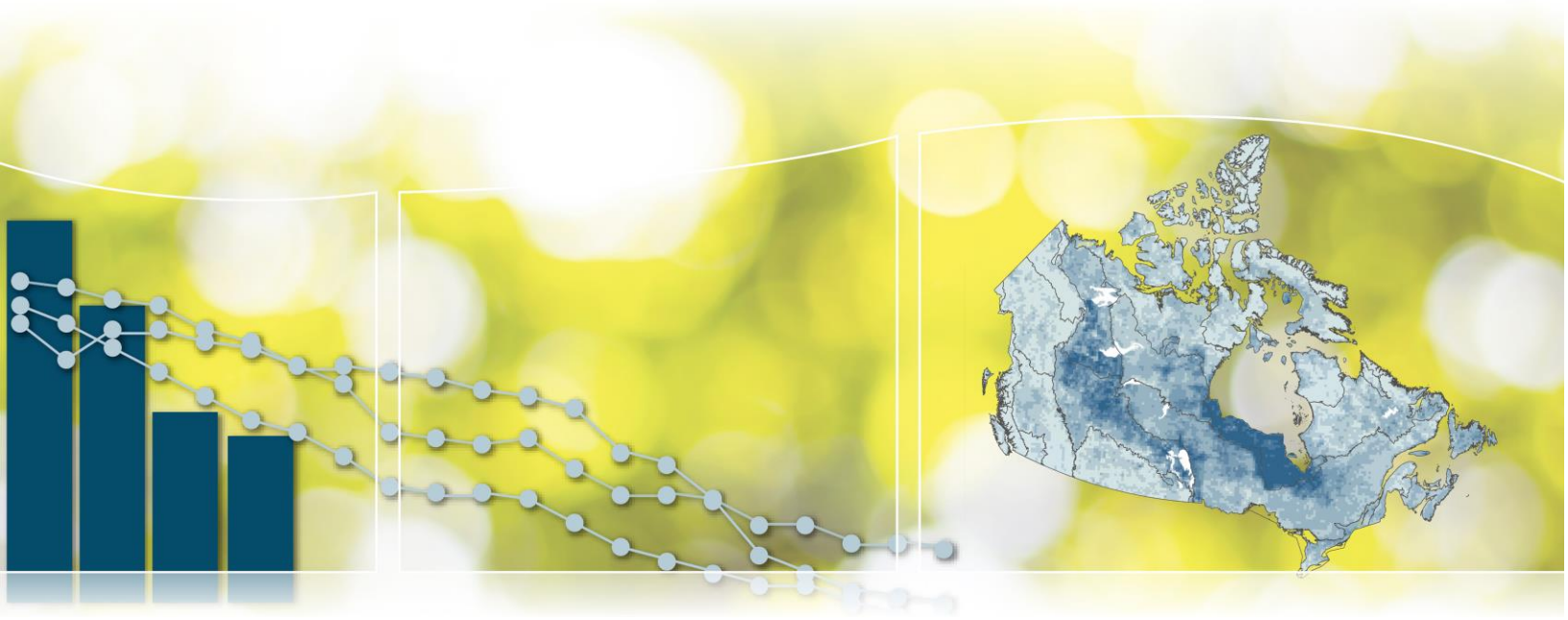
Environment and Climate Change Canada
Environnement et Changement climatique Canada

Canadian Environmental Sustainability Indicators

Water quality in Canadian rivers



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August 2017

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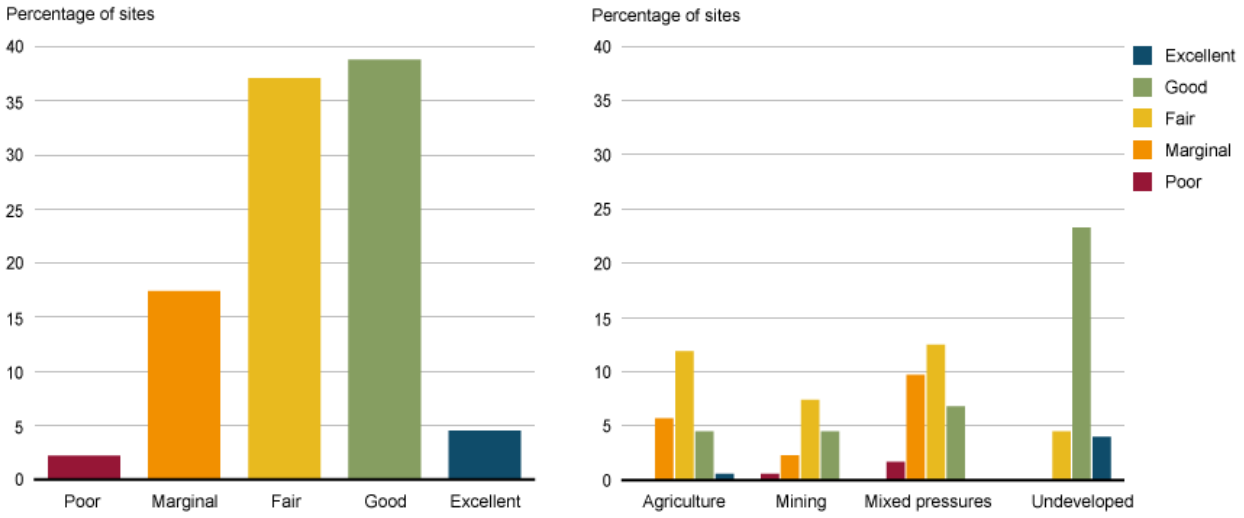
Water quality in Canadian rivers indicator

River plants and animals rely on clean water to maintain healthy populations. The quality of water, and the health of rivers, depends on how people develop and use the surrounding land.

Key results

- Most people live in southern Canada where water quality in rivers is most often classified as fair to good. This classification means it can maintain healthy river ecosystems.
- Water quality tends to be worse where there are cities, agriculture, mining, or a combination of all three (mixed pressures).

Figure 1. Water quality, Canada, 2013 to 2015 period



Data for Figure 1

Note: Water quality was evaluated at 178 sites across southern Canada using the Canadian Council of Ministers of the Environment's water quality index. Two sites have not had their land use categorized because they are close to the Canada-United States border or the ocean. They have not been included in the land use indicator.
Source: Data assembled by Environment and Climate Change Canada from federal, provincial and joint water quality monitoring programs. Population, mining and land cover statistics for each site's drainage area were provided by Statistics Canada.

For the 2013 to 2015 period, water quality at 178 monitoring sites in southern Canadian rivers was rated:

- excellent or good at 43.3% of monitoring sites
- fair at 37.1% of sites
- marginal at 17.4% of sites
- poor at 2.2% of sites

By world standards, Canada has abundant, clean freshwater resources. The quality of 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 over the rocky landscape of northern Ontario and Quebec is naturally different from water flowing through the deep soils of the Prairies. However, it is how people have developed the land around lakes and rivers that has the largest impact on water quality at each site.

Water quality is generally very good in undeveloped areas where native plants, trees and soils purify the water before it reaches the river. Adding manufacturing and cities to the landscape means

hundreds of different chemicals are released into rivers every day. As well, many contaminants make their way into rivers after being released into the air through burning. Pollution from agriculture reaches rivers through run-off across the soil surface. All of these developments change water quality in a river and put pressure on the plants and animals that live there.

Water quality is reported in this indicator by measuring the levels of a number of chemicals and physical properties (parameters) in water. The levels of each parameter are compared to their water quality guideline. Water quality guidelines are thresholds designed to indicate when a chemical may become harmful to plants and animals. The more often a parameter's concentration is above its guidelines, the poorer the rating of water quality in a river will be.

Trends in water quality in Canadian rivers

Key results

- Water quality has not changed between 2002 and 2015 at a majority of sites across southern Canada
- Where it has changed, it has improved more often than it has gotten worse

Figure 2. Trends in water quality, Canada, 2002 to 2015

Data for Figure 2

Note: The trend in water quality between the first year that data were reported for each site and 2015 was calculated at 178 sites across southern Canada. A uniform set of water quality guidelines and parameters were used through time at each site for the trend analysis. Changes in water quality from the first year of data collected at the site to 2015 are evaluated by dividing the concentration of each water quality parameter at a site by its guideline for each sampling date. These ratios are averaged annually to obtain the deviation ratio at a site. A Mann-Kendall test was used to assess whether there was a statistically-significant increasing or decreasing trend in the annual guideline deviation ratios at a site.
Source: Data assembled by Environment and Climate Change Canada from federal, provincial and joint water quality monitoring programs.

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 can mean better water quality because less pollution is washed into the river. A changing climate that results in longer wet periods may make water quality worse for longer periods of time.

How the landscape is developed also impacts how quickly water quality changes. Altered landscapes, industrial and sewage effluents, and air pollution deposited on the river surface can all affect water quality. Thus, any change in the amount or type of these inputs over time can also change water quality over the long-term.

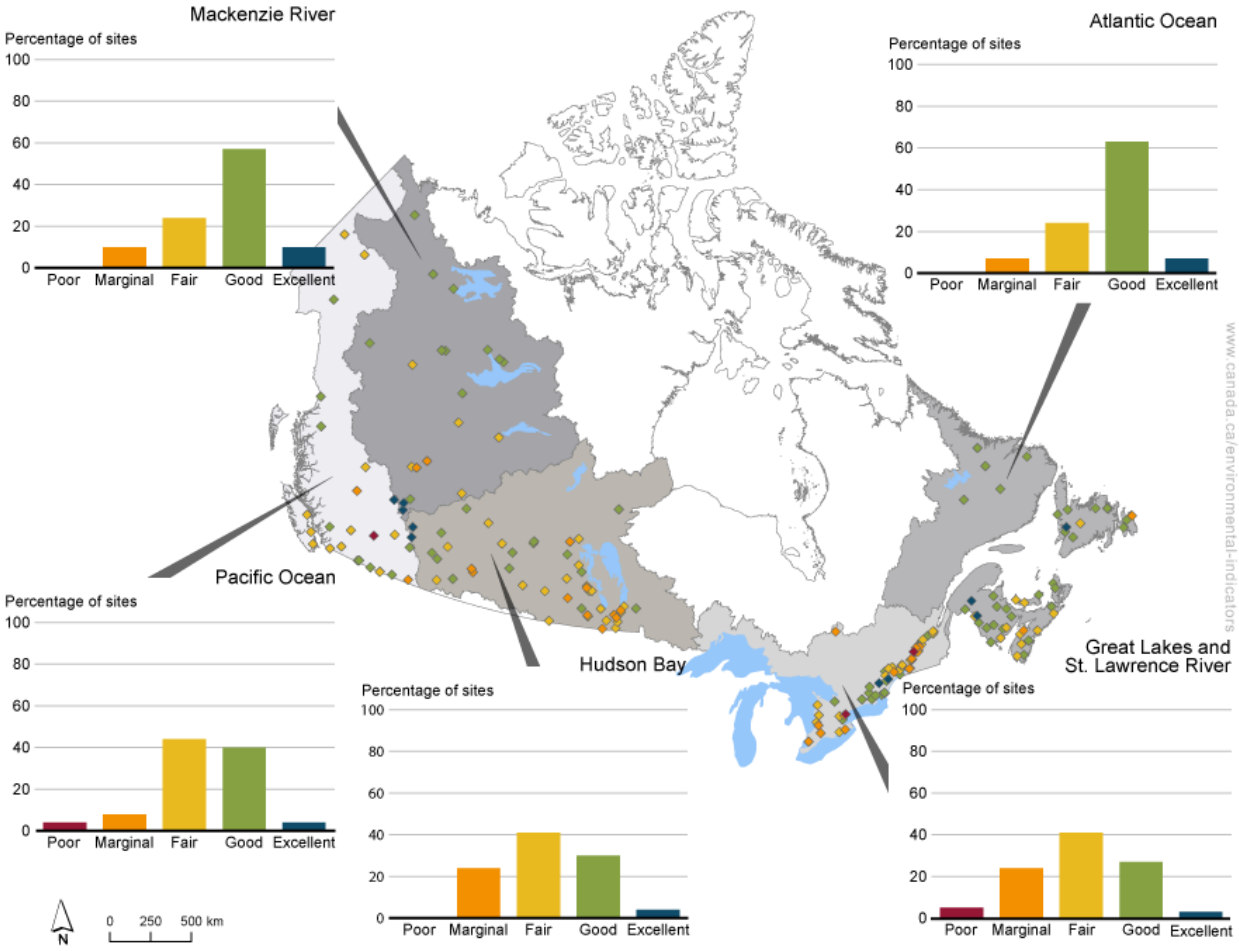
Water quality in a river can be improved by modernizing wastewater treatment plants and factories, adopting environmental farming practices, or planting vegetation along river banks.

Regional water quality in Canadian rivers

Key results

- Good or excellent water quality was more common on rivers draining into the Atlantic Ocean and the Mackenzie River
- Marginal or poor water quality was more common on rivers draining into the Great Lakes and St. Lawrence River

Figure 3. Regional water quality, Canada, 2013 to 2015 period



Data for Figure 3

Note: Water quality was assessed at 197 sites across Canada using the Canadian Council of Ministers of the Environment's water quality index. The additional monitoring sites improve the coverage of the northern portions of the McKenzie River and Pacific Ocean regions.
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 2013 to 2015 period:

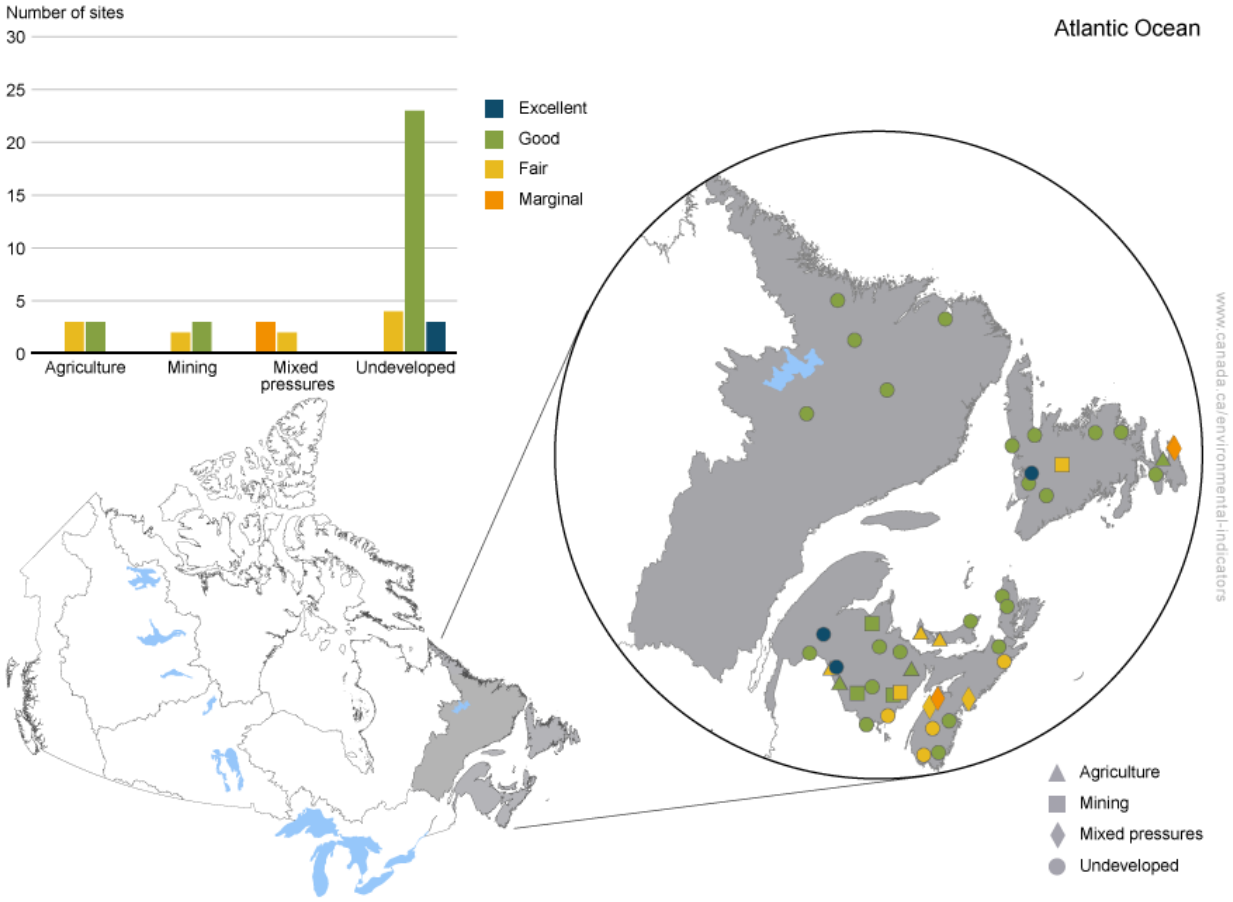
- The highest percentage of sites rated good or excellent was found on rivers draining into the Atlantic Ocean (70%) and the Mackenzie River (67%). Good or excellent water quality was found at undeveloped sites with very little human development upstream of them. The Atlantic Ocean and Mackenzie River regions have the highest proportion of undeveloped sites in Canada.
- The highest proportion of sites rated marginal or poor was found on rivers draining into the Great Lakes and St. Lawrence River (29%). This area has a lot of urban development and agriculture.

Atlantic Ocean

Key results

- Most sites in the Atlantic Ocean region are in undeveloped areas and have good or excellent water quality
- Water quality at monitoring sites close to cities, agriculture and/or mining (mixed pressures) tend to have worse water quality

Figure 4. Water quality by land use category, Atlantic Ocean region, 2013 to 2015 period



Data for Figure 4

Note: Water quality by land use category was assessed at 46 sites on rivers draining into the Atlantic Ocean using the Canadian Council of Ministers of the Environment's water quality index. 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, mining and land cover statistics for each site's drainage area were provided by Statistics Canada.

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

For the 2013 to 2015 period, water quality for 46 sites on rivers draining into the Atlantic Ocean was rated:

- excellent or good at 70% of monitoring sites
- fair at 24% of sites
- marginal at 7% of sites

Water quality tends to be good to excellent in this region of Canada because large areas are undeveloped, particularly in Labrador. The region is home to approximately 2.4 million people, or 7% of Canada's population. The majority of them live in New Brunswick, Nova Scotia 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. Fertilizers and pesticides used to help crops grow can wash into nearby rivers, impacting water quality in these areas.

Mining is one 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 aggregates, limestone and gypsum mines. Water pollution from mine effluent released 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 substances to the water.

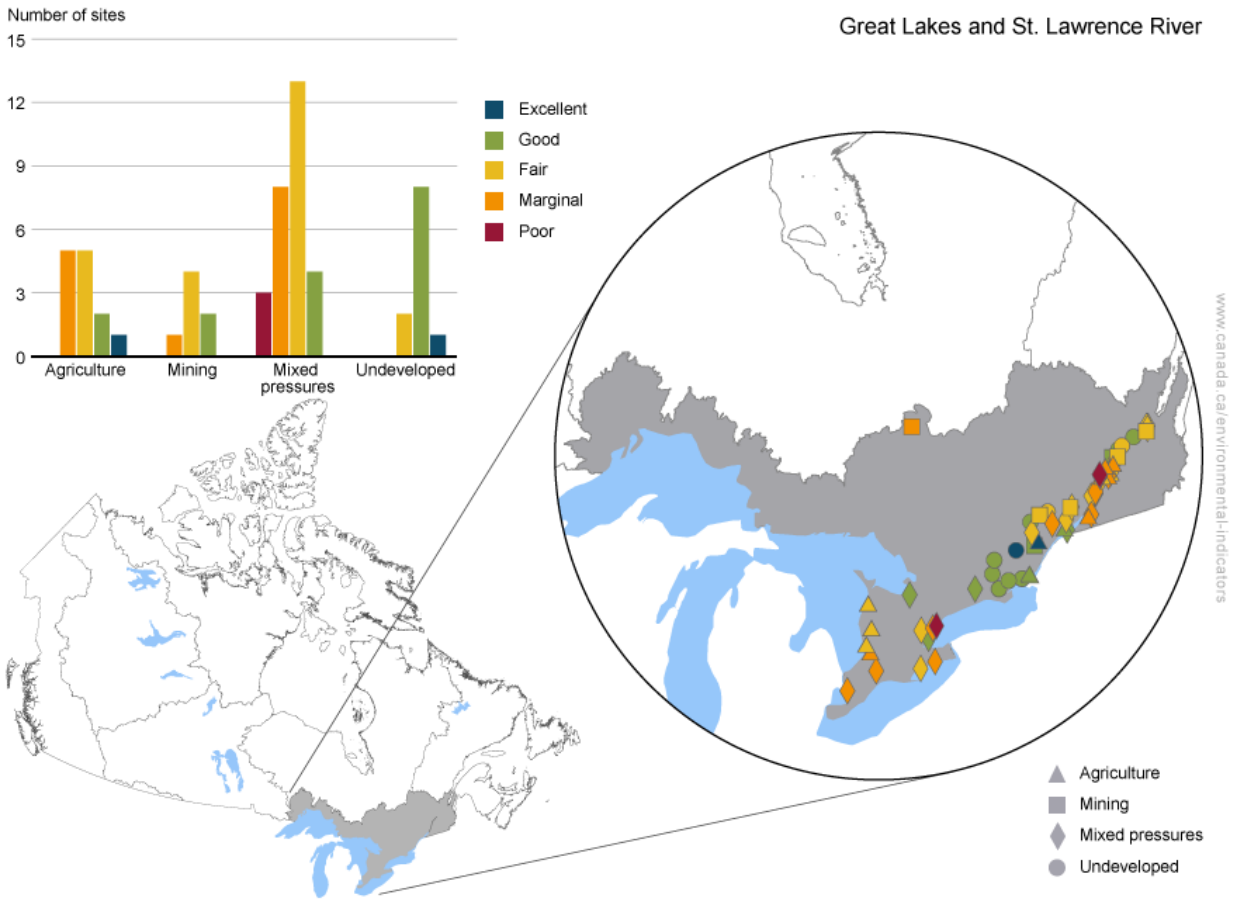
Between the first year of data collection and 2015, water quality has improved on the Terra Nova River in Newfoundland and Labrador and on the Roseway River in Nova Scotia. These 2 sites have very little development around them. Water quality has deteriorated on the Aroostook River and the Saint John River in New Brunswick in areas where there is agriculture and industrial development. There has been no change in water quality at the remaining 42 sites.

Great Lakes and St. Lawrence River

Key results

- Water quality on rivers draining into the Great Lakes and St. Lawrence River ranges from fair to poor in southwestern Ontario and along the St. Lawrence River between Montreal and Quebec City. It is good or excellent in eastern Ontario.
- Water quality at monitoring sites close to cities and agriculture (mixed pressures) tend to have worse water quality.

Figure 5. Water quality by land use category, Great Lakes and St. Lawrence River region, Canada, 2013 to 2015 period



Data for Figure 5

Note: Water quality by land use category was assessed at 59 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.
Source: Water quality data were assembled by Environment and Climate Change Canada from existing federal, provincial and joint water quality monitoring programs. Population, mining and land cover statistics for each site's drainage area were provided by Statistics Canada.

For the 2013 to 2015 period, water quality for 59 sites on rivers draining into the Great Lakes and St. Lawrence River was rated:

- excellent or good at 31% of monitoring sites
- fair at 41% of sites
- marginal at 24% of sites
- poor at 5% of sites

Home to almost 60% of Canadians, almost 20 million people, the Great Lakes and St. Lawrence River region contains 6 of the country's 10 largest cities: Toronto, Montreal, Ottawa-Gatineau, Quebec City, Hamilton, and Kitchener-Waterloo. 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. Fertilizers used to help crops grow and manure from

livestock can wash into nearby rivers impacting water quality in these areas. 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. Feldspar is a type of quartz used to make glass.

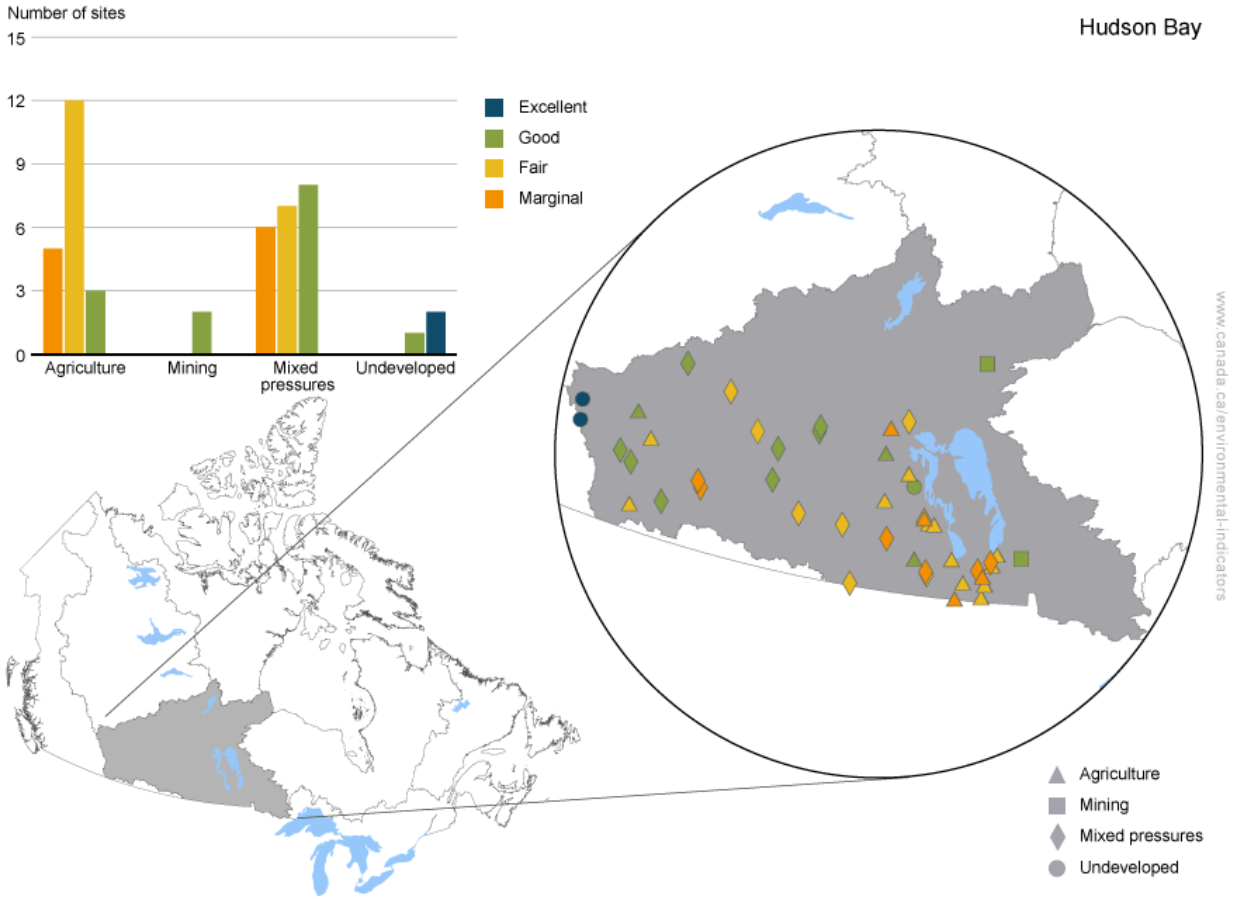
Between the first year of data collection and 2015, water quality has improved on the Gatineau River, the Bayonne River, the Saint-Charles River, the Saint François River and the Rivière du Nord in Quebec. These sites are mostly in areas where a lot of people live and have agriculture and mining in the area (mixed pressures). Water quality has deteriorated on the Credit River, the Nottawasaga River, the North Raisin River, the Gananoque River and the Fall River in Ontario. Land use at these sites is mixed pressures or agriculture. There was no change in water quality at the remaining 49 sites.

Hudson Bay

Key results

- Water quality in rivers draining into Hudson Bay tends to be good or excellent close to the Rocky Mountains and north of Lake Winnipeg. It is in these regions that there is very little development.
- Water quality tends to be fair or marginal where there is agriculture, or a mixture of agriculture and mining.

Figure 6. Water quality by land use category, Hudson Bay region, 2013 to 2015 period



Data for Figure 6

Note: Water quality by land use category was assessed at 46 sites on rivers draining into the Hudson Bay using the Canadian Council of Ministers of the Environment's water quality index.
Source: Water quality data were assembled by Environment and Climate Change Canada from existing federal, provincial and joint water quality monitoring programs. Population, mining and land cover statistics for each site's drainage area were provided by Statistics Canada.

For the 2013 to 2015 period, water quality for 46 sites on rivers draining into Hudson Bay was rated:

- excellent or good at 35% of monitoring sites
- fair at 41% of sites
- marginal at 24% of sites

The Nelson River originates at the northern tip of Lake Winnipeg and flows into the south-western corner of 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. Most of the 5.5 million people in the region live in its 5 major cities.

The prairies are the most altered landscape in Canada. Water quality in this region reflects the extensive human development. Agriculture covers almost all the land in the Prairies. Mining, particularly the production of potash and fuels, is the second most important industry. Water quality tends to be worse where rivers run through agricultural and mining areas.

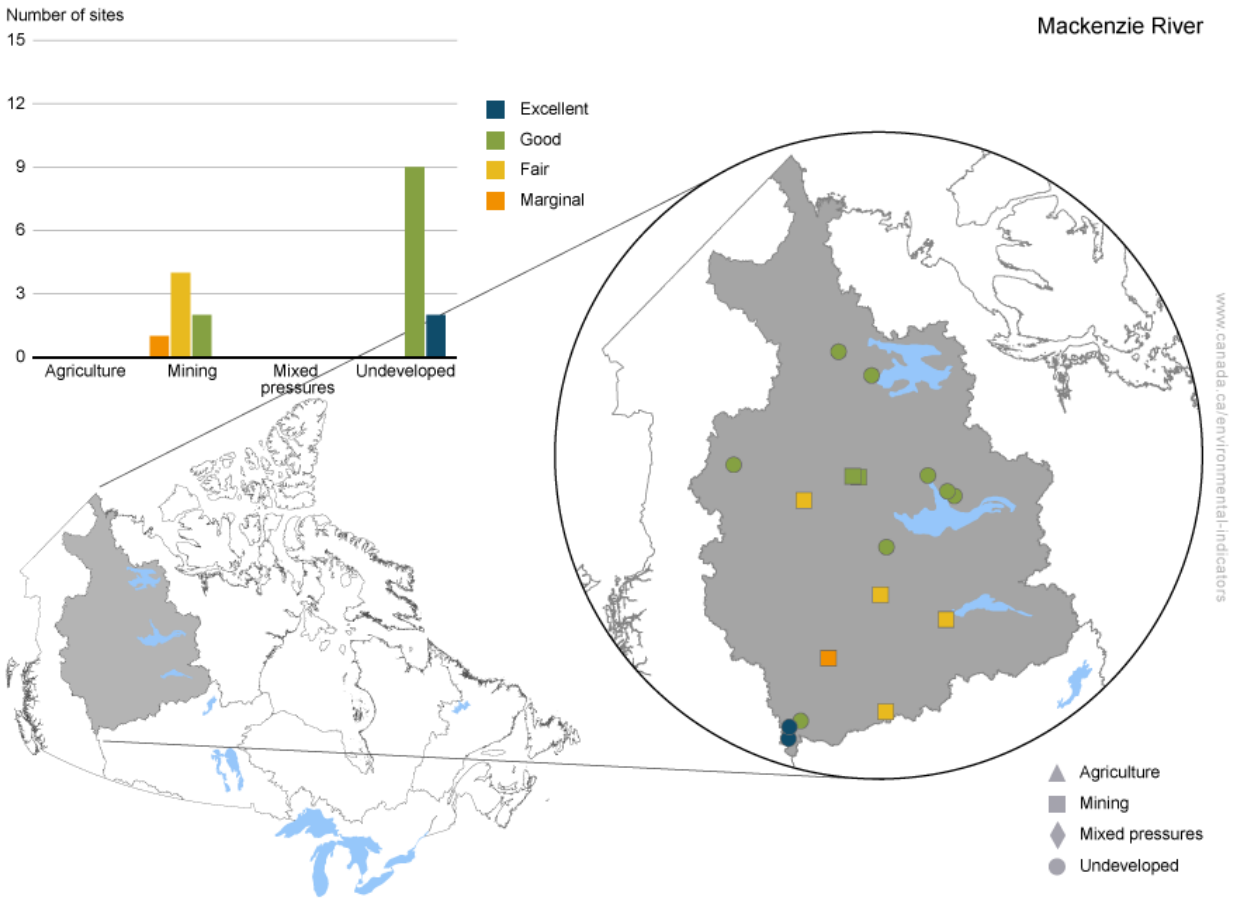
From the first year of data collection to 2015, water quality has improved on the North Saskatchewan River in Alberta, the Red Deer River, the South Saskatchewan River, and the North Saskatchewan River in Saskatchewan and the Pembina River, the Saskatchewan River, and Cooks Creek in Manitoba. Land use at these sites is either agriculture alone or a mix of agriculture and mining (mixed pressures). There has been no change in water quality at the remaining 39 sites.

Mackenzie River

Key results

- Water quality in the Mackenzie River region is generally excellent
- Water quality in the southern portion of the region is impaired by mining and oil and gas activity

Figure 7. Water quality by land use category, Mackenzie River region, 2013 to 2015 period



Data for Figure 7

Note: Water quality was assessed at 21 sites on rivers draining into the Mackenzie River using the Canadian Council of Ministers of the Environment's water quality index. Three sites have not had their land use categorized and are not included in the chart.
Source: Water quality data were assembled by Environment and Climate Change Canada from existing federal, provincial, territorial and joint water quality monitoring programs. Population, mining and land cover statistics for each site's drainage area were provided by Statistics Canada.

For the 2013 to 2015 period, water quality for 21 sites on rivers draining into Mackenzie River was rated:

- excellent or good at 67% of monitoring sites
- fair at 24% of sites
- marginal at 10% of sites

The Mackenzie River watershed is the largest in Canada, covering nearly 20% of the country and is one of the least developed. Its two largest tributaries, the Peace River and the Athabasca River, drain much of north-central Alberta and the Rocky Mountains in northern British Columbia. The majority of the 450 000 people living in the watershed live in the southern portions of the watershed.

Much of the watershed consists of unbroken wilderness. The heaviest land use in the region is oil and gas extraction in central Alberta. This land use results in water quality in these areas being degraded relative to water in the undeveloped parts of the watershed.

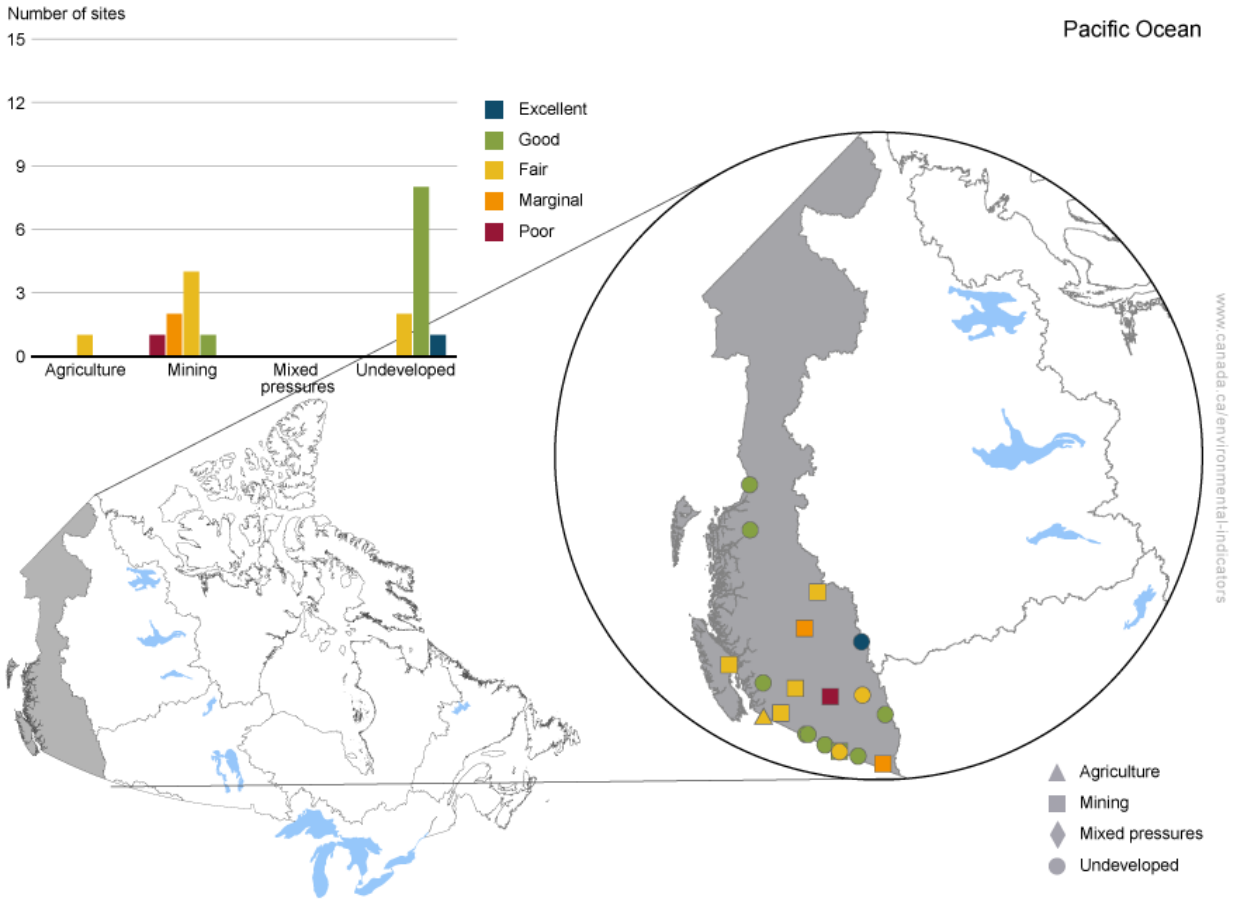
Between the first year of data collection and 2015, water quality has not changed in this region.

Pacific Ocean

Key results

- Water quality in rivers draining into the Pacific Ocean is generally good or excellent.
- Fair, marginal or poor water quality is found where there is mining.

Figure 8. Water quality by land use category, Pacific Ocean region, 2013 to 2015 period



Data for Figure 8

Note: Water quality was assessed at 25 sites on rivers draining into the Pacific Ocean using the Canadian Council of Ministers of the Environment's water quality index. Five sites are not included in the chart; their land use is not categorized because they are close to the Canada-United States border or the ocean.
Source: Water quality data were assembled by Environment and Climate Change Canada from existing federal, provincial, territorial and joint water quality monitoring programs. Population, mining and land cover statistics for each site's drainage area were provided by Statistics Canada.

For the 2013 to 2015 period, water quality for 25 sites on rivers draining into the Pacific Ocean was rated:

- excellent or good at 44% of monitoring sites
- fair at 44% of sites
- marginal at 8% of sites
- poor at 4% of sites

The landscape through which rivers draining into the Pacific Ocean flow varies from large areas with little to no development to one of Canada's largest cities, Vancouver. Roughly 4.4 million people, or 16% of Canadians, live in the watershed.

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

Mining is one of the region's largest industries. Coal, lead, zinc, copper, gold, silver, molybdenum and other precious metals are actively mined within the watershed. Soil erosion, water pollution from mine effluent released to rivers, and seepage from tailings and waste rock impoundments can have an impact on water quality.

Between the first year of data and 2015, water quality has improved at the Pend d'Oreille River, the Skeena River, the Thompson River, the Kootenay River, the Columbia River, and the Kettle River in British Columbia and declined at the Quinsam River, the Elk River, and the Fraser River. All of these sites had either no development upstream or had a mix of agriculture, mining and/or cities. There has been no change in water quality at the remaining 16 sites.

About the indicator

What does the indicator measure

This indicator provides a measure of the ability of river water across Canada to support plants and animals. At each monitoring site, water quality data are compared to water quality guidelines to create a rating for the site. If measured water quality is below the guidelines, it can maintain a healthy ecosystem.

Water quality at a monitoring site is considered excellent when substances in a river are very rarely measured above their guidelines. Conversely, water quality is rated poor when measurements are usually above their guidelines, sometimes by a wide margin.

Why is this indicator important

Clean freshwater is an essential resource. It protects aquatic plant and animal biodiversity. We drink it, use it for manufacturing, energy production, irrigation, swimming, boating and fishing. 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.

This indicator provides information about the state of surface water quality and its change through time, to support water resource management. It is used to provide information about the state and trends in water quality for the Canada Water Act report and Environment and Climate Change Canada's annual departmental performance reports. It is also used to assess progress toward the 2016–2019 Federal Sustainable Development Strategy.

What are the related indicators

The Nutrients in the St. Lawrence River and Nutrients in Lake Winnipeg indicators report the state of phosphorus and nitrogen levels in those two 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.

Pristine lakes and rivers

This indicator supports the measurement of progress towards the following 2016–2019 Federal Sustainable Development Strategy long-term goal: Clean and healthy lakes and rivers support economic prosperity and the well-being of Canadians.

Data sources and methods

What are the data sources

Water quality data for 325 monitoring sites are gathered from 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.

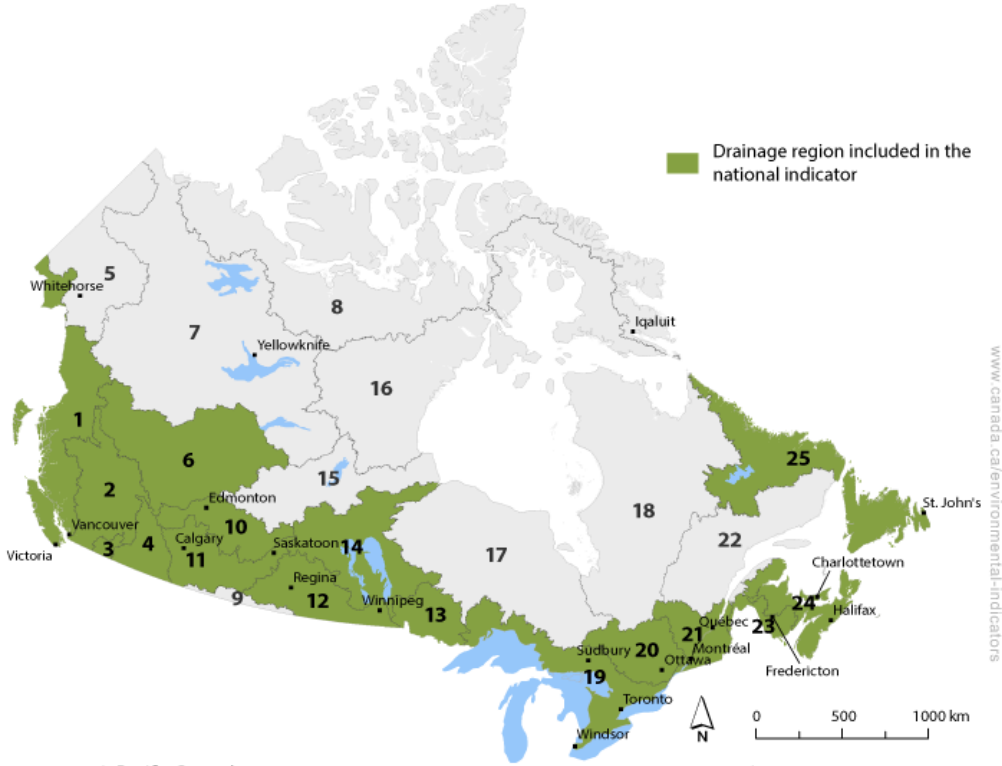
Water quality guidelines for the protection of aquatic life are used to calculate the indicator. They come from the Canadian Council of Ministers of the Environment, the United States Environmental Protection Agency, and provincial and territorial government sources. A complete list of water quality 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 2013 to 2015 period, water quality data from 178 sites were used to compile the national indicator. These data were drawn from monitoring sites in Canada's 16 southernmost drainage regions (Figure 9).

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



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

Data for 4 additional sites in Yukon, 4 sites in Alberta, 1 site in Saskatchewan, and 10 sites in the Northwest Territories were used to improve coverage of the Mackenzie River region and of Yukon in the Pacific Ocean region in the regional indicator.

Water quality is evaluated at an additional 147 monitoring sites across Canada. Water quality results for all 325 sites can be explored using the interactive water quality map.

Data used to calculate the indicator include concentrations for a total of 40 measured substances, physical parameters, and data, such as pH, temperature or hardness, required to calculate certain guidelines, for all 325 sites across Canada from 2002 to 2015. Sample timing and frequency is set by monitoring programs and vary among sites.

Each data record collected is tagged with the site name, the date the sample was collected, the name and chemical form of the parameter, and land use and ecological information. Water quality parameter data for the indicator, 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 completed in 2008. At that time, land use at each site was determined using:

- population density from Statistics Canada's 2006 Census of Population
- mine locations using Natural Resources Canada's 2006 Census of Mines
- point-source pollutant releases from industrial and commercial facilities using Environment Canada's 2007 National Pollutant Releases Inventory
- agricultural activity locations using Statistics Canada's 2006 Census of Agriculture
- land cover using Natural Resources Canada's land cover maps[1,2]

Data quality assurance and quality control

Data quality assurance/quality control is performed within each monitoring program providing data for the water quality indicator. 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 processes 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 also leads to removal of parameters due to low sampling frequencies or to detection limits being 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.[3]

Minimum sampling requirements for the 2013 to 2015 period were not met at 12 sites: 8 in Manitoba, 2 in Newfoundland and Labrador, 1 in Saskatchewan, and 1 in Ontario. The results for these sites were evaluated by local water quality experts who concluded the data could be included because they were consistent with previous years and were considered representative of local water quality.

For a parameter to be included in the calculation of the indicator, a sample value must be available for each year for at least 33% of the total number of samples.

Data timeliness

The indicator was calculated using data from 2013 to 2015, the most recent data available from all monitoring programs. For 5 sites, data from late December 2012 or early January 2016 were used to meet requirements for minimum number of samples.

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[1] Natural Resources Canada (2005) Multi-Temporal Land Cover Maps of Canada Using NOAA AVHRR 1-km Data from 1985-2005, 1st Edition, Canada Centre for Remote Sensing. Retrieved on November 4, 2016.

[2] Natural Resources Canada (2008) Land Cover Map of Canada 2005, Canada Centre for Remote Sensing. Retrieved on November 4, 2016.

[3] Statistics Canada (2007) Behaviour Study on the Water Quality Index of the Canadian Council of Ministers of the Environment. Retrieved on November 4, 2016.

How is this indicator calculated

This indicator is calculated using the water quality index as endorsed by the Canadian Council of Ministers of the Environment.[4] For each site, 5 to 15 water quality parameters are compared to their guideline value using the index calculation. The index produces a score between 1 and 100. Sites are assigned a water quality category based on the score. The results are grouped into 5 regions for presentation in the Regional water quality in Canadian rivers indicator.

Trends in water quality are evaluated using a guideline deviation ratio calculated using data from the first year of data collected at the site to 2015. To calculate the guideline deviation ratio, the concentration of each water quality parameter result at a site was divided by its guideline and averaged annually to obtain the guideline deviation ratio at a site. A Mann-Kendall test was used to assess whether there was 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 professionals select water quality chemical substances and physical properties to be assessed at each site based on their knowledge of local water quality stressors. Typically, at least one form of the following parameter groups is reported at each monitoring site: 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 exceptions are British Columbia and Yukon. In these regions, a common set of parameters is assessed at all sites with site-specific parameters added as required. Dissolved oxygen, phosphorus, pH, nitrogen and water temperature are included at sites when data are available.

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 acute toxicity. The water quality indicator uses chronic water quality guidelines for the protection of aquatic life, except for Quebec, where acute water quality guidelines for metals are used.

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.

[4] Canadian Council of Ministers of the Environment (2001) CCME Water Quality Index 1.0 User's Manual (PDF; 84.3 KB). Retrieved on November 4, 2016.

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 are developed using procedures based on background concentrations[5] 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.[6]

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 highest human density 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.[7] Where the upstream drainage areas of monitoring sites overlapped, the site furthest downstream was retained for the core network, as the downstream site is impacted by the maximum area in the river basin and, to some degree, reflects the cumulative impact of all upstream stresses. For 14 large rivers, core sites were chosen in the upper, mid and lower portions of the main river and at the most downstream sites on each tributary, when available. Additional core sites were included on these rivers, because water travels thousands of kilometres from the source to the mouth of these rivers. Water quality changes along the way and cannot be summarized by a unique downstream monitoring site. The final selection of core sites ensures monitoring sites are well distributed among provinces and drainage regions.

The number of core sites changes from year to year because samples are missed or lost and, as a result, the site may not have 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. For this analysis:

- Agricultural land cover corresponds to land cover classes 26, 27, 28 and 29
- Undisturbed land cover corresponds to land cover classes 0, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 30, 31, 32, 33 and 38[8]

Land use upstream of 16 core sites in Newfoundland and Labrador and Quebec was defined based on knowledge by local water quality professionals. Land use for 8 sites in Northwest Territories and Yukon was not classified because (1) they are trans-boundary sites and the United States portion of the sites is challenging to classify or (2) they are close to the ocean.

[5] 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 November 4, 2016.

[6] Government of Canada (2008) Technical Guidance Document for Water Quality Indicator Practitioners Reporting Under the Canadian Environmental Sustainability Indicators (CESI) Initiative 2008. Retrieved on November 4, 2016.

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

[8] 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 November 4, 2016.

Table 1. Criteria for the classification of human activity at monitoring sites

Land use	Criteria
Agriculture	> 20% of drainage area is agricultural land cover
Mining	Presence of at least one mine
Mixed pressures	Agriculture and mining OR Agriculture and population density > 25 persons/km^2 OR Mining and population density > 50 persons/km^2
Undeveloped	> 95% of drainage area is undisturbed land cover

Calculating Water Quality Status

The water quality indicator is calculated using the water quality index, as endorsed by the Canadian Council of Ministers of the Environment. The water quality index calculation considers three factors to summarize water quality at a site: scope, frequency and amplitude (Equation 1). Scope (F1) is the percentage of parameters for which the water quality guidelines are not met. Frequency (F2) is the percentage of samples for which the water quality guidelines are not met. Amplitude (F3) 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.[9] The full set of equations for the water quality index is described in Canadian Council of Ministers of the Environment Water Quality Index 1.0 Technical Report (PDF; 1.40 MB).

Equation 1.

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

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

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

Ranking	Interpretation
Excellent (95.0 to 100.0)	Water quality measurements never or very rarely exceed water quality guidelines.
Good (80.0 to 94.9)	Water quality measurements rarely exceed water quality guidelines and, if they do, it is usually by a narrow margin.
Fair (65.0 to 79.9)	Water quality measurements sometimes exceed water quality guidelines and may do so by a wide margin.

[9] Canadian Council of Ministers of the Environment (2001) CCME Water Quality Index 1.0 Technical Report (PDF; 1.40 MB). Retrieved on November 4, 2016.

Ranking	Interpretation
Marginal (45.0 to 64.9)	Water quality measurements often exceed water quality guidelines and/or exceed the guidelines by a considerable margin.
Poor (0 to 44.9)	Water quality measurements usually exceed water quality guidelines and/or exceed the guidelines by a considerable margin.

The 3 year roll-up is intended to dampen temporal variability in the results caused by annual fluctuations in weather and hydrology to make the water quality indicator more representative of how humans are impacting water quality in rivers.[10]

Calculation of trends in the water quality

To investigate if water quality at a site has changed through time, a separate set of calculations and metrics from the water quality index were carried out. The trend analysis allows for the detection of improving or deteriorating trends in water quality at a site, whether they occur above or below guideline values. 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.

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 improving water quality has a positive slope to match how water quality is portrayed with the water quality index.

Equation 2.

For each year:

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

where,

i = parameters

j = samples

n = total number of samples

p = total number of parameters

C = measured concentration

G = guideline value

As the concentration of a parameter gets closer its guideline, the guideline deviation ratio gets closer to zero. A ratio below zero means the parameter is above its guideline. When parameters are well below the guideline, the ratio is close to 1.

[10] 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 November 4, 2016.

Three 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 guideline deviation 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. For this parameter, measurements within the guideline range were given a value of 1. The guideline deviation ratio for pH values less than 6.5 was calculated by dividing the guideline by the concentration. For pH values greater than 9, the guideline deviation ratio was calculated by dividing the concentration by the guideline.
- Where temperature was used as a parameter, the absolute value of the guideline deviation 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. In one case, there was a change in the analytical form of a parameter. In 2012, Quebec began reporting unionized ammonia instead of dissolved ammonia. The ammonia data in the older data set were left as dissolved ammonia for this analysis because there is no way to convert between the two forms.

A Mann-Kendall test using the Kendall package of the statistical software R 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 year in which sampling started at each site varies from 2002 for 73 sites, 2003 for 54 sites, 2004 for 12 sites, 2005 for 7 sites, 2006 for 29 sites and 2007 for 3 sites.

What has recently changed

This indicator has undergone a major transformation since it was last published in June 2015.

- The Land use impacts of freshwater quality indicator has been integrated into the indicator results.
- Previously, trends in the water quality indicator were determined by comparing 95% confidence intervals around the water quality scores. When confidence intervals for the first and last index period did not overlap, water quality was considered to have changed. The new method uses the annual average of all ratios of the water quality measurements to their guidelines. The new method allows the use of the data underlying the indicator and can detect changes in water quality below the guideline.
- The regional analysis of water quality is no longer reported on the drainage region scale. Results are now reported based on how water flows through 5 large regions of Canada. Data for sites in northern Alberta, the Northwest Territories and Yukon have been added to the Mackenzie River and Pacific Ocean regions to fill in details about northern water quality.
- Complete data for all sites sampled under federal monitoring programs are now available online. Parameter data that underlie the calculation of the water quality index, the index scores and associated categories, and the yearly trend ratios can be found in the files.

What are the caveats and limitations

This indicator reflects the state of water quality in rivers in southern Canada. Northern Canada is under-represented.

An additional 19 non-core sites were included in the regional indicator to allow for coverage of the Mackenzie River region and on Yukon in the Pacific Ocean region, which are not included in the national water quality indicator.

The indicator only uses data for which guidelines exist. It does not cover all potential water quality issues in Canada.

The indicator is based on the impacts of a concentration of a number of chemicals 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 indicator does not directly measure biological integrity; it measures whether physical and chemical characteristics of freshwaters are acceptable for aquatic life. Although physical and chemical measurements provide good proxies of biological integrity, only biological information provides a direct measurement of conditions for aquatic life.

The water quality indicator only assesses the quality of surface waters. Groundwater is not considered in this indicator.

The trends reported in this indicator are based on annual scores 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.

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 by a considerable margin, even if the parameters are not exactly the same.

Only parameters for which water quality guidelines exist can be included in the indicator. 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 this indicator varies from 5 to 15 depending on the monitoring site, and between 9 and 60 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.[11]

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

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

Resources

References

Canadian Council of Ministers of the Environment (2001) CCME Water Quality Index 1.0 Technical Report (PDF; 1.4 MB). Retrieved on November 4, 2016.

Canadian Council of Ministers of the Environment (2001) CCME Water Quality Index 1.0 User's Manual (PDF; 84.3 KB). Retrieved on November 4, 2016.

Canadian Council of Ministers of the Environment (2006) A Sensitivity Analysis of the Canadian Water Quality Index (PDF; 515 KB). Retrieved on November 4, 2016.

Canadian Council of Ministers of the Environment (2009) Reducing the Sensitivity of the Water Quality Index to Episodic Events (PDF; 2.78 MB). November 4, 2016.

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Natural Resources Canada (2007) National Hydro Network. Retrieved on November 4, 2016.

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Related information

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Annexes

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

Table A.1. Data for Figure 1. Water quality, Canada, 2013 to 2015 period

Land use category	Poor (number of sites)	Poor (percentage of sites)	Marginal (number of sites)	Marginal (percentage of sites)	Fair (number of sites)	Fair (percentage of sites)	Good (number of sites)	Good (percentage of sites)	Excellent (number of sites)	Excellent (percentage of sites)
Agriculture[A]	0	0	10	5.7	21	11.9	8	4.5	1	0.6
Mining[A]	1	0.6	4	2.3	13	7.4	8	4.5	0	0
Mixed pressures[A]	3	1.7	17	9.7	22	12.5	12	6.8	0	0
Undeveloped[A]	0	0	0	0	8	4.5	41	23.3	7	4.0
Uncategorized	0	n/a	0	n/a	2	n/a	0	n/a	0	n/a
Total	4	2.2	31	17.4	66	37.1	69	38.8	8	4.5

Note: n/a = not applicable. Water quality was evaluated at 178 sites across southern Canada using the Canadian Council of Ministers of the Environment's water quality index. Two sites have not had their land use categorized because they are close to the Canada-United States border or the ocean. They have not been included in the land use indicator. Percentages may not add up to 100 due to rounding.
[A] Percentages by land use category do not include the 2 uncategorized sites.
Source: Data assembled by Environment and Climate Change Canada from federal, provincial and joint water quality monitoring programs. Population, mining and land cover statistics for each site's drainage area were provided by Statistics Canada.

Table A.2. Data for Figure 2. Trends in water quality, Canada, 2002 to 2015

Change	Number of sites	Percentage of sites
Improving water quality	20	11
Deteriorating water quality	10	6
No change in water quality	148	83
Total	178	100

Note: The trend in water quality between the first year that data were reported for each site and 2015 was calculated at 178 sites across southern Canada. A uniform set of water quality guidelines and parameters were used through time at each site for the trend analysis. Changes in water quality from the first year of data collected at the site to 2015 are evaluated by dividing the concentration of each water quality parameter at a site by its guideline for each sampling date. These ratios are averaged annually to obtain the deviation ratio at a site. A Mann-Kendall test was used to assess whether there was a statistically-significant increasing or decreasing trend in the annual guideline deviation ratios at a site.
Source: Data assembled by Environment and Climate Change Canada from federal, provincial and joint water quality monitoring programs.

Table A.3. Data for Figure 3. Regional water quality, Canada, 2013 to 2015 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	3	7	2	3	2	4	2	10	1	4
Good	29	63	16	27	14	30	12	57	10	40
Fair	11	24	24	41	19	41	5	24	11	44
Marginal	3	7	14	24	11	24	2	10	2	8
Poor	0	0	3	5	0	0	0	0	1	4
Total	46	100	59	100	46	100	21	100	25	100

Note: Water quality was assessed at 197 sites across Canada using the Canadian Council of Ministers of the Environment's water quality index. The additional monitoring sites improve the coverage of the northern portions of the McKenzie River and Pacific Ocean regions. 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, 2013 to 2015 period

Land use category	Poor (number of sites)	Poor (percentage of sites)	Marginal (number of sites)	Marginal (percentage of sites)	Fair (number of sites)	Fair (percentage of sites)	Good (number of sites)	Good (percentage of sites)	Excellent (number of sites)	Excellent (percentage of sites)
Agriculture	0	0	0	0	3	7	3	7	0	0
Mining	0	0	0	0	2	4	3	7	0	0
Mixed pressures	0	0	3	7	2	4	0	0	0	0
Undeveloped	0	0	0	0	4	9	23	50	3	7
Total	0	0	3	7	11	24	29	63	3	7

Note: Water quality by land use category was assessed at 46 sites on rivers draining into the Atlantic Ocean using the Canadian Council of Ministers of the Environment's water quality index. 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, mining and land cover statistics for each site's drainage area were provided by Statistics Canada.

Table A.5. Data for Figure 5. Water quality by land use category, Great Lakes and St. Lawrence River region, Canada, 2013 to 2015 period

Land use category	Poor (number of sites)	Poor (percentage of sites)	Marginal (number of sites)	Marginal (percentage of sites)	Fair (number of sites)	Fair (percentage of sites)	Good (number of sites)	Good (Percentage of sites)	Excellent (number of sites)	Excellent (percentage of sites)
Agriculture	0	0	5	8	5	8	2	3	1	2
Mining	0	0	1	2	4	7	2	3	0	0
Mixed pressures	3	5	8	14	13	22	4	7	0	0
Undeveloped	0	0	0	0	2	3	8	14	1	2
Total	3	5	14	24	24	41	16	27	2	3

Note: Water quality by land use category was assessed at 59 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. 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, mining and land cover statistics for each site's drainage area were provided by Statistics Canada.

Table A.6. Data for Figure 6. Water quality by land use category, Hudson Bay region, 2013 to 2015 period

Land use category	Poor (number of sites)	Poor (percentage of sites)	Marginal (number of sites)	Marginal (percentage of sites)	Fair (number of sites)	Fair (percentage of sites)	Good (number of sites)	Good (percentage of sites)	Excellent (number of sites)	Excellent (percentage of sites)
Agriculture	0	0	5	11	12	26	3	7	0	0
Mining	0	0	0	0	0	0	2	4	0	0
Mixed pressures	0	0	6	13	7	15	8	17	0	0
Undeveloped	0	0	0	0	0	0	1	2	2	4
Total	0	0	11	24	19	41	14	30	2	4

Note: Water quality by land use category was assessed at 46 sites on rivers draining into the Hudson Bay using the Canadian Council of Ministers of the Environment's water quality index. 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, mining and land cover statistics for each site's drainage area were provided by Statistics Canada.

Table A.7. Data for Figure 7. Water quality by land use category, Mackenzie River region, 2013 to 2015 period

Land use category	Poor (number of sites)	Poor (percentage of sites)	Marginal (number of sites)	Marginal (percentage of sites)	Fair (number of sites)	Fair (percentage of sites)	Good (number of sites)	Good (percentage of sites)	Excellent (number of sites)	Excellent (percentage of sites)
Agriculture[A]	0	0	0	0	0	0	0	0	0	0
Mining[A]	0	0	1	6	4	22	2	11	0	0
Mixed pressures[A]	0	0	0	0	0	0	0	0	0	0
Undeveloped[A]	0	0	0	0	0	0	9	50	2	11
Uncategorized	0	n/a	1	n/a	1	n/a	1	n/a	0	n/a
Total	0	0	2	10	5	24	12	57	2	10

Note: n/a = not applicable. Water quality was assessed at 21 sites on rivers draining into the Mackenzie River using the Canadian Council of Ministers of the Environment's water quality index. Three sites have not had their land use categorized and are not included in the chart. Percentages may not add up to 100 due to rounding.
[A] Percentages by land use category do not include the 3 uncategorized sites.
Source: Water quality data were assembled by Environment and Climate Change Canada from existing federal, provincial, territorial and joint water quality monitoring programs. Population, mining and land cover statistics for each site's drainage area were provided by Statistics Canada.

Table A.8. Data for Figure 8. Water quality by land use category, Pacific Ocean region, 2013 to 2015 period

Land use category	Poor (number of sites)	Poor (percentage of sites)	Marginal (number of sites)	Marginal (percentage of sites)	Fair (number of sites)	Fair (percentage of sites)	Good (number of sites)	Good (percentage of sites)	Excellent (number of sites)	Excellent (percentage of sites)
Agriculture[A]	0	0	0	0	1	5	0	0	0	0
Mining[A]	1	5	2	10	4	20	1	5	0	0
Mixed pressures[A]	0	0	0	0	0	0	0	0	0	0
Undeveloped[A]	0	0	0	0	2	10	8	40	1	5
Uncategorized	0	n/a	0	n/a	4	n/a	1	n/a	0	n/a
Total	1	4	2	8	11	44	10	40	1	5

Note: n/a = not applicable. Water quality was assessed at 25 sites on rivers draining into the Pacific Ocean using the Canadian Council of Ministers of the Environment's water quality index. Five sites are not included in the chart; their land use is not categorized because they are close to the Canada-United States border or the ocean. Percentages may not add up to 100 due to rounding.

[A] Percentages by land use category do not include the 5 uncategorized sites.

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

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, NB, NS, NL, PEI - 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	Ambient water quality monitoring network	Manitoba Water Stewardship
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 Municipal Affairs and Environment
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
Ontario	Provincial Water Quality Monitoring Network with the Conservation Authorities	Ontario Ministry of the Environment and Climate Change

Province/territory	Monitoring program	Organization(s)
Prince Edward Island	Canada-Prince Edward Island Water Quality Agreement	Environment and Climate Change Canada, Prince Edward Island Department of Environment, Energy and Forestry
Quebec	Canada-Quebec Water Quality Agreement	Environment and Climate Change Canada, Ministère du Développement durable, Environnement et Lutte contre les changements climatiques du Québec
Quebec	Réseau-Rivières	Ministère du Développement durable, Environnement et Lutte contre les changements climatiques du Québec
Saskatchewan	Saskatchewan Water Security Agency Water Quality Monitoring Program	Saskatchewan Water Security Agency
Northwest Territories and Nunavut	Parks Canada Western Arctic parks water quality monitoring program (Aulavik and Tuktut Nogait); Environment and Climate Change Canada-Parks Canada water quality monitoring program in Eastern Arctic parks (Quttinirpaaq and Auyuittuq); Environment and Climate Change Canada-Parks Canada water quality monitoring program in Nahanni National Park; Government of Northwest Territories water quality programs in the Northwest Territories basins (Coppermine, Yellowknife, Lockhart, Slave, Hay, Liard, Peel, Snare, Burnside River basins)	Environment and Climate Change Canada, Parks 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 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 by Alberta

Parameter	Form	Guideline	Source
2,4-D[A]	total	4 µg/L	1
Aluminium[A]	dissolved	0.005 mg/L for pH < 6.5 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	$e^{1.0166*\ln[\text{hardness}]-3.924}$ µg/L 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 $0.2*e^{0.8545*\ln[\text{hardness}]-1.465}$ µg/L for hardness > 90 mg [$CaCO_3$]/L	4
Lead[A]	total	$e^{1.273*\ln[\text{hardness}]-4.705}$ µg/L for hardness > 5.3 mg [$CaCO_3$]/L and ≤ 360 mg [$CaCO_3$]/L	3
Lead[B]	total	1 µg/L for hardness < 50 mg [$CaCO_3$]/L $e^{1.273*\ln[\text{hardness}]-4.705}$ µg/L for hardness ≥ 50 mg [$CaCO_3$]/L	4
MCPA[A]		2.6 µg/L	1
Mercury[A]	total inorganic	0.026 µg/L	1
Nickel[B]	total	$e^{0.76*\ln[\text{hardness}]+1.06}$ µg/L where hardness is measured as mg [$CaCO_3$]/L	4
Nitrogen	total	1 mg N/L	3

Parameter	Form	Guideline	Source
Oxygen	dissolved	6.5 mg/L	1 3
pH[B]		between 6.5 and 9	1
Phosphorus	total	0.05 mg/L	3 5
Selenium[A]	total	2 µg/L	4
Zinc	total	7.5 µg/L for hardness ≤ 90 mg [$CaCO_3$]/L 7.5 + 0.75*(hardness-90) for hardness > 90 mg [$CaCO_3$]/L	4

Note:
[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 (2016) Canadian Water Quality Guidelines for the Protection of Aquatic Life Summary Table. Retrieved on December 6, 2016.

2 United States Environmental Protection Agency (2001) 2001 Update of Ambient Water Quality Criteria for Cadmium. Document EPA 822-R-01-001. Retrieved on December 6, 2016.

3 Alberta Environment (2014) Environmental Quality Guidelines for Alberta Surface Waters (PDF; 1.8 MB). Retrieved on December 6, 2016.

4 Government of Canada (2008) Technical Guidance Document for Water Quality Index Practitioners Reporting Under the Canadian Environmental Sustainability Indicators (CESI) Initiative 2008. Environment Canada and Statistics Canada. Retrieved on December 6, 2016.

5 Prairie Provinces Water Board (1992) Master Agreement on Apportionment. Schedule E: Agreement on Water Quality. Retrieved on December 6, 2016.

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

Parameter	Form	Guideline	Source
Alkalinity		20 mg [$CaCO_3$]/L	1
Arsenic	total	5 µg/L	2
Cadmium	total	$10^{(0.83(\log10[\text{hardness}])-2.46)}$ µg/L for hardness > 50 mg [$CaCO_3$]/L 0.09 µg/L for hardness < 50 mg [$CaCO_3$]/L $SSG^{[A]}$ (certain sites)	2 3
Chloride	total dissolved	120 mg/L	2
Chromium	total	$SSG^{[A]}$	1 3 4 5 6 7 8 9 11
Copper	total	2 µg/L for hardness < 90 mg [$CaCO_3$]/L $0.2*e^{0.8545*\ln[\text{hardness}]-1.465}$ µg/L for hardness > 90 mg [$CaCO_3$]/L $SSG^{[A]}$ (certain sites)	4 8 10 11 12 13
Cyanide	weak acid dissociable	5 µg/L	2
Fluoride	total	0.3 mg/L (BC08NM001) 0.35 mg/L (BC08NN0021)	14
Iron	total	0.3 mg/L	12
Lead	total	1 µg/L for hardness < 50 mg [$CaCO_3$]/L $e^{1.273*\ln[\text{hardness}]-4.705}$ µg/L for hardness > 50 mg [$CaCO_3$]/L $SSG^{[A]}$ (certain sites)	12 15
Manganese	total dissolved	50 µg/L	16 17
Molybdenum	total	50 µg/L 73 µg/L (BC08MH0027)	2 18
Nickel	total	$e^{0.76*\ln[\text{hardness}]+1.06}$ µg/L where hardness is measured as mg [$CaCO_3$]/L	12

Parameter	Form	Guideline	Source
Nitrate	total dissolved	2.93 mg N/L	12
Nitrite	total	0.02 mg N/L	19
Nitrogen	total, total dissolved	1.1 mg N/L	19
Oxygen	dissolved	SSG[A]	2 20 21
pH		SSG[A]	2 3 11 20
Phosphorus	total and total dissolved	0.025 mg/L	12 22
Selenium	total dissolved	SSG[A]	12
Silver	total	0.05 µg/L for hardness ≤ 100 mg [$CaCO_3$]/L 1.9 µg/L for hardness > 100 mg [$CaCO_3$]/L SSG[A] (certain sites)	12 23
Sulphate	dissolved	309 mg/L (BC08MH0027) 218 mg/L (BC08NM0001)	12
Temperature		SSG[A]	24
Thallium	total	0.8 µg/L	2
Uranium	total	10 µg/L	1
Zinc	total	7.5 µg/L SSG[A] (certain sites)	3 4 8 16 25

Note:
[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).[26]

British Columbia Water Quality Guideline Sources:

1 British Columbia Ministry of Environment (2015) Working Water Quality Guidelines for British Columbia (2015) (PDF; 773 KB). Retrieved on December 6, 2016.

2 Canadian Council of Ministers of the Environment (2016) Canadian Water Quality Guidelines for the Protection of Aquatic Life Summary Table. Retrieved on December 6, 2016.

3 Butcher GA (1992) Lower Columbia River, Hugh Keeleyside dam to Birchbank water quality assessment and objectives: Technical appendix. British Columbia Ministry of the Environment, Lands and Parks (PDF; 9.87 MB). Retrieved on December 6, 2016.

4 British Columbia Ministry of Environment (2000) Ambient Water Quality Assessment and Objectives for the Lower Columbia River: Birchbank to the US border. Retrieved on December 6, 2016.

5 Environment Canada (2005) Site-specific Water Quality Guidelines for the Beaver River at Park Gate Highway 1 for the Purpose of National Reporting. Tri-Star Environmental Consulting.

6 Environment Canada (2005) Site-specific Water Quality Guidelines for the Kicking Horse River above Field, BC for the Purpose of National Reporting. Tri-Star Environmental Consulting.

7 Environment Canada (2005) Site-specific Water Quality Guidelines for the Liard River at Upper Crossing for the Purpose of National Reporting (PDF; 444 KB). Tri-Star Environmental Consulting. Retrieved on December 6, 2016.

8 Environment Canada (2005) Site-specific Water Quality Guidelines for the Skeena River at Usk for the Purpose of National Reporting (PDF; 709 KB). Tri-Star Environmental Consulting. Retrieved on December 6, 2016.

9 Environment Canada (2005) Site-specific Water Quality Guidelines for the Kootenay River at Kootenay Crossing for the Purpose of National Reporting (PDF; 591 KB). Tri-Star Environmental Consulting. Retrieved on December 6, 2016.

10 British Columbia Ministry of Environment (1987) Water Quality Criteria for Copper: Overview Report (PDF; 215 KB). Retrieved on December 6, 2016.

11 British Columbia Ministry of Water, Land and Air Protection (1997) Water Quality Assessment and Objectives for the Fraser River from Moose Lake to Hope (PDF; 12.5 MB). Retrieved on December 6, 2016.

12 Government of Canada (2008) Technical Guidance Document for Water Quality Index Practitioners Reporting Under the Canadian Environmental Sustainability Indicators (CESI) Initiative 2008. Environment Canada and Statistics Canada. Retrieved on December 6, 2016.

13 British Columbia Ministry of Water, Land and Air Protection (2004) Water Quality Assessment and Objectives for the Elk River for the Purpose of National Reporting.

14 British Columbia Ministry of Environment (2017) British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture (PDF; 1.0 MB). Retrieved on December 6, 2016.

15 British Columbia Ministry of Environment (1987) Water Quality Criteria for Lead: Overview Report (PDF; 252 KB). Retrieved on December 6, 2016.

16 Swain LG (1990) Okanagan Area, Similkameen River Sub-basin Water Quality Assessment and Objectives. British Columbia Ministry of Environment. Retrieved on December 6, 2016.

17 Nagpal NK (2001) Ambient Water Quality Guidelines for Manganese: Overview Report (PDF; 122 KB). British Columbia Ministry of Environment. December 6, 2016.

18 Environment Canada (2005) Site-specific Water Quality Guidelines for the Sumas River at the International Boundary for the Purpose of National Reporting (PDF; 414 KB). Tri-Star Environmental Consulting. Retrieved on December 6, 2016.

19 Nordin RN and Pommen LW (2009) Water Quality Criteria for Nitrogen (Nitrate, Nitrite, and Ammonia): Overview Report. British Columbia Ministry of Environment and Parks (PDF; 508 KB). Retrieved on December 6, 2016.

20 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 December 6, 2016.

21 Swain LG (1987) Takla-Nechako Areas, Nechako River Water Quality Assessment and Objectives. British Columbia Ministry of Environment and Parks. Retrieved on December 6, 2016.

22 Ontario Ministry of the Environment and Energy (1994) Water Management Policies, Guidelines, Provincial Water Quality Objectives. Retrieved on December 6, 2016.

23 British Columbia Ministry of Environment (1996) Ambient Water Quality Criteria for Silver (PDF; 121 KB). Retrieved on December 6, 2016.

24 British Columbia Ministry of Environment (2001) Water Quality Guidelines for Temperature: Overview Report (PDF; 222 KB). Retrieved on December 6, 2016.

25 British Columbia Ministry of Environment (1999) Ambient Water Quality Guidelines for Zinc: Overview Report (PDF; 191 KB). Retrieved on December 6, 2016.

26 British Columbia Ministry of Environment (1997) Guidance for the Derivation and Application of Water Quality Objectives in British Columbia (PDF; 1.2 MB). Retrieved on December 6, 2016

Table C.3. Water quality guidelines used by Manitoba

Parameter	Form	Guideline	Source
2,4-D		4 µg/L	1
Ammonia	total as N	Calculation based on pH and temperature	2 3
Ammonia	un-ionized	19 µg/L	1 4
Arsenic[A]	extractable, total	150 µg/L	5
Arsenic[B]	total	5 µg/L	1
Cadmium[A]	extractable, total	$e^{1.0166*\ln[\text{hardness}]-3.924}$ µg/L where hardness is measured as mg [$CaCO_3$]/L	6
Chloride[B]	dissolved	120 mg/L	1
Copper[A]	extractable, total	$[e^{0.8545*\ln[\text{hardness}]-1.702}]*(0.96)$ µg/L where hardness is measured as mg [$CaCO_3$]/L	2
Copper[B]	total	2 µg/L for hardness < 90 mg [$CaCO_3$]/L $0.2*[e^{0.8545*\ln[\text{hardness}]-1.465}]$ µg/L for hardness > 90 mg [$CaCO_3$]/L	4
Iron[A]	total	0.3 mg/L	4
Lead[A]	extractable, total	$(e^{1.273*\ln[\text{hardness}]-4.705}) * (1.46203 - (\ln[\text{hardness}]*0.145712))$ µg/L where hardness is measured as mg [$CaCO_3$]/L	2
Lead[B]	Total	1 µg/L for hardness < 50 mg [$CaCO_3$]/L $e^{1.273*\ln[\text{hardness}]-4.705}$ µg/L for hardness ≥ 50 mg [$CaCO_3$]/L where hardness is measured as mg [$CaCO_3$]/L	4
MCPA		2.6 µg/L	1
Nickel[A]	extractable, total	$e^{0.8460*\ln[\text{hardness}]+0.0584}$ µg/L where hardness is measured as mg [$CaCO_3$]/L	5
Nickel[B]	total	$e^{0.76*\ln[\text{hardness}]+1.06}$ µg/L where hardness is measured as mg [$CaCO_3$]/L	4
Nitrate[A]	total 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

Parameter	Form	Guideline	Source
pH		between 6.5 and 9	1
Phosphorus	total	0.05 mg/L	2 7
Suspended sediments[A]	total	Maximum increase of 25 mg/L for high flow and turbid waters above background levels	4
Zinc[A]	total	$e^{(0.8473*\ln[\text{hardness}]+0.884)}*0.986$ µg/L where hardness is measured as mg [$CaCO_3$]/L	2 6
Zinc[B]	total	7.5 µg/L for hardness ≤ 90 mg [$CaCO_3$]/L 7.5 + 0.75*(hardness-90) for hardness > 90 mg [$CaCO_3$]/L	4

Note:
[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 (2016) Canadian Water Quality Guidelines for the Protection of Aquatic Life Summary Table. Retrieved on December 6, 2016.

2 Manitoba Water Stewardship (2011) Manitoba Water Quality Standards, Objectives, and Guidelines (PDF; 905 KB). Retrieved on December 6, 2016.

3 United States Environmental Protection Agency (1999a) Update of Ambient Water Quality Criteria for Ammonia. Document EPA 822-R-99-014. Retrieved on December 6, 2016.

4 Government of Canada (2008) Technical Guidance Document for Water Quality Index Practitioners Reporting Under the Canadian Environmental Sustainability Indicators (CESI) Initiative 2008. Environment Canada and Statistics Canada. Retrieved on December 6, 2016.

5 United States Environmental Protection Agency (2016) National Recommended Water Quality Criteria – Aquatic Life Criteria Table. Retrieved on December 6, 2016.

6 United States Environmental Protection Agency (2001) 2001 Update of Ambient Water Quality Criteria for Cadmium. Document EPA 822-R-01-001 (PDF; 126 KB). Retrieved on December 6, 2016.

7 Prairie Provinces Water Board (1992) Master Agreement on Apportionment. Schedule E: Agreement on Water Quality. Retrieved on December 6, 2016.

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

Parameter	Form	Guideline	Source
Ammonia	un-ionized	19 µg/L	1
Arsenic	total	5 µg/L	2
Chloride	total	120 mg/L	2
Copper	total	2 µg/L for hardness < 90 mg [$CaCO_3$]/L $0.2*e^{0.8545*ln[hardness]-1.465}$ µg/L for hardness > 90 mg [$CaCO_3$]/L	1
Iron	total	0.3 mg/L	1
Nitrate	total	2.9 mg N/L	1
Oxygen	dissolved	6.5 mg/L	2
pH		between 6.5 and 9	2
Phosphorus	total	0.03 mg/L	1
Turbidity		10 NTU (SSG[A])	2
Zinc	total	7.5 µg/L for hardness ≤ 90 mg [$CaCO_3$]/L 7.5 + 0.75*(hardness-90) for hardness > 90 mg [$CaCO_3$]/L	1

Note:
[A] 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 Canada and Statistics Canada. Retrieved on December 6, 2016.

2 Canadian Council of Ministers of the Environment (2016) Canadian Water Quality Guidelines for the Protection of Aquatic Life Summary Table. Retrieved on December 6, 2016.

Table C.5. Water quality guidelines used by 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 $0.2*e^{0.8545*ln[hardness]-1.465}$ µg/L for hardness > 90 mg $[CaCO_3]$/L	2
Iron	total	SSG[A]	2 3
Lead	total	1 µg/L for hardness < 50 mg $[CaCO_3]$/L $e^{1.273*ln[hardness]-4.705}$ µg/L for hardness ≥ 50 mg $[CaCO_3]$/L	2
Nickel	total	$e^{0.76*ln[hardness]+1.06}$ µg/L where hardness is measured as mg $[CaCO_3]$/L	2
Nitrate	total dissolved	3 mg N/L	2
Oxygen	dissolved	between 5.5 and 9.5 mg/L	1
pH		SSG[A]	1 3
Phosphorus	total	0.03 mg/L	2
Zinc	total	7.5 µg/L for hardness ≤ 90 mg $[CaCO_3]$/L 7.5 + 0.75*(hardness-90) for hardness >90 mg $[CaCO_3]$/L	2

Note:
[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 (2016) Canadian Water Quality Guidelines for the Protection of Aquatic Life Summary Table. Retrieved on December 6, 2016.

2 Government of Canada (2008) Technical Guidance Document for Water Quality Index Practitioners Reporting Under the Canadian Environmental Sustainability Indicators (CESI) Initiative 2008. Environment Canada and Statistics Canada. December 6, 2016.

3 Khan AA et al. (2005) Application of CCME Procedures for Deriving Site-specific Water Quality Guidelines for the CCME Water Quality Index. Water Quality Research Journal 40(4):448-456.

Table C.6. Water quality guidelines used by 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 Lotic sites: SSG[A] (mean + 2 standard deviations)	1 2
Copper	total	Lentic-lotic sites: 2 µg/L for hardness < 90 mg $[CaCO_3]$/L $0.2*e^{0.8545*ln[hardness]-1.465}$ µg/L for hardness > 90 mg $[CaCO_3]$/L Lotic sites: SSG[A] (mean + 2 standard deviations)	1 3
Iron	total	Lentic-lotic sites: 0.3 mg/L Lotic sites: SSG[A] (mean + 2 standard deviations)	1 3
Lead	total	Lentic-lotic sites: 1 µg/L for hardness < 50 mg $[CaCO_3]$/L $e^{1.273*ln[hardness]-4.705}$ µg/L for hardness ≥ 50 mg $[CaCO_3]$/L Lotic sites: SSG[A] (mean + 2 standard deviations)	1 3
Nitrate and nitrite	total dissolved	SSG[A]	1
Oxygen	dissolved	5 mg/L	2
pH		Lentic-lotic sites: between 6.5 and 9 Lotic sites: SSG[A] (mean + 2 standard deviations)	1 2
Phosphorus	total	Lentic-lotic sites: 0.03 mg/L Lotic sites: SSG[A] (mean + 2 standard deviations)	2 3
Zinc	total	Lentic-lotic sites: 7.5 µg/L for hardness ≤ 90 mg $[CaCO_3]$/L 7.5 + 0.75*(hardness-90) for hardness >90 mg $[CaCO_3]$/L Lotic sites: SSG[A] (mean + 2 standard deviations)	2 3

Note:
[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. Environmental Monitoring and Assessment 113:411-429.

2 Canadian Council of Ministers of the Environment (2016) Canadian Water Quality Guidelines for

the Protection of Aquatic Life Summary Table. Retrieved on December 6, 2016.

3 Government of Canada (2008) Technical Guidance Document for Water Quality Index Practitioners Reporting Under the Canadian Environmental Sustainability Indicators (CESI) Initiative 2008. Environment Canada and Statistics Canada. Retrieved on December 6, 2016.

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

Parameter	Form	Guideline	Source
Chloride	total	120 mg/L	1
Copper	extractable	2 µg/L for hardness < 90 mg [$CaCO_3$]/L $0.2*e^{0.8545*ln[hardness]-1.465}$ µg/L for hardness > 90 mg [$CaCO_3$]/L	2
Iron	extractable	0.3 mg/L	2
Lead	extractable	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 where hardness is measured as mg [$CaCO_3$]/L	2
Nitrate	dissolved	3 mg N/L	2
Oxygen	dissolved	6.5 mg/L	1
pH		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 7.5 + 0.75*(hardness-90) for hardness > 90 mg [$CaCO_3$]/L	2

Nova Scotia Water Quality Guideline Sources:

1 Canadian Council of Ministers of the Environment (2016) Canadian Water Quality Guidelines for the Protection of Aquatic Life Summary Table. Retrieved on December 6, 2016.

2 Government of Canada (2008) Technical Guidance Document for Water Quality Index Practitioners Reporting Under the Canadian Environmental Sustainability Indicators (CESI) Initiative 2008. Environment Canada and Statistics Canada. Retrieved on December 6, 2016.

Table C.8. Water quality guidelines used by Ontario

Parameter	Form	Guideline	Source
Ammonia	un-ionized	19 µg/L	1 2
Chloride	total	120 mg/L	1
Chromium	total	2 µg/L guideline for Cr(VI) adjusted to total chromium	1
Nickel	total	$e^{0.76*\ln[\text{hardness}]+1.06}$ µg/L where hardness is measured as mg [$CaCO_3$]/L	2
Nitrate	total dissolved	2.93 mg N/L	2
Phosphorus	total	0.03 mg/L	2 3
Zinc	total	7.5 µg/L for hardness ≤ 90 mg [$CaCO_3$]/L 7.5 + 0.75*(hardness-90) for hardness > 90 mg [$CaCO_3$]/L	2

Ontario Water Quality Guideline Sources:

1 Canadian Council of Ministers of the Environment (2016) Canadian Water Quality Guidelines for the Protection of Aquatic Life Summary Table. Retrieved on December 6, 2016.

2 Government of Canada (2008) Technical Guidance Document for Water Quality Index Practitioners Reporting Under the Canadian Environmental Sustainability Indicators (CESI) Initiative 2008. Environment Canada and Statistics Canada. Retrieved on December 6, 2016.

3 Ontario Ministry of the Environment and Energy (1994) Water Management Policies, Guidelines, Provincial Water Quality Objectives. Retrieved on December 6, 2016.

Table C.9. Water quality guidelines used by 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 $0.2*e^{0.8545*ln[hardness]-1.465}$ µg/L for hardness > 90 mg [$CaCO_3$]/L	1
Nitrate	total dissolved	SSG[A]	2
Oxygen	dissolved	6.5 mg/L	1
pH		between 6.5 and 9	1
Phosphorus	total	SSG[A]	2
Suspended sediments	total	29 mg/L (SSG[A])	1
Zinc	total	7.5 µg/L for hardness ≤ 90 mg [$CaCO_3$]/L 7.5 + 0.75*(hardness-90) for hardness > 90 mg [$CaCO_3$]/L	1

Note:
[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 (2016) Canadian Water Quality Guidelines for the Protection of Aquatic Life Summary Table. Retrieved on December 6, 2016.

2 Government of Canada (2008) Technical Guidance Document for Water Quality Index Practitioners Reporting Under the Canadian Environmental Sustainability Indicators (CESI) Initiative 2008. Environment Canada and Statistics Canada. Retrieved on 17 December, 2014.

Table C.10. Water quality guidelines used by Quebec

Parameter	Form	Guideline	Source
Ammonia	un-ionized	0.05 mg/L	1
Atrazine[A]		1.8 µg/L	1
Bentazone[A]		0.51 mg/L	2
Chlorophyll a		8 mg/L	3
Copper[A]	extractable	2 µg/L for hardness < 90 mg $[CaCO_3]$/L $0.2*e^{0.8545*ln[hardness]-1.465}$ µg/L for hardness > 90 mg $[CaCO_3]$/L	3
Dicamba[A]		10 µg/L	1
Mercury[A]	total	0.05 µg/L	
Metolachlor[A]		7.8 µg/L	1
Nickel[A]	total	$e^{0.76*ln[hardness]+1.06}$ µg/L where hardness is measured as mg $[CaCO_3]$/L	3
Nitrate and nitrite	total dissolved	2.9 mg N/L	1 3
pH		between 6.5 and 9	1 2
Phosphorus	total	0.03 mg/L	2
Turbidity		10 NTU	3
Zinc[A]	total	7.5 µg/L for hardness ≤ 90 mg $[CaCO_3]$/L 7.5 + 0.75*(hardness-90) for hardness > 90 mg $[CaCO_3]$/L	3

Note:
[A] Only applies to sites monitored under federal monitoring programs.

Quebec Water Quality Guideline Sources:

1 Canadian Council of Ministers of the Environment (2016) Canadian Water Quality Guidelines for the Protection of Aquatic Life Summary Table. Retrieved on December 6, 2016.

2 Ministère du Développement durable, Environnement, Faune et Parcs (2009) Critères de qualité de l'eau de surface (available in French only). Retrieved on December 6, 2016.

3 Government of Canada (2008) Technical Guidance Document for Water Quality Index Practitioners Reporting Under the Canadian Environmental Sustainability Indicators (CESI) Initiative 2008. Environment Canada and Statistics Canada. Retrieved on December 6, 2016.

Table C.11. Water quality guidelines used by Saskatchewan

Parameter	Form	Guideline	Source
2,4-D		4 µg/L	1
Ammonia	un-ionized	19 µg/L	1
Arsenic	total	5 µg/L	1
Chloride	dissolved	120 mg/L	1
Copper	total	2 µg/L for hardness < 90 mg [$CaCO_3$]/L $0.2*e^{0.8545*ln[hardness]-1.465}$ µg/L for hardness > 90 mg [$CaCO_3$]/L	2
Lead	total	1 µg/L for hardness < 50 mg [$CaCO_3$]/L $e^{1.273*ln[hardness]-4.705}$ µg/L for hardness ≥ 50 mg [$CaCO_3$]/L	2
MCPA		2.6 µg/L	1
Nickel	total	$e^{0.76*ln[hardness]+1.06}$ µg/L where hardness is measured as mg [$CaCO_3$]/L	2
Nitrogen	total	1 mg N/L	
Oxygen	dissolved	6.5 mg/L	1
pH		between 6.5 and 9	1
Phosphorus	total	0.05 mg/L	3 4
Zinc	total	7.5 µg/L for hardness ≤ 90 mg [$CaCO_3$]/L 7.5 + 0.75*(hardness-90) for hardness > 90 mg [$CaCO_3$]/L	2

Saskatchewan Water Quality Guideline Sources:

1 Canadian Council of Ministers of the Environment (2016) Canadian Water Quality Guidelines for the Protection of Aquatic Life Summary Table. Retrieved on December 6, 2016.

2 Government of Canada (2008) Technical Guidance Document for Water Quality Index Practitioners Reporting Under the Canadian Environmental Sustainability Indicators (CESI) Initiative 2008. Environment Canada and Statistics Canada. Retrieved on December 6, 2016.

3 Alberta Environment (2014) Environmental Quality Guidelines for Alberta Surface Waters (PDF; 1.8 MB). Retrieved on December 6, 2016.

4 Prairie Provinces Water Board (1992) Master Agreement on Apportionment. Schedule E: Agreement on Water Quality. Retrieved on 17 December, 2014.

Table C.12. Water quality guidelines used by 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 $0.2*e^{0.8545*ln[hardness]-1.465}$ µg/L for hardness > 90 mg [$CaCO_3$]/L	3
Lead	total	1 µg/L for hardness < 50 mg [$CaCO_3$]/L $e^{1.273*ln[hardness]-4.705}$ 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		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 1.9 µg/L for hardness > 100 mg [$CaCO_3$]/L	3
Temperature		SSG[A]	3
Zinc	total	7.5 µg/L for hardness ≤ 90 mg [$CaCO_3$]/L 7.5 + 0.75*(hardness-90) for hardness > 90 mg [$CaCO_3$]/L	3

Note:
[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 (2016) Canadian Water Quality Guidelines for the Protection of Aquatic Life Summary Table. Retrieved on December 6, 2016.

2 Environment Canada (2005) Site-specific Water Quality Guidelines for the Liard River at Upper Crossing for the Purpose of National Reporting, Tri-Star Environmental Consulting (PDF; 444 KB). Retrieved on December 6, 2016.

3 Government of Canada (2008) Technical Guidance Document for Water Quality Index Practitioners Reporting Under the Canadian Environmental Sustainability Indicators (CESI) Initiative 2008. Environment Canada and Statistics Canada. Retrieved on December 6, 2016.

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 (PDF; 508 KB). Retrieved on December 6, 2016.

5 British Columbia Ministry of Environment (1997) Ambient Water Quality Criteria for Dissolved Oxygen (PDF; 852 KB). British Columbia Ministry of Environment, Water Management Branch. Victoria, BC. Retrieved on December 6, 2016.

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