the problem of toxic and nuisance algae in Lake Erie, a draft Canada-Ontario Lake Erie Action Plan for achieving phosphorus reductions from Canadian sources was prepared and released for public comment from March to May 2017. The draft Plan presented Canada and Ontario's proposed actions in support of binational targets and commitments under the GLWQA and the COA, and invited Canadians to contribute their ideas and actions for inclusion in the Action Plan. The final Canada-Ontario Lake Erie Action Plan was released in February 2018.

- In 2016, Canada and the U.S. designated the first set of Chemicals of Mutual Concern (CMCs) targeted for binational action as required by the GLWQA. These chemicals include Hexabromocyclododecane (HBCD); Long-chain Perfluorinated carboxylic acids (LC-PFCAs); Mercury; Perfluorooctanoic acid (PFOA); Perfluorooctane sulfonate (PFOS); Polybrominated Diphenyl Ethers (PBDEs); Polychlorinated Biphenyls (PCBs); and Short-Chain Chlorinated Paraffins (SCCPs). In 2018, Canada and the U.S. finalized Binational Strategies for the first two CMCs (HBCD and PCBs) which identify options that governments and their partners can implement to reduce releases of these substances and improve human and ecosystem health within the Great Lakes basin.

To support others in taking action to protect the Great Lakes, Canada announced application-based funding available for partner-led projects that will help move the yardstick on priorities, such as: cleaning up Areas of Concern; preventing toxic and nuisance algae in Lake Erie; reducing releases of harmful chemicals; engaging the public through citizen science; and enhancing local Indigenous capacity.

Restoring water quality and ecosystem health in Great Lakes Areas of Concern

Areas of Concern (AOCs) are specific locations, such as harbours and embayments, where water quality and ecosystem health have been severely degraded by human activity at the local level. In 1987, Canada and the United States together designated 43 AOCs, 12 of which are in Canada and 5 that are shared between Canada and the United States. In 2017–2018, coordination of restoration activities in Great Lakes AOCs continued, including assessing and reporting on the success of past actions and on the status of remaining actions. Some examples of activities which ECCC led or supported are noted below:

- The St. Lawrence River Institute for Environmental Studies continued the study to assess shoreline sediment mercury concentrations, which is expected to result in an updated contaminated sediment management plan for the river.

- The Bay of Quinte Remedial Action Plan[34] completed an assessment of the restrictions on dredging activities and concluded that this beneficial use impairment is no longer impaired.

- In the Toronto Region AOC, the first phase of the $1.25 billion Port Lands Flood Protection project got underway. This project will naturalize the mouth of the Don River to improve aquatic and terrestrial habitat in the Area of Concern, and address flooding issues in the Port Lands.

[34] www.bqrap.ca

- In the Hamilton Harbour AOC, the City of Hamilton began construction on Woodward Wastewater Treatment Plant. This $320 million upgrade, which will be completed by 2022, includes building a new pump station and a new electrical power centre to enhance biological processes, and adding tertiary treatment. This project also includes improvements to the City of Hamilton's combined sewer overflow system. Work continued on the Randle Reef Contaminated Sediment Remediation Project[35]. This $138.9 million project is the largest contaminated sediment remediation project ever undertaken in a Canadian AOC, addressing 695,000 m^3 of polycyclic aromatic hydrocarbon contaminated sediments.
- In the Peninsula Harbour AOC, ECCC and the Government of Ontario completed monitoring activities to assess the efficacy of a sediment remediation project implemented in 2012 (a $7.3 million thin-layer cap to mitigate contaminated sediment and ecosystem impairments). The data analysis and review continues, and the monitoring results are expected to be shared and discussed with members of the community in 2018-2019.
- In the St. Marys River AOC, ECCC and the Batchewana First Nation continued to advance planning, design and community engagement for improving aquatic habitat in the river to benefit native fish species, including Brook Trout, Whitefish and Walleye.
- In the Niagara River AOC, ECCC continued to provide financial support to a multi-year project to create new wetland and aquatic habitat to improve conditions for fish populations.

Science and Monitoring

ECCC undertakes research and monitoring projects to support decision-making in the Great Lakes AOCs in Canada and in binational AOCs.

In 2017-2018, a broad range of monitoring activities targeting water, sediment and aquatic biota were undertaken. Science-related work included ongoing monitoring surveys on the Great Lakes, the review and update of Lake Management Plans and ongoing data collection to support Great Lakes environmental indicator reporting.

Monitoring of nutrients continued on tributaries flowing to Lake Erie to assess tributary load targets, in-stream processes and to support the development of domestic action plans for achieving phosphorous reductions in Lake Erie. In addition, monitoring continued in the nearshore of East Basin Lake Erie to assess nearshore water quality and ecosystem health, and a similar monitoring program was initiated in Lake Ontario given growing concerns about nuisance algae along the northern shore. Monitoring results demonstrated which waters have phosphorus concentrations at established targets and which areas may require further nutrient action or controls.

Research activities under the Great Lakes Protection Initiative included determining the relationship between human activity and nutrient concentrations, thereby better informing nutrient source identification and nutrient criteria development. In addition various beneficial management practice scenarios were simulated to assess the impact on nutrients, sediment and flow for the Grand River and Thames River watersheds. Research tools are being developed to provide daily satellite imagery to map algal bloom extent and for assessing the spatial/temporal trends in Lake Erie.

[35] www.randlereef.ca

Research efforts continued on developing predictive tools for understanding of catchment inputs to local water quality and benthic algae conditions and improve understanding of major drivers of variation. Integrated watershed-lake models were implemented for Lake Erie to improve understanding of factors responsible for periodic wash-up of algae on shorelines.

6.3 ST. LAWRENCE ACTION PLAN

The St. Lawrence Action Plan[36] is a collaborative effort between the Canadian and Quebec governments intended to strengthen collective efforts for the integrated management of the St. Lawrence basin, and to carry out joint actions to conserve and enhance its ecosystem. These efforts are based on three priorities: biodiversity conservation, improved water quality, and sustainable use. This multi-year program, which has been renewed five times since it was first signed in 1988, has helped produce concrete results through the cooperative efforts of the two governments. Their efforts have benefited from participation by the private sector, universities, research centres, Areas of Prime Concern committees (zones d'intervention prioritaire, known as ZIP committees), non-governmental organizations and riverside communities. The program focuses on all of the St. Lawrence River's ecosystems and on the mouths of its main tributaries, from Lake Saint-François, straddling the border between Quebec and Ontario, to the eastern reaches of the Gulf of St. Lawrence.

The *Canada-Quebec Agreement on the St. Lawrence 2011-2026*, also known as the St. Lawrence Action Plan, covers a span of 15 years, with 5-year planning cycles.

For the year 2017–2018, 37 projects were carried out as part of the Joint Action Plan for which a number of research projects, fieldwork activities, and decision-making tools were developed, including:

- The identification of important fish and interconnected habitat for protection and restoration.
- An Integrated Biodiversity Conservation Plan for the Lowlands and Coastal Areas of the Estuary and Gulf of St. Lawrence.
- A study of the potential for re-establishing the functional connectivity of biodiversity hotspots in the St. Lawrence lowlands, including tools for knowledge transfer.
- Wetland rehabilitation guidance for the St. Lawrence.
- The integration of wildlife and habitat issues with the potential for marine transportation development.
- The promotion of recreational fishing along the St. Lawrence, including the implementation of an incentive program.
- The establishment of a committee to promote and better integrate climate change issues.
- The quantification of the contribution of dissolved and particulate organic matter to hypoxia and the acidification of the deep waters of the St. Lawrence estuary.
- A study of the impacts of hydrocarbons and dispersants on aquatic freshwater organisms.
- A study of the use of retention ponds to capture pesticides and nutrients in surface water and agricultural runoff in the Lake Saint-Pierre area.

[36] http://planstlaurent.qc.ca/en/home.html

- A study of the current state and evolution of the weed beds and plant ecosystems of Lake Saint-Pierre, including the impacts of algal blooms and the presence of cyanotoxins.
- A study of the eco-toxicological effects of sewage discharge from the city of Montreal after its disinfection treatment by ozonation (tertiary wastewater treatment).
- A study of the risk associated with the presence of the cytostatics (new pharmaceutical products/anti-cancer substances) in the St. Lawrence.

Community involvement and awareness

Under the St. Lawrence Action Plan, ECCC and Quebec's Ministry of Sustainable Development, Environment and Fight against Climate Change are implementing the Community Interaction Program (CIP), which provides funding to non-governmental organizations and Indigenous communities for projects that aim to conserve and enhance the ecosystem of the St. Lawrence. In 2017-2018, Environment and Climate Change Canada distributed $491,863 in funding for 15 projects. These projects involved key players from riverside communities, including municipalities, First Nations, academia, industry and agriculture, local communities, and relevant provincial and federal departments. Specifically, the projects funded were intended to:

- implement measures to improve the biodiversity of the littoral zone of Lake Saint-Pierre, to benefit wildlife of the St. Lawrence River;
- restore a site in order to improve fish movement between a branch of the Saint-François River (Tardif Channel) and a marsh in the Odanak community;
- protect the ecological richness of the St. Lawrence shoreline in urban and periurban areas of Montreal by preventing the spread of Japanese knotweed;
- restore portions of the shoreline of the St. Lawrence River east of the village of Saint-Ulric, in the regional county municipality of Matane; and
- promote behavioral change of boaters in order to protect the biodiversity on nine islands in the St. Lawrence River situated near the Island of Montreal.

Moreover, the Areas of Prime Concern Program (Zones d'intervention prioritaire, ZIP) supports Stratégies Saint-Laurent and its 13 committees in their cohesive actions to engage and support local stakeholders working to improve the quality of the surrounding environment. ECCC provided $1.1 million in funding under this program.

The State of the St. Lawrence River Monitoring Program

A network of governmental and non-governmental collaborators continued to conduct sampling campaigns required to obtain scientific data through the State of the St. Lawrence River Monitoring Program[37]. ECCC collected data on water levels and flow rates; the fluvial transport of contaminants; water quality; benthic communities in Lake Saint-Pierre and Northern Gannet populations. Fact sheets were released on water quality, benthic communities, sediment contamination in Lake Saint-Pierre. The interpretation of sediment contamination in Lake Saint-Louis, and land cover data was performed in 2017-2018.

[37] http://planstlaurent.qc.ca/en/home/about_us/background/st_lawrence_action_plan_2011_2016/five_year_report_2011_2016/state_of_the_st_lawrence_monitoring_program.html

Numerical Environmental Prediction Program

The Numerical Environmental Prediction Program for the St. Lawrence[38] is a program to aid decision-making and water management planning for the St. Lawrence and its watershed. It simulates the evolution of physical, biological or chemical processes in the St. Lawrence and its watershed to predict the state of the corresponding terrestrial and aquatic environment. The Program aims in particular to improve understanding of the St. Lawrence ecosystem as a whole and to provide a tool to support decisions about its integrated management. In 2017-2018, the working group made significant progress, notably through four projects that dealt with the coupling of the hydrological models of the St. Lawrence watershed, the integration of hydrodynamic modelling tools into the Montreal archipelago, and hydrological and hydraulic modelling of the Lake-Champlain/Richelieu River watershed under an IJC study (International Lake Champlain and Richelieu River Study).

6.4 GULF OF MAINE INITIATIVE

ECCC is working collaboratively with other federal departments, provincial governments, U.S. governments, and community groups to help advance efforts that enhance conservation and promote responsible development in the Gulf of Maine transboundary ecosystem, which includes watersheds and coastline in New Brunswick and Nova Scotia.

The Gulf of Maine Initiative[39] (GMI) focuses on enhancing collaborative efforts to build knowledge of the transboundary ecosystem—watershed and coast—to better understand its current condition and identify stressors and threats, which will ultimately help inform decisions.

ECCC contributes funding, technical and scientific expertise, and direct staff support for water quality projects. These contributions improve assessment, monitoring, and modeling of the area and lead to the mitigation of multiple stressors and their cumulative effects on water quality in the Gulf of Maine ecosystem.

In 2017–2018, four multi-year projects addressed water quality issues in the Gulf of Maine ecosystem:

- Building upon data from two previous GMI projects, the Gulf of Maine Council created data-based action plans for six Bay of Fundy estuaries. The action plans provide local watershed organizations a basis to create targeted environmental management strategies to ensure there is a cohesive, science-based strategy for environmental management at the watershed level.
- The Nature Conservancy of Canada classified the biological and ecological diversity within watersheds by developing a seamless aquatic ecosystem classification and stress index across the Canadian portion of the Gulf of Maine and prioritized watersheds and stressors within watersheds for conservation and restoration.
- Eastern Charlotte Waterways Inc., in partnership with Dalhousie University, completed a baseline assessment of pH in the estuarine environments of the Bay of Fundy.
- The University of New Brunswick quantified the impacts of salmon aquaculture on invertebrate and fish communities of shallow coastal habitats of the Canadian Gulf of Maine and provided recommendations to reduce the associated impacts on water quality.

[38] http://planstlaurent.qc.ca/en/home/about_us/background/st_lawrence_action_plan_2011_2016/five_year_report_2011_2016/numerical_environmental_prediction_program.html

[39] www.canada.ca/en/environment-climate-change/news/2016/08/the-gulf-of-maine-initiative.html

In addition to the grant and contribution funded projects in 2017-2018, ECCC worked in collaboration with the International Oceans Institute at Dalhousie University to develop a report on the emerging environmental issues in the Bay of Fundy/Gulf of Maine. This report will help to enhance and share knowledge of current and potential future stressors to the ecosystem, and will inform future policy and management decisions and actions.

6.5 ATLANTIC ECOSYSTEMS INITIATIVES

The Atlantic Ecosystems Initiatives[40] (AEI) program provides grants and contributions funding for projects that improve the health, productivity, and long-term sustainability of ecosystems in Atlantic Canada. The program supports projects that use an ecosystem-based approach and include broad collaboration and cooperative action resulting in positive environmental impacts throughout Atlantic Canada. The program funds Atlantic Canadian organizations, including non-government organizations, coalitions and networks of organizations, research and academic institutions, and Indigenous governments and organizations to deliver projects that address one or more of the three program priority issues of water quality, habitat and biodiversity, and the impacts of climate change.

ECCC contributes funding, technical and scientific expertise, and direct staff support, for water quality projects to improve the assessment, monitoring, modeling, and mitigation of multiple stressors and their cumulative effects on water quality in Atlantic Canada from headwaters to estuaries.

In 2017–2018, 20 AEI projects addressed water issues quality, habitat and biodiversity, and impacts of climate change. ECCC committed over $1.2 million dollars for these projects. The following multi-year projects are ongoing and represent the type of projects that received funding:

- In Prince Edward Island, the Hillsborough River Association collaborated with stakeholders from multiple sectors to plan and implement climate change monitoring in the Atlantic Region using consistent methodologies to provide reliable and comparable climate change data. The result is a better integration of climate change data into climate change adaptation decision-making in Atlantic Canada that strengthens current and future adaptation efforts in vulnerable coastal communities.
- In Nova Scotia, Bluenose Coastal Action Foundation examined the abundance and impact of microplastics as a stressor on coastal ecosystems in Atlantic Canada. The project will fill a research gap in Atlantic Canada waters and improve understanding of the impacts of microplastics to inform decision-makers in their use and management.
- The Southern Gulf of St. Lawrence Coalition on Sustainability conducted research and implemented mitigation actions related to eelgrass beds in the Atlantic Region. Eelgrass is a highly productive habitat and provides important ecosystem services in the coastal zone such as coastal erosion and carbon and nutrient sequestration. This project increases climate resiliency by mitigating stressors affecting eelgrass health and restoring eelgrass in the region to encourage widespread recolonization.

[40] www.canada.ca/en/environment-climate-change/services/environmental-funding/programs/atlantic-ecosystems-initiatives.html

6.6 WOLASTOQ/SAINT JOHN RIVER WATERSHED IN NEW BRUNSWICK

ECCC identified the Wolastoq/Saint John River Watershed in New Brunswick as a priority in the Freshwater Action Plan, under 'Other Major Basins' in 2017-2018.

In 2017, an Interim Statement of Cooperation was signed by ECCC, DFO, eight Maliseet First Nation/ Tribal Leaders, the United States Environmental Protection Agency, the United States Bureau of Indian Affairs, the United States Fish and Wildlife Service, the United States Army Corps of Engineers, and the United States Geological Survey. The Statement of Cooperation serves as an aspirational, nation-to-nation document, which will facilitate cooperation in restoring the watershed and ecosystem, as well as recognizing the rights of the Maliseet and the Saint John River (Wəlastəkw). At an international summit in the spring of 2018, preliminary discussions were held on a governance structure for the river. The Leadership (signatories on the Statement) committed to re-convening later in 2018 to advance these discussions.

In 2017-2018, ECCC focused on four key commitments for the Wolastoq/Saint John River under the Freshwater Action Plan:

- Increased coordination and cooperation among orders of government
- Enhanced Indigenous and stakeholder engagement
- Coordinated freshwater science and assessments
- Strengthened information sharing

This work involved various efforts towards a coordinated and integrated management approach for the river, including working with federal, provincial, Indigenous, and non-government organizations to identify watershed priorities, goals and objectives. ECCC facilitated internal and external meetings to identify common areas for coordination and collaboration, including water quality monitoring, data management and access, freshwater assessment, and funding arrangements.

ECCC worked with the Canadian Rivers Institute to develop an 'Emerging Environmental Issues' report for the Wolastoq/Saint John River that highlighted the current and future pressures and threats affecting the watershed. The report provided a tool to guide future discussions with partners, and defined potential issues on which to focus future efforts.

7. PUBLIC INFORMATION

There are a number of ways in which ECCC and its many collaborators provide information on the use and conservation of water. Many of these activities are discussed throughout this report, including in the section on ecosystem initiatives.

The Government of Canada's Water website[41] provides content on ECCC's water-related activities and program areas as well as general information on a wide range of water-related topics and the full text of key water publications (such as the *Great Lakes–St. Lawrence River water levels*). In addition, the site provides links to laws and regulations.

ECCC's Wateroffice[42] provides public access to real-time and archived hydrometric data collected in Canada. In 2017-2018, the Wateroffice website received over 74 million hits and nearly 2.1 million visits.

In 2017-2018, the hydrometric folder received over 232 million hits.

[41] www.canada.ca/en/environment-climate-change/services/water-overview.html
[42] https://wateroffice.ec.gc.ca