Environment and Climate Change Canada
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WATER QUALITY IN CANADIAN RIVERS

CANADIAN ENVIRONMENTAL SUSTAINABILITY INDICATORS

Canada

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Environment and Climate Change Canada
Public Inquiries Centre
Place Vincent Massey Building
351 boul. Saint-Joseph Blvd
Gatineau QC K1A 0H3
Telephone: 1-800-668-6767 (in Canada only) or 819-938-3860
Fax: 819-938-3318
Email: ec.enviroinfo.ec@ec.gc.ca

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CANADIAN ENVIRONMENTAL SUSTAINABILITY INDICATORS

WATER QUALITY IN CANADIAN RIVERS

February 2024

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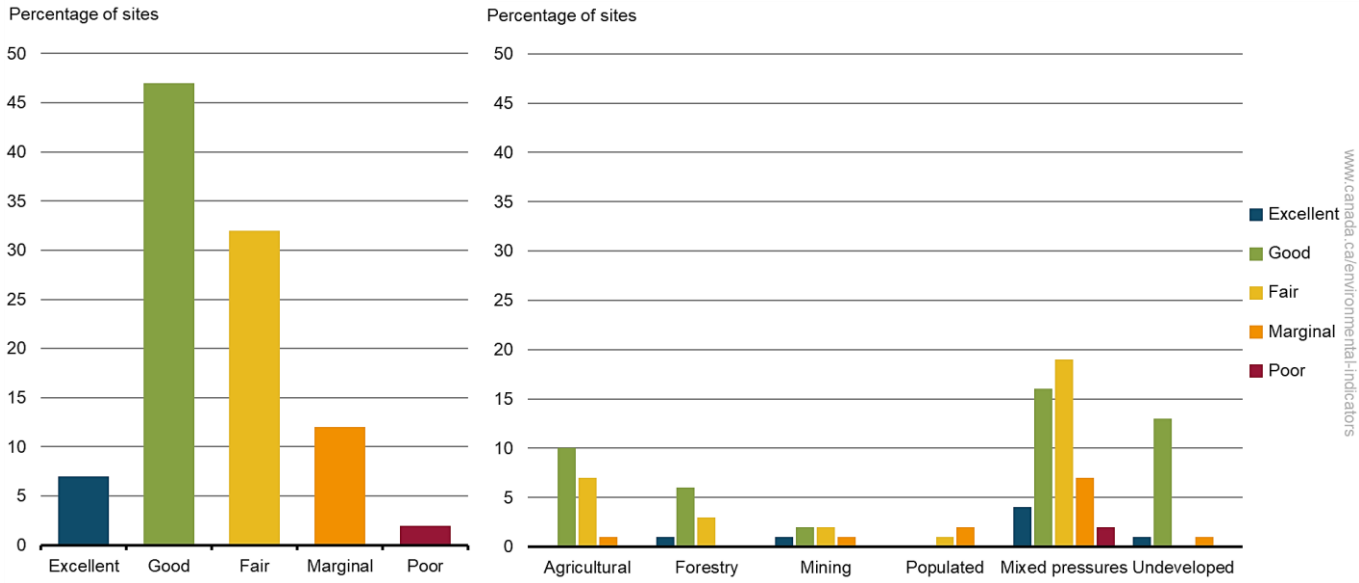
Water quality in Canadian rivers

Healthy river ecosystems rely on clean water. The quality of water and the health of rivers depend on how people develop and use the surrounding land. These indicators classify the water quality of rivers into 5 categories to give an indication of the ability of a river to support the plants and animals that live in or use the water.

Key results[1]

- For the 2020 to 2022 period, water quality in Canadian rivers was rated fair to excellent at 86% of the monitored sites
- Land development through agriculture, mining, forestry, high population density or a combination of these (mixed pressures) tends to have a negative impact on water quality

Figure 1. Water quality in Canadian rivers, national and by land use category, 2020 to 2022 period



Data for Figure 1

Note: Water quality was evaluated at 163 sites across southern Canada using the Canadian Council of Ministers of the Environment's water quality index. For more information on water quality categories, land use classification and monitoring sites selection, consult the Data sources and methods section.
Source: Data assembled by Environment and Climate Change Canada from federal, provincial and joint water quality monitoring programs. Population, forestry, mining and land cover statistics for each site's drainage area were provided by Statistics Canada, Natural Resources Canada, Environment and Climate Change Canada, Agriculture and Agri-Food Canada, the Government of Alberta and the University of Maryland.

By world standards, Canada has abundant, clean freshwater resources. The water in Canada's rivers varies naturally across the country based on the rocks and soil in the area and the climate. For example, water that flows through the rocky landscape of northern Ontario and Quebec is naturally different from water flowing through the deep soils of the Prairies. Depending on their composition, some soils may act as a filter while others may contribute elements to the water. However, it is how people have developed the land around lakes and rivers that has the largest impact on water quality at each site.

[1] Due to health measures related to COVID-19, some sampling activities and laboratory analysis were cancelled in 2020. As a result, the method related to the calculation of the water quality indicator for the 2020-2022 period was adjusted due to the lack of available data at some sites. For this reason, the comparison of results between years and stations should be interpreted as indicative. For more information, consult the Data sources and methods section

For the 2020 to 2022 period, water quality at 163 monitoring sites in southern Canadian rivers[2] was rated:

- excellent or good at 54% of monitoring sites
- fair at 32% of sites
- marginal at 12% of sites
- poor at 2% of sites

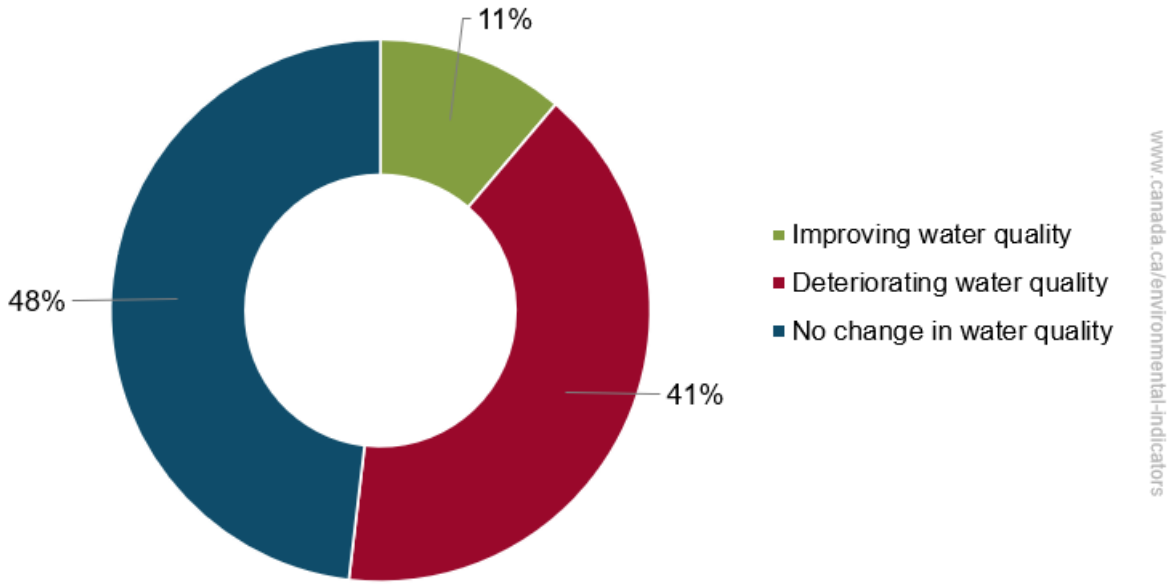
Water quality is generally good or excellent in undeveloped areas where native plants, trees and soils purify the water before it reaches the river. Adding development such as manufacturing and cities puts pressure on the landscape and increases the amount of chemicals being released into rivers every day. As well, many contaminants can be deposited in rivers after being released into the air. Fertilizers, pesticides and manure from livestock used to help crops grow can wash into nearby rivers or seep into groundwater, impacting water quality in those areas. Some forestry activities, such as removing trees and other vegetation, that would otherwise reduce the flow of surface water into rivers, may increase run-off of nutrients and contaminants into rivers. Development can change water quality in rivers and put pressure on the organisms that live there.

Trends in water quality in Canadian rivers

Key results

- Water quality has not changed between 2002 and 2022 at 48% of sites across southern Canada
- Where it has changed, it has deteriorated (41%) more often than it has improved (11%)

Figure 2. Trends in water quality, Canada, 2002 to 2022



Data for Figure 2

Note: The trend in water quality between the first year that data were reported for each site and 2022 was calculated at 160 sites across southern Canada. The trend was calculated at each site using parameters specific to the site. Therefore, an improving or a deteriorating water quality does not necessarily imply a change in water quality category. For more information on the trend method used, consult the Data sources and methods and the Caveats and limitations section.
Source: Data assembled by Environment and Climate Change Canada from federal, provincial and joint water quality monitoring programs.

[2] The indicators focus on the regions in Canada where human activity is more prevalent, as this is usually the main factor for water quality deterioration. Monitoring sites were selected based on whether there was data available for a sufficient number of years and whether the sites were representative of the drainage region. Northern Canada is underrepresented, this is due partly to the challenges related to sampling in these remote locations. For more information on site selection, consult the Data sources and methods section.

The average water quality in a river tends to change slowly. Natural factors, such as snow and rainfall, affect water quality by washing pollution that builds up on the surface of roads and fields into the river. A dry year could mean better water quality, because less pollution is washed into the river. On the other hand, a drought could lead to worse quality as there is less water to dilute pollution from point sources like urban sewage outflows. A changing climate that results in longer or more frequent wet or dry periods will affect water quality in each river differently depending on its regional characteristics.

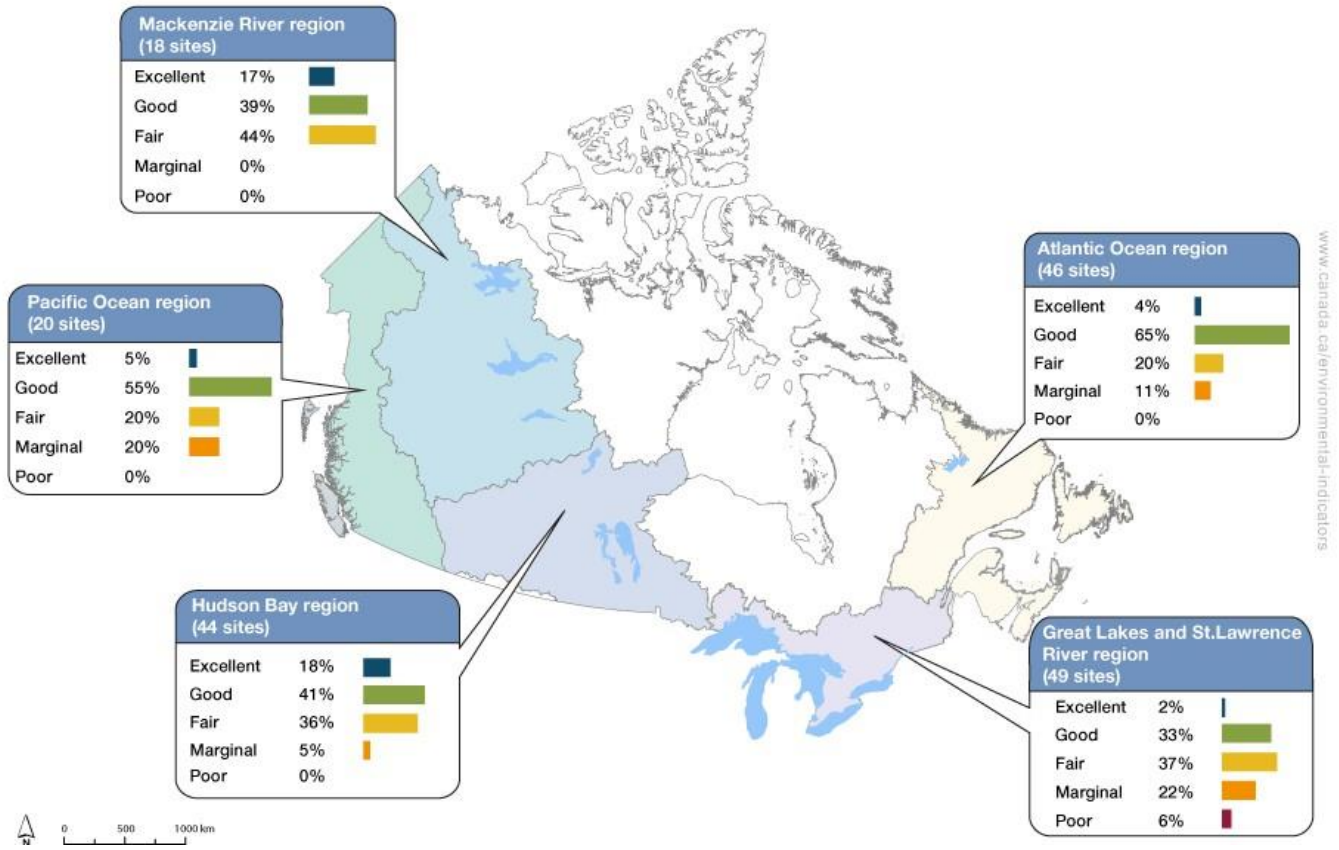
How the landscape is developed also impacts how quickly water quality changes. Altered landscapes, industrial and sewage effluents, and atmospheric deposition[3] can all affect water quality. Water quality in a river can be improved by modernizing wastewater treatment plants and factories, adopting environmental farming practices, protecting wetlands, or planting native vegetation along riverbanks, among other actions.

Regional water quality in Canadian rivers

Key results

- The Atlantic Ocean and Pacific Ocean regions followed by the Hudson Bay region had the highest proportion of sites with good or excellent water quality (69%, 60%, and 59%, respectively)
- The Great Lakes and St. Lawrence River, Pacific Ocean and Atlantic Ocean regions had the highest proportion of sites with marginal or poor water quality (28%, 20% and 11%, respectively)

Figure 3. Regional water quality, Canada, 2020 to 2022 period



Data for Figure 3

Note: For the Regional water quality in Canadian rivers indicator, water quality was assessed at 177 sites across Canada using the Canadian Council of Ministers of the Environment's water quality index. Compared to the national indicator, the Regional water quality in Canadian rivers

[3] Atmospheric deposition refers to the phenomenon through which pollutants, including gases and particles are deposited from the atmosphere in the form of dust or precipitation, ultimately entering freshwater systems.

indicator uses 14 additional monitoring sites and includes more sites in the northern portions of the Mackenzie River.
Source: Data assembled by Environment and Climate Change Canada from federal, provincial, territorial and joint water quality monitoring programs.

Water quality varies widely across Canada. For the 2020 to 2022 period:

- The highest proportion of sites rated good or excellent was found in areas where there was very little human development upstream or in the least populated areas
- The highest proportion of sites rated marginal, or poor was found in the most populated areas, in particular where agriculture, or a combination of agriculture and forestry was also present

Atlantic Ocean

Along the east coast of Canada, all rivers drain into the Atlantic Ocean. This region includes Nova Scotia, New Brunswick, Prince Edward Island, Newfoundland and Labrador, along with part of eastern Quebec.

Key results

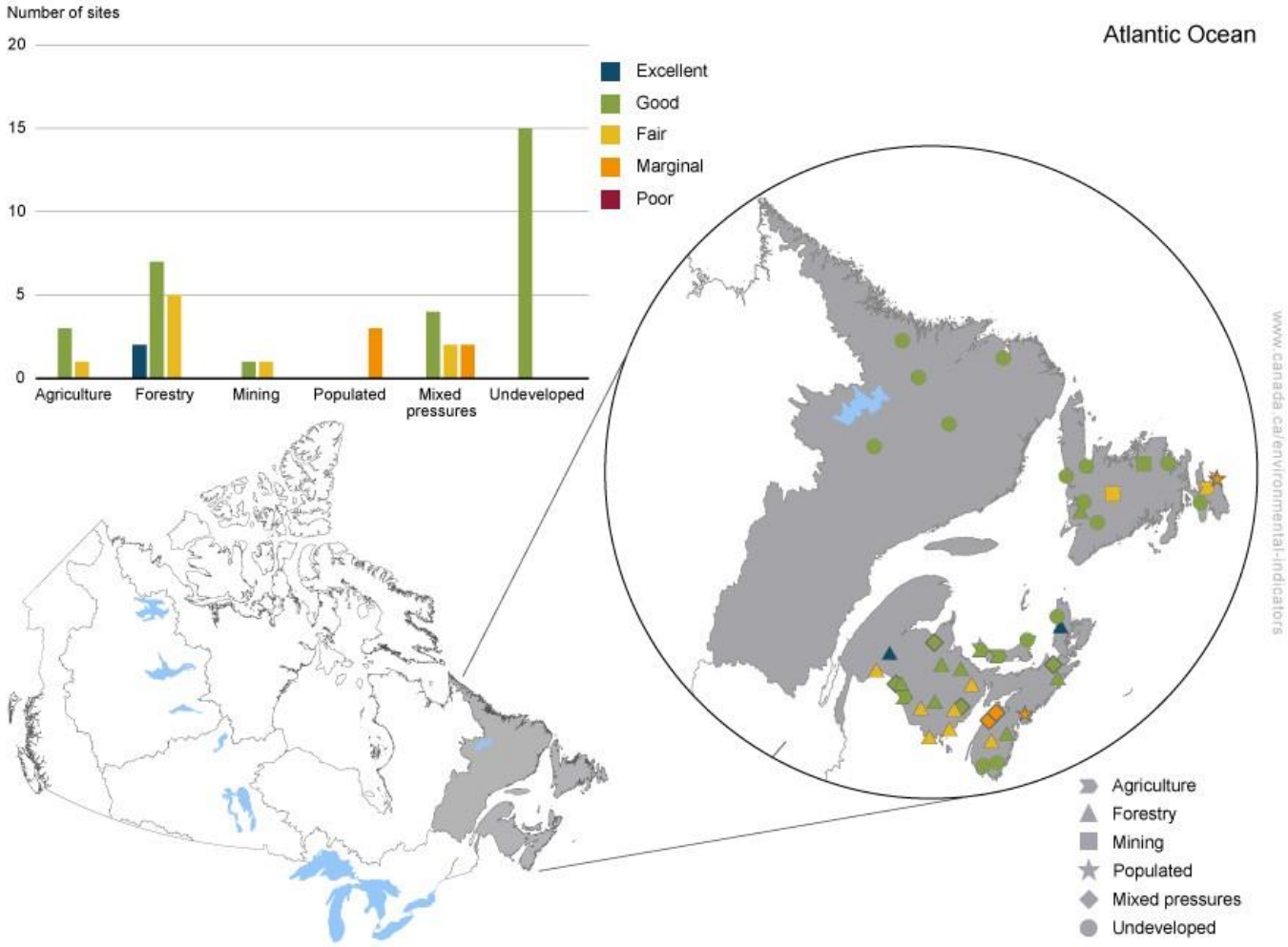
For the 2020 to 2022 period:

- most sites in the Atlantic Ocean region
  - are in areas with forestry or in undeveloped areas
  - have fair to good water quality
- monitoring sites in high population density areas and with agriculture or forestry (mixed pressures) usually have worse water quality

For the 2002 to 2022 trend period:

- nearly half of the sites (46%) had a water quality deteriorating trend
- there was no change in water quality trend for 42% of all sites
- only 11% of sites has improved their water quality

Figure 4. Water quality by land use category, Atlantic Ocean region, 2020 to 2022 period



Data for Figure 4

Note: Water quality was assessed at 46 sites on rivers draining into the Atlantic Ocean using the Canadian Council of Ministers of the Environment's water quality index. For more information on land use classification, consult the Data sources and methods section.
Source: Water quality data were assembled by Environment and Climate Change Canada from existing federal, provincial and joint water quality monitoring programs. Population, forestry, mining and land cover statistics for each site's drainage area were provided by Statistics

Canada, Natural Resources Canada, Environment and Climate Change Canada, Agriculture and Agri-Food Canada, the Government of Alberta and the University of Maryland.

This region is home to approximately 2.3 million people, or 7% of Canada's population. The majority live in Nova Scotia, New Brunswick and on the island of Newfoundland.

Agriculture is mainly found in Prince Edward Island, Nova Scotia's Annapolis Valley and New Brunswick where the soil and climate are suitable.

Mining and forestry are 2 of the region's largest industries. In Newfoundland and Labrador, iron ore, nickel, copper, cobalt and gold are mined. New Brunswick and Nova Scotia have many active aggregate, limestone, gypsum, coal and gold mines. Forestry, the largest industry in New Brunswick, is composed of solid wood and pulp production. Water pollution from mining and pulp and paper industries effluent is regulated, but limited releases to rivers and leaching from tailings and waste rock enclosures can have a local impact on water quality. Closed or abandoned metal mines may still be releasing harmful substances to the water. Also, mines are often located in areas where mineral content in the soil and in water may be naturally high.

For the 2020 to 2022 period, water quality for 46 sites on rivers draining into the Atlantic Ocean was rated:

- good or excellent at 69% of monitoring sites
- fair at 20% of sites
- marginal at 11% of sites

Water quality tends to be good to excellent in this region of Canada because large areas are undeveloped, and therefore not subject to impact from human activity, particularly in Labrador.

Calculated trends[4] using data from 2002[5] to 2022 show that water quality has improved at 5 sites: on the Gander River at Appleton and Waterford River in Newfoundland and Labrador, on the Roseway River, the Mersey River, and the Cheticamp River in Nova Scotia. These sites are in areas where there is either forestry or very little development around them, except for Gander River, where mining activity is present.

Water quality has deteriorated at 21 sites: on the Main River, the Atikonak River and the Lloyds River in Newfoundland and Labrador, on the Cornwallis River and the Annapolis River in Nova Scotia and at 3 sites on the Saint John River (Saint John River below St. Basile, Saint John River below Upper Queensbury, Saint John River at Evandale), the Aroostook River, the Big Presque Isle Stream, the Nashwaak River, the Lepreau River, the Richibucto River, the Tobique River, the Kennebecasis River, St. Croix River, the Nepisiguit River,the Petitcodiac River, the Southwest Miramichi River in New Brunswick and 2 sites in Prince Edward Island on the Mill River and the Bear River.

There was no change in water quality at the remaining 19 sites.

[4] Of the 46 sites of the Atlantic Ocean, 1 site has no data available for a sufficient number of years to calculate trend. For more information on the monitoring sites number, consult the Data sources and methods section.
[5] For some sites, the trend is calculated from data available after 2002.

Great Lakes and St. Lawrence River

Rivers in this region drain into the Great Lakes and the St. Lawrence River. It includes western Quebec, southern Ontario and the section of northern Ontario that boarders Lake Superior.

Key results

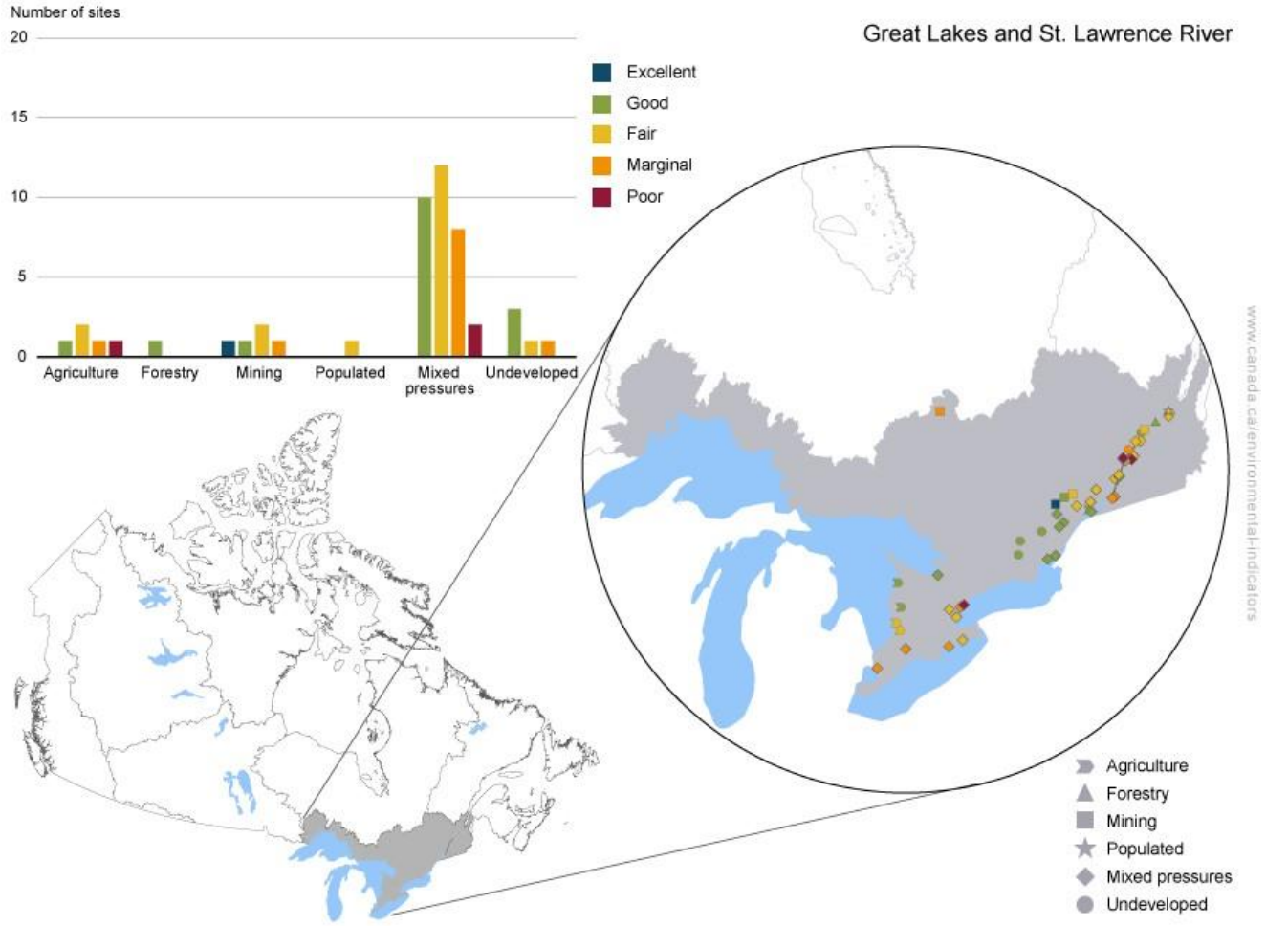
For the 2020 to 2022 period:

- water quality in rivers in the Great Lakes and St. Lawrence River region is generally
  - fair to poor in southwestern Ontario and along the St. Lawrence River between Montreal and Quebec City
  - good in eastern Ontario
- monitoring sites in areas where there are mixed pressures tend to have worse water quality

For the 2002 to 2022 trend period:

- water quality has deteriorated at 67% of all sites
- The rest of the sites (33%) showed no change (stable)

Figure 5. Water quality by land use category, Great Lakes and St. Lawrence River region, 2020 to 2022 period



Data for Figure 5

Note: Water quality was assessed at 49 sites on rivers draining into the Great Lakes or St. Lawrence River using the Canadian Council of Ministers of the Environment's water quality index. For more information on land use classification, consult the Data sources and methods section.

Source: Water quality data were assembled by Environment and Climate Change Canada from existing federal, provincial and joint water quality monitoring programs. Population, forestry, mining and land cover statistics for each site's drainage area were provided by Statistics

Canada, Natural Resources Canada, Environment and Climate Change Canada, Agriculture and Agri-Food Canada, the Government of Alberta and the University of Maryland.

Home to almost 60% of Canadians, close to 20 million people, the Great Lakes and St. Lawrence River region contains 6 of the country's 10 largest cities: Toronto, Montreal, Ottawa, Mississauga, Brampton and Hamilton. Most human activity in this area is associated with urbanization. The impact of increasing population density can be seen in the diminished water quality at sites on these rivers.

Fertile soils and a relatively mild climate combine to create productive agricultural land in the Great Lakes and St. Lawrence River region. These agricultural lands are gradually being converted by urban development changing the stresses on water quality in the region.

Mining in the region is dominated by feldspar and quartz mines. Forestry is an important industry in Quebec and Ontario. Pulp and paper mills are mainly located near the Great Lakes and the St. Lawrence River or near their tributaries. Water pollution from mining and pulp and paper industries effluent is regulated, but limited releases to rivers and leaching from tailings and waste rock enclosures can have a local impact on water quality. Closed or abandoned metal mines may still be releasing harmful substances to the water.

For the 2020 to 2022 period, water quality for 49 sites on rivers in the Great Lakes and St. Lawrence River region was rated:

- excellent or good at 35% of monitoring sites
- fair at 37% of sites
- marginal at 22% of sites
- poor at 6% of sites

Calculated trends[6] using data from 2002 to 2022 show no site with improved water quality. During that same period, water quality has deteriorated at 33 sites. Twenty four (24) of these sites are located in Ontario, on the Skootamata River, the Nottawasaga River, the Thames River, the Sydenham River, the Oakville Creek, the Credit River, the Humber River, the Don River, the Ausable River, the Saugeen River, the South Raisin River, the North Raisin River, the Bayfield River, the Maitland River, the Cataraqui River, the Gananoque River, the Delisle River, the Kemptville Creek, the Rideau River, the Jock River, the Nanticoke Creek, the South Nation River, Mississippi River and the Fall River. Nine (9) sites are located in Quebec, on the Yamaska River, the Richelieu River, the Bécancour River, the Châteauguay River, La Chaloupe River, de la Petite Nation River, the Kinojévis River, Des Prairies River, and the Jacques-Cartier River. Land use at a majority of these sites is either agriculture or a mix of agriculture and high population density.

There was no change in water quality at the remaining 16 sites.

[6] For more information on the trend calculation, consult the Data sources and methods section.

Hudson Bay

The Nelson River, the largest in this region, originates at the northern tip of Lake Winnipeg and flows into the south-western corner of the Hudson Bay. Its tributaries drain over 1 million km^2 of land starting in the Rocky Mountains running through the Prairies and into Lake Winnipeg. This region covers most of Manitoba, Saskatchewan, the southern half of Alberta and parts of northwestern Ontario.

Key results

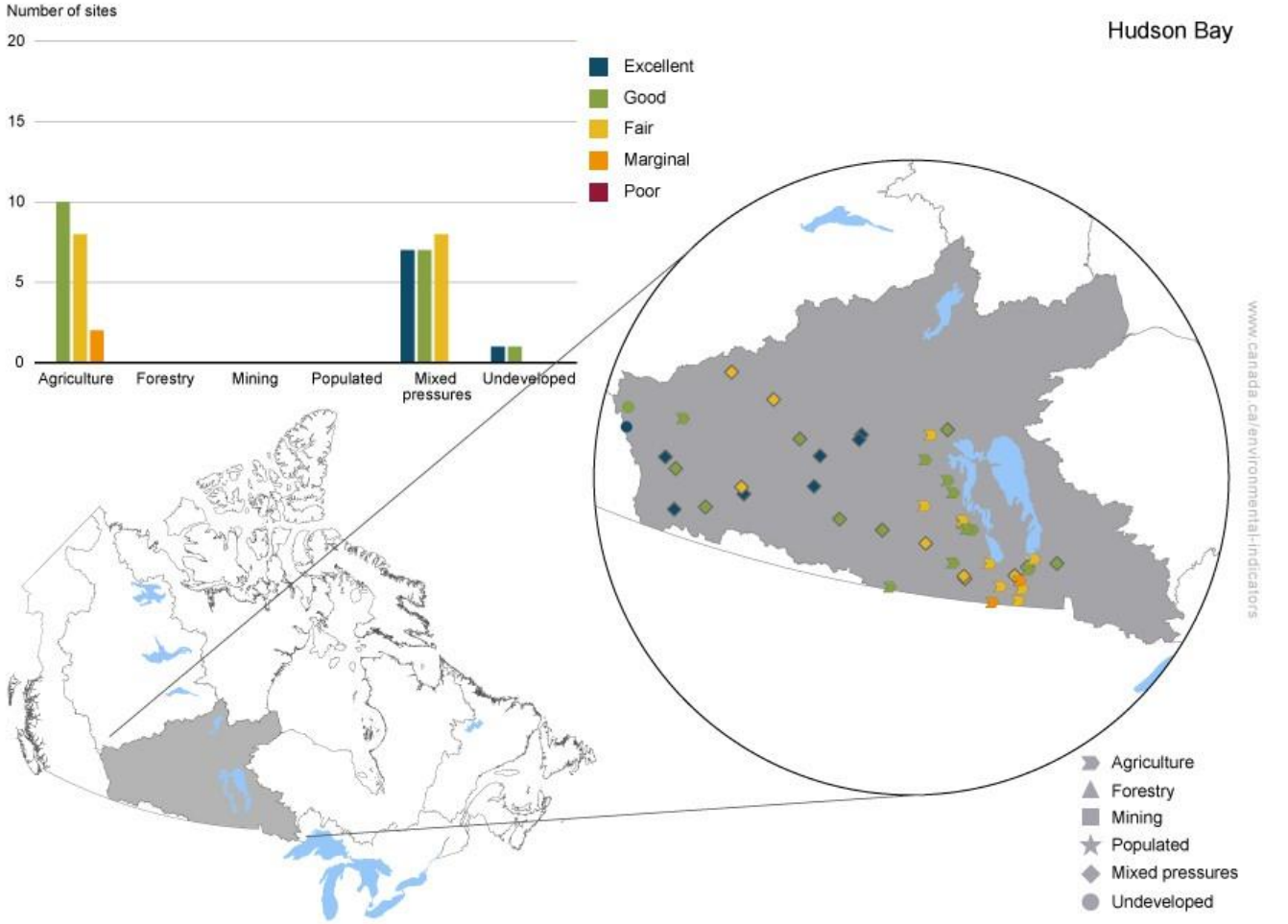
For the 2020 to 2022 period:

- water quality in rivers close to the Rocky Mountains, in Saskatchewan, and north of Lake Winnipeg in the Hudson Bay region tends to be good or excellent.
- water quality is rated fair to marginal in areas where there is agriculture, or a mixture of agriculture and mining

For the 2002 to 2022 trend period:

- very few sites (7%) showed a deteriorating trend
- 20% of sites show improvement while 73% of sites have stable trend

Figure 6. Water quality by land use category, Hudson Bay region, 2020 to 2022 period



Data for Figure 6

Note: Water quality was assessed at 44 sites on rivers draining into the Hudson Bay using the Canadian Council of Ministers of the Environment's water quality index. For more information on land use classification, consult the Data sources and methods section.
Source: Water quality data were assembled by Environment and Climate Change Canada from existing federal, provincial and joint water quality monitoring programs. Population, forestry, mining and land cover statistics for each site's drainage area were provided by Statistics Canada, Natural Resources Canada, Environment and Climate Change Canada, Agriculture and Agri-Food Canada, the Government of Alberta and the University of Maryland.

Most of the 5.5 million people in the Hudson Bay region live in its 5 major cities (Calgary, Edmonton, Winnipeg, Saskatoon and Regina). Water quality in this region reflects the soils found on the prairies, which have naturally higher concentrations of many metals. Agriculture covers almost all the land in the Prairies and mining is the second most important industry. In addition, hydroelectric power generation infrastructures on many of the rivers in Manitoba are extensive. As with other areas, human development can alter water quality. Water quality is worse for some rivers in agricultural areas where agricultural activities are more intensive. Other factors can also play a significant role in water quality of this region, such as the natural characteristics of the basin, the continuum of the river and weather conditions.

For the 2020 to 2022 period, water quality for 44 sites on rivers in the Hudson Bay region was rated:

- excellent or good at 59% of monitoring sites
- fair at 36% of sites
- marginal at 5% of sites

Calculated trends[7] using data from 2002 to 2022 show that water quality has improved at 9 sites: the Souris River, the La Salle River, the Cooks Creek, the Turtle River, the North Duck River, the Red River, the Brokenhead River and 2 sites on the Assiniboine River (Headingley and North-West of Treesbank) in Manitoba. Land use at these sites is either agriculture or a mix of agriculture and mining.

Water quality has deteriorated at 3 sites: on the Winnipeg River in Manitoba and the Carrot River. and the Assiniboine River in Saskatchewan where agriculture, in these two sites, has been and continues to be an important land use upstream of these sites.

There was no change in water quality at the remaining 32 sites.

[7] For more information on the trend calculation, consult the Data sources and methods section.

Mackenzie River

The Mackenzie River watershed is the largest in Canada, covering nearly 20% of the country and is one of the least developed. Its 2 largest tributaries, the Peace River and the Athabasca River, drain much of north-central Alberta and the Rocky Mountains in northern British Columbia.

Key results

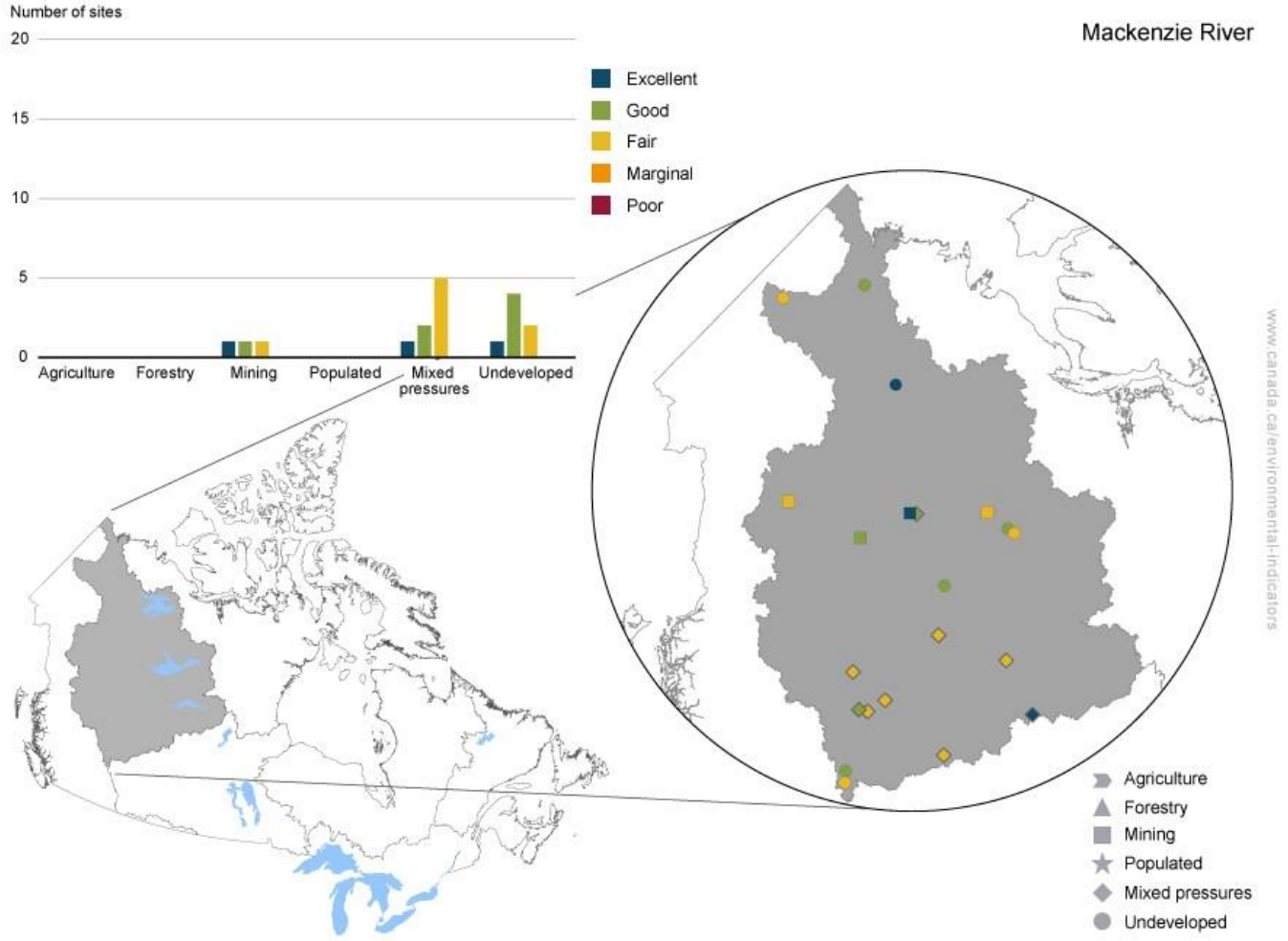
For the 2020 to 2022 period:

- water quality in the Mackenzie River region is generally good to excellent in areas where there is little development
- water quality tends to be lower where there are multiple pressures, such as agriculture, mining and forestry

For the 2002 to 2022 trend period:

- there were 2 sites with stable trends and 2 sites with deteriorating trends

Figure 7. Water quality by land use category, Mackenzie River region, 2020 to 2022 period



Data for Figure 7

Note: Water quality was assessed at 18 sites on rivers draining into the Mackenzie River using the Canadian Council of Ministers of the Environment's water quality index. For more information on land use classification, consult the Data sources and methods section.
Source: Water quality data were assembled by Environment and Climate Change Canada from existing federal, provincial, territorial and joint water quality monitoring programs. Population, forestry, mining and land cover statistics for each site's drainage area were provided by Statistics Canada, Natural Resources Canada, Environment and Climate Change Canada, Agriculture and Agri-Food Canada, the Government of Alberta and the University of Maryland.

Much of the watershed consists of unbroken wilderness. The most intensive land use in the region is oil and gas extraction in central Alberta. This land use, along with forestry and agriculture, result in water quality in these areas being degraded relative to water in the undeveloped parts of the watershed. The majority of the 450 000 people living in the watershed live in the southern portions of the watershed.

For the 2020 to 2022 period, water quality for 18 sites on rivers draining into Mackenzie River was rated:

- excellent or good at 56% of monitoring sites
- fair at 44% of sites

Calculated trends[8] using data[9] from 2002 to 2022 show that water quality has deteriorated at 2 sites: the Smoky River and the Peace River in Alberta. These sites are in areas where there is a mix of mining, forestry and agricultural activities.

Water quality has remained stable at 2 sites on the Athabasca River in Alberta (Athabasca and Old Fort).

[8] For more information on the trend calculation, consult the Data sources and methods section.
[9] Of the 18 sites of the Mackenzie River, 4 sites are core, and 14 sites are regional, only core sites were included in the trend calculation.

Pacific Ocean

Along the west coast of Canada, rivers draining into the Pacific Ocean flow through varied landscapes, from large areas with little development to one of Canada's largest cities: Vancouver.

Key results

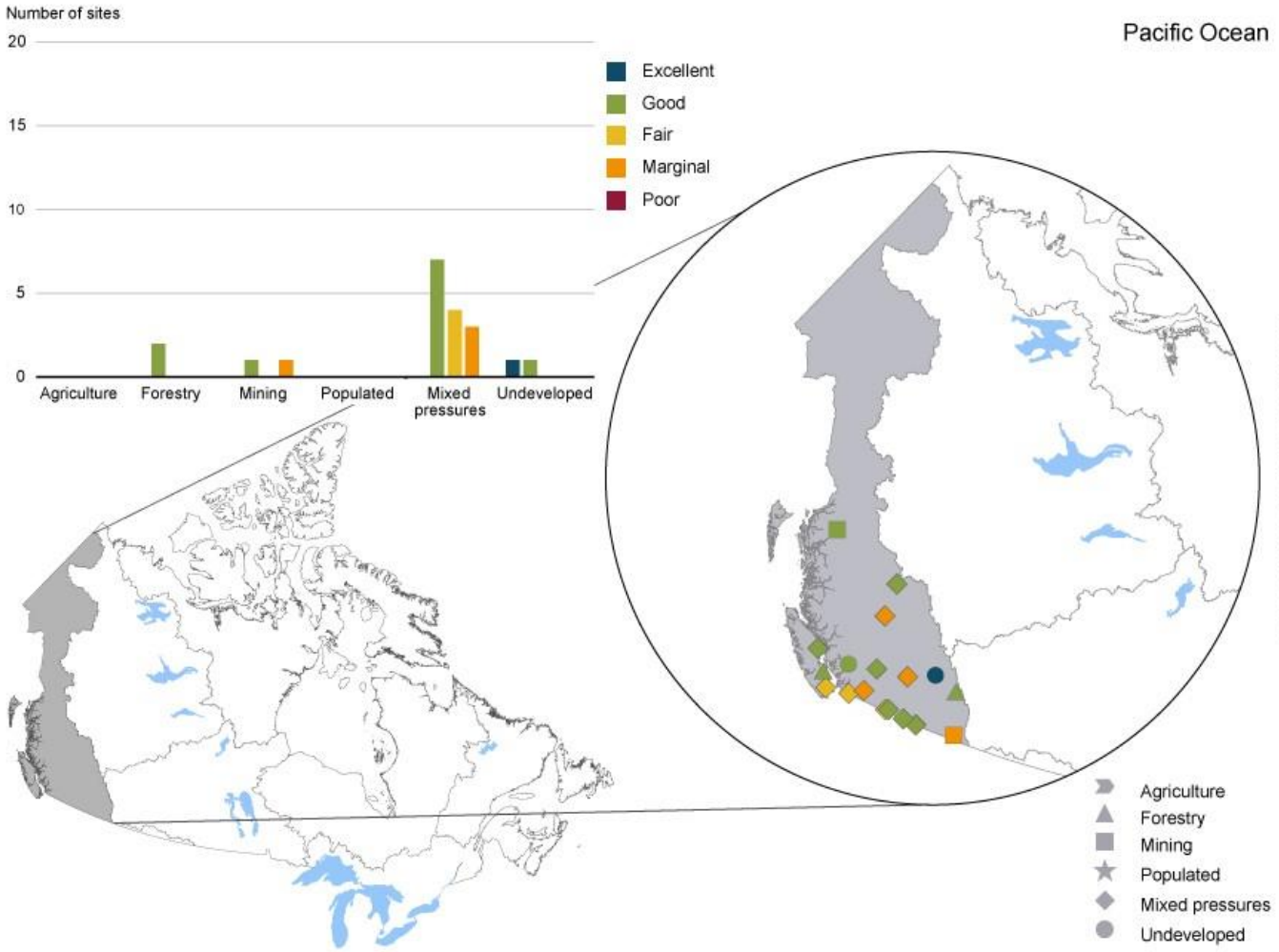
For the 2020 to 2022 period:

- water quality in the Pacific Ocean region is generally fair to good
- marginal or poor water quality is found where there is mining or a combination of mining, forestry activities and high population density

For the 2002 to 2022 trend period:

- of 20 sites monitored[11], 8 had a stable trend in water quality
- water quality at 4 sites has improved and it has deteriorated at 6 sites

Figure 8. Water quality by land use category, Pacific Ocean region, 2020 to 2022 period



Data for Figure 8

Note: Water quality was assessed at 20 sites on rivers draining into the Pacific Ocean using the Canadian Council of Ministers of the Environment's water quality index. For more information on land use classification, consult the Data sources and methods section.
Source: Water quality data were assembled by Environment and Climate Change Canada from existing federal, provincial, territorial and joint water quality monitoring programs. Population, forestry, mining and land cover statistics for each site's drainage area were provided by

Statistics Canada, Natural Resources Canada, Environment and Climate Change Canada, Agriculture and Agri-Food Canada, the Government of Alberta and the University of Maryland.

The Pacific Ocean watershed is home to roughly 4.4 million people, or 16% of Canadians.

In the Okanagan Valley and Fraser Valley, soil conditions and climate are favourable for orchards, vineyards and cash crops. Cattle ranching is dominant throughout much of the other interior plateau and valley lands.

Mining and forestry are 2 of the region's largest industries. Coal, lead, zinc, copper, gold, silver, molybdenum and other precious metals are actively mined within the Pacific Ocean watershed. The forestry industry consists of pulp and paper and wood product manufacturing as well as logging. Soil erosion, water pollution from mine and pulp and paper effluent released to rivers and seepage from tailings and waste rock impoundments may have an impact on water quality. Furthermore, mines are often located in areas where mineral content in the soil and in water may be naturally high.

For the 2020 to 2022 period, water quality for 20 sites on rivers draining into the Pacific Ocean was rated:

- excellent or good at 60% of monitoring sites
- fair at 20% of sites
- marginal at 20% of sites

Calculated trends[10] using data from 2002 to 2022 show that water quality has improved at 4 sites: the Cheakamus River, the Thompson River, the Columbia River and the Kettle River. The Cheakamus and Kettle rivers are in relatively undeveloped areas of British Columbia. The Thompson and Columbia rivers are in areas with forestry and mining activities. In addition, the Columbia River is influenced by numerous dams.

Water quality has deteriorated at 6 sites: the Nechako River, the Elk River, the Similkameen River, the Okanagan River and 2 main Fraser River sites (Marguerite and Hope). These sites are in areas where there are mining and forestry activities.

There has been no change in water quality status at the 8[11] remaining sites.

[10] For more information on the trend calculation, consult the Data sources and methods section.

[11] Of the 20 sites of the Pacific Ocean, 2 sites have not data available for a sufficient number of years to calculate trend.

About the indicators

What the indicators measure

These indicators provide a measure of the ability of river water across Canada to support plants and animals. At each monitoring site, specific water quality data are compared to water quality guidelines to create a rating for the site. If measured water quality remains within the guidelines, we assume that it can maintain a healthy ecosystem.

Water quality at a monitoring site is considered excellent when parameters in a river almost always meet their guidelines. Conversely, water quality is rated poor when parameters usually do not meet their guidelines, sometimes by a wide margin.

Why these indicators are important

Clean freshwater is an essential resource. It protects aquatic plant and animal biodiversity. We use it for manufacturing, energy production, irrigation, swimming, boating, fishing and for domestic use (drinking, washing…). Degraded water quality damages the health of all freshwater ecosystems, such as rivers, lakes, reservoirs and wetlands. It can also disrupt fisheries, tourism and agriculture and make it more expensive to treat to drinking water standards.

These indicators provide information about the state of surface water quality and its change through time, to support water resource management. They are used to provide information about the status and trends in water quality for the *Canada Water Act* report and Environment and Climate Change Canada's annual departmental performance reports.

Related initiatives

These indicators support the measurement of progress towards the following 2022 to 2026 Federal Sustainable Development Strategy Goal 6: Clean water and sanitation – ensure clean and safe water for all Canadians.

In addition, the indicators contribute to the Sustainable Development Goals of the 2030 Agenda for Sustainable Development. They are linked to Goal 6, Clean water and sanitation and 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".

The indicators also contribute towards reporting on Target 10 of the 2020 Biodiversity Goals and Targets for Canada — biodivcanada.ca: "By 2020, pollution levels in Canadian waters, including pollution from excess nutrients, are reduced or maintained at levels that support healthy aquatic ecosystems."

These indicators align with the efforts to monitor and assess Great Lakes water quality, and aquatic ecosystems under the Great Lakes Water Quality Agreement (GLWQA) signed by the governments of Canada and the United States. The State of the Great Lakes - 2022 Report presents the results of the two countries commitment on restoring and protecting Great Lakes water quality and ecosystem health.

Related indicators

The Nutrients in the St. Lawrence River, Phosphorus loading to Lake Erie, Reductions in phosphorus loads to Lake Winnipeg, and Nutrients in Lake Winnipeg indicators report the state of phosphorus and nitrogen levels and loadings in those 3 ecosystems.

The Phosphorus levels in the offshore waters of the Great Lakes indicator reports on the state of and trends in phosphorus levels in the open waters of the Canadian Great Lakes.

The Household use of chemical pesticides and fertilizers indicator reports on how many people in Canada use pesticides and fertilizers on their lawns and gardens.

Data sources and methods

Data sources

Water quality data are collected by federal, provincial and territorial monitoring programs from across Canada. The complete list of data sources from Federal and Provincial monitoring networks can be found in Annex B.

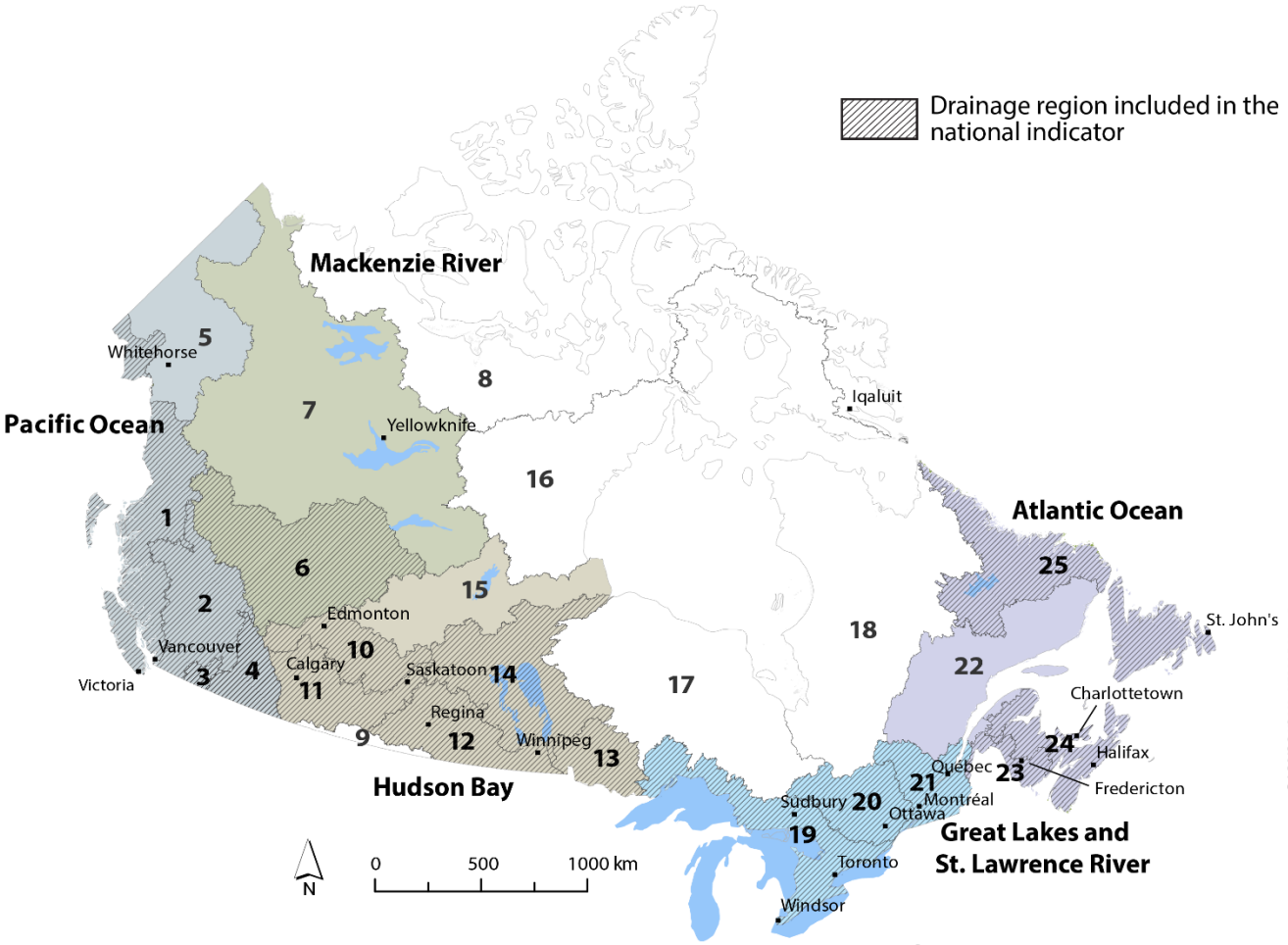
Water quality guidelines for the protection of aquatic life are used to calculate the indicators. They come from the Canadian Council of Ministers of the Environment, the United States Environmental Protection Agency, and provincial and territorial government sources. Where these guidelines do not exist, other guidelines, such as irrigation guidelines, are used. A complete list of water quality guidelines used by each jurisdiction can be found in Annex C.

Additional information from Statistics Canada, Natural Resources Canada, Agriculture and Agri-Food Canada and Environment and Climate Change Canada are used to assess land use.

More information

For the 2020 to 2022 period, water quality data from 163 sites were used to compile the national indicator. These data were drawn from monitoring sites in Canada's 16 southern most drainage regions. The 16 regions were selected based on population and land use to create the water quality indicator core network for national water quality reporting.

Figure 9. Geographic extent of the 16 drainage regions selected for the national water quality indicator



1. Pacific Coastal
2. Fraser–Lower Mainland
3. Okanagan–Similkameen
4. Columbia
5. Yukon
6. Peace–Athabasca
7. Lower Mackenzie
8. Arctic Coast–Islands
9. Missouri
10. North Saskatchewan
11. South Saskatchewan
12. Assiniboine–Red
13. Winnipeg
14. Lower Saskatchewan–Nelson
15. Churchill
16. Keewatin–Southern Baffin
17. Northern Ontario
18. Northern Quebec
19. Great Lakes
20. Ottawa
21. St. Lawrence
22. North Shore–Gaspé
23. Saint John–St. Croix
24. Maritime Coastal
25. Newfoundland–Labrador

The regional indicator groups these 16 drainage regions to 5 larger drainage regions, based on the water body in which rivers ultimately drain into:

- Atlantic Ocean region (22, 23, 24, 25)
- Great Lakes and St. Lawrence River region (19, 20, 21)
- Hudson Bay region (10, 11, 12, 13, 14, 15)
- Mackenzie River region (6, 7)
- Pacific Ocean region (1, 2, 3, 4, 5)

Parts of the Mackenzie River region fall outside of the 16 drainage regions (Figure 9). In order to ensure proper coverage of this region in the regional indicator, 14 additional sites were considered: 4 sites in Alberta, 1 site in Saskatchewan and 9 sites in the Northwest Territories. These additional sites were not

included in the national indicator nor the trend analysis. In the Atlantic Ocean region, the North Shore-Gaspé drainage region is not included in the Freshwater Quality Monitoring and Surveillance program.

Water quality is evaluated at an additional 152 monitoring sites across Canada. Although these additional sites were not used to calculate the indicators, water quality results for all 315 sites can be explored using the interactive water quality map. These additional sites are not included in the calculations because they do not meet the minimum data requirements detailed in the section below, or because including them would over represent the region.

Data used to calculate the indicator includes a selection from a total of around 40 water quality parameters, such as major ions, physical parameters, trace metals, nutrients and pesticides, as well as pH, temperature and hardness, required to calculate certain guidelines. Sample timing and frequency are set by monitoring programs and vary among sites.

Each data record is tagged with the site name, the date the sample was collected, the name and the chemical form of the parameter. Land use and ecological information are also collected for each site. Water quality data, along with water quality indicator scores and site information from the monitoring programs, are stored in a central water quality indicator dictionary housed within a larger database at Environment and Climate Change Canada.

Land use characterization for all monitoring sites was updated in 2019. Land use at each site was determined using:

- population density from Statistics Canada, Population 2016 by dissemination block level
- mine locations using Natural Resources Canada's 2018 Map 900A: Principal Mineral Areas, Producing Mines, and Oil and Gas fields in Canada, Sixty-Eight Edition
- advanced mineral projects locations using Natural Resources Canada’s Advances mineral projects inventory released in February 2019
- oil sands locations using data provided by Alberta Energy, Government of Alberta 2011
- pulp and paper locations using the Environment and Climate Change Canada's National Pollutant Release Inventory (NPRI): Geographic Distribution of NPRI-Reporting Facilities
- forest loss estimated by time-series analysis of 654 178 Landsat 7 ETM+ images in characterizing global forest extent and change from Global Forest Change 2000 to 2012
- agricultural activity locations using Natural Resources Canada's Land Cover 2010, Cropland class
- estimation of livestock using the "Agri-Environmental Indicator (AEI): Livestock Emissions from Agriculture" dataset estimating net emissions produced by livestock from Soil Landscapes of Canada agricultural areas for census years from 1981 to 2011
- land cover using Natural Resources Canada's Land Cover 2010

Data quality assurance and quality control

Data quality assurance/quality control is performed by the monitoring program providing data for the water quality indicators. Each monitoring program follows standardized methods for sample collection in the field. Chemical analyses are performed in Canadian laboratories accredited by the Canadian Association for Laboratory Accreditation or the Standards Council of Canada.

Environment and Climate Change Canada performs further quality assurance/quality control to ensure datasets meet minimum data requirements for the analysis and that calculation standards are respected. This process verifies the number of samples, sample timing, location of monitoring sites and calculations. It can lead to the removal of water quality data due to low sampling frequencies, erroneous measurements or where analytical detection limits are higher than the guidelines used in the calculation. Unusually high or low values in the monitoring datasets are double-checked and confirmed through consultation with the data provider.

Minimum data requirements

Calculating the water quality status for most sites requires a minimum of 4 samples per year collected over 3 years. A minimum of 3 samples per year is permitted for northern and remote sites, as access during winter months can be difficult, dangerous and costly. A sensitivity analysis found that there was no significant difference in the water quality index score when mid-winter samples were excluded.[12]

COVID-19 impact on the calculation of the indicators

Due to health measures related to the COVID-19 pandemic, some sampling activities and laboratory analysis were cancelled in 2020. The method for calculating the water quality status for the 2020-2022 period was adjusted to account for this lack of available data at some sites. Therefore, the scores reported were calculated using 2021 and 2022 data, as well as 2020 data when they were available (totally or partially). Where 2020 data were unavailable, the scores were calculated using 2021 and 2022 data only.

Because of this, the comparison of results, between years and stations, should be interpreted as indicative.

Methods

Water quality is reported in these indicators by measuring a number of chemical and physical properties (parameters) in water. The results for each parameter are compared to its water quality guideline.[13]

These indicators are calculated using the water quality index as endorsed by the Canadian Council of Ministers of the Environment.[14] For each site, 5 to 15 water quality parameters are compared to their guideline value using the index calculation. An index score between 1 and 100 is calculated based on these selected parameters. Sites are assigned a water quality category based on the score. The frequency and amplitude by which a parameter does not meet its guideline negatively impacts the water quality score for a given site. The results are grouped into 5 geographical regions for presentation in the Regional water quality in Canadian rivers indicator.

Trends in water quality at each site are evaluated using a guideline deviation ratio. This ratio is calculated by dividing each water quality parameter result by its guideline. Ratios from all parameters are summed and then averaged annually from 2002 (or after 2002 for certain sites) to 2022. The ratios are then multiplied by -1, so that improving water quality will show a positive slope. A Mann-Kendall test is used to assess whether there is a statistically significant increasing (improving water quality) or decreasing (deteriorating water quality) trend in the annual guideline deviation ratios at a site.

Annex C contains a complete list of parameters and guidelines used in each jurisdiction. Information on water quality parameters and guidelines used at individual sites can be found in the interactive water quality map.

More information

Parameter selection

Federal, provincial and territorial water quality experts select the parameters to be assessed at each site based on their knowledge of local water quality stressors. Selected parameters typically include at least one form of the following parameter groups: nutrients (for example, phosphorus, nitrate, nitrite, total nitrogen), metals (for example, zinc, copper, lead), and physico-chemical parameters (for example, pH, turbidity), as well as 2 to 4 regionally specific parameters (for example, chloride, ammonia, dissolved oxygen, pesticides). The water quality index score is based on these selected parameters.

Water quality guideline selection

Water quality guidelines for the protection of aquatic life are recommended limits or statements for a variety of chemical substances and physical parameters, which, if exceeded, may impair aquatic life.

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[12] Statistics Canada (2007) Behaviour Study on the Water Quality Index of the Canadian Council of Ministers of the Environment. Retrieved on December 20, 2023.

[13] Water quality guidelines are thresholds designed to indicate when a chemical or physical property may become harmful to plants and animals.

[14] Canadian Council of Ministers of the Environment (2017) CCME Water Quality Index 2.0 User's Manual (PDF; 1.61 MB). Retrieved on December 20, 2023

These guidelines are based on existing knowledge of a substance's environmental fate, behaviour and chronic or, in a few cases, acute toxicity.

Federal, provincial or territorial water quality experts select the guidelines to use in the calculation of the water quality indicator based on their local relevance. The Canadian Freshwater Quality Guidelines for the Protection of Aquatic Life are recommended if locally relevant. Annex C provides a complete list of guidelines used by provinces and territories and their source.

Background concentrations of naturally-occurring substances and other local river characteristics can impact the measured concentration and toxicity of some substances. In these cases, site-specific guidelines may be developed using procedures based on background concentrations[15] or a rapid assessment approach. The rapid assessment approach uses long-term monitoring data and adjusts for natural events, such as high flows, that may influence results.[16]

Selection of national core sites for the development of the national indicator

Among Canada's 25 drainage regions (Figure 9), 16 were selected based on population and land use to create the water quality indicator core network for national water quality reporting. Within the 16 selected drainage regions, core sites were selected to ensure site drainage areas do not overlap and are independent of one another. The upstream drainage area of each monitoring site was delineated by Statistics Canada using the National Hydro Network.[17] Where the upstream drainage areas of monitoring sites overlapped, the site furthest downstream was retained for the core network, as the downstream site is impacted by the maximum area in the river basin and, to some degree, reflects the cumulative impact of all upstream stresses. For 14 large rivers, core sites were chosen in the upper, mid and lower portions of the main river and at the most downstream sites on each tributary, when available. Additional core sites were included on these rivers because water travels thousands of kilometres from the source to the mouth of these rivers. Water quality changes along the way and cannot be summarized by a unique downstream monitoring site. The final selection of core sites ensures monitoring sites are well distributed among provinces and drainage regions.

The number of core sites changes from year to year due to samples being missed or lost, which can lead to the site not having the minimum data required to be reported.

Classification of sites

Land use was assessed in the drainage area of core sites and classified according to the criteria presented in Table 1 using the drainage area of each monitoring site.[18] Even if a site's land use classification is Agriculture, Forestry, Mining or Populated, it does not mean that these are the only activities taking place at that site. These land use classifications were determined to be the most representative of the environmental pressures on each site's drainage area based on the data available at the time the analysis was done.

[15] Canadian Council of Ministers of the Environment (2003) Guidance on the Site-Specific Application of Water Quality Guidelines in Canada: Procedures for Deriving Numerical Water Quality Objectives (reviewboard.ca) (PDF; 1.25 MB). Retrieved on December 20, 2023.
[16] Government of Canada (2008) Technical Guidance Document for Water Quality Indicator Practitioners Reporting Under the Canadian Environmental Sustainability Indicators (CESI) Initiative 2008. Retrieved on December 20, 2023.
[17] Henry, M. et al. (2009) Canadian Environmental Sustainability Indicators: Water Quality Index Representivity Report, Statistics Canada.
[18] For more information about land cover classes, consult Natural Resources Canada (2019) Land Cover Product.

Table 1. Criteria for the classification of land use at monitoring sites

Classification	Agriculture[A]		Forestry[A]		Mining[A]		Populated
	Cropland (percentage)	Livestock intensity[B]	Forest loss (percentage)	Number of pulps, paper or saw mills	Number of mines[C]	Number of advanced mineral projects	Population density (people/km^2)
Undeveloped	<1	<0.1	<5	0	0	0	<10
Agriculture (low)	>20	>0.1	<10	0	0	0	<25
Agriculture (medium)	>35	>0.5	<10	0	0	0	<25
Agriculture (high)	>50	>1	<10	0	0	0	<25
Forestry	<1	<0.1	>5	>0	0	0	<25
Mining	<10	<0.1	<5	0	>0	>0	<25
Populated	<10	<0.1	<10	0	0	0	>25
Mixed (agriculture, forestry)	>10	>0.1	>5	>0	0	0	<25
Mixed (agriculture, mining)	>10	>0.1	<5	0	>0	>0	<25
Mixed (agriculture, forestry, mining)	>10	>0.1	>5	>0	>0	>0	<25
Mixed (mining, forestry)	<10	<0.1	>5	>0	>0	>0	<25
Mixed (populated, agriculture)	>10	>0.1	<5	0	0	0	>25
Mixed (populated, agriculture, mining)	>10	>0.1	<5	0	>0	>0	>25
Mixed (populated, forestry, mining)	<10	<0.1	>5	>0	>0	>0	>25
Mixed (populated, agriculture, forestry)	>10	>0.1	>5	>0	0	0	>25
Mixed (populated, forestry)	<10	<0.1	>5	>0	0	0	>25
Mixed (populated, mining)	<10	<0.1	<5	0	>0	>0	>25
Mixed (populated, agriculture, forestry, mining)	>10	>0.1	>5	>0	>0	>0	>25

Note: [A] Either criteria must be met. [B] Livestock intensity was calculated by proxy by dividing the total estimated emissions of greenhouse gas by the basin area. The lower value was attributed an intensity value of 0 and the highest value, an intensity value of 1. [C] Mines includes metal mines and mills, non-metal mines, quarries, coal mines and oil sands mines.

Calculating water quality status

The water quality indicators are calculated using the water quality index, as endorsed by the Canadian Council of Ministers of the Environment. The water quality index calculation considers 3 factors to summarize water quality at a site: scope, frequency and amplitude (Equation 1):

- Scope (F_1) is the percentage of parameters for which the water quality guidelines are not met
- Frequency (F_2) is the percentage of samples for which the water quality guidelines are not met
- Amplitude (F_3) refers to the amount by which the water quality guidelines are not met

The score is normalized to yield a score between 1 and 100. The full set of equations for the water quality index is described in the Canadian Council of Ministers of the Environment (2017) CCME Water Quality Index 2.0 User's Manual (PDF; 1.60 MB).

Equation 1.

$$\text{Water quality index} = 100 - \sqrt{\frac{F_1^2 + F_2^2 + F_3^2}{3}}$$

Water quality scores are grouped into 5 categories following the Canadian Council of Ministers of the Environment's water quality index (Table 2).

Table 2. Score rankings for the Canadian Council of Ministers of the Environment's water quality index

Ranking	Interpretation
Excellent (95.0 to 100.0)	Water quality is protected with a virtual absence of threat of impairment; conditions are very close to natural.
Good (80.0 to 94.9)	Water quality is protected with only a minor degree of threat or impairment; conditions rarely depart from natural or desirable levels.
Fair (65.0 to 79.9)	Water quality is usually protected but occasionally threatened or impaired; conditions sometimes depart from natural or desirable levels.
Marginal (45.0 to 64.9)	Water quality is frequently threatened or impaired; conditions often depart from natural or desirable levels.
Poor (0 to 44.9)	Water quality is almost always threatened or impaired; conditions usually depart from natural or desired levels.

Except where 2020 data was not available, 3 years of data are used to calculate the indicator. This is to dampen temporal variability in the results caused by annual fluctuations in weather and hydrology, to make the water quality indicators more representative of how humans are impacting water quality in rivers.[19]

Calculation of trends in the water quality

The water quality index formulation can only detect change once parameter values exceed their guidelines, making it a metric that is much less sensitive to change over time. In order to increase trend detection sensitivity, a separate set of calculations and metrics were carried out. This trend analysis allows for the detection of improving or deteriorating trends in water quality status at a site, whether they occur above or below guideline values.

[19] Government of Canada (2008) Technical Guidance Document for Water Quality Indicator Practitioners Reporting Under the Canadian Environmental Sustainability Indicators (CESI) Initiative 2008. Retrieved on December 20, 2023.

For each year a guideline deviation ratio was calculated by dividing each parameter concentration (C) by its guideline value (G) for each sampling date. The logarithm of the ratios was calculated and averaged for each year to produce a mean annual value (Equation 2). The ratios were multiplied by -1 to invert the values so that improving water quality will show a positive slope to match how water quality is portrayed with the water quality index.

Equation 2.

For each year:

$$\text{guideline deviation ratio} = -1 * \frac{\sum_{j=1}^{n} \sum_{i=1}^{p} \log_{10}\left(\frac{C_{ij}}{G_i}\right)}{T}$$

where,

i = parameters

j = samples

n = total number of samples

p = total number of parameters

C = measured concentration

G = guideline value

T = total number of samples per year

As the parameter concentrations get closer to their guidelines, the guideline deviation ratio gets closer to zero. A guideline deviation ratio below zero means the parameter concentrations are above their recommended guidelines. When parameter concentrations are well below the guidelines, the ratio is above 1.

3 parameters were exceptions:

- Dissolved oxygen and total alkalinity have guidelines for which measurements must be above, rather than below like the majority of parameters. The ratio for dissolved oxygen was calculated by dividing the guideline by the concentration.
- pH measurements must lie within a range of generally 6.5 and 9. The ratio for pH values less than 6.5 was calculated by dividing the lower guideline (6.5) by the concentration (measured pH). For pH values greater than 9, the ratio was calculated by dividing the concentration by the upper guideline (9).
- Where temperature was used as a parameter, the negative value was replaced by zero.

Current parameters and guidelines at each site were used through the entire record to avoid mistaking methodological changes in the water quality indicator for water quality change. When historical data were missing for a parameter, the parameter was dropped from the trend analysis. Where there was a change in the analytical form of a parameter, and there was no way of converting to the new form, the old dataset was used.

A Mann-Kendall test using the zyp (version 0.11-1, 2023) and Kendall packages (version 2.2, 2011) of the statistical software R (version 4.3, 2023) was used to detect the presence of statistically-significant trends in the guideline deviation ratios. A count of sites with increasing, declining and no trends in the water quality indicator was compiled for the indicator of change through time, from 2002 (or after 2002 for certain sites) to 2022.

Caveats and limitations

These indicators reflect the state of water quality in rivers in southern Canada. Northern Canada is under-represented.

The trends reported are based on annual ratios that aggregate parameter data. In the aggregation, negative and positive trends may cancel each other out. The trends may be different from analyses performed on a parameter-by-parameter basis.

An additional 14 non-core sites were included in the regional indicator to allow for coverage of the Mackenzie River region, which are not included in the national water quality indicator.

The indicators only use data for a subset of variables where guidelines exist. They do not cover all potential water quality issues in Canada.

The indicators are based on the impacts of a number of parameters at each site. These concentrations do not show the effect of spills or other transient events unless samples were collected right after the spill happened or their effect on water quality is long-lasting.

More information

Water quality guidelines are derived from laboratory studies that do not consider, among other things, the impact of flow on sediment loads in a river. Although site-specific guidelines try to take into account the impact of elevated flows on parameter concentrations, elevated levels of naturally-occurring substances, such as minerals, nutrients, glacier deposits and soils, can lower water quality ratings.

The water quality indicators do not directly measure biological integrity; it measures whether physical and chemical characteristics of freshwater bodies are acceptable for aquatic life. Although physical and chemical measurements provide good proxies for biological integrity, only biological information provides a direct measurement of conditions for aquatic life.

The water quality indicators only assess the quality of surface waters. Groundwater is not considered in these indicators.

It can be difficult to compare water quality index scores among sites due to flexibility in the selection of parameters and guidelines to reflect local and regional water quality concerns. The water quality categories assigned based on the scores, however, are comparable. A site classified as marginal has water quality guidelines that are being exceeded frequently and/or by a considerable margin, even if the parameters and guidelines used to make that classification are not exactly the same at all sites.

Only parameters for which water quality guidelines exist can be included in the indicators. The absence of a water quality guideline for a parameter does not mean the parameter is unimportant.

The water quality indicator scores are sensitive to the number of parameters and samples used in their calculation. The number of parameters used in the indicators varies from 5 to 15 depending on the monitoring site, and between 9 and 36 samples can be used for a given parameter. In general, as the number of parameters, or samples, used to calculate the index increases, the score decreases because there is a greater chance of a guideline exceedance.[20]

Water quality varies naturally with weather and hydrological cycles. Although the Water quality in Canadian rivers indicators use a 3-year average to dampen the influence of specific rain fall and snow melt events on the water quality scores, care must be taken in comparing one period to another.

Resources

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Related information

Navigate data using the interactive map

Access data files

Annexes

Annex A. Data tables for the figures presented in this document

Table A.1. Data for Figure 1. Water quality in Canadian rivers, national and by land use category, 2020 to 2022 period

Land use category	Excellent (number of sites)	Excellent (percentage of sites)	Good (number of sites)	Good (percentage of sites)	Fair (number of sites)	Fair (percentage of sites)	Marginal (number of sites)	Marginal (percentage of sites)	Poor (number of sites)	Poor (percentage of sites)
Agriculture	0	0	16	10	11	7	2	1	0	0
Forestry	2	1	10	6	5	3	0	0	0	0
Mining	1	1	3	2	3	2	2	1	0	0
Populated	0	0	0	0	1	1	3	2	0	0
Mixed pressures	7	4	26	16	32	19	12	7	3	2
Undeveloped	2	1	21	13	0	0	1	1	0	0
Total	12	7	76	47	52	32	20	12	3	2

Note: Water quality was evaluated at 163 sites across southern Canada using the Canadian Council of Ministers of the Environment's water quality index. For more information on land use classification and monitoring sites selection, consult the Data sources and methods section.
Source: Data assembled by Environment and Climate Change Canada from federal, provincial and joint water quality monitoring programs. Population, forestry, mining and land cover statistics for each site's drainage area were provided by Statistics Canada, Natural Resources Canada, Environment and Climate Change Canada, Agriculture and Agri-Food Canada, the Government of Alberta and the University of Maryland.

Table A.2. Data for Figure 2. Trends in water quality, Canada, 2002 to 2022

Change	Number of sites	Percentage of sites
Improving water quality	18	11
Deteriorating water quality	65	41
No change in water quality	77	48
Total	160	100

Note: The trend in water quality between the first year that data were reported for each site and 2022 was calculated at 160 sites across southern Canada. 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. The trend was calculated at each site using parameters specific to the site. Therefore, an improving or a deteriorating water quality does not necessarily imply a change in water quality category. For more information on the trend calculation, consult the Data sources and methods section.
Source: Data assembled by Environment and Climate Change Canada from federal, provincial and joint water quality monitoring programs.

Table A.3. Data for Figure 3. Regional water quality, Canada, 2020 to 2022 period

Water quality category	Atlantic Ocean (number of sites)	Atlantic Ocean (percentage of sites)	Great Lakes and St. Lawrence River (number of sites)	Great Lakes and St. Lawrence River (percentage of sites)	Hudson Bay (number of sites)	Hudson Bay (percentage of sites)	Mackenzie River (number of sites)	Mackenzie River (percentage of sites)	Pacific Ocean (number of sites)	Pacific Ocean (percentage of sites)
Excellent	2	4	1	2	8	18	3	17	1	5
Good	30	65	16	33	18	41	7	39	11	55
Fair	9	20	18	37	16	36	8	44	4	20
Marginal	5	11	11	22	2	5	0	0	4	20
Poor	0	0	3	6	0	0	0	0	0	0
Total	46	100	49	100	44	100	18	100	20	100

Note: For the Regional water quality in Canadian rivers indicator, water quality was assessed at 177 sites across Canada using the Canadian Council of Ministers of the Environment's water quality index. Compared to the national indicator, the Regional water quality in Canadian rivers indicator uses 14 additional monitoring sites and includes more sites in the northern portions of the Mackenzie River region.
Source: Data assembled by Environment and Climate Change Canada from federal, provincial, territorial, and joint water quality monitoring programs.

Table A.4. Data for Figure 4. Water quality by land use category, Atlantic Ocean region, 2020 to 2022 period

Land use category	Excellent (number of sites)	Excellent (percentage of sites)	Good (number of sites)	Good (percentage of sites)	Fair (number of sites)	Fair (percentage of sites)	Marginal (number of sites)	Marginal (percentage of sites)	Poor (number of sites)	Poor (percentage of sites)
Agriculture	0	0	3	7	1	2	0	0	0	0
Forestry	2	4	7	15	5	11	0	0	0	0
Mining	0	0	1	1	1	2	0	0	0	0
Populated	0	0	0	0	0	0	3	7	0	0
Mixed pressures	0	0	4	9	2	4	2	4	0	0
Undeveloped	0	0	15	33	0	0	0	0	0	0
Total	2	4	30	65	9	19	5	11	0	0

Note: Water quality was assessed at 46 sites on rivers draining into the Atlantic Ocean using the Canadian Council of Ministers of the Environment's water quality index. For more information on land use classification, consult the Data sources and methods section. Percentages may not add up to 100 due to rounding.
Source: Water quality data were assembled by Environment and Climate Change Canada from existing federal, provincial and joint water quality monitoring programs. Population, forestry, mining and land cover statistics for each site's drainage area were provided by Statistics Canada, Natural Resources Canada, Environment and Climate Change Canada, Agriculture and Agri-Food Canada, the Government of Alberta and the University of Maryland.

Table A.5. Data for Figure 5. Water quality by land use category, Great Lakes and St. Lawrence River region, 2020 to 2022 period

Land use category	Excellent (number of sites)	Excellent (percentage of sites)	Good (number of sites)	Good (percentage of sites)	Fair (number of sites)	Fair (percentage of sites)	Marginal (number of sites)	Marginal (percentage of sites)	Poor (number of sites)	Poor (percentage of sites)
Agriculture	0	0	1	2	2	4	1	2	1	2
Forestry	0	0	1	2	0	0	0	0	0	0
Mining	1	2	1	2	2	4	1	2	0	0
Populated	0	0	0	0	1	2	0	0	0	0
Mixed pressures	0	0	10	20	12	24	8	16	2	4
Undeveloped	0	0	3	6	1	2	1	2	0	0
Total	1	2	16	33	18	37	11	22	3	6

Note: Water quality was assessed at 49 sites on rivers draining into the Great Lakes or St. Lawrence River using the Canadian Council of Ministers of the Environment's water quality index. For more information on land use classification, consult the Data sources and methods section. Percentages may not add up to 100 due to rounding.
Source: Water quality data were assembled by Environment and Climate Change Canada from existing federal, provincial and joint water quality monitoring programs. Population, forestry, mining and land cover statistics for each site's drainage area were provided by Statistics Canada, Natural Resources Canada, Environment and Climate Change Canada, Agriculture and Agri-Food Canada, the Government of Alberta and the University of Maryland.

Table A.6. Data for Figure 6. Water quality by land use category, Hudson Bay region, 2020 to 2022 period

Land use category	Excellent (number of sites)	Excellent (percentage of sites)	Good (number of sites)	Good (percentage of sites)	Fair (number of sites)	Fair (percentage of sites)	Marginal (number of sites)	Marginal (percentage of sites)	Poor (number of sites)	Poor (percentage of sites)
Agriculture	0	0	10	23	8	18	2	5	0	0
Forestry	0	0	0	0	0	0	0	0	0	0
Mining	0	0	0	0	0	0	0	0	0	0
Populated	0	0	0	0	0	0	0	0	0	0
Mixed pressures	7	16	7	16	8	18	0	0	0	0
Undeveloped	1	2	1	2	0	0	0	0	0	0
Total	8	18	18	41	16	36	2	5	0	0

Note: Water quality was assessed at 44 sites on rivers draining into the Hudson Bay using the Canadian Council of Ministers of the Environment's water quality index. For more information on land use classification, consult the Data sources and methods section.
Source: Water quality data were assembled by Environment and Climate Change Canada from existing federal, provincial and joint water quality monitoring programs. Population, forestry, mining and land cover statistics for each site's drainage area were provided by Statistics Canada, Natural Resources Canada, Environment and Climate Change Canada, Agriculture and Agri-Food Canada, the Government of Alberta and the University of Maryland.

Table A.7. Data for Figure 7. Water quality by land use category, Mackenzie River region, 2020 to 2022 period

Land use category	Excellent (number of sites)	Excellent (percentage of sites)	Good (number of sites)	Good (percentage of sites)	Fair (number of sites)	Fair (percentage of sites)	Marginal (number of sites)	Marginal (percentage of sites)	Poor (number of sites)	Poor (percentage of sites)
Agriculture	0	0	0	0	0	0	0	0	0	0
Forestry	0	0	0	0	0	0	0	0	0	0
Mining	1	6	1	6	1	6	0	0	0	0
Populated	0	0	0	0	0	0	0	0	0	0
Mixed pressures	1	6	2	11	5	28	0	0	0	0
Undeveloped	1	6	4	22	2	11	0	0	0	0
Total	3	18	7	39	8	44	0	0	0	0

Note: Water quality was assessed at 18 sites on rivers draining into the Mackenzie River using the Canadian Council of Ministers of the Environment's water quality index. For more information on land use classification, consult the Data sources and methods section**.** Percentages may not add up to 100 due to rounding.
Source: Water quality data were assembled by Environment and Climate Change Canada from existing federal, provincial, territorial and joint water quality monitoring programs. Population, forestry, mining and land cover statistics for each site's drainage area were provided by Statistics Canada, Natural Resources Canada, Environment and Climate Change Canada, Agriculture and Agri-Food Canada, the Government of Alberta and the University of Maryland.

Table A.8. Data for Figure 8. Water quality by land use category, Pacific Ocean region, 2020 to 2022 period

Land use category	Excellent (number of sites)	Excellent (percentage of sites)	Good (number of sites)	Good (percentage of sites)	Fair (number of sites)	Fair (percentage of sites)	Marginal (number of sites)	Marginal (percentage of sites)	Poor (number of sites)	Poor (percentage of sites)
Agriculture	0	0	0	0	0	0	0	0	0	0
Forestry	0	0	2	10	0	0	0	0	0	0
Mining	0	0	1	5	0	0	1	5	0	0
Populated	0	0	0	0	0	0	0	0	0	0
Mixed Pressures	0	0	7	35	4	20	3	15	0	0
Undeveloped	1	5	1	5	0	0	0	0	0	0
Total	1	5	11	55	4	20	4	20	0	0

Note: Water quality was assessed at 20 sites on rivers draining into the Pacific Ocean using the Canadian Council of Ministers of the Environment's water quality index. For more information on land use classification, consult the Data sources and methods section.
Source: Water quality data were assembled by Environment and Climate Change Canada from existing federal, provincial, territorial and joint water quality monitoring programs. Population, forestry, mining and land cover statistics for each site's drainage area were provided by Statistics Canada, Natural Resources Canada, Environment and Climate Change Canada, Agriculture and Agri-Food Canada, the Government of Alberta and the University of Maryland.

Annex B. Monitoring programs providing data on ambient water quality

Table B.1. Monitoring programs providing data on ambient water quality

Province/Territory	Monitoring program	Organization(s)
All Canada	Environment and Climate Change Canada's water quality monitoring network (NWT, YK, BC, AB, SK, MB, ON, QC, NS, transboundary and interprovincial monitoring sites, federal lands)	Environment and Climate Change Canada
Alberta	Long-term river network monitoring program	Alberta Environment
British Columbia	Canada–British Columbia Water Quality Monitoring Agreement	Environment and Climate Change Canada, British Columbia Ministry of Environment
Manitoba	Ambient Water Quality Monitoring Network	Environment and Climate Change Manitoba
New Brunswick	Canada–New Brunswick Water Quality Monitoring Agreement	Environment and Climate Change Canada, New Brunswick Department of Environment and Local Government
New Brunswick	Long-range Transport of Atmospheric Pollutants Program	Environment and Climate Change Canada
New Brunswick	Surface water monitoring network	New Brunswick Department of Environment and Local Government
Newfoundland and Labrador	Canada–Newfoundland and Labrador Water Quality Monitoring Agreement	Environment and Climate Change Canada, Environment and Climate Change Newfoundland and Labrador
Nova Scotia	Long-range Transport of Atmospheric Pollutants Program	Environment and Climate Change Canada
Nova Scotia	Nova Scotia Surface Water Quality Monitoring Network	Environment and Climate Change Nova Scotia
Ontario	Ontario Provincial Water Quality Monitoring Network	Ontario Ministry of the Environment, Conservation and Parks
Prince Edward Island	Canada–Prince Edward Island Water Quality Agreement	Environment and Climate Change Canada, Environment, Energy and Climate Action Prince Edward Island
Quebec	Canada–Quebec Water Quality Agreement	Environment and Climate Change Canada, ministère de l'Environnement et de la Lutte contre les changements climatiques, de la Faune et des Parcs du Québec
Quebec	Réseau-Rivières	Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs du Québec
Saskatchewan	Surface Water Quality Monitoring Program	Water Security Agency Saskatchewan

Province/Territory	Monitoring program	Organization(s)
Northwest Territories and Nunavut	Water Quality Monitoring Network	Environment and Climate Change Canada
Northwest Territories and Nunavut	Local Rivers Water Quality Monitoring Program	Indian and Northern Affairs Canada
Yukon	Canada–Yukon Water Quality & Aquatic Ecosystem Monitoring Agreement	Government of Yukon, Environment and Climate Change Canada

Annex C. Water quality guidelines used by each province and territory

Abbreviations used in the following tables:

- 2,4-dichlorophenoxyacetic acid (2,4-D)
- 2-methyl-4-chlorophenoxyacetic acid (MCPA)
- calcium carbonate ($CaCO_3$)
- hexavalent chromium (Cr(VI))
- litre (L)
- microgram (µg)
- milligram (mg)
- nephelometric turbidity unit (NTU)
- nitrogen (N)
- site-specific guidelines (SSG)

Table C.1. Water quality guidelines used in Alberta

Parameter	Form	Guideline	Source
2,4-D[A]	n/a	4 µg/L	1
Aluminium[A]	dissolved	0.1 mg/L for pH ≥ 6.5	1
Ammonia[B]	unfiltered	0.019 mg/L	1
Arsenic	total	5 µg/L	1
Cadmium[A]	total	$e^{1.0166*ln[hardness]-3.924}$ µg/L where hardness is measured as mg [$CaCO_3$]/L	2
Chloride[B]	dissolved	SSG	1
Copper[A]	total	7 µg/L	3
Copper[B]	total	2 µg/L for hardness < 90 mg [$CaCO_3$]/L $0.2*e^{0.8545*ln[hardness]-1.465}$ µg/L for hardness > 90 mg [$CaCO_3$]/L	4
Lead[A]	total	1 µg/L for hardness < 50 mg [$CaCO_3$]/L $e^{1.273*ln[hardness]-4.705}$ µg/L for hardness ≥ 50 mg [$CaCO_3$]/L	4
MCPA[A]	n/a	2.6 µg/L	1
Mercury[A]	total inorganic	0.013 µg/L	1
Nickel[B]	total	$e^{0.76*ln[hardness]+1.06}$ µg/L where hardness is measured as mg [$CaCO_3$]/L	5
Nitrate-Nitrite[B]	dissolved	SSG	5
Nitrogen[A]	total	1 mg /L	4
Nitrogen[B]	total	SSG	
Oxygen[A]	dissolved	6.5 mg/L	1, 3
Oxygen[B]	dissolved	SSG	5
pH	n/a	lower 6.5 and upper 9	1
Phosphorus[A]	total	0.05 mg/L	5
Phosphorus[B]	total	SSG	5
Selenium[A]	total	1 µg/L	4
Zinc[A]	total	7.5 µg/L for hardness ≤ 90 mg [$CaCO_3$]/L 7.5 + 0.75*(hardness-90) for hardness > 90 mg [$CaCO_3$]/L	4
Zinc[B]	total	SSG	5

Note: n/a = not applicable.
[A] Applies to sites monitored under provincial monitoring programs.
[B] Applies to sites monitored under federal monitoring programs, including the Prairie Provinces Water Board.
SSG denotes that different site-specific guidelines or formulas were used at sites. Specific site information is available upon request.

Alberta Water Quality Guideline Sources:

1 Canadian Council of Ministers of the Environment (2023) Canadian Water Quality Guidelines for the Protection of Aquatic Life. Summary Table. Retrieved on December 20, 2023.

2 United States Environmental Protection Agency (2001) 2001 Update of Ambient Water Quality Criteria for Cadmium. Document EPA 822-R-01-001. Retrieved on December 20, 2023.

3 Alberta Environment (2018) Environmental Quality Guidelines for Alberta Surface Waters (PDF; 704 kB). Retrieved on December 20, 2023.

4 Government of Canada (2008) Technical Guidance Document for Water Quality Index Practitioners Reporting Under the Canadian Environmental Sustainability Indicators (CESI) Initiative 2008. Environment and Climate Change Canada and Statistics Canada. Retrieved on December 20, 2023.

5 Prairie Provinces Water Board (1992) Master Agreement on Apportionment. Schedule E: Agreement on Water Quality. Retrieved on December 20, 2023.

Table C.2. Water quality guidelines used in British Columbia

Parameter	Form	Guideline	Source
Alkalinity	n/a	20 mg [$CaCO_3$]/L	1
Arsenic	total	5 µg/L	2
Cadmium	total	$10^{(0.83(\log10[\text{hardness}])-2.46)}$ µg/L for hardness > 50 mg [$CaCO_3$]/L 0.09 µg/L for hardness < 50 mg [$CaCO_3$]/L SSG	2, 3
Chloride	dissolved	120 mg/L	2
Chromium	total	SSG	2, 3, 4, 5 6, 7
Copper	total	2 µg/L for hardness < 90 mg [$CaCO_3$]/L $0.2*e^{0.8545*\ln[\text{hardness}]-1.465}$ µg/L for hardness > 90 mg [$CaCO_3$]/L SSG	3, 6, 8, 9, 10
Cyanide	total	5 µg/L	2
Fluoride	total	[-51.73+92.57$\log_{10}$(hardness)] X 0.01 µg/L (BC08NM001) 0.35 mg/L (BC08NN0021)	11
Iron	total	300 µg/L	9
Lead	total	1 µg/L for hardness < 50 mg [$CaCO_3$]/L $e^{1.273*\ln[\text{hardness}]-4.705}$ µg/L for hardness > 50 mg [$CaCO_3$]/L SSG	3, 9, 10
Manganese	total dissolved	50 µg/L	12
Molybdenum	total	50 µg/L 73 µg/L (BC08MH0027)	2
Nickel	total	$e^{0.76*\ln[\text{hardness}]+1.06}$ µg/L where hardness is measured as mg [$CaCO_3$]/L	9
Nitrate	total dissolved	2.93 mg N/L	9
Nitrite	total	0.02 mg N/L	9
Nitrogen	total, dissolved	SSG	13, 9
Oxygen	dissolved	SSG	2, 10, 14, 15, 16
pH	n/a	SSG	2, 3, 14
Phosphorus	total, dissolved	SSG	9, 17
Selenium	total dissolved	SSG	11
Silver	total	0.05 µg/L for hardness ≤ 100 mg [$CaCO_3$]/L 1.9 µg/L for hardness > 100 mg [$CaCO_3$]/L SSG	9
Sulphate	dissolved	309 mg/L (BC08MH0027) 218 mg/L for hardness < 31(BC08NM0001) 309 mg/L for hardness < 76 (BC08NM0001)	9
Temperature	n/a	SSG	18
Thallium	total	0.8 µg/L	2
Uranium	total	10 µg/L	1
Zinc	total	7.5 µg/L SSG	3, 4, 6, 12

Note: n/a = not applicable.
SSG denotes that different site-specific guidelines or formulas were used at sites. For details on the derivation of site-specific guidelines, consult BCMOE (1997).

British Columbia Water Quality Guideline Sources:

1 British Columbia Ministry of Environment (2021) British Columbia Working Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture (PDF; 745 kB). Retrieved on December 20, 2023.

2 Canadian Council of Ministers of the Environment (2023) Canadian Water Quality Guidelines for the Protection of Aquatic Life Summary Table. Retrieved on December 20, 2023.

3 Butcher, GA. (1992) Lower Columbia River, Hugh Keeleyside dam to Birchbank water quality assessment and objectives: Technical appendix (PDF; 9.9 MB). British Columbia Ministry of the Environment, Lands and Parks. Retrieved on December 20, 2023.

4 British Columbia Ministry of Environment and Climate Change Strategy (2000) Ambient Water Quality Assessment and Objectives for the Lower Columbia River Birchbank to the US border (PDF; 231 kB). Retrieved on December 20, 2023.

5 Environment and Climate Change Canada (2005) Site-specific Water Quality Guidelines for the Liard River at Upper Crossing for the Purpose of National Reporting. Tri-Star Environmental Consulting.

6 Environment and Climate Change Canada (2009) Site-specific Water Quality Guidelines for the Skeena River at Usk for the Purpose of National Reporting. Tri-Star Environmental Consulting.

7 Environment and Climate Change Canada (2009) Site-specific Water Quality Guidelines for the Kootenay River at Kootenay Crossing for the Purpose of National Reporting. Tri-Star Environmental Consulting.

8 British Columbia Ministry of Environment (2019) Copper Water Quality Guideline for the Protection of Marine Aquatic Life (PDF; 592 kB). Retrieved on December 20, 2023.

9 Government of Canada (2013) Technical Guidance Document for Water Quality Index Practitioners Reporting Under the Canadian Environmental Sustainability Indicators (CESI) Initiative 2008. Environment and Climate Change Canada and Statistics Canada. Retrieved on December 20, 2023...

10 Obee, N. (2011) Water Quality Assessment and Objectives for the Cowichan and Koksilah Rivers: First Update. British Columbia Ministry of Environment, Environmental Protection Division and Environmental Sustainability and Strategic Policy Division. Victoria, BC. (PDF; 4.64 MB). Retrieved on December 20, 2023.

11 British Columbia Ministry of Environment and Climate Change Strategy (2023) British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture Summary Report (PDF; 1.13 MB). Retrieved on December 20, 2023.

12 Swain, LG. (1990) Ambient Water Quality Objectives for the Similkameen River Okanagan Area Overview Report. British Columbia Ministry of Environment. Retrieved on December 20, 2023.

13 Nordin, RN. and Pommen, LW. (2009) Water Quality Criteria for Nitrogen (Nitrate, Nitrite, and Ammonia): Overview Report. British Columbia Ministry of Environment (PDF; 565 kB). Retrieved on December 20, 2023.

14 British Columbia Ministry of Water, Land and Air Protection (1998) Water Quality Assessment and Recommended Objectives for the Salmon River. Summary Report (PDF; 257 kB). Retrieved on December 20, 2023.

15 Swain LG (1987) Takla-Nechako Areas, Nechako River Water Quality Assessment and Objectives. British Columbia Ministry of Environment and Parks (PDF; 1.15 MB) Retrieved on December 20, 2023.

16 Environment and Climate Change Canada (2005) Site-specific Water Quality Guidelines for the Sumas River at the International Boundary for the Purpose of National Reporting. Tri-Star Environmental Consulting.

17 Ontario Ministry of the Environment and Energy (1994) Water Management Policies, Guidelines, Provincial Water Quality Objectives. Retrieved on December 20, 2023.

18 British Columbia Ministry of Environment (2001) Water Quality Guidelines for Temperature: Overview Report (PDF; 221 kB). Retrieved on December 20, 2023.

Table C.3. Water quality guidelines used in Manitoba

Parameter	Form	Guideline	Source
2,4-D	n/a	4 µg/L	1
Ammonia[A]	unfiltered	Calculation based on pH and temperature	2, 3
Ammonia[B]	unfiltered	0.019 mg/L	1, 4
Arsenic[A]	total	150 µg/L	5
Arsenic[B]	total	5 µg/L	5
Cadmium[A]	total	$e^{1.0166*\ln[\text{hardness}]-3.924}$ µg/L where hardness is measured as mg [$CaCO_3$]/L	6
Chloride[B]	dissolved	SSG	5
Copper[A]	total	[$e^{0.8545*\ln[\text{hardness}]-1.702}$]*(0.96) µg/L where hardness is measured as mg [$CaCO_3$]/L	2
Copper[B]	total	2 µg/L for hardness < 90 mg [$CaCO_3$]/L 0.2*[$e^{0.8545*\ln[\text{hardness}]-1.465}$] µg/L for hardness > 90 mg [$CaCO_3$]/L	4
Iron[A]	total	300 µg /L	4
Lead[A]	total	($e^{1.273*\ln[\text{hardness}]-4.705}$)*(1.46203 - (ln[hardness]*0.145712)) µg/L where hardness is measured as mg [$CaCO_3$]/L	2
Lead[B]	total	1 µg/L for hardness < 50 mg [$CaCO_3$]/L $e^{1.273*\ln[\text{hardness}]-4.705}$ µg/L for hardness ≥ 50 mg [$CaCO_3$]/L where hardness is measured as mg [$CaCO_3$]/L	4
MCPA	n/a	2.6 µg/L	1
Nickel[A]	total	$e^{0.8460*\ln[\text{hardness}]+0.0584}$ µg/L where hardness is measured as mg [$CaCO_3$]/L	5
Nickel[B]	total	$e^{0.76*\ln[\text{hardness}]+1.06}$ µg/L where hardness is measured as mg [$CaCO_3$]/L	4
Nitrate[A]	total	2.9 mg N/L	4
Nitrate-Nitrite[B]	dissolved	SSG	5
Nitrogen[B]	total	SSG	7
Oxygen[A]	dissolved	5 mg/L	4
Oxygen[B]	dissolved	SSG	1
pH	n/a	lower 6.5 and upper 9	1
Phosphorus[A]	total	0.05 mg/L	2, 7
Phosphorus[B]	total	SSG	
Suspended sediments[A]	n/a	Maximum increase of 25 mg/L for high flow and turbid waters above background levels	4
Zinc[A]	total	$e^{(0.8473*\ln[\text{hardness}]+0.884)}$*0.986 µg/L where hardness is measured as mg [$CaCO_3$]/L	2, 6
Zinc[B]	total	7.5 µg/L for hardness ≤ 90 mg [$CaCO_3$]/L 7.5 + 0.75*(hardness-90) for hardness > 90 mg [$CaCO_3$]/L	4
Zinc[B]	total	30 µg/L	5

Note: n/a = not applicable.
[A] Applies to sites monitored under provincial monitoring programs.
[B] Applies to sites monitored under federal monitoring programs (Prairie Provinces Water Board).
SSG denotes that different site-specific guidelines or formulas were used at sites. Specific site information is available upon request.

Manitoba Water Quality Guideline Sources:

1 Canadian Council of Ministers of the Environment (2018) Canadian Water Quality Guidelines for the Protection of Aquatic Life Summary Table. Retrieved on December 20, 2023.

2 Manitoba Water Stewardship (2011) Manitoba Water Quality Standards, Objectives, and Guidelines (PDF; 912 kB). Retrieved on December 20, 2023.

3 United States Environmental Protection Agency (1999) Update of Ambient Water Quality Criteria for Ammonia. Document EPA 822-R-99-014. Retrieved on December 20, 2023.

4 Government of Canada (2008) Technical Guidance Document for Water Quality Index Practitioners Reporting Under the Canadian Environmental Sustainability Indicators (CESI) Initiative 2008. Environment and Climate Change Canada and Statistics Canada. Retrieved on December 20, 2023.

5 United States Environmental Protection Agency (2023) National Recommended Water Quality Criteria – Aquatic Life Criteria Table. Retrieved on December 20, 2023.

6 United States Environmental Protection Agency (2001) 2001 Update of Ambient Water Quality Criteria for Cadmium. Document EPA 822-R-01-001 (PDF; 10.7 MB). Retrieved on December 20, 2023.

7 Prairie Provinces Water Board (1992) Master Agreement on Apportionment. Schedule E: Agreement on Water Quality. Retrieved on December 20, 2023.

Table C.4. Water quality guidelines used in New Brunswick

Parameter	Form	Guideline	Source
Ammonia[A]	unfiltered	0.0156 mg/L	2
Arsenic	total	5 µg/L	2
Chloride	total	120 mg/L	2
Copper	total	2 µg/L for hardness < 90 mg [$CaCO_3$]/L $0.2*e^{0.8545*ln[hardness]-1.465}$ µg/L for hardness > 90 mg [$CaCO_3$]/L	1
Iron	total	0.3 mg/L	1
Nitrate	total	2.9 mg N/L	1
Oxygen	dissolved	6.5 mg/L	2
pH	n/a	Lower 6.5 and upper 9	2
Phosphorus	total	0.03 mg/L	1
Turbidity	n/a	10 NTU	2
Zinc	total	7.5 µg/L for hardness ≤ 90 mg [$CaCO_3$]/L 7.5 + 0.75*(hardness-90) for hardness > 90 mg [$CaCO_3$]/L	1

Note: n/a = not applicable.
[A] In New Brunswick, the CCME guideline recommended by Environment and Climate Change Canada is adjusted to address the ammonia form measured by the provincial laboratories, which differs from the form used by the CCME.

New Brunswick Water Quality Guideline Sources:

1 Government of Canada (2008) Technical Guidance Document for Water Quality Index Practitioners Reporting Under the Canadian Environmental Sustainability Indicators (CESI) Initiative 2008. Environment and Climate Change Canada and Statistics Canada. Retrieved on December 20, 2023.

2 Canadian Council of Ministers of the Environment (2018) Canadian Water Quality Guidelines for the Protection of Aquatic Life Summary Table. Retrieved on December 20, 2023.

Table C.5. Water quality guidelines used in Newfoundland and Labrador

Parameter	Form	Guideline	Source
Chloride	total	120 mg/L	1
Copper	total	2 µg/L for hardness < 90 mg [$CaCO_3$]/L $0.2*e^{0.8545*ln[hardness]-1.465}$ µg/L for hardness > 90 mg [$CaCO_3$]/L	2
Iron	total	SSG	2, 3
Lead	total	1 µg/L for hardness < 50 mg [$CaCO_3$]/L $e^{1.273*ln[hardness]-4.705}$ µg/L for hardness ≥ 50 mg [$CaCO_3$]/L	2
Nickel	total	$e^{0.76*ln[hardness]+1.06}$ µg/L where hardness is measured as mg [$CaCO_3$]/L	2
Nitrate	total	3 mg/L	2
Oxygen	dissolved	9.5 mg/L	1
pH	n/a	SSG	1, 3
Phosphorus	total	0.03 mg/L	2
Zinc	total	7.5 µg/L for hardness ≤ 90 mg [$CaCO_3$]/L 7.5 + 0.75*(hardness-90) for hardness >90 mg [$CaCO_3$]/L	2

Note: n/a = not applicable.
SSG denotes that different site-specific guidelines or formulas were used at sites. Specific site information is available upon request.

Newfoundland and Labrador Water Quality Guideline Sources:

1 Canadian Council of Ministers of the Environment (2018) Canadian Water Quality Guidelines for the Protection of Aquatic Life Summary Table. Retrieved on December 20, 2023.

2 Government of Canada (2008) Technical Guidance Document for Water Quality Index Practitioners Reporting Under the Canadian Environmental Sustainability Indicators (CESI) Initiative 2008. Environment and Climate Change Canada and Statistics Canada. Retrieved on December 20, 2023.

3 Khan AA et al. (2005) Application of CCME Procedures for Deriving Site-specific Water Quality Guidelines for the CCME Water Quality Index (PDF; 288 kB). Water Quality Research Journal 40(4):448-456. Retrieved on December 20, 2023.

Table C.6. Water quality guidelines used in the Northwest Territories

Parameter	Form	Guideline	Source
Ammonia	unfiltred, dissolved	SSG	1
Arsenic	total	SSG	2
Chloride	dissolved	Lentic-lotic sites: 150 mg/L Lotic sites: SSG	1, 2
Chromium	total	SSG	2
Copper	total	Lentic-lotic sites: 2 µg/L for hardness < 90 mg [$CaCO_3$]/L $0.2*e^{0.8545*ln[hardness]-1.465}$ µg/L for hardness > 90 mg [$CaCO_3$]/L Lotic sites: SSG	1, 3
Iron	total	Lentic-lotic sites: 0.3 mg/L Lotic sites: SSG	1, 3
Lead	total	Lentic-lotic sites: 1 µg/L for hardness < 50 mg [$CaCO_3$]/L $e^{1.273*ln[hardness]-4.705}$ µg/L for hardness ≥ 50 mg [$CaCO_3$]/L Lotic sites: SSG	1, 3
Nitrate-Nitrite	dissolved	SSG	1
Nitrogen	total dissolved	SSG	
Oxygen	dissolved	SSG	2
pH	n/a	Lentic-lotic sites: lower 6.5 and upper 9 Lotic sites: SSG	1, 2
Phosphorus	total	Lentic-lotic sites: 0.03 mg/L Lotic sites: SSG	2, 3
Zinc	total	Lentic-lotic sites: 7.5 µg/L for hardness ≤ 90 mg [$CaCO_3$]/L 7.5 + 0.75*(hardness-90) for hardness >90 mg [$CaCO_3$]/L Lotic sites: SSG	2, 3

Note: n/a = not applicable.
SSG denotes that different site-specific guidelines or formulas were used at sites. Specific site information is available upon request.

Northwest Territories Water Quality Guideline Sources:

1 Lumb, A. et al. (2006) Application of CCME Water Quality Index to Monitor Water Quality: A Case of the Mackenzie River Basin, Canada (PDF; 287 kB). Environmental Monitoring and Assessment 113:411-429. Retrieved on Decembre 20, 2023.

2 Canadian Council of Ministers of the Environment (2018) Canadian Water Quality Guidelines for the Protection of Aquatic Life Summary Table. Retrieved on Decembre 20, 2023.

3 Government of Canada (2008) Technical Guidance Document for Water Quality Index Practitioners Reporting Under the Canadian Environmental Sustainability Indicators (CESI) Initiative 2008. Environment and Climate Change Canada and Statistics Canada. Retrieved on Decembre 20, 2023.

Table C.7. Water quality guidelines used in Nova Scotia

Parameter	Form	Guideline	Source
Chloride	dissolved	120 mg/L	1
Copper	total	2 µg/L for hardness < 120 mg [$CaCO_3$]/L 3 µg/L for hardness 120 to 180 mg [$CaCO_3$]/L 4 µg/L for hardness > 180 mg [$CaCO_3$]/L	2
Iron	total	0.3 mg/L	2
Lead	total	1 µg/L for hardness < 60 mg [$CaCO_3$]/L 2 µg/L for hardness 60 to 120 mg [$CaCO_3$]/L 4 µg/L for hardness 120 to 180 mg [$CaCO_3$]/L 7 µg/L for hardness > 180 mg [$CaCO_3$]/L	1
Nitrate	dissolved	3 mg N/L	2
Oxygen	dissolved	6.5 mg/L	1
pH	n/a	Lower 6.5 and upper 9	1
Phosphorus	total	0.03 mg/L	2
Zinc	total	7.5 µg/L for hardness ≤ 90 mg [$CaCO_3$]/L 7.5 + 0.75*(hardness-90) for hardness > 90 mg [$CaCO_3$]/L	2

Note: n/a = not applicable.

Nova Scotia Water Quality Guideline Sources:

1 Canadian Council of Ministers of the Environment (2018) Canadian Water Quality Guidelines for the Protection of Aquatic Life Summary Table. Retrieved on Decembre 20, 2023.

2 Government of Canada (2008) Technical Guidance Document for Water Quality Index Practitioners Reporting Under the Canadian Environmental Sustainability Indicators (CESI) Initiative 2008. Environment and Climate Change Canada and Statistics Canada. Retrieved on Decembre 20, 2023.

Table C.8. Water quality guidelines used in Ontario

Parameter	Form	Guideline	Source
Ammonia	unfiltered	0.019 mg/L	1, 2
Chloride	total	120 mg/L	1
Chromium	total	2 µg/L (guideline for Cr(VI) adjusted to total chromium)	1
Nickel	total	$e^{0.76*\ln[\text{hardness}]+1.06}$ µg/L where hardness is measured as mg [$CaCO_3$]/L	2
Nitrate	total	2.93 mg N/L	2
Phosphorus	total	0.03 mg/L	2, 3
Zinc	total	7.5 µg/L for hardness ≤ 90 mg [$CaCO_3$]/L 7.5 + 0.75*(hardness-90) for hardness > 90 mg [$CaCO_3$]/L	2

Ontario Water Quality Guideline Sources:

1 Canadian Council of Ministers of the Environment (2018) Canadian Water Quality Guidelines for the Protection of Aquatic Life Summary Table. Retrieved on Decembre 20, 2023.

2 Government of Canada (2008) Technical Guidance Document for Water Quality Index Practitioners Reporting Under the Canadian Environmental Sustainability Indicators (CESI) Initiative 2008. Environment and Climate Change Canada and Statistics Canada. Retrieved on Decembre 20, 2023.

3 Ontario Ministry of the Environment and Energy (1994) Water Management Policies, Guidelines, Provincial Water Quality Objectives. Retrieved on Decembre 20, 2023.

Table C.9. Water quality guidelines used on Prince Edward Island

Parameter	Form	Guideline	Source
Chloride	dissolved	120 mg/L	1
Copper	dissolved	2 µg/L for hardness < 90 mg [$CaCO_3$]/L $0.2*e^{0.8545*ln[hardness]-1.465}$ µg/L for hardness > 90 mg [$CaCO_3$]/L	1
Nitrate	dissolved	SSG	2
Oxygen	dissolved	6.5 mg/L	1
pH	n/a	lower 6.5 and upper 9	1
Phosphorus	total	SSG	3
Suspended sediments	n/a	SSG	1
Zinc	dissolved	7.5 µg/L for hardness ≤ 90 mg [$CaCO_3$]/L 7.5 + 0.75*(hardness-90) for hardness > 90 mg [$CaCO_3$]/L	1

Note: n/a = not applicable.
SSG denotes that different site-specific guidelines or formulas were used at sites. Specific site information is available upon request.

Prince Edward Island Water Quality Guideline Sources:

1 Canadian Council of Ministers of the Environment (2018) Canadian Water Quality Guidelines for the Protection of Aquatic Life Summary Table. Retrieved on Decembre 20, 2023.

2 Bugden, G., Jiang, Y., van den Heuvel, MR., Vandermeulen, H., MacQuarrie, KTB., Crane, CJ. and Raymond, BG. (2014) Nitrogen Loading Criteria For Estuaries In Prince Edward Island. Canadian Technical Report of Fisheries and Aquatic Sciences 3066 (PDF; 1.10 MB). Retrieved on Decembre 20, 2023.

3 Van den Heuvel MR (2009) Site Specific Guidelines for Phosphorus in relation to the Water Quality Index Calculations for Prince Edward Island (PDF; 1.49 MB). Canadian Rivers Institute, University of Prince Edward Island. 35pp. Retrieved on Decembre 20, 2023.

Table C.10. Water quality guidelines used in Quebec

Parameter	Form	Guideline	Source
Ammonia	dissolved	19 µg/L	1, 3
Atrazine[A]	n/a	1,8 µg/L	1
Bentazone[A]	n/a	0.51 mg/L	2
Chlorophyll a	n/a	8 mg/m^3	3
Copper[A]	total	2 µg/L for hardness < 90 mg [$CaCO_3$]/L $0.2*e^{0.8545*ln[hardness]-1.465}$ µg/L for hardness > 90 mg [$CaCO_3$]/L	3
Dicamba[A]	n/a	10 µg/L	1
Mercury[A]	total	0,026 µg/L	1
Metolachlor[A]	n/a	7,8 µg/L	1
Nickel[A]	total	$e^{0.76*ln[hardness]+1.06}$ µg/L where hardness is measured as mg [$CaCO_3$]/L	3
Nitrate-Nitrite	dissolved	2.9 mg/L	1, 3
pH	n/a	Lower 6.5 and upper 9	1 2
Phosphorus	total	0.03 mg/L	2
Turbidity	n/a	10 NTU	3
Zinc[A]	total	7.5 µg/L for hardness ≤ 90 mg [$CaCO_3$]/L 7.5 + 0.75*(hardness-90) for hardness > 90 mg [$CaCO_3$]/L	3

Note: n/a = not applicable.
[A]Only applies to sites monitored under federal monitoring programs.

Quebec Water Quality Guideline Sources:

1 Canadian Council of Ministers of the Environment (2018) Canadian Water Quality Guidelines for the Protection of Aquatic Life - Summary Table. Retrieved on Decembre 20, 2023.

2 Ministère de l'Environnement et de la Lutte contre les changements climatiques, de la Faune et des Parcs (2023) Critères de la qualité de l'eau de surface (in French only). Retrieved on December 20, 2023

3 Government of Canada (2008) Technical Guidance Document for Water Quality Index Practitioners Reporting Under the Canadian Environmental Sustainability Indicators (CESI) Initiative 2008. Environment and Climate Change Canada and Statistics Canada. Retrieved on Decembre 20, 2023.

Table C.11. Water quality guidelines used in Saskatchewan

Parameter	Form	Guideline	Source
2,4-D	n/a	4 µg/L	1
Ammonia[A]	N	0.0156 mg/L	3
Ammonia[B]	unfiltered	0.019 mg/L	1
Arsenic	total	5 µg/L	1
Chloride[A]	dissolved	120 mg/L	1
Chloride[B]	dissolved	SSG	3
Copper	total	2 µg/L for hardness < 82 mg/L $0.2*e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ for hardness from 82 to ≤180 mg/L 4 µg/L for hardness >180 mg/L,	2
Lead	total	1 µg/L for hardness ≤ 60 mg/L $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ for hardness from 60 to 180 mg/L 7 µg/L for hardness > 180 mg/L	2
MCPA[A]	n/a	2.6 µg/L	1
MCPA[B]	n/a	SSG	3
Nickel	total	$e^{0.76*\ln[\text{hardness}]+1.06}$ µg/L where hardness is measured as mg [$CaCO_3$]/L	2
Nitrate[A]	N	3 mg/L	3
Nitrogen[B]	total	SSG	3
Oxygen[A]	dissolved	5.5 mg/L	1
Oxygen[B]	dissolved	SSG	3
pH	n/a	Lower 6.5 and upper 9	1
Phosphorus[A]	total	Northern sites: 0.035 mg/L Southern sites: 0.1 mg/L	4
Phosphorus[B]	total	SSG	3
Zinc[A]	total	7.5 µg/L for hardness ≤ 90 mg [$CaCO_3$]/L 7.5 + 0.75*(hardness-90) for hardness > 90 mg [$CaCO_3$]/L	2
Zinc[B]	total	30 µg/L	3

Note: n/a = not applicable.

[A] Applies to sites monitored under provincial monitoring programs.
[B] Applies to sites monitored under federal monitoring programs (Prairie Provinces Water Board).
SSG denotes that different site-specific guidelines or formulas were used at sites. Specific site information is available upon request.

Saskatchewan Water Quality Guideline Sources:

1 Canadian Council of Ministers of the Environment (2018) Canadian Water Quality Guidelines for the Protection of Aquatic Life Summary Table. Retrieved on December 20, 2023.

2 Government of Canada (2008) Technical Guidance Document for Water Quality Index Practitioners Reporting Under the Canadian Environmental Sustainability Indicators (CESI) Initiative 2008. Environment and Climate Change Canada and Statistics Canada. Retrieved on December 20, 2023.

3 Prairie Provinces Water Board (2015). Review of the 1992 Interprovincial Water Quality Objectives and Recommendations for Change. Technical Report to the PPWB Committee on Water Quality, Report #174, Regina.

4 Canadian Council of Ministers of the Environment (2004). Canadian Water Quality Guidelines for the Protection of Aquatic Life: Phosphorus: Canadian Guidance Framework for the Management of Freshwater Systems. (PDF; 542 kB). Retrieved on December 20, 2023.

Table C.12. Water quality guidelines used in the Yukon

Parameter	Form	Guideline	Source
Alkalinity	total	SSG	6
Arsenic	total	5 µg/L	1
Chromium	total	2.3 µg/L	2
Copper	total	2 µg/L for hardness < 90 mg [$CaCO_3$]/L $0.2*e^{0.8545*ln[hardness]-1.465}$ µg/L for hardness > 90 mg [$CaCO_3$]/L	3
Iron	dissolved	300 µg/L	3
Lead	total	1 µg/L for hardness < 50 mg [$CaCO_3$]/L $e^{1.273*ln[hardness]-4.705}$ µg/L for hardness > 50 mg [$CaCO_3$]/L	3
Nitrate	dissolved	2.93 mg/L	3
Nitrite	total	0.02 mg/L	4
Nitrogen	total dissolved	0.7 mg/L	3
Oxygen	dissolved	8 mg/L	5
pH	n/a	lower 6.5 and upper 9	1
Phosphorus	total, total dissolved	0.025 mg/L	3
Selenium	total	1 µg/L (YT09EA0001) 2 µg/L (YT08AB0009, YT10MA0011)	3
Silver	total	0.05 µg/L for hardness < 100 mg [$CaCO_3$]/L 1.9 µg/L for hardness > 100 mg [$CaCO_3$]/L	3
Sulfate	dissolved	SSG	4
Temperature	n/a	SSG	3
Zinc	total	7.5 µg/L for hardness ≤ 90 mg [$CaCO_3$]/L 7.5 + 0.75*(hardness-90) for hardness > 90 mg [$CaCO_3$]/L	3

Note: n/a = not applicable.
SSG denotes that different site-specific guidelines or formulas were used at sites. Specific site information is available upon request.

Yukon Water Quality Guideline Sources:

1 Canadian Council of Ministers of the Environment (2018) Canadian Water Quality Guidelines for the Protection of Aquatic Life Summary Table. Retrieved on December 20, 2023.

2 Environment and Climate Change Canada (2005) Site-specific Water Quality Guidelines for the Liard River at Upper Crossing for the Purpose of National Reporting. Tri-Star Environmental Consulting.

3 Government of Canada (2008) Technical Guidance Document for Water Quality Index Practitioners Reporting Under the Canadian Environmental Sustainability Indicators (CESI) Initiative 2008. Environment and Climate Change Canada and Statistics Canada. Retrieved on December 20, 2023.

4 Nordin RN and Pommen LW (2009) Ambient Aquatic Life Guidelines for Nitrogen (Nitrate, Nitrite, and Ammonia) (PDF; 565 kB). Retrieved on December 20, 2023.

5 British Columbia Ministry of Environment (1997) Ambient Water Quality Criteria for Dissolved Oxygen (PDF; 126 kB). Retrieved on December 20, 2023.

6 British Columbia Ministry of Environment (2021) British Columbia Working Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture (PDF; 745 kB). Retrieved on December 20, 2023

Additional information can be obtained at:

Environment and Climate Change Canada
Public Inquiries Centre
Place Vincent Massey Building
351 Saint-Joseph Blvd
Gatineau, QC K1A 0H3
Telephone: 1-800-668-6767 (in Canada only) or 819-938-3860
Fax: 819-938-3318
Email: enviroinfo.ec@ec.gc.ca