Environment and Climate Change Canada
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# WATER QUALITY IN CANADIAN RIVERS

## CANADIAN ENVIRONMENTAL SUSTAINABILITY INDICATORS

Canada

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## CANADIAN ENVIRONMENTAL SUSTAINABILITY INDICATORS

# WATER QUALITY IN CANADIAN RIVERS

### February 2023

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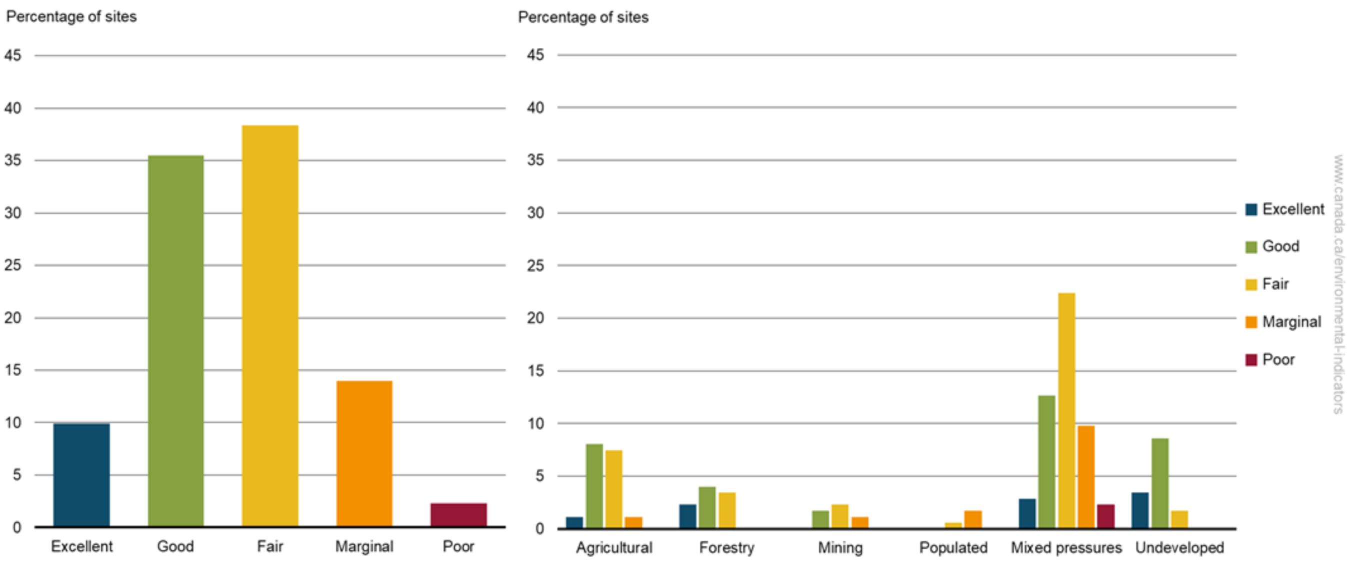
# Water quality in Canadian rivers

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 2018 to 2020 period, water quality in rivers in Canada was rated fair to excellent at 83% 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, 2018 to 2020 period**




Data for Figure 1

**Note:** Water quality was evaluated at 172 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.

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[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 2018-2020 period was adjusted due to the lack of available data at some sites in 2020. Where 2020 data is unavailable, the indicator was calculated using 2018 and 2019 data only. For this reason, the comparison of results between years and stations should be interpreted as indicative. For more details on the methodology used for the 2018-2020 calculations, please see the Data sources and methods section.

For the 2018 to 2020 period,[2] water quality at 172 monitoring sites in southern Canadian rivers[3] was rated:

- excellent or good at 45% of monitoring sites
- fair at 38% of sites
- marginal at 14% of sites
- poor at 2% of sites

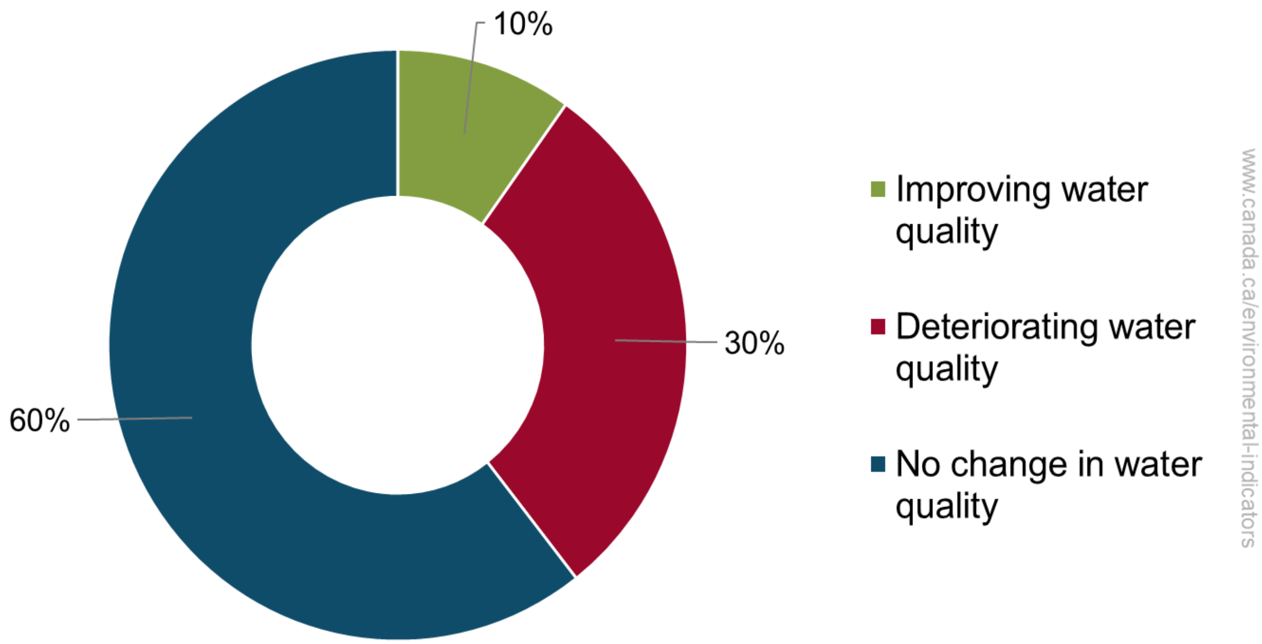
Water quality is generally good or excellent in undeveloped areas where native plants, trees and soils purify the water before it reaches the river. Adding development such as manufacturing and cities puts pressure on the landscape and increases the amount of chemicals being released into rivers every day. As well, many contaminants can be deposited in rivers after being released into the air. Fertilizers and pesticides, used to help crops grow and manure from livestock, can wash into nearby rivers or seep into groundwater, impacting water quality in these 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. All of these developments change water quality in a river and put pressure on the plants and animals that live there.

## Trends in water quality in Canadian rivers

### Key results

- Water quality has not changed between 2002 and 2020 at over half of the sites (60%) across southern Canada
- Where it has changed, it has deteriorated (30%) more often than it has improved (10%)

**Figure 2. Trends in water quality, Canada, 2002 to 2020**




[2] Percentages may not add up to 100 due to rounding.

[3] 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, please see the Data sources and methods section.

Data for Figure 2

**Note:** The trend in water quality between the first year that data were reported for each site and 2020 was calculated at 142[4] 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 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.

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[5] 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 river banks, among other actions.

[4] Of the 172 sites used in the calculation of the National indicator, 1 site was reported for the first time in 2019. This site did not have sufficient historical data to be included in the trend analysis. A further 29 sites did not have data reported in 2020, due to COVID-related measures. These sites were also excluded from the trend analysis.

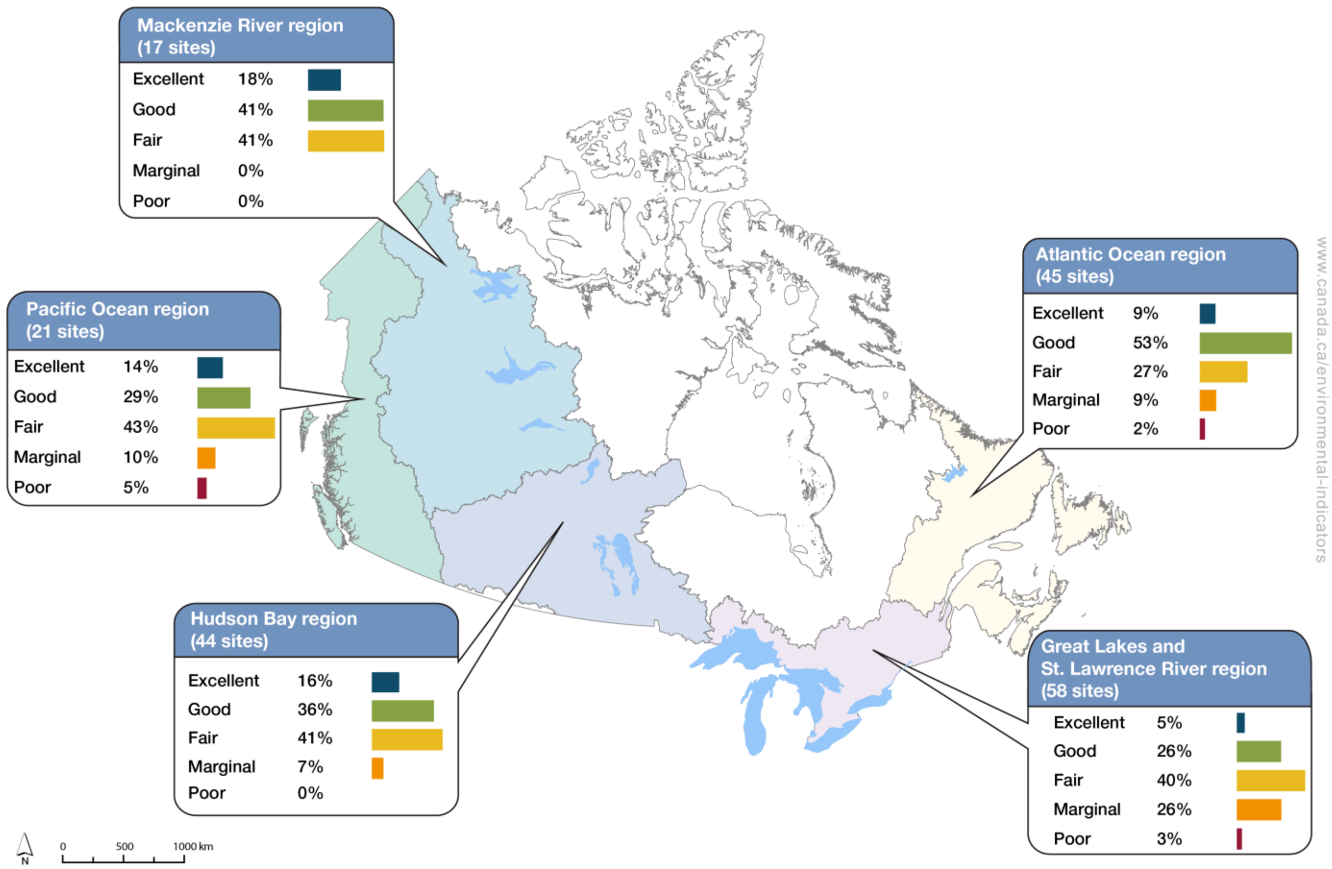
[5] Atmospheric deposition refers to the phenomenon through which pollutants, including gases and particles are deposited from the atmosphere in the form of dust or precipitation, ultimately entering fresh water systems.

## Regional water quality in Canadian rivers

### Key results

- The Atlantic Ocean, Mackenzie River and Hudson Bay regions had the highest proportion of sites with good or excellent water quality (62%, 59%, and 52%, 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 (29%, 15% and 11%, respectively)

**Figure 3. Regional water quality, Canada, 2018 to 2020 period**




Data for Figure 3

**Note:** For the Regional water quality in Canadian rivers indicator, water quality was assessed at 185 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 13 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 2018 to 2020 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

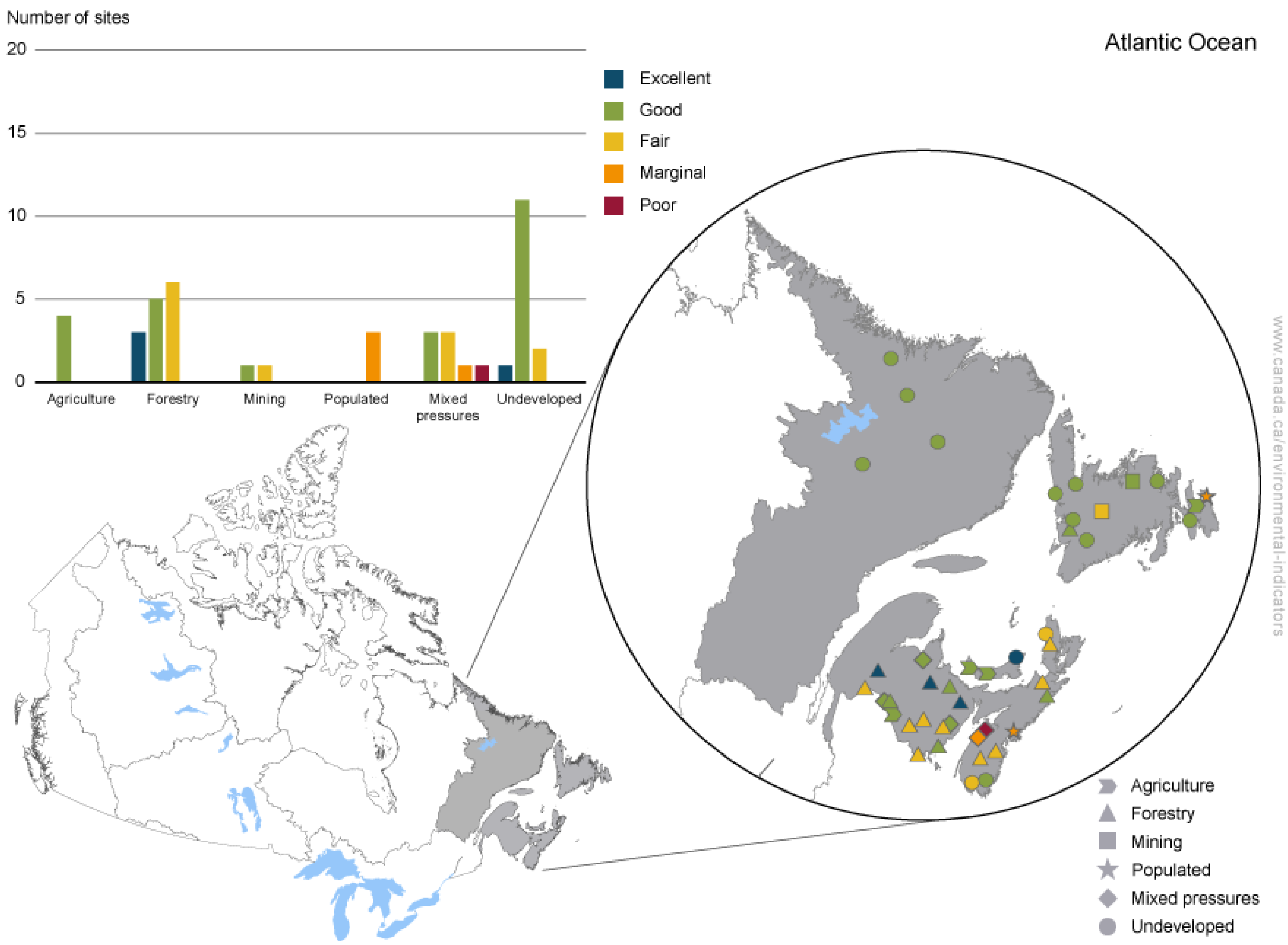
## Atlantic Ocean

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

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

**Figure 4. Water quality by land use category, Atlantic Ocean region, 2018 to 2020 period**




[Data for Figure 4]

**Note:** Water quality was assessed at 45 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 2018 to 2020 period, water quality for 45 sites on rivers draining into the Atlantic Ocean was rated:

- excellent or good at 62% of monitoring sites
- fair at 27% of sites
- marginal at 9% of sites
- poor at 2% 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 using data from 2002 to 2020[6,7] show that water quality has improved at 8 sites: on the Humber River and the Gander River in Newfoundland and Labrador, on the Tusket River, the Roseway River, the Mersey River, the Lahave River and the Cheticamp River in Nova Scotia and on the Wilmot River in Prince Edward Island. 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, and Wilmot river, where there is extensive agriculture.

Water quality has deteriorated at 13 sites: on the Main River and the Lloyds River in Newfoundland and Labrador, on the Annapolis River and the Cornwallis 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 Southwest Miramichi River and the Petitcodiac River in New Brunswick.

There was no change in water quality at the remaining 24 sites.

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

[7] In this region, 1 site did not have data for 2020, therefore it is not included in the national trend analysis. For more information, consult the COVID-19 impact on the calculation of the indicators section.

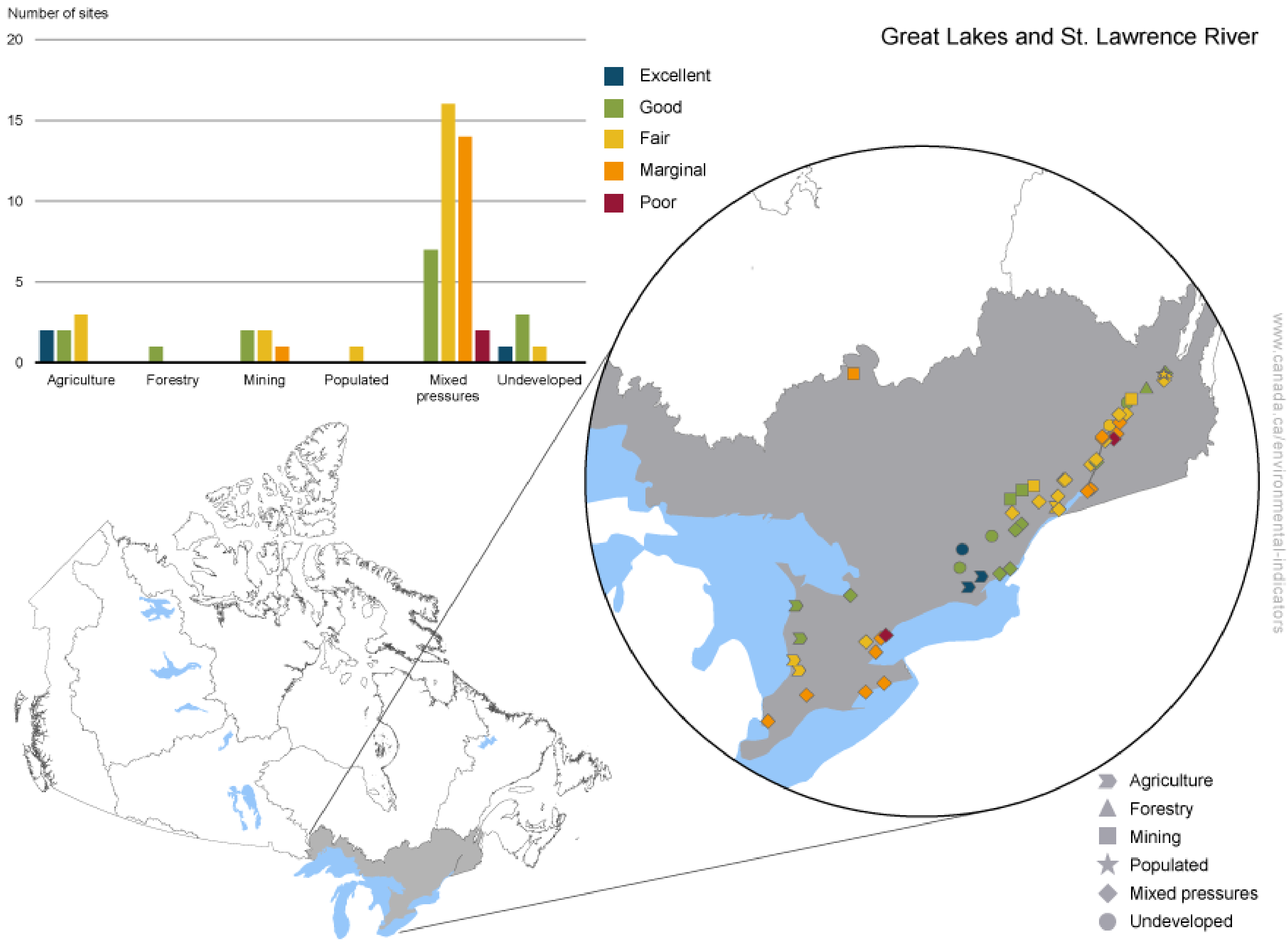
## Great Lakes and St. Lawrence River

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

- 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
  - excellent or good in eastern Ontario
- Monitoring sites in areas where there are mixed pressures tend to have worse water quality

**Figure 5. Water quality by land use category, Great Lakes and St. Lawrence River region, 2018 to 2020 period**




Data for Figure 5

**Note:** Water quality was assessed at 58 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 rivers.

Fertile soils and a relatively mild climate combine to create productive agricultural land in the Great Lakes and St. Lawrence River region. Agricultural land is steadily being covered by cities 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 2018 to 2020 period, water quality for 58 sites on rivers in the Great Lakes and St. Lawrence River region was rated:

- excellent or good at 31% of monitoring sites
- fair at 40% of sites
- marginal at 26% of sites
- poor at 3% of sites

Calculated trends using data from 2002 to 2020[8,9] show no site with improved water quality. During that same period, water quality has deteriorated at 24 sites. Twenty (20) 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 Gananoque River, the Delisle River, the Kemptville Creek, the Rideau River, the Jock River and the Fall River. Four (4) sites are located in Québec, on the Châteauguay River, the La Chaloupe River, the de la Petite Nation 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 25 sites.

8 For more information on the trend, consult the Data sources and methods.

9 In this region, 9 sites did not have data for 2020, therefore they are not included in the national trend analysis. For more information, consult the COVID-19 impact on the calculation of the indicators section.

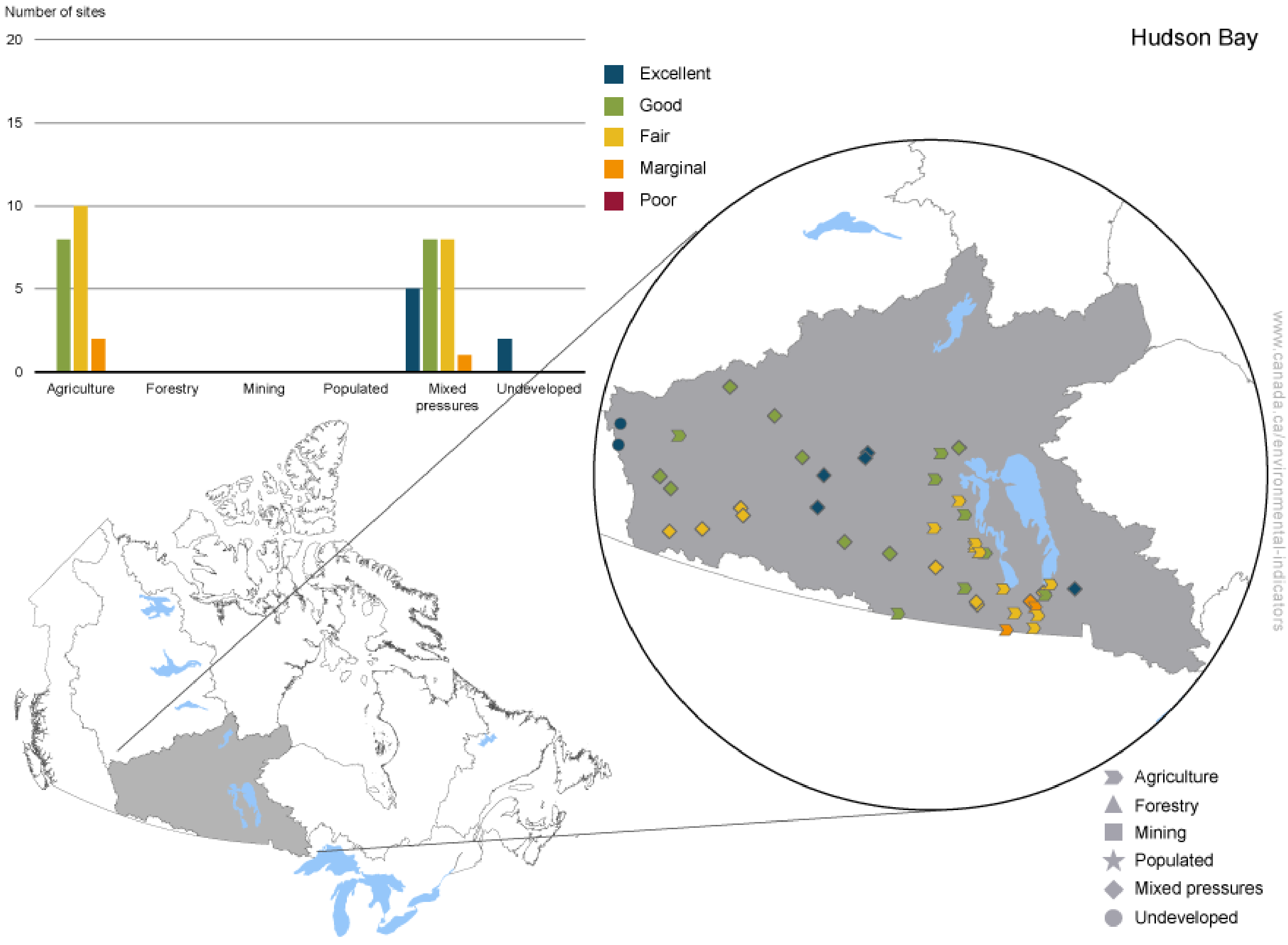
## Hudson Bay

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 and the southern half of Alberta.

### Key results

- 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. There is very little development in these areas
- Water quality tends to be worse in areas where there is agriculture, or a mixture of agriculture and mining

**Figure 6. Water quality by land use category, Hudson Bay region, 2018 to 2020 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 certain metals, such as copper. Agriculture covers almost all the land in the Prairies and mining is the second most important industry. As with other areas, human development can alter this water quality. Water quality tends to be worse where rivers run through agricultural and mining areas. 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 2018 to 2020 period, water quality for 44 sites on rivers in the Hudson Bay region was rated:

- excellent or good at 52% of monitoring sites
- fair at 41% of sites
- marginal at 7% of sites

Calculated trends using data from 2002 to 2020[10] show that water quality has improved at 6 sites: the Souris River, the La Salle River, the Cooks Creek, 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 there is extensive agriculture. In the case of the Carrot River, variable hydrology plays an important role in determining the source of the water flowing through the river, and therefore the parameters' values.

There was no change in water quality at the remaining 35 sites.

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

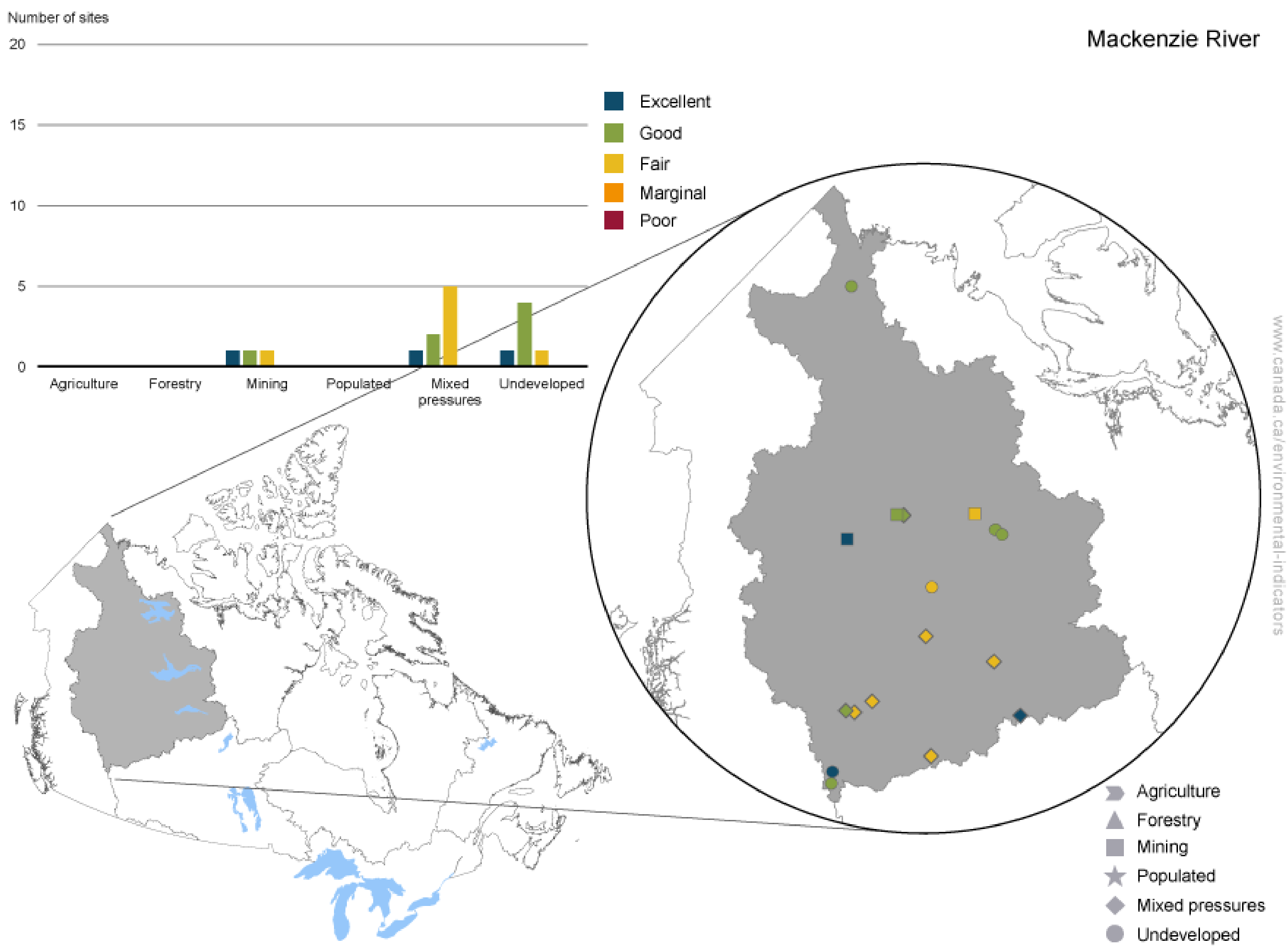
## Mackenzie River

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

- 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

**Figure 7. Water quality by land use category, Mackenzie River region, 2018 to 2020 period**




Data for Figure 7

**Note:** Water quality was assessed at 17 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 2018 to 2020 period, water quality for 17 sites on rivers draining into Mackenzie River was rated:

- excellent or good at 53% of monitoring sites
- fair at 47% of sites

Calculated trends using data from 2002 to 2020[11] 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).

Trends were not calculated at the remaining 13 sites.[12]

[11] For more information on the trend, consult the Data sources and methods.

[12] Only core sites were included in the trends analysis. For more information on the trend, consult the Data sources and methods section.

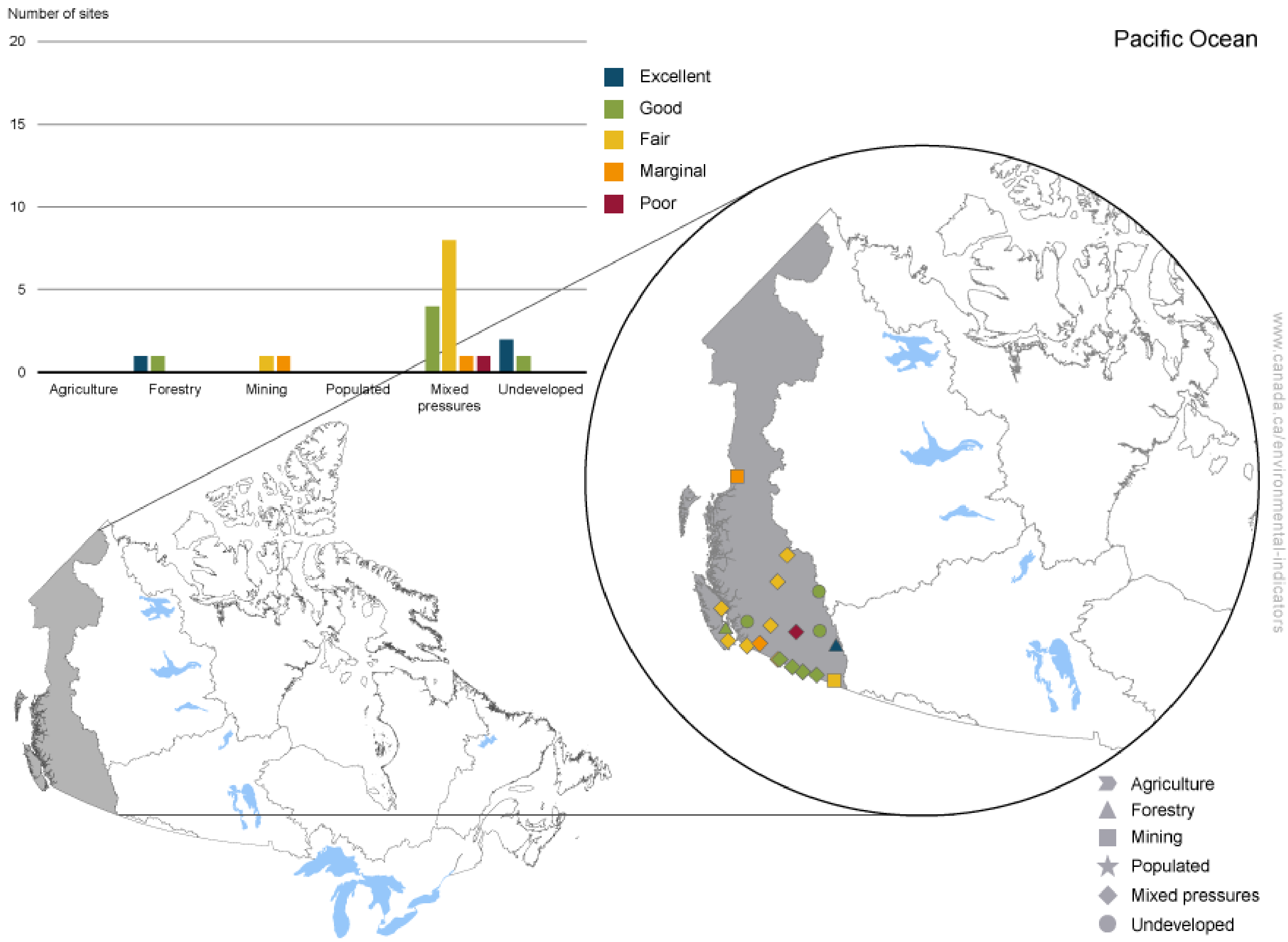
## Pacific Ocean

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

- 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

**Figure 8. Water quality by land use category, Pacific Ocean region, 2018 to 2020 period**




[Data for Figure 8]

**Note:** Water quality was assessed at 21 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 2018 to 2020 period,[13] water quality for 21 sites on rivers draining into the Pacific Ocean was rated:

- excellent or good at 41% of monitoring sites
- fair at 41% of sites
- marginal at 14% of sites
- poor at 5% of sites

Only 2018 and 2019 data was used to to calculate the indicator due to a lack of data in 2020. Moreover, the 2002-2020 trend for the Pacific sites could not be calculated. The trends from the previous report (2002-2019) were as follows:

Calculated trends using data from 2002 to 2019[14] 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 Quinsam River, the Nechako River, the Elk River, and the 3 main Fraser River sites (Marguerite, Red Pass, and Hope). These sites are in areas where there are mining and forestry activities, except for Red Pass, which is in an undeveloped area. There has been no change in water quality status at the remaining 11 sites: Cowichan River, Pend d'Oreille River, Similkameen River, Okanagan River, Englishman River, Illecillewaet River, Sumas River, Salmon River at Hyder, Salmon River at Highway 1, and 2 sites on the Kootenay River (Kootenay Crossing and Creston).

[13] Percentages may not add up to 100 due to rounding.

[14] For more information on the trend, consult the Data sources and methods.

## 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 (for example, drinking and 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 target for Canada: "By 2020, pollution levels in Canadian waters, including pollution from excess nutrients, are reduced or maintained at levels that support healthy aquatic ecosystems."

### 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 2018 to 2020 period, water quality data from 172 sites were used to compile the national indicator. These data were drawn from monitoring sites in Canada's 16 southernmost 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**


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, 13 additional sites were considered: 4 sites in Alberta, 1 site in Saskatchewan and 8 sites in the Northwest Territories. These additional 13 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 140 monitoring sites across Canada. Although these additional sites were not used to calculate the indicators, water quality results for all 325 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.[15]

### 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 2018-2020 period was adjusted to account for this lack of available data at some sites in 2020. Therefore, the scores reported were calculated using 2018 and 2019 data, as well as 2020 data when they were available (totally or partially). Where 2020 data were unavailable, the scores were calculated using 2018 and 2019 data only. Because of this, the comparison of results, between years and stations, should be interpreted as indicative.

**Atlantic Ocean:** In Nova Scotia, all 11 sites had fewer number of samples in 2020 compared to previous years. One (1) site in Newfoundland and Labrador had no data for the period index and was therefore excluded.

**Great Lakes and St Lawrence:** In Ontario, 2 sites had no data for 2020. The remaining Ontario sites had fewer number of samples in 2020 compared to previous years.

In Quebec, 7 sites on the St. Lawrence River had no data in 2020. For these sites, the 2002 to 2019 trend was used. There was a deterioration for 2 of these sites (St. Lawrence River at Levis and Richelieu River) for this period.

These sites (2 in Ontario and 7 in Quebec) were not included in the National trend.

**Hudson Bay:** In Alberta, Saskatchewan and Manitoba, 12 sites had fewer number of samples in 2020 compared to previous years.

**Mackenzie River:** In the Northwest Territories, 2 sites had an insufficient number of samples in 2020 and were therefore excluded.

**Pacific Ocean:** All 21 sites from this region had fewer number of samples compared to previous years. The trends for these 21 sites could not be calculated due to this lack of data in 2020. Therefore, for the 2018-2020 index period, the 2002-2019 trend was used for each station. These sites were not included in the National trend.

## Decision tree related to the calculation of the Water quality indicator 2018-2020

An analysis was done to determine the best way to mitigate the impact of the missing 2020 data. The analysis included a comparison of 4 scenarios using different periods:

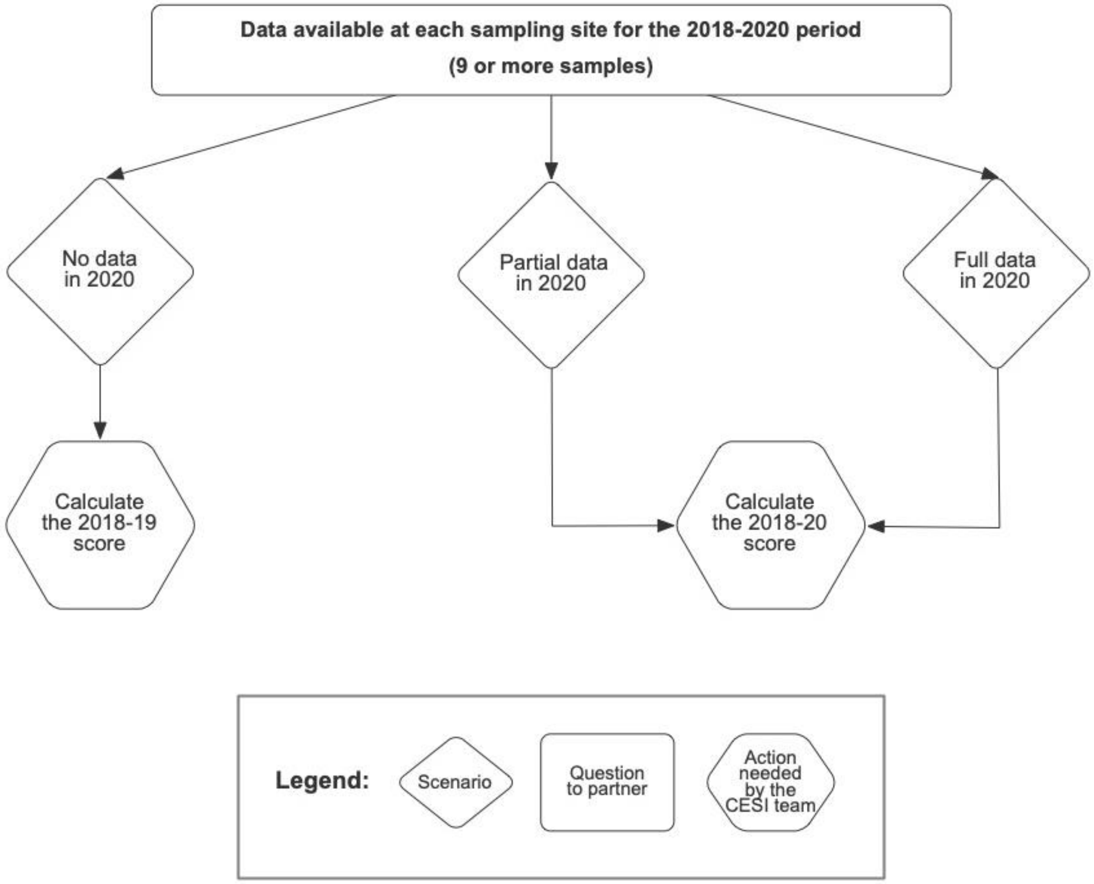
- The default 3-year period (2018-2020)
- A 4-year period (2017-2020)
- A 2-year period (2018-2019)
- The previous period (2017-2019)

The comparison between the 2018-2019 and the 2018-2020 (when data was available) highlighted the impact of the year 2020 on the 2018-2020 score, for full and partial data sets. The 2018-2019 period was therefore determined to be the best alternative when data was missing for 2020.

The decision tree below illustrates the process explained above.

[15] Statistics Canada (2007) Behaviour Study on the Water Quality Index of the Canadian Council of Ministers of the Environment. Retrieved on June 6, 2022.

**Figure 10. Decision tree related to the calculation of the Water quality indicator 2018-2020**




### Data timeliness

The indicators were calculated using data from 2018 to 2020, the most recent data available from all monitoring programs. Where 2020 data was not available, the indicators were calculated using data from 2018 to 2019.

## 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.[16]

These indicators are calculated using the water quality index as endorsed by the Canadian Council of Ministers of the Environment.[17] 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.

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

[17] Canadian Council of Ministers of the Environment (2017) CCME Water Quality Index 2.0 User's Manual (PDF; 1.61 MB). Retrieved on June 6, 2022.

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 to 2020. 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. 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[18] 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.[19]

#### 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.[20] 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

[18] 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 (PDF; 1.25 MB). Retrieved on June 6, 2022.

[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 June 6, 2022.

[20] Henry M et al. (2009) Canadian Environmental Sustainability Indicators: Water Quality Index Representivity Report, Statistics Canada.

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.[21] 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.

[21] For more information about land cover classes, please see Natural Resources Canada (2008) Land Cover Map of Canada 2005, Canada Centre for Remote Sensing. Retrieved on June 6, 2022.

**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 pulp, 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; 1.61 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<br>(95.0 to 100.0) | Water quality is protected with a virtual absence of threat of impairment; conditions are very close to natural. |
| Good<br>(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<br>(65.0 to 79.9) | Water quality is usually protected but occasionally threatened or impaired; conditions sometimes depart from natural or desirable levels. |
| Marginal<br>(45.0 to 64.9) | Water quality is frequently threatened or impaired; conditions often depart from natural or desirable levels. |
| Poor<br>(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 is 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.[22]

### 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.

[22] Government of Canada (2008) Technical Guidance Document for Water Quality Indicator Practitioners Reporting Under the Canadian Environmental Sustainability Indicators (CESI) Initiative 2008, p.15-16. Retrieved on June 6, 2022.

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 absolute value of the ratio was used if temperatures were below 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 0.10-1.1, 2019) and Kendall packages (version 2.2, 2011) of the statistical software R (version 3.5.2, 2018) 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.

The trend was calculated using different starting years for each site based on data availability. For this year's calculation, the starting year was: 2002 for 64 sites, 2003 for 53 sites, 2004 for 12 sites, 2005 for 7 sites, 2006 for 28 sites, 2007 for 3 sites and 2011 for 3 sites. For 28 sites located in British Columbia and Quebec, there was insufficient data to calculate the trend for 2020; therefore, for these 28 sites, the previous year's trend was reported (2019).

## 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 13 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.[23]

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

## References


Canadian Council of Ministers of the Environment (2017) CCME Water Quality Index 2.0 User's Manual (PDF; 1.61 MB). Retrieved on June 6, 2022.


[23] Painter S and Waltho J (2004) Canadian Water Quality Index: A Sensitivity Analysis. Environment and Climate Change Canada.

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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, 2018 to 2020 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 | 2 | 1 | 14 | 8 | 13 | 7 | 2 | 1 | 0 | 0 |
| Forestry | 4 | 2 | 7 | 4 | 6 | 3 | 0 | 0 | 0 | 0 |
| Mining | 0 | 0 | 3 | 2 | 4 | 2 | 2 | 1 | 0 | 0 |
| Populated | 0 | 0 | 0 | 0 | 1 | 1 | 3 | 2 | 0 | 0 |
| Mixed pressures | 5 | 3 | 22 | 13 | 39 | 22 | 17 | 10 | 4 | 2 |
| Undeveloped | 6 | 3 | 15 | 9 | 3 | 2 | 0 | 0 | 0 | 0 |
| Total | 17 | 10 | 61 | 35 | 66 | 38 | 24 | 14 | 4 | 2 |

**Note:** Water quality was evaluated at 172 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. Percentages may not add up to 100 due to rounding.
**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 2020

| Change | Number of sites | Percentage of sites |
|---|---|---|
| Improving water quality | 14 | 10 |
| Deteriorating water quality | 42 | 30 |
| No change in water quality | 86 | 60 |
| Total | 142 | 100 |

**Note:** The trend in water quality between the first year that data were reported for each site and 2020 was calculated at 142 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, consult the Data sources and methods section. Percentages may not add up to 100 due to rounding.
**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, 2018 to 2020 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 | 4 | 9 | 3 | 5 | 7 | 16 | 3 | 18 | 3 | 14 |
| Good | 24 | 53 | 15 | 26 | 16 | 36 | 7 | 41 | 6 | 29 |
| Fair | 12 | 27 | 23 | 40 | 18 | 41 | 7 | 41 | 9 | 43 |
| Marginal | 4 | 9 | 15 | 26 | 3 | 7 | 0 | 0 | 2 | 10 |
| Poor | 1 | 2 | 2 | 3 | 0 | 0 | 0 | 0 | 1 | 5 |
| Total | 45 | 100 | 58 | 100 | 44 | 100 | 17 | 100 | 21 | 100 |

**Note:** For the Regional water quality in Canadian rivers indicator, water quality was assessed at 185 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 13 additional monitoring sites and includes more sites in the northern portions of the Mackenzie River region. Percentages may not add up to 100 due to rounding.
**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, 2018 to 2020 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 | 4 | 9 | 0 | 0 | 0 | 0 | 0 | 0 |
| Forestry | 3 | 7 | 5 | 11 | 6 | 13 | 0 | 0 | 0 | 0 |
| Mining | 0 | 0 | 1 | 2 | 1 | 2 | 0 | 0 | 0 | 0 |
| Populated | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 7 | 0 | 0 |
| Mixed pressures | 0 | 0 | 3 | 7 | 3 | 7 | 1 | 2 | 1 | 2 |
| Undeveloped | 1 | 2 | 11 | 24 | 2 | 4 | 0 | 0 | 0 | 0 |
| Total | 4 | 9 | 24 | 53 | 12 | 27 | 4 | 9 | 1 | 2 |

**Note:** Water quality was assessed at 45 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, 2018 to 2020 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 | 2 | 3 | 2 | 3 | 3 | 5 | 0 | 0 | 0 | 0 |
| Forestry | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mining | 0 | 0 | 2 | 3 | 2 | 3 | 1 | 2 | 0 | 0 |
| Populated | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 0 |
| Mixed pressures | 0 | 0 | 7 | 12 | 16 | 28 | 14 | 24 | 2 | 3 |
| Undeveloped | 1 | 2 | 3 | 5 | 1 | 2 | 0 | 0 | 0 | 0 |
| Total | 3 | 5 | 15 | 26 | 23 | 40 | 15 | 26 | 2 | 3 |

**Note:** Water quality was assessed at 58 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, 2018 to 2020 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 | 8 | 18 | 10 | 23 | 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 | 5 | 11 | 8 | 18 | 8 | 18 | 1 | 2 | 0 | 0 |
| Undeveloped | 2 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 7 | 16 | 16 | 36 | 18 | 41 | 3 | 7 | 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. 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.7. Data for Figure 7. Water quality by land use category, Mackenzie River region, 2018 to 2020 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 | 12 | 5 | 29 | 0 | 0 | 0 | 0 |
| Undeveloped | 1 | 6 | 4 | 24 | 1 | 6 | 0 | 0 | 0 | 0 |
| Total | 3 | 18 | 7 | 41 | 7 | 41 | 0 | 0 | 0 | 0 |

**Note:** Water quality was assessed at 17 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, 2018 to 2020 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 | 1 | 5 | 1 | 5 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mining | 0 | 0 | 0 | 0 | 1 | 5 | 1 | 5 | 0 | 0 |
| Populated | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mixed Pressures | 0 | 0 | 4 | 19 | 8 | 38 | 1 | 5 | 1 | 5 |
| Undeveloped | 2 | 10 | 1 | 5 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 3 | 14 | 6 | 29 | 9 | 43 | 2 | 10 | 1 | 5 |

**Note:** Water quality was assessed at 21 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. 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.

## 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 and Parks |
| British Columbia | Canada–British Columbia Water Quality Monitoring Agreement | British Columbia Ministry of Environment, Environment and Climate Change Canada |
| Manitoba | Long-term Water Quality Monitoring Program | Manitoba Agriculture and Resource Development |
| 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, Newfoundland and Labrador Department of Environment, Climate Change and Municipalities |
| Nova Scotia | Long-range Transport of Atmospheric Pollutants Program | Environment and Climate Change Canada |
| Nova Scotia | Nova Scotia Automated Surface Water Quality Monitoring Network | Nova Scotia Environment and Climate Change |
| Ontario | Provincial Water Quality Monitoring Network | Ministry of Environment, Conservation and Parks |
| Prince Edward Island | Canada–Prince Edward Island Memorandum of Agreement on Water | Environment and Climate Change Canada, Prince Edward Island Department of Environment, Water and Climate Change |

| Province/Territory | Monitoring program | Organization(s) |
|---|---|---|
| Quebec | Canada–Quebec Water Quality Agreement | Environment and Climate Change Canada, Ministère de l’Environnement et de la Lutte contre les changements climatiques du Québec |
| Quebec | Réseau-Rivières | Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs |
| Saskatchewan | Saskatchewan Water Security Agency Primary Water Quality Monitoring Program | Saskatchewan Water Security Agency |
| Northwest Territories and Nunavut | Government of Northwest Territories water quality programs in the Northwest Territories basins (North Slave region); Environment and Climate Change Canada Longterm Northern Water Quality Monitoring Network | Environment and Climate Change Canada, Government of Northwest Territories (Environment and Natural Resources) |
| Yukon | Canada–Yukon Water Quality Monitoring Network; Parks Canada Western Arctic parks water quality monitoring program (Ivvavik National Park) | Yukon Governmemt (Department of Environment), Environment and Climate Change Canada, Parks 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 | un-ionized | 19 µg/L | 1 |
| Arsenic | total | 5 µg/L | 1 |
| Cadmium[A] | total | $e^{1.0166*\ln[hardness]-3.924}$ µg/L<br>where hardness is measured as mg [$CaCO_3$]/L | 2 |
| Chloride[B] | dissolved | 120 mg/L | 1 |
| Copper[A] | total | 7 µg/L | 3 |
| Copper[B] | total | 2 µg/L for hardness < 90 mg [$CaCO_3$]/L<br>$0.2*e^{0.8545*\ln[hardness]-1.465}$ µg/L for hardness > 90 mg [$CaCO_3$]/L | 4 |
| Lead | total | 1 µg/L for hardness < 50 mg [$CaCO_3$]/L<br>$e^{1.273*\ln[hardness]-4.705}$ µg/L for hardness ≥ 50 mg [$CaCO_3$]/L | 4 |
| MCPA[A] | n/a | 2.6 µg/L | 1 |
| Mercury[A] | total inorganic | 0.026 µg/L | 1 |
| Nickel[B] | total | $e^{0.76*\ln[hardness]+1.06}$ µg/L<br>where hardness is measured as mg [$CaCO_3$]/L | 4 |
| Nitrogen | total | 1 mg /L | 4 |
| Oxygen | dissolved | 6.5 mg/L | 1<br>3 |
| pH[B] | n/a | between 6.5 and 9 | 1 |
| Phosphorus | total | 0.05 mg/L | 5 |
| Selenium[A] | total | 1 µg/L | 4 |
| Zinc | total | 7.5 µg/L for hardness ≤ 90 mg [$CaCO_3$]/L<br>7.5 + 0.75*(hardness-90) for hardness > 90 mg [$CaCO_3$]/L | 4 |

**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.

**Alberta 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 September 20, 2021.
2. United States Environmental Protection Agency (2001) 2001 Update of Ambient Water Quality Criteria for Cadmium. Document EPA 822-R-01-001. Retrieved on September 20, 2021.
3. Alberta Environment (2018) Environmental Quality Guidelines for Alberta Surface Waters (PDF; 704 kB). Retrieved on September 20, 2021.
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 September 20, 2021.
5. Prairie Provinces Water Board (1992) Master Agreement on Apportionment. Schedule E: Agreement on Water Quality. Retrieved on September 20, 2021.

**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 | $10^{(0.83(log10[hardness])-2.46)}$ µg/L for hardness > 50 mg [$CaCO_3$]/L<br>0.09 µg/L for hardness < 50 mg [$CaCO_3$]/L<br>SSG[A] (certain sites) | 2<br>3 |
| Chloride | total dissolved | 120 mg/L | 2 |
| Chromium | total | SSG[A] | 2<br>3<br>4<br>5<br>6<br>7 |
| Copper | total | 2 µg/L for hardness < 90 mg [$CaCO_3$]/L<br>0.2*$e^{0.8545*ln[hardness]-1.465}$ µg/L for hardness > 90 mg [$CaCO_3$]/L<br>SSG[A] (certain sites) | 3<br>6<br>8<br>9<br>10 |
| Cyanide | total | 5 µg/L | 2 |
| Fluoride | total | [-51.73+92.57$log_{10}$(hardness)] X 0.01 ug/L (BC08NM001)<br>0.35 mg/L (BC08NN0021) | 11 |
| Iron | total | 0.3 mg/L | 9 |
| 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<br>SSG[A] (certain sites) | 3<br>9<br>10 |
| Manganese | total dissolved | 50 µg/L | 12 |
| Molybdenum | total | 50 µg/L<br>73 µg/L (BC08MH0027) | 2 |

| Parameter | Form | Guideline | Source |
|---|---|---|---|
| Nickel | total | $e^{0.76*\ln[hardness]+1.06}$ µg/L<br>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,<br>total dissolved | 1.1 mg N/L (certain sites) | 13 |
| Oxygen | dissolved | SSG[A] | 2<br>10<br>14<br>15<br>16 |
| pH | n/a | SSG[A] | 2<br>3<br>14 |
| Phosphorus | total and total dissolved | 0.025 mg/L (certain sites) | 9<br>17 |
| Selenium | total dissolved | SSG[A] | 11 |
| Silver | total | 0.05 µg/L for hardness ≤ 100 mg [$CaCO_3$]/L<br>1.9 µg/L for hardness > 100 mg [$CaCO_3$]/L<br>SSG[A] (certain sites) | 9 |
| Sulphate | dissolved | 309 mg/L (BC08MH0027)<br>218 mg/L for gardness < 31(BC08NM0001)<br>309 mg/L for hardness < 76 (BC08NM0001) | 9 |
| Temperature | n/a | SSG[A] | 18 |
| Thallium | total | 0.8 µg/L | 2 |
| Uranium | total | 10 µg/L | 1 |
| Zinc | total | 7.5 µg/L<br>SSG[A] (certain sites) | 3<br>4<br>6<br>12<br>19 |

**Note:** n/a = not applicable.
[A] 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 (2017) British Columbia Working Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture (PDF; 990 kB). Retrieved on September 20, 2021.

2 Canadian Council of Ministers of the Environment (2018) Canadian Water Quality Guidelines for the Protection of Aquatic Life Summary Table. Retrieved on September 20, 2021.

3 Butcher GA (1992) Lower Columbia River, Hugh Keeleyside dam to Birchbank water quality assessment and objectives: Technical appendix (PDF; 10.2 MB). British Columbia Ministry of the Environment, Lands and Parks. Retrieved on September 20, 2021.

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 September 20, 2021.

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. Retrieved on September 20, 2021.

6 Environment and Climate Change Canada (2005) Site-specific Water Quality Guidelines for the Skeena River at Usk for the Purpose of National Reporting. Tri-Star Environmental Consulting. Retrieved on September 20, 2021.

7 Environment and Climate Change Canada (2005) Site-specific Water Quality Guidelines for the Kootenay River at Kootenay Crossing for the Purpose of National Reporting. Tri-Star Environmental Consulting. Retrieved on September 20, 2021.

8 British Columbia Ministry of Environment (2019) Copper Water Quality Guideline for the Protection of Marine Aquatic Life (PDF; 592 kB). Retrieved on September 20, 2021.

9 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 September 20, 2021.

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 September 20, 2021.

11 British Columbia Ministry of Environment and Climate Change Strategy (2018) British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture Summary Report (PDF; 1.02 MB). Retrieved on September 20, 2021.

12 Swain LG (1990) Ambient Water Quality Objectives for the Similkameen River Okanagan Area Overview Report. British Columbia Ministry of Environment. Retrieved on September 20, 2021.

13 Nordin RN and Pommen LW (2009) Water Quality Criteria for Nitrogen (Nitrate, Nitrite, and Ammonia): Overview Report. British Columbia Ministry of Environment. Retrieved on September 20, 2021.

14 British Columbia Ministry of Water, Land and Air Protection (1998) Water Quality Assessment and Recommended Objectives for the Salmon River. MacDonald Environmental Sciences Ltd. Retrieved on September 20, 2021.

15 Swain LG (1987) Takla-Nechako Areas, Nechako River Water Quality Assessment and Objectives. British Columbia Ministry of Environment and Parks. Retrieved on September 20, 2021.

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. Retrieved on September 20, 2021.

17 Ontario Ministry of the Environment and Energy (1994) Water Management Policies, Guidelines, Provincial Water Quality Objectives. Retrieved on September 20, 2021.

18 British Columbia Ministry of Environment (2001) Water Quality Guidelines for Temperature: Overview Report (PDF; 222 kB). Retrieved on September 20, 2021.

19 British Columbia Ministry of Environment (1999) Ambient Water Quality Guidelines for Zinc: Overview Report. Retrieved on September 20, 2021.

**Table C.3. Water quality guidelines used in Manitoba**

| Parameter | Form | Guideline | Source |
|---|---|---|---|
| 2,4-D | n/a | 4 µg/L | 1 |
| Ammonia | total as N | Calculation based on pH and temperature | 2<br>3 |
| Ammonia | un-ionized | 19 µg/L | 1<br>4 |
| Arsenic[A] | extractable, total | 150 µg/L | 5 |
| Arsenic[B] | total | 5 µg/L | 1 |
| Cadmium[A] | extractable, total | $e^{1.0166*\ln[hardness]-3.924}$ µg/L<br>where hardness is measured as mg $[CaCO_3]$/L | 6 |
| Chloride[B] | dissolved | 120 mg/L | 1 |
| Copper[A] | extractable, total | $[e^{0.8545*\ln[hardness]-1.702}]*(0.96)$ µg/L<br>where hardness is measured as mg $[CaCO_3]$/L | 2 |
| Copper[B] | total | 2 µg/L for hardness < 90 mg $[CaCO_3]$/L<br>$0.2*[e^{0.8545*\ln[hardness]-1.465}]$ µg/L for hardness<br>> 90 mg $[CaCO_3]$/L | 4 |
| Iron[A] | total | 0.3 mg/L | 4 |
| Lead[A] | extractable, total | $(e^{1.273*\ln[hardness]-4.705})*(1.46203 - (\ln[hardness]*0.145712))$<br>µg/L<br>where hardness is measured as mg $[CaCO_3]$/L | 2 |
| Lead[B] | Total | 1 µg/L for hardness < 50 mg $[CaCO_3]$/L<br>$e^{1.273*\ln[hardness]-4.705}$ µg/L for hardness ≥ 50 mg $[CaCO_3]$/L<br>where hardness is measured as mg $[CaCO_3]$/L | 4 |
| MCPA | n/a | 2.6 µg/L | 1 |
| Nickel[A] | extractable, total | $e^{0.8460*\ln[hardness]+0.0584}$ µg/L<br>where hardness is measured as mg $[CaCO_3]$/L | 5 |
| Nickel[B] | total | $e^{0.76*\ln[hardness]+1.06}$ µg/L<br>where hardness is measured as mg $[CaCO_3]$/L | 4 |
| Nitrate[A] | total dissolved | 2.9 mg N/L | 4 |
| Nitrogen[B] | total | 1 mg N/L | 7 |
| Oxygen[A] | dissolved | 5 mg/L | 4 |
| Oxygen[B] | dissolved | 6.5 mg/L | 1 |
| pH | n/a | between 6.5 and 9 | 1 |
| Phosphorus | total | 0.05 mg/L | 2<br>7 |
| Suspended sediments[A] | total | Maximum increase of 25 mg/L for high flow and turbid waters above background levels | 4 |
| Zinc[A] | total | $e^{(0.8473*\ln[hardness]+0.884)}*0.986$ µg/L<br>where hardness is measured as mg $[CaCO_3]$/L | 2<br>6 |

| Parameter | Form | Guideline | Source |
|---|---|---|---|
| Zinc[B] | total | 7.5 µg/L for hardness ≤ 90 mg [$CaCO_3$]/L<br>7.5 + 0.75*(hardness-90) for hardness > 90 mg [$CaCO_3$]/L | 4 |

**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).

**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 September 20, 2021.

2 Manitoba Water Stewardship (2011) Manitoba Water Quality Standards, Objectives, and Guidelines (PDF; 905 kB). Retrieved on September 20, 2021.

3 United States Environmental Protection Agency (1999) Update of Ambient Water Quality Criteria for Ammonia. Document EPA 822-R-99-014. Retrieved on September 20, 2021.

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 September 20, 2021.

5 United States Environmental Protection Agency (2019) National Recommended Water Quality Criteria – Aquatic Life Criteria Table. Retrieved on September 20, 2021.

6 United States Environmental Protection Agency (2001) 2001 Update of Ambient Water Quality Criteria for Cadmium. Document EPA 822-R-01-001 (PDF; 10.7MB). Retrieved on September 20, 2021.

7 Prairie Provinces Water Board (1992) Master Agreement on Apportionment. Schedule E: Agreement on Water Quality. Retrieved on September 20, 2021.


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

| Parameter | Form | Guideline | Source |
|---|---|---|---|
| Ammonia | un-ionized | 15.6 µg/L[A] | 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<br>$0.2*e^{0.8545*ln[hardness]-1.465}$ 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 | between 6.5 and 9 | 2 |
| Phosphorus | total | 0.03 mg/L | 1 |
| Turbidity | n/a | 10 NTU (SSG[B]) | 2 |
| Zinc | total | 7.5 µg/L for hardness ≤ 90 mg [$CaCO_3$]/L<br>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. [B] SSG denotes that different site-specific guidelines or formulas were used at sites. Specific site information is available upon request.

**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 September 20, 2021.

2 Canadian Council of Ministers of the Environment (2018) Canadian Water Quality Guidelines for the Protection of Aquatic Life Summary Table. Retrieved on September 20, 2021.

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

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

**Note:** n/a = not applicable.
[A] 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 September 20, 2021.

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 September 20, 2021.

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 September 20, 2021.

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

| Parameter | Form | Guideline | Source |
|---|---|---|---|
| Ammonia | un-ionized, dissolved | SSG[A] (mean + 2 standard deviations) | 1 |

| | | | |
|---|---|---|---|
| Arsenic | total | SSG[A] | 2 |
| Chloride | dissolved | Lentic-lotic sites: 150 mg/L<br>Lotic sites: SSG[A] (mean + 2 standard deviations) | 1<br>2 |
| Copper | total | Lentic-lotic sites: 2 µg/L for hardness < 90 mg $[CaCO_3]$/L<br>$0.2*e^{0.8545*ln[hardness]-1.465}$ µg/L for hardness > 90 mg $[CaCO_3]$/L<br>Lotic sites: SSG[A] (mean + 2 standard deviations) | 1<br>3 |
| Iron | total | Lentic-lotic sites: 0.3 mg/L<br>Lotic sites: SSG[A] (mean + 2 standard deviations) | 1<br>3 |
| Lead | total | Lentic-lotic sites: 1 µg/L for hardness < 50 mg $[CaCO_3]$/L<br>$e^{1.273*ln[hardness]-4.705}$ µg/L for hardness ≥ 50 mg $[CaCO_3]$/L<br>Lotic sites: SSG[A] (mean + 2 standard deviations) | 1<br>3 |
| Nitrate and nitrite | total dissolved | SSG[A] | 1 |
| Oxygen | dissolved | 5 mg/L | 2 |
| pH | n/a | Lentic-lotic sites: between 6.5 and 9<br>Lotic sites: SSG[A] (mean + 2 standard deviations) | 1<br>2 |
| Phosphorus | total | Lentic-lotic sites: 0.03 mg/L<br>Lotic sites: SSG[A] (mean + 2 standard deviations) | 2<br>3 |
| Zinc | total | Lentic-lotic sites: 7.5 µg/L for hardness ≤ 90 mg $[CaCO_3]$/L<br>7.5 + 0.75*(hardness-90) for hardness >90 mg $[CaCO_3]$/L<br>Lotic sites: SSG[A] (mean + 2 standard deviations) | 2<br>3 |

**Note:** n/a = not applicable.
[A] 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 Study of the Mackenzie River Basin, Canada (PDF; 668 MB). Environmental Monitoring and Assessment 113:411-429. Retrieved on September 20, 2021.

2 Canadian Council of Ministers of the Environment (2018) Canadian Water Quality Guidelines for the Protection of Aquatic Life Summary Table. Retrieved on September 20, 2021.

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 September 20, 2021.


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

| Parameter | Form | Guideline | Source |
|---|---|---|---|
| Chloride | total | 120 mg/L | 1 |
| Copper | extractable | 2 µg/L for hardness < 90 mg $[CaCO_3]$/L<br>$0.2*e^{0.8545*ln[hardness]-1.465}$ µg/L for hardness > 90 mg $[CaCO_3]$/L | 2 |
| Iron | extractable | 0.3 mg/L | 2 |

| | | | |
|---|---|---|---|
| Lead | extractable | 1 µg/L for hardness < 60 mg [$CaCO_3$]/L<br>$e^{1.273*\ln[hardness]-4.705}$ µg/L for hardness ≥ 60 mg [$CaCO_3$]/L<br>where hardness is measured as mg [$CaCO_3$]/L | 1 |
| Nitrate | dissolved | 3 mg N/L | 2 |
| Oxygen | dissolved | 6.5 mg/L | 1 |
| pH | n/a | between 6.5 and 9 | 1 |
| Phosphorus | total | 0.03 mg/L | 2 |
| Zinc | extractable | 7.5 µg/L for hardness ≤ 90 mg [$CaCO_3$]/L<br>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 September 20, 2021.

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 September 20, 2021.

**Table C.8. Water quality guidelines used in Ontario**

| Parameter | Form | Guideline | Source |
|---|---|---|---|
| Ammonia | un-ionized | 19 µg/L | 1<br>2 |
| Chloride | total | 120 mg/L | 1 |
| Chromium | total | 2 µg/L<br>guideline for Cr(VI) adjusted to total chromium | 1 |
| Nickel | total | $e^{0.76*\ln[hardness]+1.06}$ µg/L<br>where hardness is measured as mg [$CaCO_3$]/L | 2 |
| Nitrate | total dissolved | 2.93 mg N/L | 2 |
| Phosphorus | total | 0.03 mg/L | 2<br>3 |
| Zinc | total | 7.5 µg/L for hardness ≤ 90 mg [$CaCO_3$]/L<br>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 September 20, 2021.

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 September 20, 2021.

3 Ontario Ministry of the Environment and Energy (1994) Water Management Policies, Guidelines, Provincial Water Quality Objectives. Retrieved on September 20, 2021.

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

| Parameter | Form | Guideline | Source |
|---|---|---|---|
| Chloride | total | 120 mg/L | 1 |
| Copper | extractable | 2 µg/L for hardness < 90 mg [$CaCO_3$]/L<br>$0.2*e^{0.8545*\ln[hardness]-1.465}$ µg/L for hardness > 90 mg [$CaCO_3$]/L | 1 |
| Nitrate | total dissolved | SSG[A] | 2 |
| Oxygen | dissolved | 6.5 mg/L | 1 |
| pH | n/a | between 6.5 and 9 | 1 |
| Phosphorus | total | SSG[A] | 3 |
| Suspended sediments | total | 29 mg/L (SSG[A]) | 1 |
| Zinc | total | 7.5 µg/L for hardness ≤ 90 mg [$CaCO_3$]/L<br>7.5 + 0.75*(hardness-90) for hardness > 90 mg [$CaCO_3$]/L | 1 |

**Note:** n/a = not applicable.
[A] 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 September 20, 2021.

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; 1.14 MB). Fisheries and Oceans Canada. Retrieved on September 20, 2021.

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 September 20, 2021.


**Table C.10. Water quality guidelines used in Quebec**

| Parameter | Form | Guideline | Source |
|---|---|---|---|
| Ammonia | un-ionized | 0.05 mg/L | 1 |
| Ammonia[A] | un-ionized | 19 µg/L | 1<br>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/L | 3 |
| Copper[A] | extractable | 2 µg/L for hardness < 90 mg [$CaCO_3$]/L<br>$0.2*e^{0.8545*\ln[hardness]-1.465}$ 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<br>where hardness is measured as mg [$CaCO_3$]/L | 3 |
| Nitrate and nitrite | total dissolved | 2.93 mg N/L | 1<br>3 |
| pH | n/a | between 6.5 and 9 | 1<br>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<br>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 September 20, 2021.

2 Ministère du Développement durable, Environnement et Lutte contre les changements climatiques (2017) Critères de la qualité de l'eau de surface (in French only). Retrieved on September 20, 2021.

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 September 20, 2021.

**Table C.11. Water quality guidelines used in Saskatchewan**

| Parameter | Form | Guideline | Source |
|---|---|---|---|
| 2,4-D | n/a | 4 µg/L | 1 |
| Ammonia | N | 0.0156 mg N/L | 3 |
| Arsenic | total | 5 µg/L | 1 |
| Chloride | dissolved | 120 mg/L | 1 |
| Copper | total | hardness 0 to < 82 mg/L, 2 µg/L<br>hardness ≥ 82 mg/L to ≤180 mg/L= $0.2*e^{\{0.8545[\ln(hardness)]-1.465\}}$<br>hardness >180 mg/L, 4 µg/L | 2 |
| Lead | total | hardness 0 to ≤ 60 mg/L, 1 µg/L<br>hardness > 60 to ≤ 180 mg/L= $e^{\{1.273[\ln(hardness)]-4.705\}}$<br>hardness > 180 mg/L, 7 µg/L | 2 |
| MCPA | n/a | 2.6 µg/L | 1 |
| Nickel | total | $e^{0.76*\ln[hardness]+1.06}$ µg/L<br>where hardness is measured as mg [$CaCO_3$]/L | 2 |
| Nitrate | N | 3 mg N/L | 3 |
| Oxygen | dissolved | 5.5 mg/L | 1 |
| pH | n/a | between 6.5 and 9 | 1 |

| | | | |
|---|---|---|---|
| Phosphorus | total | Northern sites: 0.035 mg/L<br>Southern sites: 0.1 mg/L | 4 |
| Zinc | total | 7.5 µg/L for hardness ≤ 90 mg [$CaCO_3$]/L<br>7.5 + 0.75*(hardness-90) for hardness > 90 mg [$CaCO_3$]/L | 2 |

**Note:** n/a = not applicable.

**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 September 20, 2021.
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 September 20, 2021.
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. Retrieved on September 20, 2021.
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. In: Canadian environmental quality guidelines, 2004, Canadian Council of Ministers of the Environment, Winnipeg. Retrieved on September 20, 2021.

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

| Parameter | Form | Guideline | Source |
|---|---|---|---|
| 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<br>$0.2*e^{0.8545*ln[hardness]-1.465}$ µg/L for hardness > 90 mg [$CaCO_3$]/L | 3 |
| Lead | total | 1 µg/L for hardness < 50 mg [$CaCO_3$]/L<br>$e^{1.273*ln[hardness]-4.705}$ µg/L for hardness > 50 mg [$CaCO_3$]/L | 3 |
| Nitrate | total dissolved | 2.93 mg N/L | 3 |
| Nitrite | total | 0.02 mg N/L | 4 |
| Nitrogen | dissolved | 0.7 mg N/L | 3 |
| Oxygen | dissolved | 8 mg/L | 5 |
| pH | n/a | between 6.5 and 9 | 1 |
| Phosphorus | total | 0.025 mg/L | 3 |
| Selenium | total | 1 µg/L | 3 |
| Silver | total | 0.05 µg/L for hardness < 100 mg [$CaCO_3$]/L<br>1.9 µg/L for hardness > 100 mg [$CaCO_3$]/L | 3 |
| Temperature | n/a | SSG[A] | 3 |
| Zinc | total | 7.5 µg/L for hardness ≤ 90 mg [$CaCO_3$]/L<br>7.5 + 0.75*(hardness-90) for hardness > 90 mg [$CaCO_3$]/L | 3 |

**Note:** n/a = not applicable.
[A] 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 September 20, 2021.

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. Retrieved on September 20, 2021.

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 September 20, 2021.

4 Nordin RN and Pommen LW (2009) Water Quality Criteria for Nitrogen (Nitrate, Nitrite, and Ammonia): Overview Report. British Columbia Ministry of Environment and Parks. Retrieved on September 20, 2021.

5 British Columbia Ministry of Environment (1997) Ambient Water Quality Criteria for Dissolved Oxygen (PDF; 852 kB). British Columbia Ministry of Environment, Water Protection and Sustainability Branch. Victoria, BC. Retrieved on September 20, 2021.

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