Environment and Climate Change Canada
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METAL AND DIAMOND MINING EFFLUENT QUALITY

CANADIAN ENVIRONMENTAL SUSTAINABILITY INDICATORS

Canada

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Environment and Climate Change Canada
Public Inquiries Centre
12th Floor Fontaine Building
200 Sacré-Coeur Blvd
Gatineau QC K1A 0H3
Telephone: 1-800-668-6767 (in Canada only) or 819-938-3860
Fax: 819-938-3318
Email: enviroinfo@ec.gc.ca

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Metal and diamond mining effluent quality

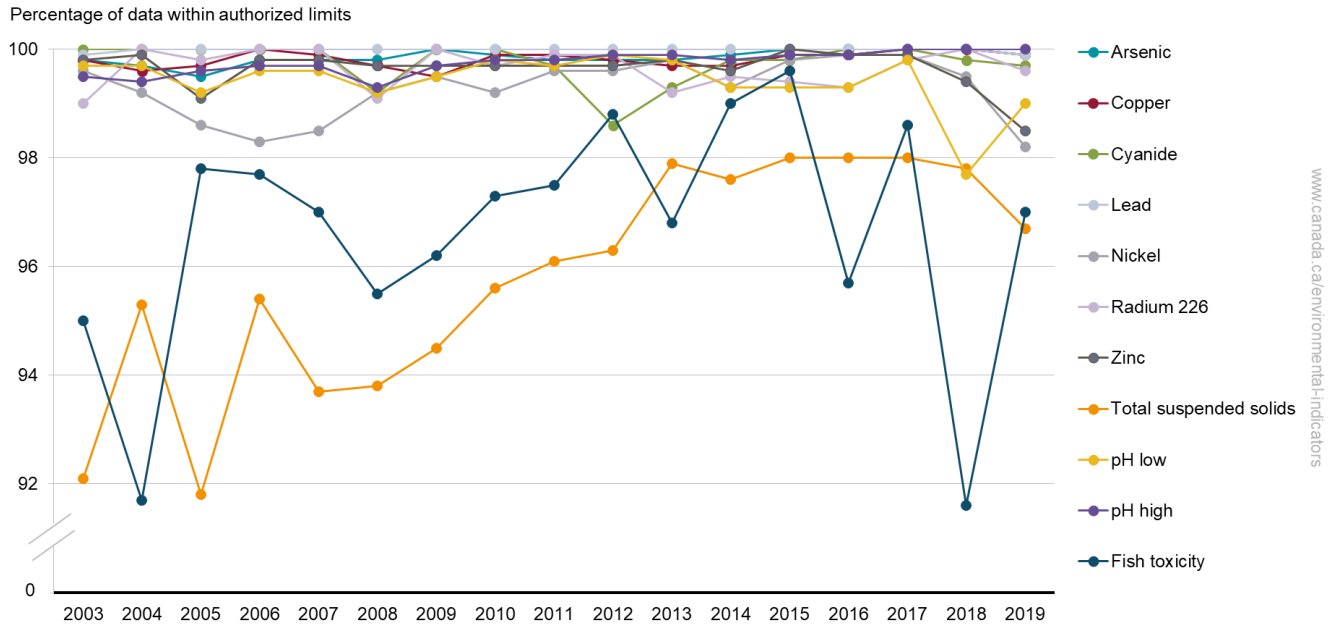
The effects of untreated mining effluent could be highly damaging to aquatic environments. The *Metal and Diamond Mining Effluent Regulations* are designed to protect fish and fish habitat by governing the discharge of mining effluent into water frequented by fish. The indicator summarizes the test results observed since the regulations came into effect in 2002. In 2018 the regulations were amended to include diamond mines, to strengthen effluent limits and to improve the monitoring of environmental effects.[1]

Key results

Between 2003 and 2019, for reported results,

- fish toxicity test results varied between 91.7% and 99.6% compliance with regulatory limits
- the percentage of mining operations meeting regulatory standards for total suspended solids increased from 92.1% to 96.7%
- test results for all other deleterious substances and pH levels[2] ranged from 97.7% to 100% compliance

Figure 1. Percentage of regulatory data submitted by metal and diamond mines within authorized limits,[3] Canada, 2003 to 2019



Data for Figure 1

Note: Deleterious substances listed in the *Metal and Diamond Mining Effluent Regulations* include arsenic, copper, cyanide, lead, nickel, zinc, total suspended solids, and radium 226. The regulations set a minimum (pH low) and maximum (pH high) level for the pH of effluent released. Fish toxicity refers to tests of effluent on mortality rate to fish.
Source: Environment and Climate Change Canada (2021) Mining and Processing Division.

[1] The *Metal and Diamond Mining Effluent Regulations* apply to all Canadian metal mines operating on or after June 6, 2002 and diamond mines operating on or after June 1, 2018.

[2] pH is a measure of the acidity or basicity of water. The range goes from 0 to 14, with 7 being neutral. When the pH is less than 7 the water is acidic whereas a pH greater than 7 indicates a base. Excessively high and low pHs can affect aquatic organisms.

[3] The indicator is calculated by measuring the percentage of reported test results for all metal and diamond mines that are within authorized limits for deleterious substances, pH levels and fish toxicity. Consult the Methods section for more information.

In 2019, the second year diamond mines reported under the amended *Metal and Diamond Mining Effluent Regulations*, 5 diamond mining facilities and 140 metal mining facilities in Canada were subject to the regulations. Compared to the previous year, the percentage of mining operations meeting regulatory standards for deleterious substances and the maximum level for the pH (pH high) decreased or remained at the same level, whereas the compliance percentage for the minimum pH level (pH low) and the fish toxicity increased. For deleterious substances, compliance was 99% for 5 substances and above 98% for the remaining substances, except for total suspended solids which had a compliance rate of 96.7%.

About the indicator

What the indicator measures

The Metal and diamond mining effluent quality indicator presents the annual percentage of reported test results for all metal and diamond mines that are within authorized limits for deleterious substances, pH levels and fish toxicity from 2003 to 2019. The indicator helps Environment and Climate Change Canada evaluate the degree of compliance with the *Metal and Diamond Mining Effluent Regulations* and the effectiveness of pollution prevention and control technologies, practices and programs within the metal and diamond mining sectors. This indicator summarizes the results achieved since the regulations came into effect in June 2002.

Why this indicator is important

Mining is an important sector for the Canadian economy. In 2019, the metal ore and diamond mining industries combined employed 43 110 persons,[4] and accounted for about 1% (19 859 million dollars) of Canada's gross domestic product.[5] Canada ranks among the top 5 countries in terms of the production of diamonds and a number of major metals.[6]

Without adequate regulations, metal and diamond mining could have harmful impacts on the environment. For example, the effects of untreated mining effluent could be highly damaging to aquatic environments, as well as fish and fish habitat. Proper management regimes can mitigate these impacts. These regulations are designed to protect fish and fish habitat by setting standards for effluent released from metal and diamond mines into water frequented by fish. Specifically, the regulations prohibit discharge of effluent that is acutely lethal to fish and set limits for pH of effluent and concentrations of arsenic, copper, cyanide, lead, nickel, zinc, radium 226 and total suspended solids.

Pristine lakes and rivers

This indicator supports the measurement of progress towards the following 2019 to 2022 Federal Sustainable Development Strategy long-term goal: Clean and healthy lakes and rivers support economic prosperity and the well-being of Canadians.

It is used to assess progress towards the short-term milestone: Maintain high compliance rates with *Fisheries Act* regulations to reduce risks from metal mining and pulp and paper effluent.

In addition, the indicator contributes to the Sustainable Development Goals of the 2030 Agenda for Sustainable Development. It is 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."

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[4] Statistics Canada, Table 36-10-0489-01: Labour statistics consistent with the System of National Accounts, by job category and industry, for the metal ore mining (NAICS 2122) and diamond mining (NAICS 212392) industries, annual (persons). Retrieved on June 30, 2021.

[5] Statistics Canada, Table 36-10-0434-03: Gross domestic product at basic prices, by Industry, for the metal ore mining industry (NAICS 2122), annual average (2012 constant million dollars). Retrieved on June 30, 2021.

[6] In 2019, Canada was the third-largest producer of uranium and diamonds. Mining Association of Canada (2021) Facts and Figures of the Canadian Mining Industry 2020. Retrieved on June 30, 2021.

Related indicator

The Pulp and paper effluent quality indicator summarizes the degree of compliance achieved since 1985 under the *Pulp and Paper Effluent Regulations*.

Data sources and methods

Data sources

This indicator uses compliance data provided by metal and diamond mines to Environment and Climate Change Canada under section 22 of the *Metal and Diamond Mining Effluent Regulations* (the regulations).

More information

In 2018, the *Metal Mining Effluent Regulations* were amended to include diamond mines, becoming the *Metal and Diamond Mining Effluent Regulations*. This indicator uses reported data from all mines subject to the regulations that came into effect in June 2002 for metal mines and in June 2018 for diamond mines. They apply to all Canadian metal and diamond mines that have an effluent flow rate exceeding 50 cubic metres per day, and that deposit a deleterious substance in any water or place defined in the regulations.

The regulations define metal mines as any work or undertaking that is designed or is used, or has been used, in connection with a mining, milling or hydrometallurgical activity to produce a metal or a metal concentrate or an ore from which a metal or a metal concentrate may be produced, as well as any cleared or disturbed area that is adjacent to such a work or undertaking. It includes any work or undertaking, such as a smelter, pelletizing plant, sintering plant, refinery or acid plant, if its effluent is combined with the effluent from a mining, milling or hydrometallurgical activity whose purpose is to produce a metal or a metal concentrate or an ore from which a metal or a metal concentrate may be produced. Table 1 presents the number of metal mines subject to the regulations by province and territory from 2003 to 2019.

The regulations define diamond mines as any work or undertaking that is designed or is used, or has been used, in connection with a mining or milling activity to produce a diamond or an ore from which a diamond may be produced. It includes any cleared or disturbed area that is adjacent to such a work or undertaking. Table 2 presents the number of diamond mines subject to the regulations by province and territory for 2018 and 2019.

The indicator uses the quarterly and annual reports of metal and diamond mining effluent discharges submitted to Environment and Climate Change Canada under the regulations.

Table 1. Number of metal mines subject to the regulations by province and territory, 2003 to 2019

Province or territory	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Newfoundland and Labrador	3	3	5	5	5	6	6	6	8	9	10	10	11	11	11	11	10
Prince Edward Island	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nova Scotia	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	2	2
New Brunswick	1	1	1	1	3	3	3	3	3	3	3	3	3	3	3	2	2
Quebec	20	21	21	26	28	30	31	28	28	31	32	32	34	35	35	36	35
Ontario	21	21	22	25	28	29	31	34	37	38	40	40	45	46	46	47	46
Manitoba	9	9	9	8	9	10	10	10	11	10	10	10	10	10	10	10	10
Saskatchewan	8	8	8	8	8	8	8	7	7	9	9	9	8	8	8	8	8
Alberta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
British Columbia	5	5	5	5	6	6	8	9	10	8	8	12	11	13	13	13	14
Yukon	0	0	0	1	1	1	2	2	3	3	3	3	3	3	3	3	4
Northwest Territories	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3
Nunavut	3	3	3	3	2	1	1	2	2	2	2	2	3	4	4	5	6
Canada	**73**	**74**	**77**	**85**	**94**	**98**	**104**	**105**	**112**	**117**	**121**	**125**	**132**	**137**	**137**	**140**	**140**

Source: Environment and Climate Change Canada (2021) Mining and Processing Division.

Table 2. Number of diamond mines subject to the regulations by province and territory, 2018 to 2019

Province or territory	2018	2019
Newfoundland and Labrador	0	0
Prince Edward Island	0	0
Nova Scotia	0	0
New Brunswick	0	0
Quebec	1	1
Ontario	1	1
Manitoba	0	0
Saskatchewan	0	0
Alberta	0	0
British Columbia	0	0
Yukon	0	0
Northwest Territories	3	3
Nunavut	0	0
Canada	**5**	**5**

Source: Environment and Climate Change Canada (2021) Mining and Processing Division.

Methods

The indicator is calculated by measuring the percentage of reported test results for all metal and diamond mines that are within limits authorized for the reported year for deleterious substances, pH levels and fish toxicity. For each substance, this is done by dividing the number of monthly mean results that meet the authorized limits by the total number of monthly mean results reported in a given year. For pH, this is done by dividing the number of pH measurements that are within the allowable pH range by the total number of pH measurements reported in a given year. For fish toxicity, this is done by dividing the number of non lethal fish toxicity test results by the total number of fish toxicity test results reported in a given year.

More information

The regulations include provisions to allow the discharge of metal and diamond mine effluent into water frequented by fish, subject to certain requirements. Mines that are subject to the regulations may deposit an effluent that contains a deleterious substance if:

- the concentration of the deleterious substance in the effluent does not exceed the authorized limits
- the pH of the effluent is equal to, or greater than, 6.0 but is not greater than 9.5
- the effluent is not acutely lethal (an effluent is deemed non-acutely lethal if it kills less than or equal to 50% of the rainbow trout or threespine stickleback subjected to it at 100% concentration over a 96-hour period)

For deleterious substances, individual test results for each substance are compared with the maximum authorized concentration in a grab or composite sample set out in the regulations. All the test results in a month for each substance are used to calculate monthly mean concentrations for each final discharge point. These monthly means are compared to the maximum authorized monthly mean concentration limits set out in the regulations. Table 3 summarizes the maximum authorized monthly mean concentrations, in milligrams per litre or in becquerels per litre, for the deleterious substances listed in the regulations. Note that the regulations have been amended and, as of June 1, 2021, new concentration limits apply and a new substance (un-ionized ammonia) has been added to the list of deleterious substances to report on. These changes will be applicable for the reporting year 2021 onward.

The frequency of test measurements varies depending on the individual mine and its performance. Under the regulations, operators are required to test the effluent at each discharge point weekly for deleterious substances and monthly for acute lethality (fish toxicity) and to record the results of all tests.

The frequency of testing can be reduced to once per quarter in the following instances:

- for arsenic, copper, cyanide, lead, nickel and zinc: if the concentration of the substance from a discharge point is less than 10% of the regulations monthly mean concentration limit for that substance over a period of 12 consecutive months
- for radium 226 from a mine, other than uranium mines: if the concentration of radium 226 is less than 0.037 becquerel per litre in 10 consecutive weeks of testing
- for fish toxicity: if the effluent is determined not to be acutely lethal over a period of 12 consecutive months

Table 3. Authorized limits for deleterious substances

Substances	Maximum authorized monthly mean concentration
Arsenic	0.50 milligram per litre
Copper	0.30 milligram per litre
Cyanide	1.00 milligram per litre
Lead	0.20 milligram per litre
Nickel	0.50 milligram per litre
Zinc	0.50 milligram per litre
Total suspended solids	15.00 milligrams per litre

Substances	Maximum authorized monthly mean concentration
Radium 226	0.37 becquerel per litre

Note: Concentration limits are 1 of the 3 types of limits included in the regulations, the others being the maximum authorized concentration in a composite sample and the maximum authorized concentration in a grab sample. More information about these limits is available in Schedule 4 of the regulations.
Source: *Metal and Diamond Mining Effluent Regulations*, SOR/2002-222.

Caveats and limitations

The 2019 data were compiled by Environment and Climate Change Canada officials using the effluent quality information provided by the metal and diamond mines in their annual and quarterly reports.

For the 2019 data, mining facilities submitted their effluent monitoring information through a new regulatory reporting system. Based on previous reporting years, not all mining facilities provide complete reports. It was determined that 12 facilities did not submit any reports for the 2019 reporting year. At the time of publishing, the number of facilities that provided incomplete reports was not available.

The indicator includes all Canadian metal and diamond mines subject to the *Metal and Diamond Mining Effluent Regulations*, which came into effect for metal mines on June 6, 2002 and diamond mines on June 1, 2018. Mining operations that are not captured under the regulations include placer mines,[7] coal mines, quarries, and other non-metallic mineral mining facilities.

Resources

References

Environment and Climate Change Canada (2021) Mining and Processing Division.

Metal and Diamond Mining Effluent Regulations, SOR/2002-222.

Related information

Assessment of the Aquatic Effects of Mining in Canada: AQUAMIN Final Report

National assessment of phase 1 data from the Metal Mining Environmental Effects Monitoring Program

Regulations Amending the Metal Mining Effluent Regulations

Second national assessment of environmental effects monitoring data from metal mines

Third National Assessment of Environmental Effects Monitoring Information from Metal Mines Subject to the *Metal Mining Effluent Regulations*

[7] Placer mines are mining operations that extract minerals or metals from stream sediments by gravity or magnetic separation.

Annex

Annex A. Data table for the figure presented in this document

Table A.1. Data for Figure 1. Percentage of regulatory data submitted by metal and diamond mines within authorized limits, Canada, 2003 to

Year	Arsenic (percentage)	Copper (percentage)	Cyanide (percentage)	Lead (percentage)	Nickel (percentage)	Radium 226 (percentage)	Zinc (percentage)	Total suspended solids (percentage)	pH low (percentage)	pH high (percentage)	Fish toxicity (percentage)
2003	99.8	99.8	100.0	99.9	99.6	99.0	99.8	92.1	99.7	99.5	95.0
2004	99.7	99.6	100.0	100.0	99.2	100.0	99.9	95.3	99.7	99.4	91.7
2005	99.5	99.7	100.0	100.0	98.6	99.8	99.1	91.8	99.2	99.6	97.8
2006	99.8	100.0	100.0	100.0	98.3	100.0	99.8	95.4	99.6	99.7	97.7
2007	99.8	99.9	100.0	100.0	98.5	100.0	99.8	93.7	99.6	99.7	97.0
2008	99.8	99.7	99.2	100.0	99.2	99.1	99.7	93.8	99.2	99.3	95.5
2009	100.0	99.5	100.0	100.0	99.5	100.0	99.7	94.5	99.5	99.7	96.2
2010	99.9	99.9	100.0	100.0	99.2	99.7	99.7	95.6	99.8	99.8	97.3
2011	99.8	99.9	99.7	100.0	99.6	99.9	99.7	96.1	99.7	99.8	97.5
2012	99.8	99.8	98.6	100.0	99.6	99.9	99.7	96.3	99.9	99.9	98.8
2013	99.8	99.7	99.3	100.0	99.8	99.2	99.8	97.9	99.8	99.9	96.8
2014	99.9	99.7	99.8	100.0	99.3	99.5	99.6	97.6	99.3	99.8	99.0
2015	100.0	99.9	99.8	100.0	99.8	99.4	100.0	98.0	99.3	99.9	99.6
2016	100.0	99.9	100.0	100.0	99.9	99.3	99.9	98.0	99.3	99.9	95.7
2017	100.0	100.0	100.0	100.0	99.9	99.8	99.9	98.0	99.8	100.0	98.6
2018	100.0	100.0	99.8	100.0	99.5	100.0	99.4	97.8	97.7	100.0	91.6
2019	99.9	99.9	99.7	99.9	98.2	99.6	98.5	96.7	99.0	100.0	97.0

Note: Deleterious substances listed in the *Metal and Diamond Mining Effluent Regulations* include arsenic, copper, cyanide, lead, nickel, zinc, total suspended solids, and radium 226. The regulations set a minimum (pH low) and maximum (pH high) level for the pH of effluent released. Fish toxicity refers to tests of effluent on mortality rate to fish.
Source: Environment and Climate Change Canada (2021) Mining and Processing Division.

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