Reports of the Commissioner of the Environment and Sustainable Development to the Parliament of Canada

Report 3

Scientific Activities in Selected Water Basins

Independent Auditor's Report | 2021

Office of the Auditor General of Canada

Bureau du vérificateur général du Canada

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Introduction

Background

Canadian water basins

3.1 Canada has a variety of water basins—areas where freshwater collects and flows. They range greatly in size and can cross provincial and national boundaries. For example, Lake Winnipeg receives water from rivers flowing through Alberta, Saskatchewan, Manitoba, and Ontario, as well as through the United States.

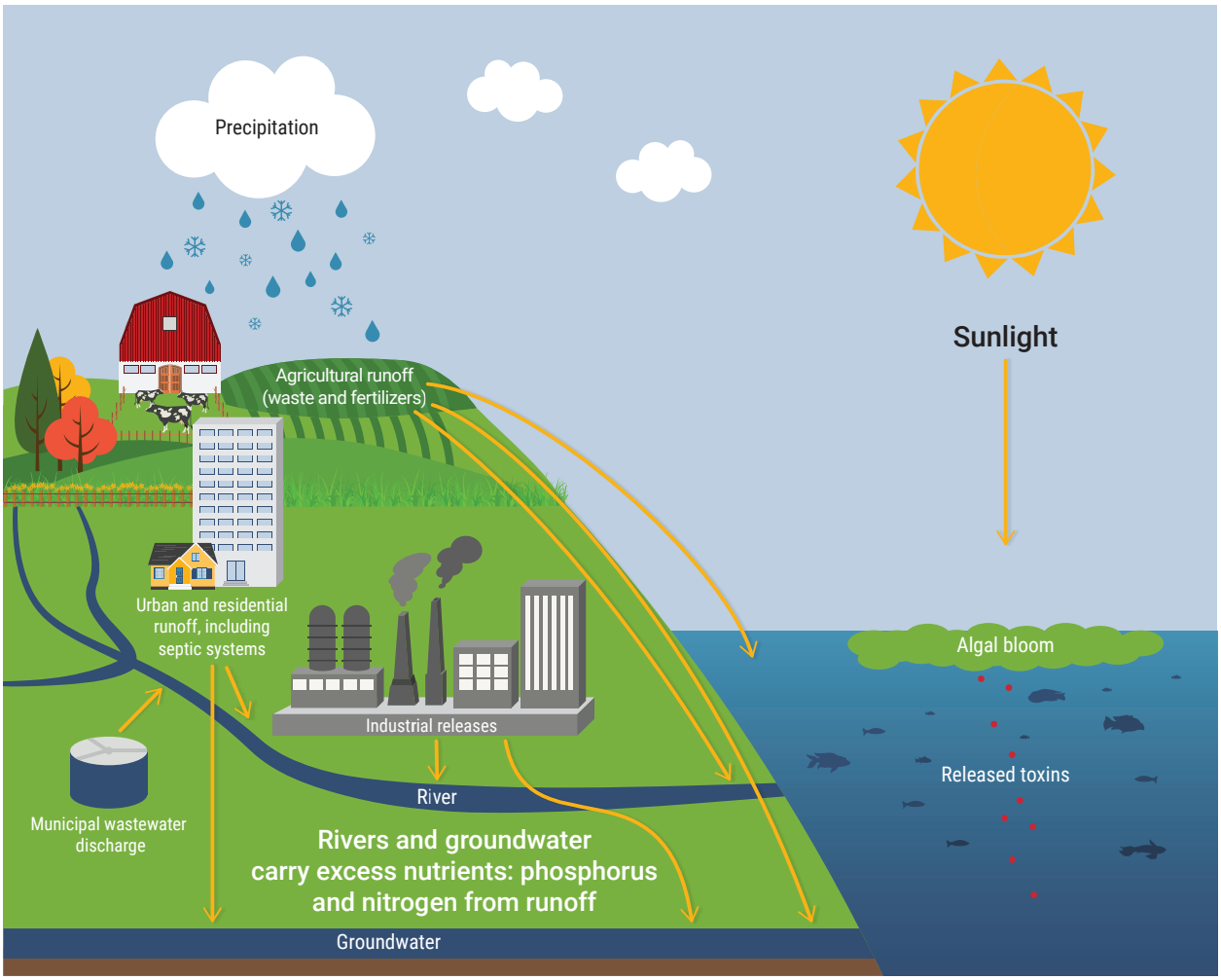
3.2 Nutrients such as phosphorus and nitrogen occur naturally in these water basins, supporting plants and animals. The living systems within each water basin use nutrients at a pace that depends on many factors, including the water's depth and temperature. However, excess nutrients from human sources can upset the balance of the ecosystem and can have negative effects. These nutrients may come directly from point sources, such as municipal wastewater discharge, or from non-point sources that are less easily monitored, such as rainfall or snowmelt carrying agricultural runoff, including animal waste as well as phosphorus and nitrogen used in fertilizers.

3.3 Excess nutrients, in combination with other factors such as a warming climate, can lead to runaway growth of algae, such as the blue-green algae (cyanobacteria) naturally found in many types of water systems. This growth creates algal blooms (Exhibit 3.1), which can

- produce and release toxins that are harmful to humans, livestock, pets, and wildlife, including fish
- reduce oxygen levels in the water, harming aquatic life
- create odours or affect water taste
- lead to loss of recreational opportunities and the value of waterfront properties

3.4 Algal blooms have occurred in water basins across Canada, including Lake Erie, Lake Winnipeg, and the Wolastoq, Saint John River—the 3 water basins selected for this audit (Exhibit 3.2).

Exhibit 3.1—How algal blooms are formed



Source: Based on information from Water Quality Status and Trends of Nutrients in Major Drainage Areas of Canada: Technical Summary, Environment Canada, 2011; Phosphorus in Aquatic Ecosystems, Environment and Climate Change Canada, 30 November 2015 (date on website)

3.5 For decades, several governments have expressed concern about the levels of excess nutrients and the water quality in all 3 water basins.

3.6 **Lake Erie.** The federal government has worked with many partners since the 1970s to reduce excess nutrients in the Great Lakes, including phosphorus levels in Lake Erie. The following reports were written about the condition of Lake Erie:

- The Canada–United States joint State of the Great Lakes 2019 report rated Lake Erie's status as "poor" and "unchanging" because of excess nutrients and labelled the trend of harmful algal blooms as "deteriorating."
- In the Canada–Ontario Lake Erie Action Plan published in 2018, the federal government and the Ontario provincial government reported the resurgence of harmful algal blooms and zones of low oxygen.

Exhibit 3.2—The 3 water basins examined in this audit

Source: Adapted from Canada Drainage Basins, Natural Resources Canada, 2012

3.7 **Lake Winnipeg.** The following reports were written about the condition of Lake Winnipeg:

- In the State of Lake Winnipeg: 1999 to 2007 report, the federal government and the Manitoba provincial government reported that the quality of Lake Winnipeg waters had deteriorated through the effects of excess nutrients and of increased frequency and severity of algal blooms.
- More recently, according to the Canadian Environmental Sustainability Indicator on phosphorus and nitrogen levels in Lake Winnipeg, reported in 2018, phosphorus concentrations in the smaller, shallow area of the south basin remained higher than historical concentrations and were double the provincial government's phosphorus objective for the lake. In the large,

deeper north basin, the average phosphorus concentrations were lower than in the south basin and appeared slightly lower in the last 5 years of the reporting period of record.

3.8 **Wolastoq, Saint John River.** The following are reports about results from monitoring the Wolastoq, Saint John River:

- In 1977, the International Joint Commission published the Water Quality in the Saint John River Basin report. The joint Canada–United States commission found that water quality was being affected by several activities, including pulp and paper production, agriculture, and industrial and municipal waste disposal. The commission noted significant water quality problems in the international portions of the river along the Canada–United States border.
- In water quality monitoring results from 2003 to 2016, the Government of New Brunswick reported elevated values of phosphorus along the river.
- In July 2019, the provincial government issued a public health advisory about blue-green algal blooms for the river from Fredericton to Woodstock. They took the form of benthic mats, clumps of organic material that originate at the bottom of the river and then break off and float in the water or end up on shore. The alert was intended to warn the public to be aware that similar blooms could recur because the area had blue-green algal blooms in the past.

3.9 To help control algal blooms, research in Canada and around the world aims to identify technologies and improve the accuracy of techniques that will reduce the release of excess nutrients into bodies of water. Climate change is predicted to increase both lake-water temperatures and the number of extreme precipitation events—which in turn could increase the risk of more frequent and intense harmful algal blooms.

Roles and responsibilities

3.10 **Environment and Climate Change Canada.** This is the lead federal department on freshwater management. It conducts research and monitoring of water quality and quantity in water basins across the country. With the approval of the **Governor in Council**, the Minister of Environment and Climate Change has the authority to enter into agreements with provincial governments under the *Canada Water Act*.

Governor in Council—The Governor General, who acts on the advice of Cabinet and, as the formal executive body, gives legal effect to those decisions of Cabinet that are to have the force of law.

3.11 The department is responsible for the 2019–2022 Federal Sustainable Development Strategy targets under the goal of pristine lakes and rivers. Among other things, the purpose of these targets is to reduce nutrients in Lake Erie and Lake Winnipeg. Achieving these targets involves collaboration with the United States, provinces, and other federal departments and agencies, including Agriculture and Agri-Food Canada.

3.12 The Minister of Environment and Climate Change's 2019 mandate letter stated that the Minister was to work with provinces, territories, Indigenous communities, local authorities, and scientists to protect Canadian water, ensuring that it is clean and well managed. Furthermore, the department was expected to work cooperatively with provincial governments and other organizations or people in any programs that had similar goals.

3.13 The 1987 Federal Water Policy provides a framework for coordinating federal actions on fresh water. The policy encourages the integration of water management plans and objectives into those of other natural resource interests, including agriculture, to reflect the interdependence of uses and users in water basins. Environment and Climate Change Canada has a role of promoting "a partnership approach among the various levels of government and private sector interests" on the sustainable use of water.

3.14 **Agriculture and Agri-Food Canada.** This department helps Canadian farmers and businesses produce the best possible food and agriculture products, with programs and services that include support for innovation and sustainable farming. The department undertakes research, development, and knowledge transfer that support sustainable agriculture and improve water management practices. The department also compiles and analyzes data on agri-environmental indicators, including excess phosphorus in water. It does not have a role in monitoring water quality.

3.15 Agriculture and Agri-Food Canada is the lead department responsible for 2 targets related to the sustainable food goal in the 2019–2022 Federal Sustainable Development Strategy:

- "By 2030, support improvement in the environmental performance of the agriculture sector by achieving a score of 71 or higher for the Index of Agri-Environmental Sustainability (reflecting the quality of water, soil, air and biodiversity)."
- "Grow Canada's agri-food exports to $75 billion per year by 2025," with a related target of increasing the number of agri-food products by 4.5% annually from 2017 to 2025.

Increased agricultural activity can lead to an increase in the amounts of nutrients discharged into the water.

3.16 The Minister of Agriculture and Agri-Food's 2015 mandate letter stated that one of the Minister's priorities was to work with provinces, territories, and other partners to help the agriculture sector better address water conservation. This meant that Agriculture and Agri-Food Canada was expected to work with other federal departments and agencies, such as Environment and Climate Change Canada.

3.17 **Provinces.** Canadian provinces have an important role in managing Canada's water resources, with primary jurisdiction over most areas of water management and protection. Most of those governments delegate some authorities to municipalities, including stormwater management and wastewater treatment. For particular areas or basins, the provinces may also delegate some management responsibilities to local authorities.

3.18 **Other jurisdictions.** Just as water basins cross many boundaries, the responsibility for their management falls to a variety of jurisdictions. Here are some examples:

- Indigenous communities can be involved in developing and implementing coordinated planning processes and best management practices, participating in committee meetings, and developing and implementing programs and other measures to achieve objectives, including for desired concentrations of phosphorus. Indigenous knowledge can also complement western science to manage water.
- The United States collaborates with Canada about transboundary basins. For example, in Lake Erie, Canada and the United States work together to achieve the binational targets set out by the Great Lakes Water Quality Agreement.
- The International Joint Commission is a forum for Canada and the United States to manage waters along the 8,891-kilometre border between the 2 countries.

United Nations' Sustainable Development Goals

3.19 In September 2015, Canada committed to achieving the United Nations' 2030 Agenda for Sustainable Development. In 2017, the Office of the Auditor General of Canada committed to examining how federal organizations are contributing to the United Nations' Sustainable Development Goals. The matters examined in this audit relate to the goal of clean water and sanitation (Goal 6) and 2 of its associated targets:

- Target 6.3: "By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally."

- Target 6.5: “By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate.”

Focus of the audit

3.20 This audit focused on whether Environment and Climate Change Canada and Agriculture and Agri-Food Canada took a coordinated and risk-based approach to reduce the impact of excess nutrients on ecosystem health in selected Canadian water basins. Our audit examined 3 water basins:

- Lake Erie
- Lake Winnipeg
- Wolastoq, Saint John River

We selected these 3 water basins in part because they cross international or interprovincial borders and because each basin has significant or emerging harmful and nuisance algal blooms.

3.21 This audit is important because harmful algal blooms are a significant and growing problem in bodies of water across Canada. These blooms affect the health of humans and ecosystems and have economic consequences. Climate change is expected to contribute to more frequent and severe harmful algal blooms. To contribute to reducing the risk and impact of harmful algal blooms, federal departments need to coordinate—among themselves and with external groups—to address the problem of excess nutrients.

3.22 More details about the audit objective, scope, approach, and criteria are in **About the Audit** at the end of this report (see pages 26–28).

Findings, Recommendations, and Responses

Overall message

3.23 Overall, Environment and Climate Change Canada and Agriculture and Agri-Food Canada took a coordinated and risk-based approach to reduce the impact of excess nutrients in the 3 water basins we examined. However, increased coordination of the departments’ scientific efforts would support achieving the best outcomes possible in terms of improving water quality and limiting the potential impact of algal blooms. Given that the levels of excess nutrients and quantity of algal blooms have been a concern in all 3 water basins, coordinated efforts between the 2 departments are important to identify and address

significant sources of excess nutrients and to help reduce the risk and impact of harmful algal blooms on human health, ecosystems, and economic activity.

3.24 Both departments had tools for assessing risks and used the risks they identified to guide their scientific activities. Coordination between departments was occurring within individual projects. However, the departments were not formally and consistently sharing information on the risks they had identified. More formal and consistent sharing of information about current and emerging risks to the 3 water basins would help ensure that both departments had the most complete picture of risks, could strengthen coordination and planning of their scientific work, and could support a cohesive response for managing excess nutrients.

3.25 Unlike efforts in Lake Erie and Lake Winnipeg and the Agriculture and Agri-Food Canada's Living Lab—Atlantic project, mechanisms for coordinating scientific activities for the Wolastoq, Saint John River were limited. Leveraging opportunities to share information between the departments and with regional and other partners and to discuss the results of their scientific activities would support improved outcomes in terms of water quality.

3.26 Environment and Climate Change Canada and Agriculture and Agri-Food Canada had several ways of communicating to external groups the results of their scientific activities in the 3 selected water basins. However, the departments did not know whether their communication activities were effective or were meeting external groups' needs.

Scientific activities on excess nutrients

Both departments used information on risks to water quality to guide scientific activities but did not formally share this information with one another

What we found

3.27 We found that Environment and Climate Change Canada and Agriculture and Agri-Food Canada had tools and processes to identify and prioritize current and emerging risks to water quality from excess nutrients. They used information on those risks to guide their scientific activities. However, Environment and Climate Change Canada's tool for understanding current and emerging risks to water basins was not complete. Furthermore, neither department had a formal and consistent process for sharing information about risks with the other, although some informal mechanisms were in place.

3.28 The analysis supporting this finding discusses the following topics:

- Incomplete risk identification at Environment and Climate Change Canada
- Risk identification at Agriculture and Agri-Food Canada guiding research
- Incomplete sharing of risk information

Why this finding matters

3.29 This finding matters because having complete information on risks to water quality helps ensure that scientific activities are focused on threats to water quality. Moreover, formal and consistent sharing of current and emerging risk information would allow both departments to have a more complete picture of the risks facing the bodies of water and of the gaps in their knowledge of risks. This information could better guide scientific activities that support improving water quality in the basins we examined.

Recommendations

3.30 Our recommendations in this area of examination appear at paragraphs 3.37 and 3.41.

Analysis to support this finding

Incomplete risk identification at Environment and Climate Change Canada

3.31 We found that Environment and Climate Change Canada had tools and processes to identify and prioritize current and emerging risks to water quality. It used information on the identified risks to water quality to inform its scientific activities.

3.32 We examined a sample of 4 of the department's water-related research projects to see whether they had been informed by identified risks to water quality. We found that they were. The projects were designed to respond to the broad objectives established by agreements or ecosystem initiatives in place. For example, the department established the Great Lakes Protection Initiative to help it understand the factors contributing to toxic and nuisance algae and to decrease phosphorus loadings from Canadian sources in Lake Erie. To respond to this objective, the department prioritized research projects through expert consultation and regular review of research results.

3.33 We found that the department had developed 2 tools to identify and assess risks to inform its water quality monitoring activities:

- The risk-based site-analysis tool is designed to assess the relative level of risk at individual monitoring sites within a specific water basin.
- The risk-based basin-analysis tool is designed to identify and compare relative levels of risk to water quality and aquatic ecosystems in 1 basin among all of Canada's drainage areas.

3.34 The risk-based basin-analysis tool consists of 7 goals, 3 of which have been met:

- Supply information about the relative intensity of stressors, including nutrients, to water ecosystems.
- Allow the department to improve its interpretation and reporting of water quality data.
- Allow information to be scaled from the individual sites to the sub-water-basin level.

3.35 We found that the department's monitoring and surveillance programs in all 3 water basins we examined used both of its risk-based analysis tools. For example, the department considered both tools when developing work plans to define monitoring activities (such as establishing site locations and parameters that would be monitored) for a given year. Furthermore, the department's Lake Winnipeg Water Quality Monitoring and Surveillance Program assessed risks to a range of sites to help determine baseline or upstream conditions and to evaluate impact from single and multiple stressors.

3.36 However, we found that the department had not achieved 4 of the 7 goals of its risk-based basin-analysis tool:

- Identify where national monitoring efforts could be optimized, where there may be duplication of effort, or where there are gaps in the national networks.
- Ensure that the department is monitoring the appropriate parameters at monitoring sites given the upstream stressors and activities and the downstream aquatic resources.
- Develop a tool or methodology to better assess sensitivity of aquatic resources that would improve prediction of the likelihood of an impact.
- Demonstrate the department's leadership role in water quality monitoring.

Because these goals were not met, the department did not have all the information it needed to inform its monitoring activities. For example, it did not achieve its goal of using risk-based basin analysis to identify areas where national monitoring efforts could be optimized, where

duplication of effort could be reduced, or where gaps in national efforts could be filled. Not achieving its goal of ensuring that the department is monitoring the appropriate parameters at monitoring sites, given the upstream stressors and activities and the downstream aquatic resources, meant that the department's ability to consider links between drainage areas and the risks from upstream activities was limited. The department assessed activities in the upstream part of the Lake Winnipeg water basin (in Alberta, Saskatchewan, Ontario, and Manitoba) and not in the whole drainage basin—that is, on a sub-drainage-basin scale. However, because the whole basin was not assessed, the department could not know the cumulative contribution of nutrients from upstream areas to Lake Winnipeg. So the department could not know which sub-drainage basins posed the most risk to the lake and where the most effective management actions could be taken.

3.37 **Recommendation.** To enable comprehensive risk assessment and thus strengthen decision making on where scientific efforts should be directed, Environment and Climate Change Canada should achieve the 4 remaining goals of the risk-based basin-analysis tool.

Environment and Climate Change Canada's response. *Agreed. Currently, Environment and Climate Change Canada uses various science-based tools to identify current and emerging risks to water quality and optimize its water monitoring network. These tools, such as the risk-based basin-analysis tool, are described in a risk-based adaptive management framework, which is under ongoing implementation.*

The department will pursue the formal implementation of the framework in the priority basins of Lake Erie, Lake Winnipeg, and the Wolastoq, Saint John River, as well as in the other freshwater basins throughout Canada within its long-term water monitoring program. The expected completion dates are March 2022 for the Wolastoq, Saint John River and March 2023 for Lake Erie and Lake Winnipeg.

Starting in the 2021–22 fiscal year, the department is initiating a 5-year review cycle of its risk-based approach to the long-term freshwater quality monitoring program. Each large Canadian watershed will apply the framework in a comprehensive analysis for optimization of the water monitoring network. The expected completion date is March 2026.

Risk identification at Agriculture and Agri-Food Canada guiding research

3.38 We found that, as part of its risk-based approach to selecting research projects, Agriculture and Agri-Food Canada required projects to contribute to the objectives and priorities of its Agro-Ecosystem Resilience Science Strategy. The strategy outlined the department's environmental priorities, objectives, and focus areas for research, development, and technology transfer, including those concerning nutrients and sediment losses from agricultural activities. One of the

strategy's focus areas was the enhancement of the quality of surface water and groundwater, including by reducing nutrients. We noted that the strategy did not present targeted approaches for specific water basins. However, the annual call for research proposals under the strategy identified the Great Lakes water basin as a priority for the 2018–19 fiscal year and priority basins for the 2019–20 fiscal year. The strategy presented approaches for minimizing environmental impact. For example, it outlined the department's objectives, actions, timelines, and performance indicators that would increase understanding of nutrients and sediment losses.

3.39 We found that Agriculture and Agri-Food Canada used the identified risks to water quality to determine its research activities. The department's identification of current and emerging risks originated from scientists. Through prior research, professional knowledge, industry contacts, and literature reviews, scientists identified issues, current and emerging risks, and gaps in knowledge and submitted research proposals during the annual call for proposals to address them.

Incomplete sharing of risk information

3.40 We found that neither department coordinated with the other to formally and consistently share current and emerging risks to inform Environment and Climate Change Canada's scientific activities or Agriculture and Agri-Food Canada's research activities. Officials from both departments stated that some sharing of risk information took place through committees, working groups, and projects that both worked on. However, we found that there were no formalized processes to keep one another regularly informed of current and emerging risks. Sharing information on these risks is important because this information could contribute to identifying areas of common interest and would enable each department to focus its activities related to excess nutrients more effectively.

3.41 **Recommendation.** Environment and Climate Change Canada and Agriculture and Agri-Food Canada should formally and consistently share with one another information on nutrient management and on current and emerging risks facing each water basin. This sharing would contribute to identifying areas of common interest that could benefit from the departments' coordinated scientific efforts and ensure that important risks are identified and addressed.

The departments' coordinated response. *Agreed. Collaborative opportunities identified in the recommendation will be supported through the revision of the Agriculture and Agri-Food Canada–Environment and Climate Change Canada Memorandum of Understanding between the 2 science and technology branches. The memorandum of understanding will formalize a variety of partnerships, collaborations, and information-sharing activities between Agriculture and Agri-Food Canada and Environment and Climate Change Canada that will support*

the government's goal of keeping Canada's freshwater safe, clean, and well managed.

Agriculture and Agri-Food Canada's response. *Agreed. Under the revised memorandum of understanding, regional science committees will be re-established. These committees will discuss opportunities for coordinated research plans on a variety of subjects. This would include current and emerging risks faced by each water basin. This sharing of risks could lead to joint projects between the 2 organizations. The expected completion date is December 2022.*

Environment and Climate Change Canada's response. *Agreed. Environment and Climate Change Canada should share information with Agriculture and Agri-Food Canada on current and emerging risks related to excess phosphorus loads faced by each water basin in order to better inform and, if appropriate, coordinate monitoring and research activities being undertaken by each department.*

In each water basin, Environment and Climate Change Canada and Agriculture and Agri-Food Canada have established processes to share information on current and emerging risks and monitoring and research activities through formal and informal processes, such as interagency agreements, working groups, and committees. These processes vary across the 3 water basins. Environment and Climate Change Canada and Agriculture and Agri-Food Canada agree to share information on a more systematic basis to better inform and strengthen monitoring and research efforts and maximize outcomes. The expected completion date is December 2022.

Coordination of scientific activities took place but was limited in the Wolastoq, Saint John River

What we found

3.42 We found that Environment and Climate Change Canada and Agriculture and Agri-Food Canada had mechanisms to coordinate scientific activity, mostly for Lake Erie and Lake Winnipeg. However, coordination mechanisms for the Wolastoq, Saint John River were limited. We identified several opportunities for strengthening the formal coordination and improving the coordination of scientific activities. One case, Agriculture and Agri-Food Canada's Living Lab—Atlantic project, is a good example of the formal coordination of scientific activities.

3.43 The analysis supporting this finding discusses the following topics:

- Appropriate mechanisms for interdepartmental and interjurisdictional cooperation
- Limited formal regional coordination of scientific activities
- Some interdepartmental coordination of individual projects

Why this finding matters

3.44 This finding matters because, despite the differences in the mandates of Environment and Climate Change Canada and Agriculture and Agri-Food Canada, they share a priority of protecting and sustainably managing water resources. The departments invest considerable resources in scientific activities aimed at improving water quality in the 3 basins. Collaboration allows each department to benefit from the other's expertise, which in turn improves their collective capacity and knowledge. Collaboration can also result in joint initiatives that benefit from the involvement of both departments.

Recommendations

3.45 Our recommendations in this area of examination appear at paragraphs 3.52, 3.56, and 3.64.

Analysis to support this finding

Appropriate mechanisms for interdepartmental and interjurisdictional cooperation

3.46 We found that there were appropriate mechanisms for interdepartmental and interjurisdictional cooperation. These mechanisms encouraged collaborative activities, including sharing information between the 2 departments and participating on interjurisdictional boards to understand one another's nutrient-reduction activities.

3.47 In 2017, the departments put in place an interdepartmental memorandum of understanding that covered the period up to 31 March 2021. In 2019, an amendment to the memorandum was signed, extending the period to 31 March 2025. The memorandum provided a framework to promote science collaboration on a range of activities. These activities included general research across the country on the effectiveness of best management practices for reducing nutrients from agricultural land in water and on how to improve measures and indicators of sustainability. The memorandum's overall objectives included

- building and strengthening relationships between the departments to identify, design, and coordinate complementary scientific activities to address climate change, air quality, and land-use planning for soil, water, and biodiversity conservation
- working toward common approaches to science management processes and systems, toward the sharing of resources such as co-location of staff or equipment, and toward the development of joint communications

3.48 Agriculture and Agri-Food Canada stated that, of the 36 projects completed under the memorandum, 22 related to nutrients and involved both departments working together.

3.49 Both departments also participated in the work of the International Joint Commission. For example, Environment and Climate Change Canada was co-chair of the commission's International Red River Board, while Agriculture and Agri-Food Canada was a member. The Red River is a significant source of nutrients for Lake Winnipeg. In 2019, the board proposed nutrient concentration objectives and targets for the Red River at the boundary between the United States and Canada. In 2020, the commission approved the proposal and submitted the objectives and targets to the governments of the United States and Canada for their consideration.

3.50 We found that there were also formal agreements in place among Canada, the provinces, and the United States to coordinate information sharing about excess nutrients in Lake Erie and Lake Winnipeg:

- **Lake Erie.** There were 2 agreements and 1 action plan to guide scientific collaboration on water quality for Lake Erie. These agreements made provisions for several committees and subcommittees for coordinating actions among the various stakeholders. While Agriculture and Agri-Food Canada's roles and responsibilities are not described in the 2 agreements, the department is a permanent member of the nutrient annex subcommittees under both agreements. These agreements' partners, which include both departments, share information regularly. For example, Agriculture and Agri-Food Canada provides Environment and Climate Change Canada with technical advice on land cover, soil health, erosion, agricultural practices, and the risk of phosphorus loss from agricultural lands that can contribute to excess nutrients in bodies of water.
- **Lake Winnipeg.** Both departments were members of the 3 interjurisdictional boards and committees that relate to Lake Winnipeg. Participation on these boards and committees was, among other things, intended to help the departments understand one another's nutrient-reduction activities.

These committees served as vehicles to coordinate activities through information sharing. However, specific project results were often not discussed at binational or federal–provincial committee meetings. Instead, they were more often reserved for specific science forums organized by individual committee members.

3.51 Conversely, there were no binational or federal–provincial agreements or associated committees or boards to address excess

nutrients from agriculture in the Wolastoq, Saint John River. There were, however, some other interjurisdictional collaboration mechanisms for the river:

- A memorandum of understanding between Canada and New Brunswick to monitor water quality included basic nutrient parameters.
- In 2020, Environment and Climate Change Canada began a 2-phase initiative to enhance coordination of and collaboration on water quality monitoring. Phase 1 included a multi-stakeholder meeting in early 2020 that Agriculture and Agri-Food Canada participated in. The purpose of the meeting was to identify water quality issues and discuss how to move toward more coordinated and integrated water quality monitoring and reporting.
- In 2017, the Wəlastəkw (Wolastoq) River Interim Statement of Cooperation among Maliseet Tribal/First Nation Leaders, United States federal agencies, and Canadian federal departments was established. The signatories affirmed their intention to cooperate to address cultural and natural resource sustainability through fish passage, habitat restoration, and ecosystem rehabilitation. Environment and Climate Change Canada and Fisheries and Oceans Canada signed this agreement.

3.52 **Recommendation.** Environment and Climate Change Canada and Agriculture and Agri-Food Canada should institute a formal mechanism for coordinating scientific activity in the Wolastoq, Saint John River. The aims of this mechanism would be to increase the departments' understanding of water quality issues in the river and encourage coordination of activities aimed at improving water quality.

The departments' coordinated response. *Agreed. Collaborative opportunities identified in the recommendation will be supported through the revision of the Agriculture and Agri-Food Canada–Environment and Climate Change Canada Memorandum of Understanding between the 2 science and technology branches. The memorandum of understanding will formalize a variety of partnerships, collaborations, and information-sharing activities between Agriculture and Agri-Food Canada and Environment and Climate Change Canada that will support the government's goal of keeping Canada's freshwater safe, clean, and well managed.*

Agriculture and Agri-Food Canada's response. *Agreed. Under the revised memorandum of understanding, regional science committees will be re-established. These committees will discuss opportunities for coordinated research plans on a variety of subjects including a terms of reference that specifies areas of interest in each region—including the Wolastoq, Saint John River basin for the Atlantic region. The expected completion date is December 2022.*

Environment and Climate Change Canada's response. *Agreed. Environment and Climate Change Canada is committed to working with other departments and agencies to coordinate activities through information sharing.*

Environment and Climate Change Canada will build on current informal arrangements with Agriculture and Agri-Food Canada to develop and implement a formal mechanism for coordinating activities related to the management of excess nutrients, with a specific focus on phosphorus loads, in the Wolastoq, Saint John River. The expected completion date is December 2022.

Limited formal regional coordination of scientific activities

3.53 The departments established joint watershed science coordination committees in 2018 for Lake Erie, Lake Winnipeg, Missisquoi Bay (a body of water in Quebec and Vermont), and the Atlantic region. Their goal was to share activities and improve collaboration on water quality and quantity, focusing on regional water basins. We found that although they had planned to hold 3 meetings per year, only 1 meeting per basin had taken place since 2018.

3.54 We found that no national science coordination steering committee included both departments. Such a committee could provide a forum to discuss monitoring and research and how these activities could be best used to understand problems and identify potential solutions for excess nutrients and water quality issues across the country.

3.55 Regional joint committees and national coordination committees provide an opportunity for regions to come together to understand and address knowledge gaps and research and monitoring needs. They also provide a forum for strategic discussions on regional and national coordination of science research and monitoring.

3.56 **Recommendation.** To increase knowledge about water quality issues and contribute to more strategic and targeted actions to address water quality issues, Environment and Climate Change Canada and Agriculture and Agri-Food Canada should re-establish regional joint science committees for the 3 water basins. These committees should develop coordinated plans for their scientific activities under the oversight and direction of a national joint steering committee for science coordination.

The departments' coordinated response. *Agreed. Collaborative opportunities identified in the recommendation will be supported through the revision of the Agriculture and Agri-Food Canada–Environment and Climate Change Canada Memorandum of Understanding between the 2 science and technology branches. The memorandum of understanding will formalize a variety of partnerships, collaborations, and information-sharing activities between Agriculture and Agri-Food*

Canada and Environment and Climate Change Canada that will support the government's goal of keeping Canada's freshwater safe, clean, and well managed.

Agriculture and Agri-Food Canada's response. *Agreed. Under the revised memorandum of understanding, regional science committees will be re-established. These committees will discuss opportunities for coordinated research plans on a variety of subjects including a terms of reference that specifies areas of interest in each region—including the Wolastoq, Saint John River basin for the Atlantic region.*

Each of the regional committees will report to a national joint steering committee on an annual basis.

The expected completion date is March 2022.

Environment and Climate Change Canada's response. *Agreed. Environment and Climate Change Canada agrees that regional joint water basin science committees that fall under the oversight and direction of a national joint steering committee will be a valuable mechanism for science coordination.*

Environment and Climate Change Canada and Agriculture and Agri-Food Canada will update and strengthen the existing interdepartmental science memorandum of understanding to reinforce the importance of these committees to coordinate research and monitoring plans. The expected completion date is March 2022.

Some interdepartmental coordination of individual projects

3.57 We examined a sample of 3 Agriculture and Agri-Food Canada research projects and a sample of 4 Environment and Climate Change Canada monitoring and research projects to determine whether the departments coordinated with one another. We found that coordination took place, to varying degrees, in most of these projects. Coordination mostly took place within individual projects, where both departments participated in specific project activities. For example, in Lake Winnipeg, Agriculture and Agri-Food Canada conducted hydrological research to improve model simulations of crop production and the water balance. The 2 departments collaborated on various components of the project, mainly by sharing data and by publishing academic articles.

3.58 Although project coordination was taking place in individual projects, we also found that the departments had missed some opportunities to better coordinate projects in the basins we examined. For example, the departments were working on 2 related projects in Lake Erie. An Agriculture and Agri-Food Canada project was evaluating the effects of best management practices on phosphorus and agricultural production. Meanwhile, Environment and Climate Change Canada was conducting research on whether implementing best management practices on reducing phosphorus could improve water quality. Both

projects were operating in the same water basin, and both focused on the effects of implementing best management practices.

3.59 In both projects, we found that the departments did coordinate some activities by sharing information on various project components and by participating in the same committees. For example, the departments shared high-level project updates during roundtable discussions. However, we noted that other opportunities could have been taken to work more cooperatively and enhance coordination between projects throughout the life cycle of the projects, from project planning to knowledge transfer. Coordination between the 2 projects, starting at the project-planning stage, could have provided opportunities to identify and address monitoring or research gaps, to minimize duplication, and to meet stakeholders' needs.

3.60 A similar example involved projects by the 2 departments to determine whether best management practices helped reduce nutrients. Agriculture and Agri-Food Canada was researching best management practices in the Atlantic region through a large project involving dozens of internal and external scientists. Meanwhile, Environment and Climate Change Canada was collaborating with the Government of New Brunswick to monitor water quality in the Wolastoq, Saint John River, with the aim of identifying trends in nutrient concentrations. The department added or changed monitoring sites in response to evaluations through its risk-based basin-analysis tool.

3.61 We found that, when placing its monitoring sites, Environment and Climate Change Canada did not take into account areas where best management practices had been implemented. In our view, this would have been an opportunity for the departments to coordinate—for example, by combining resources and technical expertise—to better understand results of using best management practices and to assess nutrient reductions.

3.62 We noted that the departments had been coordinating in Agriculture and Agri-Food Canada's Living Lab—Atlantic project at various sites in the Atlantic region (Exhibit 3.3). In our view, Living Lab—Atlantic is emerging as a model for coordination in both planning and project execution.

3.63 We noted another opportunity for the departments to work together. In 2018, the departments' joint watershed science coordination committee for the Atlantic region highlighted that Agriculture and Agri-Food Canada had a large number of scientists in the region. These included many who worked on water quality, soil health, and other agro-ecosystem fields and who had many complementary skills. Agriculture and Agri-Food Canada also had several laboratories, which might also be shared. The committee reported that its project to reduce sediment, nitrogen, and phosphorus runoff from farms to waters in eastern Canada was an opportunity to strengthen collaboration.

Exhibit 3.3—The Living Lab—Atlantic project is emerging as a model for coordinating agri-environmental activities

Agriculture and Agri-Food Canada's Living Lab—Atlantic project is part of the Living Laboratories Initiative. The department launched the initiative in Atlantic Canada in 2019 as a way for farmers, scientists, and other collaborators to co-develop, test, and monitor innovative practices and technologies to address agri-environmental issues. Two other living laboratories have since been launched in the Prairies and in eastern Quebec.

Both Agriculture and Agri-Food Canada and Environment and Climate Change Canada fully participated in the Living Lab—Atlantic project and coordinated with 15 external project partners. Environment and Climate Change Canada was involved in project proposals and plans to implement activities identified under the initiative's objectives at sites in the Atlantic region and the eastern Prairies. Environment and Climate Change Canada also helped develop and test best management practices. Its staff worked with Agriculture and Agri-Food Canada staff in the conception, planning, and execution of projects. The project adopted an integrated approach to agricultural research, bringing farmers, scientists, and other stakeholders together.

Project end users such as farmers are directly involved in project activities, from planning and development to testing project components. Although it is too early to report on progress, this coordinated approach aims to increase adoption by farmers of new, practical technologies and sustainable farming practices.

Through the Living Lab—Atlantic project, Agriculture and Agri-Food Canada was able to work with the East Prince Agri-Environment Association, an external partner, to plan activities and identify best management practices. These activities were integrated and coordinated between internal and external work plans, which complemented each other and highlighted areas where internal and external project components worked together. This ensured that there were no gaps or overlaps in project components.

3.64 **Recommendation.** Environment and Climate Change Canada and Agriculture and Agri-Food Canada should jointly review their scientific projects related to nutrient management in the Lake Erie, Lake Winnipeg, and Wolastoq, Saint John River water basins. This review should identify opportunities for coordinating activities throughout the life cycle of the projects, from project planning to knowledge transfer, to share and leverage resources and expertise and to address gaps in their scientific activities.

The departments' coordinated response. *Agreed. Collaborative opportunities identified in the recommendation will be supported through the revision of the Agriculture and Agri-Food Canada–Environment and Climate Change Canada Memorandum of Understanding between the 2 science and technology branches. The memorandum of understanding will formalize a variety of partnerships, collaborations, and information-sharing activities between Agriculture and Agri-Food Canada and Environment and Climate Change Canada that will support the government's goal of keeping Canada's freshwater safe, clean, and well managed.*

Agriculture and Agri-Food Canada's response. *Agreed. Under the revised memorandum of understanding, Environment and Climate Change Canada and Agriculture and Agri-Food Canada will be reviewing research projects to look for opportunities to gain efficiencies throughout the implementation of the various projects in a region.*

There may be opportunities to leverage resources throughout the life cycles of projects, which could allow for improved project planning and knowledge transfer.

The expected completion date is December 2022.

Environment and Climate Change Canada's response. *Agreed. Environment and Climate Change Canada agrees that the joint review with Agriculture and Agri-Food Canada of monitoring and research projects related to nutrient management will help to identify opportunities for coordination that would otherwise be missed.*

Environment and Climate Change Canada and Agriculture and Agri-Food Canada will update and strengthen the existing interdepartmental science memorandum of understanding as a mechanism to jointly review projects and help identify opportunities for improved coordination. The expected completion date is December 2022.

The departments shared results of their scientific activities with external groups but lacked an overall strategy for doing so

What we found

3.65 We found that Environment and Climate Change Canada and Agriculture and Agri-Food Canada had several ways of communicating to external groups the results of their scientific activities in the 3 water basins, including the results of research by both departments and the results of monitoring by Environment and Climate Change Canada. However, neither department had defined its overall strategy for transferring knowledge to external groups. Both departments' communication had shortcomings. For example, they did not know whether their communication activities were effective or were meeting external groups' needs.

3.66 The analysis supporting this finding discusses the following topic:

- No overall strategy for communications

Why this finding matters

3.67 This finding matters because each water basin has many external groups with interests in the results of the 2 departments' scientific activities. These interests include not only how nutrients affect water quality, plant and animal life, soil quality, and agricultural performance, but also the effectiveness of best management practices. Assessing whether the departments' communication activities are effective can inform how the departments can best meet the needs of external groups—and in turn support efforts to improve water quality.

Recommendation

3.68 Our recommendation in this area of examination appears at paragraph 3.73.

Analysis to support this finding

No overall strategy for communications

3.69 We found that Environment and Climate Change Canada and Agriculture and Agri-Food Canada had several ways of communicating to external groups the results of their scientific activities in the 3 selected water basins. These included publishing the results of these activities or sharing them during the conferences that both departments attended with other organizations interested in reducing the effects of nutrients. Knowledge transfer and collaboration mechanisms were defined project by project.

3.70 However, we found that neither department had defined its overall strategy for transferring knowledge to external groups. Neither department had determined how it planned to share information to others interested in water quality, beyond those target groups.

3.71 We also found that neither department had mechanisms to determine whether information-sharing activities in the 3 selected water basins were effective or whether their knowledge-transfer methods were meeting external groups' needs. For example, Agriculture and Agri-Food Canada tracked progress and the number and type of knowledge-transfer activities annually through research project reporting and interim reports. However, the department did not have a defined approach to inform whether information-sharing activities were effective in any of the 3 basins or at the project level. We also noted that the department's plans for some water basins included success indicators. However, we found that the effectiveness of these plans was not assessed. Likewise, with the exception of the Lake Winnipeg Basin Program communication plan, Environment and Climate Change Canada did not have performance measures in place for evaluating success.

3.72 We sent a questionnaire to selected organizations involved in water quality issues about whether and how the departments shared information from their scientific activities, including in the 3 selected water basins. The results from the 15 respondents showed the following:

- There were varying levels of communication from the departments to those organizations.
- Respondents' knowledge of what information might be available from the departments varied.

- Several organizations not in communication with the departments expressed an interest in speaking with departmental representatives.

3.73 **Recommendation.** To enable external groups interested in improving water quality to maximize the benefits of departmental scientific information, Environment and Climate Change Canada and Agriculture and Agri-Food Canada should collaborate to establish and implement strategies for information sharing and communication to external groups on their scientific efforts for the Lake Erie, Lake Winnipeg, and Wolastoq, Saint John River water basins. These strategies should

- define departmental objectives and timelines for knowledge-transfer activities
- define levels of contact with involved organizations, as well as feedback mechanisms, to ensure that the organizations receive information relevant to their mandates or interests
- set requirements for assessing the effectiveness of departmental outreach and knowledge-transfer activities and whether these efforts are meeting the needs of external groups

The departments' coordinated response. *Agreed. Collaborative opportunities identified in the recommendation will be supported through the revision of the Agriculture and Agri-Food Canada–Environment and Climate Change Canada Memorandum of Understanding between the 2 science and technology branches. The memorandum of understanding will formalize a variety of partnerships, collaborations, and information-sharing activities between Agriculture and Agri-Food Canada and Environment and Climate Change Canada that will support the government's goal of keeping Canada's freshwater safe, clean, and well managed.*

Agriculture and Agri-Food Canada's response. *Agreed. Under the revised memorandum of understanding, Environment and Climate Change Canada and Agriculture and Agri-Food Canada will establish a knowledge-transfer working group, which will share knowledge-transfer strategies between the 2 organizations. The goal is for both groups to learn and share best practices for knowledge transfer.*

Agriculture and Agri-Food Canada's Science Technology Branch is already in the process of evaluating its current knowledge and technology transfer approach. A working group was established in July 2020 to provide options to senior management. The working group is currently engaging with various stakeholders and users to define a path forward for more effective knowledge transfer and adoption of scientific results.

The expected completion date is December 2022.

Environment and Climate Change Canada's response. *Agreed. Environment and Climate Change Canada agrees that it should collaborate with Agriculture and Agri-Food Canada to review existing forums that enable the translation of findings on their research and monitoring of Canadian water basins into knowledge for transfer to end users.*

Currently, Environment and Climate Change Canada and Agriculture and Agri-Food Canada share their research and monitoring information during conferences and through formal and informal interdepartmental boards and committees.

For each water basin, Environment and Climate Change Canada will work with Agriculture and Agri-Food Canada to review their respective departmental objectives for knowledge-transfer activities and will define levels of contacts with organizations to ensure they receive information relevant to their mandates or interest. Additionally, requirements will be set for assessing the effectiveness of departmental outreach and knowledge-transfer activities and whether knowledge-transfer efforts are meeting end users' needs. The expected completion date is December 2022.

Conclusion

3.74 We concluded that Environment and Climate Change Canada and Agriculture and Agri-Food Canada took a coordinated and risk-based approach to reduce the impact of excess nutrients on ecosystems in selected Canadian water basins. However, we identified several areas where coordination could be strengthened to achieve the best outcomes possible, given the current state of water quality in the 3 selected water basins and the threat posed by climate change on algal blooms.

3.75 While both departments had tools for assessing risks, neither department shared this information with one another in a formal and consistent way. Environment and Climate Change Canada's tool for understanding current and emerging risks to water basins was also not complete. Coordination between the departments was occurring within individual projects, but opportunities existed to strengthen coordination and planning across scientific activities. Finally, both departments had several ways of communicating results of their projects, but neither department knew whether its communication activities were effective or were meeting the needs of external groups.

3.76 Excess nutrients and algal blooms have been concerns in all 3 water basins and may be exacerbated by climate change. Meanwhile, Canada has a stated goal of increasing agricultural production, which could contribute to nutrient runoff. As Environment

and Climate Change Canada and Agriculture and Agri-Food Canada have important roles to play in balancing these interests, coordination between the departments is vital to addressing water quality issues.

About the Audit

This independent assurance report was prepared by the Office of the Auditor General of Canada on reducing the impact of excess nutrients on ecosystem health in Canadian water basins. Our responsibility was to provide objective information, advice, and assurance to assist Parliament in its scrutiny of the government's management of resources and programs, and to conclude on whether Environment and Climate Change Canada and Agriculture and Agri-Food Canada complied in all significant respects with the applicable criteria.

All work in this audit was performed to a reasonable level of assurance in accordance with the Canadian Standard on Assurance Engagements (CSAE) 3001—Direct Engagements, set out by the Chartered Professional Accountants of Canada (CPA Canada) in the CPA Canada Handbook—Assurance.

The Office of the Auditor General of Canada applies the Canadian Standard on Quality Control 1 and, accordingly, maintains a comprehensive system of quality control, including documented policies and procedures regarding compliance with ethical requirements, professional standards, and applicable legal and regulatory requirements.

In conducting the audit work, we complied with the independence and other ethical requirements of the relevant rules of professional conduct applicable to the practice of public accounting in Canada, which are founded on fundamental principles of integrity, objectivity, professional competence and due care, confidentiality, and professional behaviour.

In accordance with our regular audit process, we obtained the following from entity management:

- confirmation of management's responsibility for the subject under audit
- acknowledgement of the suitability of the criteria used in the audit
- confirmation that all known information that has been requested, or that could affect the findings or audit conclusion, has been provided
- confirmation that the audit report is factually accurate

Audit objective

The objective of this audit was to determine whether Environment and Climate Change Canada and Agriculture and Agri-Food Canada took a coordinated and risk-based approach to reduce the impact of excess nutrients on ecosystem health in selected Canadian bodies of water.

Scope and approach

The audit team reviewed Environment and Climate Change Canada's documentation on monitoring and research activities and Agriculture and Agri-Food Canada's documentation on research activities related to reducing the impact of excess nutrients in the Lake Erie, Lake Winnipeg, and Wolastoq, Saint John River water basins. Because of the coronavirus disease (COVID-19) pandemic, we were unable to visit the 3 water basins.

We selected the Lake Erie, Lake Winnipeg, and Wolastoq, Saint John River water basins as examples of water basins that

- had existing or emerging nutrient issues
- represented diverse geographies
- crossed international or interprovincial borders
- had varying governance arrangements

We invited a non-representative sample of federal, provincial, national, international, and other organizations that were involved in water quality issues in the 3 water basins to complete a questionnaire. We did this to gain an understanding of whether and how they shared information from their monitoring and/or research activities. Of the 40 questionnaires sent, 15 organizations responded, with representatives of 2 organizations choosing to respond by interview.

We did not examine provincial, territorial, municipal, or Indigenous jurisdictions' activities. We also did not look at the work that the United States government is undertaking to manage water within its borders.

This audit examined activities that supported Canada's actions in relation to the United Nations' Sustainable Development Goal of clean water and sanitation (Goal 6).

Criteria

Criteria	Sources
We used the following criteria to determine whether Environment and Climate Change Canada and Agriculture and Agri-Food Canada took a coordinated and risk-based approach to reduce the impact of excess nutrients on ecosystem health in selected Canadian bodies of water:	
Environment and Climate Change Canada and Agriculture and Agri-Food Canada collaborate to develop and implement risk-based systems and practices to prevent excess nutrients from agricultural sources from entering bodies of water and to mitigate the impact of nutrient content in selected Canadian bodies of water.	• *Department of the Environment Act* • *Canada Water Act* • Minister of Agriculture and Agri-Food Mandate Letter, 2015 • Minister of Environment and Climate Change Mandate Letter, 2019 • Guide to Integrated Risk Management, Treasury Board of Canada Secretariat, 2016 • Directive on Results, Treasury Board, 2016 • Federal Water Policy, Environment Canada, 1987 • Achieving a Sustainable Future: A Federal Sustainable Development Strategy for Canada 2016–2019, Environment and Climate Change Canada, 2016 • Overview of Science and Technology Branch Sector Science Strategies, Agriculture and Agri-Food Canada, 2016

Criteria	Sources
We used the following criteria to determine whether Environment and Climate Change Canada and Agriculture and Agri-Food Canada took a coordinated and risk-based approach to reduce the impact of excess nutrients on ecosystem health in selected Canadian bodies of water:	
Environment and Climate Change Canada and Agriculture and Agri-Food Canada monitor and conduct research on nutrients to reduce the impact of excess nutrients.	• *Canada Water Act* • Achieving a Sustainable Future: A Federal Sustainable Development Strategy for Canada 2016–2019, Environment and Climate Change Canada, 2016 • Great Lakes Water Quality Agreement, Environment and Climate Change Canada, 2012 • Canada–Manitoba Memorandum of Understanding Respecting Lake Winnipeg and the Lake Winnipeg Basin, Government of Canada and Government of Manitoba, 2010
Environment and Climate Change Canada and Agriculture and Agri-Food Canada share the results of their work with other stakeholders to inform decisions related to reducing the impact of nutrients from agricultural sources in selected bodies of water in Canada.	• *Department of the Environment Act* • *Canada Water Act* • Minister of Agriculture and Agri-Food Mandate Letter, 2015 • Minister of Environment and Climate Change Mandate Letter, 2019 • Achieving a Sustainable Future: A Federal Sustainable Development Strategy for Canada 2016–2019, Environment and Climate Change Canada, 2016

Period covered by the audit

The audit covered the period from 1 January 2018 to 28 February 2020. This is the period to which the audit conclusion applies. However, to gain a more complete understanding of the subject matter of the audit, we also examined certain matters that preceded the start date of this period.

Date of the report

We obtained sufficient and appropriate audit evidence on which to base our conclusion on 14 May 2021, in Ottawa, Canada.

Audit team

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Director: Susan Gomez

Vanessa Alboiu
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List of Recommendations

The following table lists the recommendations and responses found in this report. The paragraph number preceding the recommendation indicates the location of the recommendation in the report, and the numbers in parentheses indicate the location of the related discussion.

Recommendation	Response
Scientific activities on excess nutrients	
3.37 To enable comprehensive risk assessment and thus strengthen decision making on where scientific efforts should be directed, Environment and Climate Change Canada should achieve the 4 remaining goals of the risk-based basin-analysis tool. **(3.31–3.36)**	**Environment and Climate Change Canada's response.** Agreed. Currently, Environment and Climate Change Canada uses various science-based tools to identify current and emerging risks to water quality and optimize its water monitoring network. These tools, such as the risk-based basin-analysis tool, are described in a risk-based adaptive management framework, which is under ongoing implementation. The department will pursue the formal implementation of the framework in the priority basins of Lake Erie, Lake Winnipeg, and the Wolastoq, Saint John River, as well as in the other freshwater basins throughout Canada within its long-term water monitoring program. The expected completion dates are March 2022 for the Wolastoq, Saint John River and March 2023 for Lake Erie and Lake Winnipeg. Starting in the 2021–22 fiscal year, the department is initiating a 5-year review cycle of its risk-based approach to the long-term freshwater quality monitoring program. Each large Canadian watershed will apply the framework in a comprehensive analysis for optimization of the water monitoring network. The expected completion date is March 2026.

Recommendation	Response
3.41 Environment and Climate Change Canada and Agriculture and Agri-Food Canada should formally and consistently share with one another information on nutrient management and on current and emerging risks facing each water basin. This sharing would contribute to identifying areas of common interest that could benefit from the departments' coordinated scientific efforts and ensure that important risks are identified and addressed. **(3.40)**	**The departments' coordinated response.** Agreed. Collaborative opportunities identified in the recommendation will be supported through the revision of the Agriculture and Agri-Food Canada–Environment and Climate Change Canada Memorandum of Understanding between the 2 science and technology branches. The memorandum of understanding will formalize a variety of partnerships, collaborations, and information-sharing activities between Agriculture and Agri-Food Canada and Environment and Climate Change Canada that will support the government's goal of keeping Canada's freshwater safe, clean, and well managed. **Agriculture and Agri-Food Canada's response.** Agreed. Under the revised memorandum of understanding, regional science committees will be re-established. These committees will discuss opportunities for coordinated research plans on a variety of subjects. This would include current and emerging risks faced by each water basin. This sharing of risks could lead to joint projects between the 2 organizations. The expected completion date is December 2022. **Environment and Climate Change Canada's response.** Agreed. Environment and Climate Change Canada should share information with Agriculture and Agri-Food Canada on current and emerging risks related to excess phosphorus loads faced by each water basin in order to better inform and, if appropriate, coordinate monitoring and research activities being undertaken by each department. In each water basin, Environment and Climate Change Canada and Agriculture and Agri-Food Canada have established processes to share information on current and emerging risks and monitoring and research activities through formal and informal processes, such as interagency agreements, working groups, and committees. These processes vary across the 3 water basins. Environment and Climate Change Canada and Agriculture and Agri-Food Canada agree to share information on a more systematic basis to better inform and strengthen monitoring and research efforts and maximize outcomes. The expected completion date is December 2022.

Recommendation	Response
3.52 Environment and Climate Change Canada and Agriculture and Agri-Food Canada should institute a formal mechanism for coordinating scientific activity in the Wolastoq, Saint John River. The aims of this mechanism would be to increase the departments' understanding of water quality issues in the river and encourage coordination of activities aimed at improving water quality. **(3.46–3.51)**	**The departments' coordinated response.** Agreed. Collaborative opportunities identified in the recommendation will be supported through the revision of the Agriculture and Agri-Food Canada–Environment and Climate Change Canada Memorandum of Understanding between the 2 science and technology branches. The memorandum of understanding will formalize a variety of partnerships, collaborations, and information-sharing activities between Agriculture and Agri-Food Canada and Environment and Climate Change Canada that will support the government's goal of keeping Canada's freshwater safe, clean, and well managed. **Agriculture and Agri-Food Canada's response.** Agreed. Under the revised memorandum of understanding, regional science committees will be re-established. These committees will discuss opportunities for coordinated research plans on a variety of subjects including a terms of reference that specifies areas of interest in each region—including the Wolastoq, Saint John River basin for the Atlantic region. The expected completion date is December 2022. **Environment and Climate Change Canada's response.** Agreed. Environment and Climate Change Canada is committed to working with other departments and agencies to coordinate activities through information sharing. Environment and Climate Change Canada will build on current informal arrangements with Agriculture and Agri-Food Canada to develop and implement a formal mechanism for coordinating activities related to the management of excess nutrients, with a specific focus on phosphorus loads, in the Wolastoq, Saint John River. The expected completion date is December 2022.

Recommendation	Response
3.56 To increase knowledge about water quality issues and contribute to more strategic and targeted actions to address water quality issues, Environment and Climate Change Canada and Agriculture and Agri-Food Canada should re-establish regional joint science committees for the 3 water basins. These committees should develop coordinated plans for their scientific activities under the oversight and direction of a national joint steering committee for science coordination. **(3.53–3.55)**	**The departments' coordinated response.** Agreed. Collaborative opportunities identified in the recommendation will be supported through the revision of the Agriculture and Agri-Food Canada–Environment and Climate Change Canada Memorandum of Understanding between the 2 science and technology branches. The memorandum of understanding will formalize a variety of partnerships, collaborations, and information-sharing activities between Agriculture and Agri-Food Canada and Environment and Climate Change Canada that will support the government's goal of keeping Canada's freshwater safe, clean, and well managed. **Agriculture and Agri-Food Canada's response.** Agreed. Under the revised memorandum of understanding, regional science committees will be re-established. These committees will discuss opportunities for coordinated research plans on a variety of subjects including a terms of reference that specifies areas of interest in each region—including the Wolastoq, Saint John River basin for the Atlantic region. Each of the regional committees will report to a national joint steering committee on an annual basis. The expected completion date is March 2022. **Environment and Climate Change Canada's response.** Agreed. Environment and Climate Change Canada agrees that regional joint water basin science committees that fall under the oversight and direction of a national joint steering committee will be a valuable mechanism for science coordination. Environment and Climate Change Canada and Agriculture and Agri-Food Canada will update and strengthen the existing interdepartmental science memorandum of understanding to reinforce the importance of these committees to coordinate research and monitoring plans. The expected completion date is March 2022.

Recommendation	Response
3.64 Environment and Climate Change Canada and Agriculture and Agri-Food Canada should jointly review their scientific projects related to nutrient management in the Lake Erie, Lake Winnipeg, and Wolastoq, Saint John River water basins. This review should identify opportunities for coordinating activities throughout the life cycle of the projects, from project planning to knowledge transfer, to share and leverage resources and expertise and to address gaps in their scientific activities. **(3.57–3.63)**	**The departments' coordinated response.** Agreed. Collaborative opportunities identified in the recommendation will be supported through the revision of the Agriculture and Agri-Food Canada–Environment and Climate Change Canada Memorandum of Understanding between the 2 science and technology branches. The memorandum of understanding will formalize a variety of partnerships, collaborations, and information-sharing activities between Agriculture and Agri-Food Canada and Environment and Climate Change Canada that will support the government's goal of keeping Canada's freshwater safe, clean, and well managed. **Agriculture and Agri-Food Canada's response.** Agreed. Under the revised memorandum of understanding, Environment and Climate Change Canada and Agriculture and Agri-Food Canada will be reviewing research projects to look for opportunities to gain efficiencies throughout the implementation of the various projects in a region. There may be opportunities to leverage resources throughout the life cycles of projects, which could allow for improved project planning and knowledge transfer. The expected completion date is December 2022. **Environment and Climate Change Canada's response.** Agreed. Environment and Climate Change Canada agrees that the joint review with Agriculture and Agri-Food Canada of monitoring and research projects related to nutrient management will help to identify opportunities for coordination that would otherwise be missed. Environment and Climate Change Canada and Agriculture and Agri-Food Canada will update and strengthen the existing interdepartmental science memorandum of understanding as a mechanism to jointly review projects and help identify opportunities for improved coordination. The expected completion date is December 2022.

Recommendation	Response
3.73 To enable external groups interested in improving water quality to maximize the benefits of departmental scientific information, Environment and Climate Change Canada and Agriculture and Agri-Food Canada should collaborate to establish and implement strategies for information sharing and communication to external groups on their scientific efforts for the Lake Erie, Lake Winnipeg, and Wolastoq, Saint John River. These strategies should • define departmental objectives and timelines for knowledge-transfer activities • define levels of contact with involved organizations, as well as feedback mechanisms, to ensure that the organizations receive information relevant to their mandates or interests • set requirements for assessing the effectiveness of departmental outreach and knowledge-transfer activities and whether these efforts are meeting the needs of external groups **(3.69–3.72)**	**The departments' coordinated response.** Agreed. Collaborative opportunities identified in the recommendation will be supported through the revision of the Agriculture and Agri-Food Canada–Environment and Climate Change Canada Memorandum of Understanding between the 2 science and technology branches. The memorandum of understanding will formalize a variety of partnerships, collaborations, and information-sharing activities between Agriculture and Agri-Food Canada and Environment and Climate Change Canada that will support the government's goal of keeping Canada's freshwater safe, clean, and well managed. **Agriculture and Agri-Food Canada's response.** Agreed. Under the revised memorandum of understanding, Environment and Climate Change Canada and Agriculture and Agri-Food Canada will establish a knowledge-transfer working group, which will share knowledge-transfer strategies between the 2 organizations. The goal is for both groups to learn and share best practices for knowledge transfer. Agriculture and Agri-Food Canada's Science Technology Branch is already in the process of evaluating its current knowledge and technology transfer approach. A working group was established in July 2020 to provide options to senior management. The working group is currently engaging with various stakeholders and users to define a path forward for more effective knowledge transfer and adoption of scientific results. The expected completion date is December 2022. **Environment and Climate Change Canada's response.** Agreed. Environment and Climate Change Canada agrees that it should collaborate with Agriculture and Agri-Food Canada to review existing forums that enable the translation of findings on their research and monitoring of Canadian water basins into knowledge for transfer to end users. Currently, Environment and Climate Change Canada and Agriculture and Agri-Food Canada share their research and monitoring information during conferences and through formal and informal interdepartmental boards and committees.

Recommendation	Response
	For each water basin, Environment and Climate Change Canada will work with Agriculture and Agri-Food Canada to review their respective departmental objectives for knowledge-transfer activities and will define levels of contacts with organizations to ensure they receive information relevant to their mandates or interest. Additionally, requirements will be set for assessing the effectiveness of departmental outreach and knowledge-transfer activities and whether knowledge-transfer efforts are meeting end users' needs. The expected completion date is December 2022.