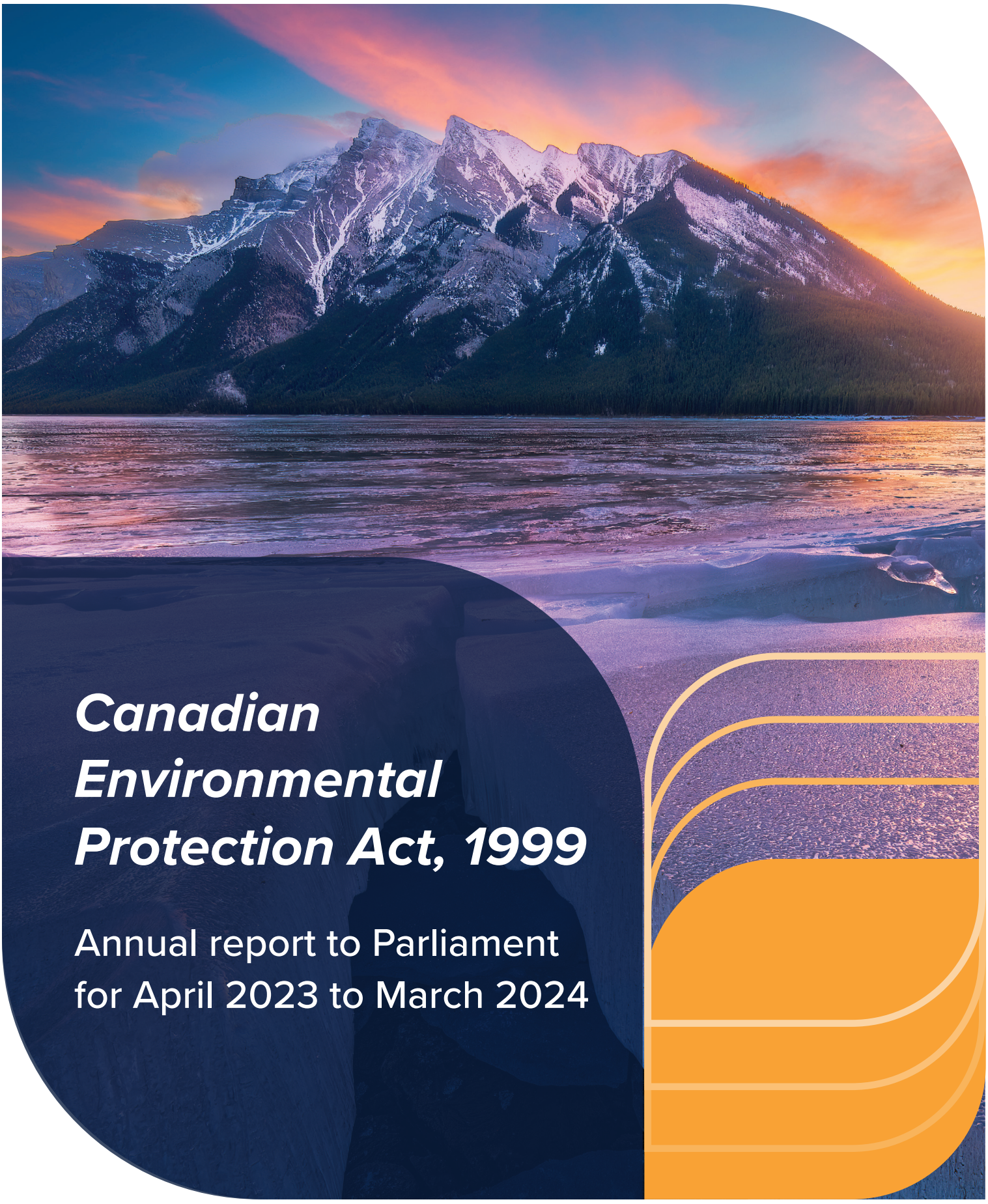

# *Canadian Environmental Protection Act, 1999*

## Annual report to Parliament for April 2023 to March 2024

Environment and Climate Change Canada
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Environment and Climate Change Canada
Public Information Centre
Place Vincent Massey building
351 St-Joseph boulevard
Gatineau Quebec K1A 0H3
Toll free: 1-800-668-6767
Email: enviroinfo@ec.gc.ca



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# 1. Introduction

Protecting the environment and human health lies at the heart of the *Canadian Environmental Protection Act, 1999* (CEPA, the Act). The Government of Canada (the Government) delivers many of the environmental and health protection programs administered by Environment and Climate Change Canada (ECCC) and Health Canada (HC) through CEPA, such as the Chemicals Management Plan (CMP), the National Environmental Emergencies Centre and the Air Quality Program (AQP). CEPA is also the legislative basis to implement several regulations and risk management instruments related to waste, disposals at sea, pollutant emissions, as well as Canada's obligations under numerous bilateral and international environmental agreements, such as the Basel Convention, the Gothenburg Protocol and the London Protocol.

Bill S-5, *Strengthening Environmental Protection for a Healthier Canada Act*, received Royal Assent on June 13, 2023. The Bill modernized CEPA by recognizing that every individual in Canada has the right to a healthy environment as provided for in the Act, strengthening Canada's chemicals management regime and increasing transparency in the way it is administered. The amendments included in that Act represent the first set of comprehensive amendments to CEPA since it was enacted over 20 years ago.

This annual report provides an overview of the activities conducted and results achieved under CEPA from April 1, 2023, to March 31, 2024[1] by both ECCC and HC. It responds to the statutory requirement in Section 342 of the Act to provide an annual report to Parliament on its administration and enforcement.[2]

## 1.1 Environmental Protection Management Process

The environmental protection management process used in the implementation of CEPA centres on six key activities (see **Figure 1**). At each stage of the cycle, the Government invites stakeholders and the public to participate in consultations and decision-making processes, and works closely with provincial, territorial, municipal, Indigenous[3] and international partners.

[1] Please consult the CEPA registry for up-to-date information on CEPA related activities, such as: regulations, Canada Gazette notices and orders, permits, guidelines, codes of practice, agreements, plans, policies, substances, enforcement and compliance actions.

[2] CEPA requires the annual report to include information on the following: the right to a healthy environment framework (s. 5.1(5)); activities of the National Advisory Committee (s.8); activities under administrative agreements (s.9(8)) and equivalency agreements (s.10(10)); progress of the Plan on Chemicals Management Priorities (s. 74); progress made in developing subsequent instruments (s. 78(3)(4)); reasons for confidential business information requests (s. 313(2)); disclosure of explicit names of masked substances or living organisms (s. 317.3); advancing Indigenous reconciliation (s. 342.1); and, report on research s.342(2).
The Act also requires the inclusion of activities under the international air pollution provisions (s.174); the international water pollution provisions (s.184); and, any committees established under s. 7(1)(a) in the annual report. However, there were no activities under any of these sections during the reporting period.

[3] The terms 'Indigenous' and 'Aboriginal' are both used in this report. The modernized CEPA continues to apply the term "Aboriginal" as previously used in the *Canadian Environmental Protection Act, 1999* and as used in s. 35 of the *Constitution Act, 1982*, while the term "Indigenous" is used in the *United Nations Declaration on the Rights of Indigenous Peoples*.

Figure 1. The Environmental Protection Management Process


Please refer to the Guide to Understanding CEPA, 1999 (the Guide) for further explanation of the environmental management process. The Guide describes CEPA's role in environmental management in Canada; its objectives and guiding principles; its environmental protection management process; and its key programs aimed at protecting the environment and human health. ECCC and HC have been working on an updated Guide to Understanding CEPA to reflect the changes under the modernized CEPA. The revised Guide is expected to be published in 2025.

## 1.2 Update on the *Implementation of Strengthening Environmental Protection for a Healthier Canada Act* (known as Bill S-5)

### 1.2.1 Progress on the Development of the Implementation Framework for the Right to a Healthy Environment as Provided for in CEPA

Every individual in Canada has a right to a healthy environment, subject to any reasonable limits, as provided for in CEPA. The Act requires the Government of Canada to develop an implementation framework to set out how it will fulfill its duty to protect the right to a healthy environment when administering CEPA.

During 2023-2024, engagement activities were undertaken to inform the development of a draft version of the implementation framework. This included two webinars held in October 2023 with a combined 270 participants that served to introduce the right to a healthy environment under CEPA and the planned engagement timelines. A subsequent engagement milestone was the publication of a *Discussion Document on the Implementation Framework for a Right to a Healthy Environment under the Canadian Environmental Protection Act, 1999* for a public comment period held from February to April 2024. Over 130 submissions were received from industry, non-governmental and civil society organizations, Indigenous Peoples and organizations, as well as members of the public. The discussion document was also used to support engagement activities with over 60 non-governmental, academic, youth, Indigenous, and industry participants at government-led workshops.

#### 1.2.1.1 Indigenous Engagement

Engagement with Indigenous organizations, nations, and communities in a distinctions-based manner is a priority in the development of the implementation framework. In 2023-2024, funding was provided to 15 Indigenous recipients, including national and regional Indigenous organizations and individual nations, to support them in leading meaningful engagement activities with communities that informed the development of the draft implementation framework.

### 1.2.2 Progress on the Development of a Plan of Priorities

With new chemicals being developed, new uses for existing chemicals, increasingly complex supply chains, and emerging science about risks including cumulative effects, the modernized CEPA requires the Government to establish a new Plan of Priorities for the assessment and management of risks from chemicals. This plan will outline the substances prioritized for assessments, and other activities to assess, control or manage the risks to the environment or human health. The plan will also include approaches to meaningfully inform the public (for example, labelling), and activities to replace, reduce or refine reliance on vertebrate animal toxicity testing. The Act requires that this plan is reviewed at least every eight years. In 2023-2024, ECCC and HC initiated the development of a proposed Plan of Priorities.

#### 1.2.2.1 Replacing, Reducing or Refining Reliance on Vertebrate Animal Testing

In 2023-2024, HC and ECCC began work on the development of a strategy to guide efforts to replace, reduce or refine vertebrate animal testing for the purpose of assessing substances under CEPA.

A notice of intent regarding the development of this strategy was published on November 30, 2023, for a 60-day public consultation period. The notice included proposed key elements to be addressed under the strategy. Informed by comments received, ECCC and HC worked on the development of a draft strategy to be published for public consultation. The consultation on the notice generated approximately 4,300 responses. The comments represented the views of members of the general public, industry, non-governmental and civil society organizations, and other groups, such as academia. The vast majority of responses received were from members of the general public (99%).

# 2. Monitoring the Environment and Human Health

Monitoring changes in the environment and human health trends is essential for assessing the impact of toxic substances. It is also essential for assessing the effectiveness of measures put in place to minimize environmental harm and reduce current and potential threats to human life.

In 2023-2024, monitoring led by ECCC and HC supported domestic policy development, reporting and public outreach, as well as Canada's efforts to implement international agreements.

**Table 1. Select National and International Programs and Agreements that Contribute to Monitoring the Environment and Human Health**

| National Programs and Agreements | International Programs and Agreements |
|---|---|
| Environmental Monitoring and Surveillance Program: chemicals management | Canada-United States Air Quality Agreement |
| St. Lawrence Action Plan | Global Atmospheric Passive Sampling network |
| Freshwater Quality Monitoring Program | Canada-United States Great Lakes Water Quality Agreement and Great Lakes Basin (GLB) Monitoring and Surveillance Program |
| Whales Initiative | Great Lakes Herring Gull Contaminants Monitoring Program |
| Canada's Plastics Science Agenda | Minamata Convention on Mercury |
| Northern Contaminants Program (NCP) | United Nations Economic Commission for Europe's Convention on Long-range Transboundary Air Pollution |
| Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health | Arctic Council's Arctic Monitoring and Assessment Programme and the Arctic Contaminants Action Program |

## 2.1 Chemicals

### 2.1.1 Chemicals in Our Environment

The CMP Environmental Monitoring and Surveillance Program involves the collection of data on the concentration of chemical substances in various environmental media across Canada. Environmental media include surface water, sediment, air, aquatic biota and wildlife. Wastewater system influent, effluent and biosolids are also monitored across a range of input and treatment system types. These activities provide data to inform the assessment and management of chemical substances in the environment.

Examples of priority substances monitored in 2023-2024 as part of the CMP Environmental Monitoring and Surveillance Program include:

- bisphenols
- chlorinated alkanes
- hexabromocyclododecane
- metals, including mercury
- organochlorine pesticides
- organotins
- other flame retardants

- per- and polyfluoroalkyl substances (PFAS)
- polybrominated diphenyl ethers (PBDEs)
- polychlorinated biphenyls (PCBs)
- polycyclic aromatic hydrocarbons (PAHs)
- quaternary Ammonium Compounds
- siloxanes
- triclocarban

### 2.1.2 Chemical Substances in Canadians

HC's human biomonitoring efforts continued in 2023-2024. As part of the national biomonitoring program conducted under the Canadian Health Measures Survey (CHMS), data was collected on environmental chemical exposures in a nationally representative sample of Canadians aged 1–79 years. Collection of data for cycle 7 of CHMS continued throughout this time and included emerging chemicals such as Bisphenol A (BPA) substitutes, glyphosate, DEET and neonicotinoid pesticides, as well as the first national samples from children aged 1-2 for the measurement of metals in blood.

A biobank analysis of certain priority chemicals was completed by the end of 2023-2024. These results provide additional data to show trends over time for plasticizers, pesticides and metals.

Data dissemination efforts under the national biomonitoring program in 2023-2024 included:

- A first-of-its-kind, new online dashboard, called the Canadian Biomonitoring Dashboard, which was released on the Public Health Agency of Canada's (PHAC) Health Infobase platform in August 2023. The dashboard allows the public to access and download CHMS biomonitoring data, compare time points and subpopulations, and easily generate figures and tables. In addition to housing data for chemicals previously measured in CHMS cycles 1-6 and reported in cycle-specific biomonitoring reports, the dashboard also includes new baseline data from the biobank analysis of certain priority chemicals, such as flame retardants, and self-care and consumer product chemicals.
- Fact sheets for benzene, bisphenol analogues, organophosphate flame retardants, oxybenzone, and PAHs were drafted.

HC's continued analysis and publication of biomonitoring and research results from the Maternal-Infant Research on Environmental Chemicals (MIREC) Research Platform. These included novel assessments of prenatal and early-childhood exposure to chemicals and the establishment of national estimates of maternal and fetal exposures.

The MIREC Biobank, created at the beginning of the MIREC study in 2008, has grown with each follow-up study. The Biobank stores all the data and biological specimens collected since the inception of MIREC. Human biomonitoring data is being continuously added to the MIREC Biobank. Measures added to the Biobank in 2023-2024 include novel measures of herbicides in biospecimens collected from MIREC youth, as well as additional data on PFAS and metals in biospecimens collected from adult female MIREC participants. At year-end 2023-2024, the MIREC biobank had four preliminary Biobank access requests under review, and six preliminary access requests in development. There are also nearly 20 ongoing MIREC Biobank projects using MIREC data and biospecimens to answer new research questions.

A sample of the research papers published by HC scientists in peer-reviewed scientific journals in 2023-2024 may be found in the Report on Research (section 8).

HC contributes to the Northern Contaminants Program (NCP, led by Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC)). HC partners with CIRNAC on the human health component of the NCP, which addresses concerns about human exposure to elevated levels of contaminants in wildlife species important to the traditional diets of northern Indigenous peoples. In 2023-2024, HC supported seven human biomonitoring and health projects under the NCP in several Arctic regions including the Yukon, Inuvialuit Settlement Region, Northwest Territories, and in Nunavik. These projects addressed:

- exposure to contaminants and links to country foods
- understanding dietary decision-making and supporting the development of communication materials
- the integration of information on country foods, nutrition, food security and health messaging
- identifying sources and patterns of persistent organic pollutants (POPs)
- understanding the health impacts of elevated exposure to perfluoroalkyl acids (PFAAs)

In October 2023, ECCC and HC co-led a monitoring results workshop that gathered over 100 scientists from both regulatory and monitoring groups.

- ECCC monitoring experts presented data and trends for priority substances across dozens of sites in Canada. Findings from monitoring programs in air, surface water, sediment, wastewater, aquatic biota (fish) and birds were provided.
- Health related topics included results from MIREC, and studies under the Canadian System for Poison Information (CCSPO) and the Toxicovigilance Canada Network.

### 2.1.3 Wildlife Contaminant Monitoring

ECCC has been monitoring contaminants in wildlife, primarily bird eggs, since the early 1970s. The data has been used to assess the health of wildlife, including polluted regions (such as the Great Lakes Areas of Concern), and to ascertain whether mitigation strategies and modifications to chemical regulation and management have been successful in lowering chemical levels in wildlife. Colonial waterbirds (such as gulls) are the prime species being monitored on all three coasts and, in the prairies, the Arctic and sub-Arctic, and the Great Lakes and the St. Lawrence River basin. Because they feed from the aquatic environment, colonial waterbirds are a good indicator of trophic transfer of contaminants in freshwater and marine ecosystems. Colonial waterbirds are monitored through the Great Lakes Herring Monitoring Program, the NCP, the Atlantic and Pacific Seabird monitoring programs and the CMP Environmental Monitoring and Surveillance Program. These monitoring programs are active on an annual or semi-annual basis, depending on the program, and some have been active since 1974.

Starlings are monitored annually throughout Canada's east and west coasts, the prairies, the Arctic, Great Lakes and the St. Lawrence River basin as part of the terrestrial component of the CMP Environmental Monitoring and Surveillance. Monitoring targets rural, urban, and landfill sites as possible sources of emissions to the environment.

Data collected from the eggs of both seabirds and starlings are used to assess legacy compounds, such as PCBs, pesticides and mercury, but also current or recently used substances of mutual concern, such as PFAS, brominated flame retardants, and rare earth elements.

## 2.2 Air Pollutants and Greenhouse Gases Monitoring

Monitoring and reporting activities are important for identifying and tracking levels and trends of air pollutants that impact both the environment and human health, as well as greenhouse gases (GHGs) that lead to climate change.

Ambient (outdoor) air quality monitoring informs air quality management in Canada, including tracking progress relative to the Canadian Ambient Air Quality Standards (CAAQS). The data is used to validate numerical air quality prediction models, evaluate the benefits and effectiveness of air pollution control measures, and assess the impact of air pollution on Canadians and the environment.

ECCC continued to monitor ambient air quality across the country through two complementary networks.

- the National Air Pollution Surveillance (NAPS) program provides long-term air quality data from populated regions of Canada. This program is managed through a formal agreement between the provincial and territorial governments and ECCC
- the Canadian Air and Precipitation Monitoring Network (CAPMoN) provides information on regional patterns and trends of atmospheric pollutants both in the air and in precipitation at rural and remote sites

Data collected through NAPS, CAPMoN, and other provincial, territorial, and municipal monitoring stations were used to calculate air quality indicators. The air quality indicators track ambient concentrations of fine particulate matter ($PM_{2.5}$), ground-level ozone (ozone), sulphur dioxide ($SO_2$), nitrogen dioxide ($NO_2$), and volatile organic compounds (VOCs) at the national, regional, and urban levels, and at local monitoring stations.

Additional air pollutant monitoring carried out by ECCC in 2023-2024 includes the following networks:

- AEROCAN, the Canadian sub-network of NASA's global AERONET satellite network, which takes optical readings of solar radiation to measure atmospheric aerosols
- the Canadian Brewer Spectrophotometer Network, which measures the total thickness of the ozone layer (known as total column ozone) and ultraviolet (UV) radiation at selected locations across Canada
- the Canadian Ozonesonde Network, which measures vertical column ozone from ground level up to 36 km altitude by launching weekly ozonesondes affixed to balloons, providing long-term ozone data

ECCC continued to monitor greenhouse gas concentrations via a network of stations across the country:

- The Canadian Greenhouse Gas Measurement Program includes observations of carbon dioxide ($CO_2$) and other GHGs from 16 long-term measurement sites across Canada. Among the sites is the Alert Global Atmosphere Watch Observatory. Alert serves as one of three global GHG inter-comparison sites to ensure consistent measurement of carbon dioxide ($CO_2$) and other greenhouse gas concentrations across the world.

ECCC makes its atmospheric monitoring data available to the public through national and international databases, including the Government of Canada Open Data Portal, the World Meteorological Organization (WMO), World Data Centres for GHGs, the WMO World Data Centre for Precipitation Chemistry, and the WMO World Ozone and Ultraviolet Data Centre which is operated by the Meteorological Service of Canada.

## 2.3 Disposal at Sea Site Monitoring Program

ECCC monitors disposal sites to verify that permitting of disposals at sea is sustainable and ensure continued access to suitable sites. When a problem is identified or a site reaches capacity, ECCC takes management actions, such as moving or altering the use of the site. ECCC works with Indigenous groups, the public, and other stakeholders to ensure early and meaningful opportunities for engagement on proposed disposal activities and integration of recommendations and concerns as appropriate into monitoring and site management measures.

Each year, ECCC monitors a selected number of sites in each region, according to established criteria. Due to the nature of field work cycles, analysis and interpretation of monitoring results is not always finalized in the same year that the monitoring was conducted.

### Pacific Region

In 2023-2024, four sites were monitored off the coast of British Columbia in the Pacific region. The monitoring studies did not raise any concerns.

#### Five Finger Island, Thornborough Channel and Sand Heads

Monitoring at these three disposal sites all included sediment chemistry and toxicity testing. At each site, lower contaminant concentrations were found within the disposal site than outside the disposal site, which demonstrates that disposal activities are not transporting contaminants to the disposal sites. At all sites, the results were within ranges observed in previous monitoring projects; although, there were some slightly elevated results, such as arsenic and copper concentrations between the CCME Interim Sediment Quality Guideline and Probable Effects Level and, at Thornborough Channel, slightly elevated concentrations of cadmium and dioxins and furans. At all three sites, results of the acute and sub-lethal toxicity tests for sediment composites collected within and outside the disposal sites confirmed no evidence of toxicity to amphipods, echinoids, or bacteria. All the sediment composites passed sediment toxicity testing.

Monitoring studies at Five Finger Island and Thornborough Channel disposal sites also included Sediment Profile Imaging (SPI). SPI involves deploying a frame that houses two cameras to capture profile and surface images of the sediment-water interface. This method was used to measure and analyze physical and biological parameters in and surrounding the disposal site. At both sites, benthic habitat quality parameters, such as the apparent redox potential discontinuity (aRPD) depth and infaunal successional stage, indicated a resilient benthic community at the site that has adapted to periodic disturbances from disposal activity. The monitoring stations outside the disposal sites had mature healthy benthic communities in relatively deep aRPD depths. These results confirmed that disposal material is found within the disposal site and that disposal activity did not affect the benthic habitat condition outside of the disposal site.

#### Cape Mudge

In 2023-2024, ECCC continued a project with Natural Resources Canada on monitoring sediment movement on the seafloor. The objective is to characterize the movement of sediment over time at and around the disposal footprint, which can be used in future sediment dispersion modelling to predict the short- and long-term fate of material following disposal. An Acoustic Doppler Current Profiler (ADCP) device is deployed on the seafloor at disposal sites to collect seasonal current velocity and directional information 1 m above the seafloor over a one year period. This is a multi-year research project and an ADCP has been deployed for one year periods at other sites in the Pacific region in previous years. In 2023-2024, an ADCP was deployed at the Cape Mudge disposal site and data is currently being analyzed and results should be ready next year.

## Quebec Region

Three disposal sites were monitored in the Gaspé region and four near the Magdalen Islands to verify compliance with permit conditions, establish the height of the material disposed (that is, mounds) for navigation safety purposes and investigate the dispersion of sediments. All monitoring utilized hydrographic surveys which measure the depth of the seafloor using a multibeam echo sounder from a ship. The resulting image allows for the interpretation of where and how sediment and disposal material has settled at disposal sites. Post-disposal hydrographic surveys were compared to previous surveys, to obtain a "before and after" survey of the sea floor.

### Gaspé Disposal Sites (Port-Daniel, St-Godefroi and Sainte-Thérèse-de-Gaspé

In recent years, hydrographic surveys at the disposal sites in the Gaspé region have given some unexpected results, where not all the material reported as disposed could be located at the site. While monitoring at some of the sites in this area has returned to expected results, these three sites were monitored in 2023-2024 as unexpected results have continued. Surveys completed in 2023-2024 again did not detect any sediment or material deposit. At the Saint-Godefroi site, a cumulative volume of more than 30,000 $m^3$ of dredged material has been reported as disposed since 2013 and yet is not detected with the annual hydrographic surveys. ECCC has been exploring the reason for this discrepancy. ECCC verified disposal locations and amounts with the disposal operator and backscatter results at St-Godefroi and Sainte-Thérèse-de-Gaspé showed a change in seabed density within the disposal sites, suggesting the addition of unconsolidated loose sediment, but it was not possible to conclude that this was disposal material. Incorrect dumping location has now been ruled out as a cause, and targeted studies are planned for 2024-2025 to investigate the changes in the bottom currents and velocity over a one year period to determine if the sites are more dispersive than anticipated. The results of this work will inform potential future management actions regarding these sites.

### Magdalen Islands (Ile d'Entrée, Millerand, Pointe-Basse, Gascons)

Hydrographic surveys at Ile d'Entrée, Millerand, Pointe-Basse sites detected the reported disposal volumes in acceptable amounts and the backscatter results at Gascons confirmed that the small volume of disposed material is in place at that site. Monitoring over the past few years at Millerand has suggested that the disposal site is subject to currents that vary based on the presence or absence of ice cover. That is, the dispersibility of the site depends on winter storms and ice cover. In 2023-2024 hydrographic surveys found 86% of material was in place, one of the highest rates observed at this site. Observations suggest that the sediments deposited at the site migrate eastward, feeding the sand dunes on the seabed. At Pointe-Basse, results indicated that the western portion of the site has reached full capacity. The eastern side will be used for upcoming disposal of dredged material, to ensure navigational safety.

### Arctic Region

No disposal site monitoring took place in the Arctic region in 2023-2024 as no disposal permits were issued since the last monitoring event in 2021-2022.

### Atlantic Region

Two disposal sites were monitored off the coast of New Brunswick and one off the coast of Prince Edward Island.

#### Black Point Disposal Site, New Brunswick

The elevation of material accumulated at this disposal site is assessed annually to confirm it is less than 7 metres above the 1959 baseline criteria. This was selected as a conservative navigational criterion. A hydrographic survey was conducted, including multibeam and backscatter analyses, in the summer of 2023. Results confirmed that the areas of the seabed under the current release zone do not exceed 7 metres above the 1959 seabed elevation and the current release zone can continue to be used.

#### Shippagan Gully Disposal Site, New Brunswick

Monitoring at this disposal site is driven by the need to monitor the fate of disposed materials and to verify the rate of dispersion against that predicted by the model. Three bathymetric surveys were conducted each year from 2021 to 2024. Observations of appreciable dispersion will require the full study period to assess; therefore, results will not be available until the 2024-2025 CEPA report. The results of this multi-year study are being shared with Saint Mary's University, to be used in their proposed research program on the beneficial re-use of the dredged material and effectiveness of mitigation measures related to the Piping Plover Recovery Strategy.

#### West Point Small Craft Harbour Disposal Site, Prince Edward Island

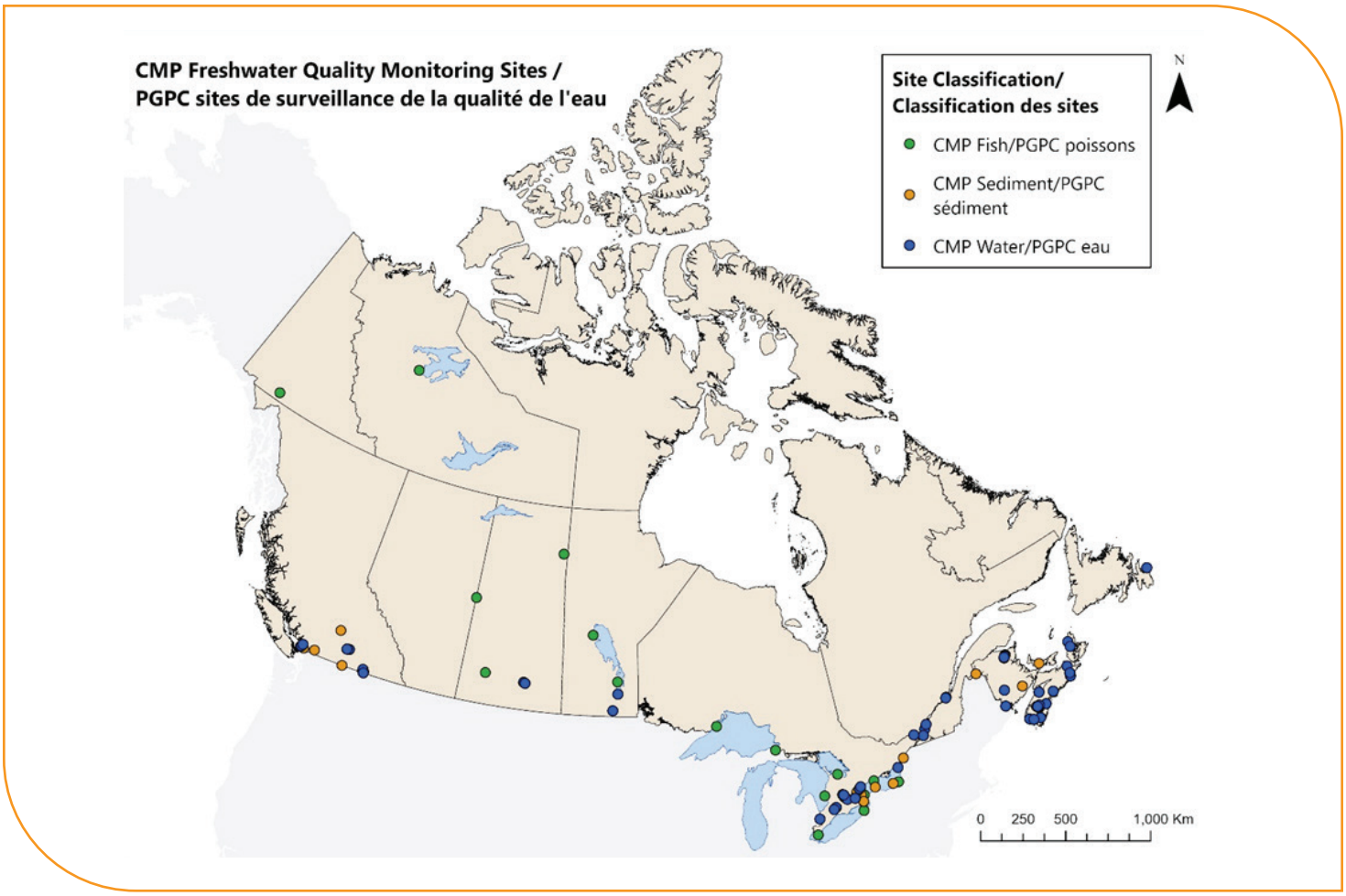
An underwater video survey of three transects through the disposal site was conducted to collect information regarding the benthic habitat. The habitat in the transects consisted of light brown silty sand substrate with varying presence of storm cast algae and shell fragment. Hermit crabs and thread green algae were also observed. This study will be useful as a basis for comparison of benthic conditions following future disposal events.

## 2.4 Water Quality Monitoring

Freshwater quality monitoring and surveillance has been a core ECCC program since the Department's inception in the early 1970s. The Department's monitoring and surveillance activities are critical for assessing and reporting on water quality status and trends in addition to fulfilling federal domestic and international commitments and legislative obligations. Much of the Program's monitoring is carried out through federal-provincial/territorial agreements, ensuring cost-effective and non-duplicative program delivery.

The program continues to monitor chemicals of concern in water, sediments and aquatic biota at sites across Canada in support of the CMP (**Figure 2**) and the Great Lakes Water Quality Agreement. This work also contributes to the overall CEPA management cycle through research and monitoring and preparation of reports on specific substances to support risk assessment and risk management evaluation.

**Figure 2. Freshwater Quality Monitoring Programs Sites in Support of The CMP Environmental Monitoring and Surveillance in 2023-2024 (fish, Water, and Sediment)**




## 2.4.1 Enhanced Data Access

Several additional aquatic contaminant datasets are now available to the public on Open Data including the Fish Contaminant Monitoring Program (FCMP). ECCC began monitoring contaminants in fish in the late 1970s and continues to support the CMP to this day. The FCMP dataset consists of data from several rivers and lakes across Canada on fish species, sex, age, and size, as well as chemicals of concern such as trace metals, PCBs, PBDEs, and PFAS. Fish from Northern Canada are collected by local Indigenous nations through agreements with ECCC. The FCMP dataset can be found at Great Lakes Fish Contaminants Monitoring and Surveillance Data - Open Government Portal (canada.ca).

Additional CMP datasets for water and sediment are also available on Open Data:

- Chemical Management Plan Monitoring Program – Surface Water - ECCC Data Catalogue
- Great Lakes Sediment Monitoring and Surveillance Data - ECCC Data Catalogue

## 2.4.2 Research and Reporting

ECCC's Freshwater Quality Monitoring program continues to support performance measurement and evaluation of regulated chemicals by providing data and/or syntheses to determine the status and trends of PAHs and perfluorooctane sulfonate (PFOS) in the Canadian environment. The toxic chemicals monitoring programs in water, sediments, and biota in the Great Lakes are contributing data, analyses, and syntheses for the next update of the State of the Great Lakes Report which will be released in 2025.

Please see the *Canada Water Act* Annual Reports for additional updates on freshwater quality monitoring in Canada.

## 2.5 Canadian Environmental Sustainability Indicators

The Canadian Environmental Sustainability Indicator Program (CESI) is the prime instrument to measure the progress of the Federal Sustainable Development Strategy and responds to ECCC's commitments under CEPA and the *Department of the Environment Act* to report to Canadians on the state of the environment. The CESI Program produces a suite of 57 state-of-the-environment indicators related to air, water, the climate, biodiversity, and pollutants and contaminants. Many of these indicators are updated annually (see **Table 2**). CESI indicators provide readers with the latest data, historical trends, plain language contextual information, and data visualizations including maps, graphs, and Power BI tools.

**Table 2. CESI Updates and New Releases From April 2023 to March 2024**

| Date | Indicators |
|---|---|
| April | • Greenhouse gas emissions<br>• Greenhouse gas emissions from large facilities |
| May | • Temperature change in Canada |
| June | • Greenhouse gas concentrations<br>• Air pollutant emissions<br>• Canada's conserved areas |
| August | • Global trends in conserved areas<br>• Harvest levels of key fish stocks<br>• Status of key fish stocks |
| September | • Population exposure to outdoor air pollutants<br>• Releases of harmful substances to water<br>• Restoring the Great Lakes Areas of Concern<br>• Canadian species index |
| November | • Emissions of harmful substances to air<br>• Human exposure to harmful substances |
| December | • Greenhouse gas emissions projections<br>• Phosphorus loading to Lake Erie<br>• Changes in the status of wildlife species at risk<br>• Species at risk population trends |
| January | • Reductions in phosphorus loads to Lake Winnipeg<br>• Solid waste diversion and disposal |
| February | • Water quality in Canadian rivers |
| March | • Water quantity in Canadian rivers<br>• Snow cover<br>• International comparison: air pollutant emissions in selected countries<br>• Forest management and disturbances |

## 2.6 Engagement Activities With Indigenous Peoples

### 2.6.1 SmoKE Data Knowledge Exchange

HC's SmoKE project aims to make data and information on air pollution exposure available to rural, remote, and Indigenous communities across Canada. The SmoKE Portal is being developed along with partners from the British Columbia Centre for Disease Control, the Canadian Urban Environmental Health Research Consortium at University of Toronto and the Centre for Indigenous Environmental Resources (CIER). In alignment with the HC Framework for Science and Research Excellence, the portal is intended to weave Indigenous Knowledge alongside conventional scientific information, following a two-eyed seeing approach, and includes Indigenous Knowledge incorporated through community stories and takeaways from engagement sessions. In 2023-2024, the CIER hosted engagement sessions and focus groups to discuss Indigenous language translations and the application of Indigenous knowledge to SmoKE's knowledge translation tools to ensure they are culturally sensitive, responsive to community needs, and that translations are free of errors.


### 2.6.2 Integrated Chemical Mixtures Project

The Integrated Chemical Mixtures Project (ICMP) is a research and monitoring project initiated by ECCC in 2023-2024. It was funded as part of the implementation of Bill S-5 to expand the knowledge base to support the right to a healthy environment under CEPA; notably, to generate knowledge on real-world exposure to, and effects from, chemical mixtures in the environment.

The goal of the ICMP is to develop an innovative approach to investigate exposure to multiple substances and their cumulative impacts on the environment. Two regions were selected to be the focus of ICMP activities and to demonstrate its soundness. Information gathering and consultation activities took place, as well as engagement with impacted Indigenous communities, industries, municipalities, and provincial partners. Research and monitoring workplanning were examined. ECCC representatives travelled to First Nation communities to hear their ideas and concerns with regard to chemicals in the environment and seek their involvement in the project. Indigenous Knowledge will be sought throughout the project. Local knowledge and priorities along with cutting-edge science will ensure the project supports the right to a healthy environment in a meaningful manner.

### 2.6.3 Disposal at Sea Program Monitoring Plans and Studies

In 2023-2024, the Disposal at Sea program consulted First Nations on proposed disposal site monitoring plans and studies, such as the Statement of Work for an Underwater Acoustic Study at the Point Grey disposal site in the Pacific Region. Monitoring results, such as in the Point Grey Current Monitoring Final Report, were shared with Nations. Nations were also invited to join monitoring activities at disposal sites within their traditional territories. In the Atlantic Region, the Disposal at Sea program engaged with two New Brunswick First Nation umbrella organizations, representing 14 First Nation rights holder communities to provide the results of monitoring studies conducted at NB disposal sites. The results were tailored to the communities and their interests.

# 3. Addressing Key Risks: Risk Assessment and Risk Management

## 3.1 Chemicals

CEPA includes specific requirements for the assessment and management of substances in Canada. The Minister of Environment and Climate Change[4] and the Minister of Health jointly administer this part of the Act.

Under CEPA, the risk assessment and management process for substances is divided into two streams: existing substances and new substances.

### 3.1.1 Information Gathering

Notices issued under s. 71 of CEPA are used to gather information that helps support priority-setting, risk assessment and risk management activities and decision making.

In 2023-2024:

- On June 24, 2023, ECCC and HC published a comprehensive information gathering notice under s. 71 of CEPA, titled *"Notice with respect to certain substances under the Chemicals Management Plan — 2023."* The notice took into account feedback from stakeholders to establish a standardized more streamlined approach that fulfills the various data needs across the program (in other words, risk assessment, risk management, performance measurement).
- On November 23, 2023, ECCC and HC published a compilation of the non-confidential information received in response to the section 71 *Notice with respect to certain substances on the Revised In Commerce List, including biopolymers, plant extracts, mineral extracts, proteins, fats, animal extracts, waxes, and carbohydrates.*
- ECCC and HC continued to hold discussions and information sessions with stakeholders to promote compliance and inform stakeholders of the future direction of the program and gather comments to help balance stakeholder capacities with core program needs.

### 3.1.2 Identifying Risk Assessment Priorities

In 2023-2024, assessment priorities for existing substances under CEPA's proposed Plan of Priorities were identified by building on the existing approach for the identification of risk assessment priorities. Work began on the identification and prioritization of chemicals in plastics.

### 3.1.3 Existing Substances

#### 3.1.3.1 Risk Assessment of Existing Substances

ECCC and HC conduct risk assessments to determine whether existing substances pose a risk to human health or the environment as set out in section 64 of the Act. Draft assessments are published for a 60-day public comment period, followed by the publication of the final assessments.

In 2023-2024, the Ministers of ECCC and HC (see **Table 3**):

- published eight draft assessment reports covering 133 substances
- published the Draft State of Per- and Polyfluoroalkyl Substances (PFAS) Report covering the class of PFAS
- proposed that 31 substances and the class of PFAS met one or more of the toxicity criteria set out in section 64 of CEPA
- published seven final assessment reports covering 51 substances, and concluded that eight of these substances met one or more of the toxicity criteria set out in section 64 of CEPA

[4] Although CEPA refers to the "Minister of the Environment", this report will refer to the Minister using the current title of "Minister of the Environment and Climate Change."

Table 3. Summary of Existing Substance Assessment Publications From April 2023 to March 2024 (*Shaded Cells Indicate Action Taken During Reporting Period)

| | Risk Assessment | | | Risk Management | |
|---|---|---|---|---|---|
| Name of Substance (Number of Substances) | Draft Assessment[1] | Final Assessment[2] | Conclusion on s.64 Toxicity Criteria? (Number of Substances) | Risk Management Scope Document[1] | Risk Management Approach Document[2] |
| Aluminum-containing Substances Group (55) | January 27, 2024 | Not yet published in 2023-2024 | Proposed<br>Toxic (2)<br>Not met (53) | January 27, 2024 | Not yet published in 2023-2024 |
| Commercial Naphthenic Acids Group (2) | August 18, 2018 | January 27, 2024 | Not met | NA[3] | NA |
| Coumarin 1 (1) | October 31, 2020 | May 13, 2023 | Toxic (1) | October 31, 2020 | May 13, 2023 |
| Hydrogen sulfide ($H_2S$), sodium sulfide (Na(SH)) and sodium sulfide ($Na_2S$) (3) | February 3, 2024 (updated draft assessment) | Not yet published in 2023-2024 | Proposed<br>Toxic (1)<br>Not met (2) | February 3, 2024 | Not yet published in 2023-2024 |
| Low Boiling Point Naphthas (27) | March 16, 2024 | Not yet published in 2023-2024 | Proposed<br>Toxic (17)<br>Not met (10) | March 16, 2024 | Not yet published in 2023-2024 |
| Naphthalene Sulfonic Acids and Salts (NSAs) Group (6) | July 4, 2020 | June 10, 2023 | Not met (6) | NA | NA |
| NMP and NEP (2) | January 27, 2024 (updated draft assessment) | Not yet published in 2023-2024 | Proposed<br>Toxic (1)<br>Not met (1) | January 27, 2024 | Not yet published in 2023-2024 |
| Other Polymers Group (5) | October 3, 2020 | May 13, 2023 | Toxic (2)<br>Not met (3) | October 3, 2020 | May 13, 2023 |
| Per-and polyfluoroalkyl substances (PFAS) | May 20, 2023 | Not yet published in 2023-2024 | Proposed<br>Toxic (various[4]) | May 20, 2023 | Not yet published in 2023-2024 |
| Phenylpropanoids and Aldehydes Group (12) | February 3, 2024 | Not yet published in 2023-2024 | Proposed<br>Toxic (6) | February 3, 2024 | Not yet published in 2023-2024 |
| Selected C3-C5 Alcohols Group (6) | June 10, 2023 | Not yet published in 2023-2024 | Proposed<br>Not met | NA | NA |
| Siloxanes Group (5) | June 1, 2019 | December 9, 2023 | Not met | NA | NA |

| | Risk Assessment | | | Risk Management | |
|---|---|---|---|---|---|
| Name of Substance (Number of Substances) | Draft Assessment[1] | Final Assessment[2] | Conclusion on s.64 Toxicity Criteria? (Number of Substances) | Risk Management Scope Document[1] | Risk Management Approach Document[2] |
| Substituted Phenols Group (15) | January 13, 2024 | Not yet published in 2023-2024 | Proposed<br>Toxic (4)<br>Not met (11) | January 13, 2024 | Not yet published in 2023-2024 |
| Thallium and its compounds (5) | September 19 2020 | 30 March 2024 | Toxic (5) | September 19, 2020 | March 30, 2024 |
| Titanium-containing Substances Group (13) | October 28, 2023 | Not yet published in 2023-2024 | Proposed<br>Not met | NA | NA |
| Twenty-six industry-restricted gas oils and kerosenes (26) | May 11, 2019 | December 9, 2023 | Not met | NA | NA |

[1] Date that the draft assessment was published in the Canada Gazette. When a draft risk assessment proposes a conclusion that the substance is "toxic" under CEPA, a risk management scope document is published at the same time as the draft assessment report.

[2] Date that the final assessment was published in the Canada Gazette. When a final risk assessment concludes that the substance is "toxic" under CEPA, a risk management approach document is published at the same time as the final assessment report.

[3] NA – not applicable due to Assessment concluding that the substance(s) have not met any of the criteria in section 64.

[4] The class of per- and polyfluoroalkyl substances, referred to as PFAS is based on the Organisation for Economic Co-operation and Development (OECD) definition, which is "fluorinated substances that contain at least 1 fully fluorinated methyl or methylene carbon atom (without any H/Cl/Br/I atom attached to it), that is, with a few noted exceptions, any chemical with at least a perfluorinated methyl group ($–CF_3$) or a perfluorinated methylene group ($–CF_2–$) is a PFAS" (OECD 2021).

### 3.1.3.2 Orders Adding Substances to Schedule 1

No substances were added to Schedule 1 in 2023-2024. On April 1, 2023, the Ministers published their recommendation that the Governor in Council make an order to add chlorocresol to Schedule 1 of CEPA.

### 3.1.3.3 Risk Management Measures of Existing Substances

Risk management measures can be put in place to reduce or eliminate risks to the environment and/or human health after a substance has been concluded toxic.

**Table 4. Summary of Proposed or Finalized Risk Management Measures for Existing Substances Published From April 2023 to March 2024**

| **Proposed Regulations** | | **Date Published** |
|---|---|---|
| *Certain Products Containing Toxic Substances Regulations* (70-day comment period) | | November 18, 2023 |
| *Regulations Amending the PCB Regulations and the Regulations Designating Regulatory Provisions for Purposes of Enforcement* (60-day comment period) | | December 23, 2023 |
| **Final Codes of Practice** | | **Date Published** |
| Code of practice for the Environmentally Sound Management of Chemical Substances in the Chemicals, Plastics and Rubber Sectors | | February 24, 2024 |
| **Proposed Application of Significant New Activity (SNAc) Provisions** | | **Date Published** |
| Notice of intent to amend the Domestic Substances List (DSL) to apply SNAc provisions for three existing substances:<br>• Naphthalenesulfonic acid, dinonyl- (CAS RN 25322-17-2)<br>• Naphthalenesulfonic acid, dinonyl-, barium salt (CAS RN 25619-56-1)<br>• Naphthalenesulfonic acid, dinonyl-, calcium salt (CAS RN 57855-77-3) | | June 10, 2023 |
| **Proposed Pollution Prevention Plans** | | |
| Consultation document: Pollution prevention planning notice for primary food plastic packaging: Targets for reduction, reuse, redesign, and recycled content | | August 1, 2023 |
| **Proposed Canadian Environmental Quality Guidelines (CEQGs)**[1] | | |
| **Environmental Compartment** | **Draft Guidelines Published for Comments** | **Date Published** |
| Water | Perfluorooctanoic acid (PFOA) | October 19, 2023 |
| Soils | Cadmium (human health only) | December 11, 2023 |
| | Chromium III and VI (human health only) | October 30, 2023 |
| **Proposed Federal Environmental Quality Guidelines (FEQGs)** | | |
| **Environmental Compartment** | **Draft Guidelines Published for Comments** | **Date published** |
| Water | BTEX (benzene, toluene, ethylbenzene, xylene) | June 24, 2023 |

| Final Federal Environmental Quality Guidelines (FEQGs) | | |
|---|---|---|
| **Environmental Compartment** | **Completed and Published Guidelines** | |
| Water | Triclocarban | March 16, 2024 |
| Sediment | Triclocarban | March 16, 2024 |
| **Proposed Release Guidelines** | | |
| Notice with respect to the proposed amended Guidelines for the Reduction of Dyes Released from Pulp and Paper Mills | | May 6, 2023 |

[1] Various guidelines continue to be under development with involvement from HC and ECCC

**Table 5. Summary of Regulatory Administration for Existing Substances From April 2023 to March 2024**

| Regulatory Administration | |
|---|---|
| **Instrument** | **Activity** |
| *Ozone-depleting Substances and Halocarbon Alternatives Regulations* | • approximately 130 permists issued, including:<br>  ○ 35 essential purpose permits<br>  ○ 23 consumption allowances issued to eligible companies<br>  ○ 11 requests granted for transfer of allowances |
| *Export of Substances on the Export Control List Regulations* | • 73 notices of proposed export submitted<br>• 0 export permits requested |
| *Products Containing Mercury Regulations* | • publication of the *Key results from the 2022 reports under the Products Containing Mercury Regulations* |
| *Prohibition of Asbestos and Products Containing Asbestos Regulations* | • 1 permit issued for the use of product(s) containing processed asbestos fibres already in Canada to service eligible equipment |
| *Solvent Degreasing Regulations* | • issued consumption units to 18 degreasers for 2024<br>• 4 transfers of consumption units for 2024 |

### 3.1.3.4 Other Risk Management Actions on CEPA Toxic Substances

The Government of Canada has access to risk management tools outside of CEPA. In cases where another federal act or minister is best placed to manage the risks identified for a toxic substance, a new regulation or instrument can be made under that other federal act, for instance, the *Canada Consumer Product Safety Act* (CCPSA) or the *Food and Drug Act* (FDA), in order to formally fulfill the legal obligation under CEPA to develop a risk management instrument.

**Table 6. Risk Management Activities Taken Outside of CEPA for Toxic Substances in 2023-2024**

| Environmental Performance Agreement | |
|---|---|
| The proposed renewal of the Environmental Performance Agreement for the Refractory Ceramic Fibre Industry in Canada (30-day public consultation period) | August 22, 2023 |
| Third progress report for the 2020 to 2025 Environmental Performance Agreement Respecting the Use of Tin Stabilizers in the Vinyl Industry | February 6, 2024 |
| **Recall Notices, Regulations, Packaging and Labelling Requirements Under the CCPSA** | |
| HC uses the authorities under the CCPSA and the Cosmetic Regulations of the FDA to address human health and safety concerns related to non-compliance of consumer products and cosmetics, some of which may include non-compliance related to CEPA toxic substances. When a recall is determined to be the appropriate compliance enforcement action, HC works with industry to post the recall information on the Recalls and Alerts website. In 2023-2024, there were 271 recalls posted. | |

### 3.1.3.5 Subsequent Regulations or Instruments

For the reporting period, no statements under section 78 of CEPA were published respecting the development of subsequent proposed regulations or instruments and the estimated timeframes for their development.

### 3.1.3.6 Risk Management Performance Measurement Evaluation Strategy

While there have not been any new publications of performance measurement evaluation reports, the 2020 Performance Measurement Evaluation Strategy continues to be implemented to provide Canadians with information on the effectiveness of risk management actions in place for toxic substances.

Evaluations are being conducted in accordance with the rolling workplan, which provides a high-level workplan of performance measurement evaluations currently underway or to be initiated in the coming years.

### 3.1.3.7 Evaluating Specific Non-Regulatory Risk Management Instruments

Some risk management instruments are evaluated at regular intervals to assess their effectiveness. **Table 7** presents review of progress documents published in 2023-2024.

Table 7. **Progress Under Non-Regulatory Risk Management Instruments From April 2023 to March 2024**

| Review of Progress on Codes of Practice | |
|---|---|
| Review of progress: code of practice for the environmental management of road salts, (2014-2019) | July 2023 |
| **Progress Reports on Pollution Prevention (P2) Plans** | |
| Progress Report: P2 notice for the iron, steel and ilmenite sector | May 2023 |
| Progress Report: P2 notice for Reaction products of 2-propanone with diphenylamine (PREPOD) | August 2023 |
| **Progress Reports on Environmental Performance Agreement** | |
| Third progress report for the 2020 to 2025 Environmental Performance Agreement Respecting the Use of Tin Stabilizers in the Vinyl Industry | February 2024 |

### 3.1.4 New Substances: Risk Assessment and Risk Management

Substances that are new to Canada require notification to the Government prior to being imported into or manufactured in Canada. In 2023-2024:

- 231 New Substance Notifications were assessed under the *New Substances Notification Regulations (Chemicals and Polymers)*
- 29 waivers of information requirements were published in the *Canada Gazette*, Part I for new chemical and polymer substances
- 745 inquiries addressed new substances from April 1, 2023, to March 31, 2024

**Table 8. Summary of New Substance Decisions From April 2023 to March 2024**

| Risk Assessment Decisions | | | | | |
|---|---|---|---|---|---|
| **New Substance Notifications (NSN)** | | **Risk Assessment Summaries** | **Waiver of Information Requirements** | **Pre-Notification Consultations** | **Action Taken**[1] |
| **Total** | 231[2] | 65 | 29 | 59 | 10 |

| Risk Management Actions | | | |
|---|---|---|---|
| | **Number** | **Name of Substance** | **Date Published** |
| Ministerial Conditions | 6396[3] | Ethane, 1,2-dichloro-, polymer with ammonia, N-substituted reaction products sodium hydroxide | December 30, 2023 |
| | 19317[3] | Bentonite, lanthanian | August 5, 2023 |
| | 20267[3] | Bentonite, lanthanian | August 5, 2023 |
| | 20655 | Octanamide, N-hydroxy- | February 24, 2024 |
| | 21471 | Ethane, 1-ethoxy-2-(2-methoxyethoxy)- | May 20, 2023 |
| | 21535 | 1-Hexanol, 2-ethyl-, reaction products with 1,6-diisocyanatohexane | September 23, 2023 |
| | 21551 | Propenoic acid, 2-methyl-, 2-hydroxyethyl ester, polymer with chloroethene, 1,1-dichloroethene and 3,3,4,4,5,5,6,6,7,7,8,8,8-tridecafluorooctyl 2-alkyl-2-propenoate | July 29, 2023 |
| | 21574 | 1-Octanesulfonic acid, 3,3,4,4,5,5,6,6,7,7,8,8,8-tridecafluoro- | August 5, 2023 |
| | 21689 | Amides, tall-oil fatty, N-[3-(dimethylamino)propyl] | March 23, 2024 |
| | 21690 | Methyl-N-(2-oxo-2-(alkyn-1-ylamino)ethyl)-5-(5-(3,4,5-trichlorocarbomonocycle)-5-(trifluoromethyl)-heteromonocycle-3-yl)heteromonocycle-2-carboxamide | March 2, 2024 |

[1] The Minister may:
- permit the manufacture or import of the substance subject to specified conditions
- prohibit the manufacture or import of the substance
- request additional information considered necessary for the purpose of assessment

[2] 54 NSNs were for new substances in products regulated under the FDA

[3] Rescission of a Notice of Ministerial Conditions

### 3.1.5 Communication Activities

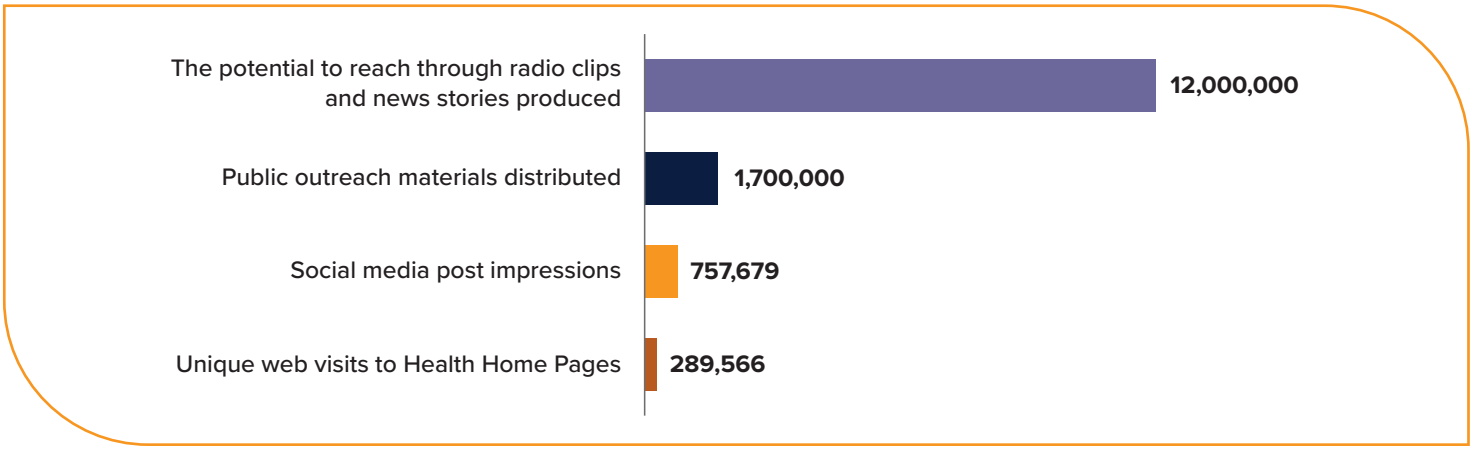
The following communications activities and products relating to the health and environmental risks of chemicals were published:

- 3 new fact sheets as part of the Fact Sheet Series on topics on substances in risk assessment under CEPA (totaling 17 fact sheets):
  - species sensitivity distributions for water quality guidelines and ecological risk assessment
  - the ecological risk classification of organic substances approach
  - use of new approach methods in risk assessment
- 18 Information Sheets to summarize the various risk assessment or management documents published during the year (see **Table 3** for the list of documents in 2023-2024)

#### Healthy Home Campaign

The Healthy Home social marketing campaign provides people living in Canada with tips to help reduce the risks from certain chemicals and pollutants found in and around the home. In 2023–2024, a mix of traditional and digital approaches was utilized to help expand CMP reach. This included:

| **104** social media posts | **12** plain language summaries | **2** radio clips | **8** new articles |
|---|---|---|---|




In-person and virtual Healthy Home public outreach activities targeted underserved rural communities, seniors, new Canadians, persons with disabilities, and students.

| **103** public outreach activities created | → | **10,862** interactions with people in Canada |
|---|---|---|

Healthy Home presentation participants reported the following:

- **100%** increase in their knowledge of environmental health
- **98%** intended to act on HC's recommendations

Access to Healthy Home messaging across Canada was improved with the development of new and customized communications products and supported through collaborations with key regional organizations to reach disproportionately impacted peoples such as the visually impaired, newcomers, seniors and pregnant people. Through these partnerships, HC:

- developed a Healthy Home guide in braille
- developed an Environmental Health Guide translated in Arabic, Farsi, Ukranian, Korean, Spanish, Punjabi, Persian, and Simplified Chinese
- distributed 41,000 calendars to seniors with tips to prevent unintentional poisoning and safe storage of medication
- provided 25,200 Healthy Home brochures in gift bags for new mothers and expecting women in 200 locations

The Healthy Home Challenge, an interactive online game designed to help inform the public about the potential health risks associated with certain chemicals and pollutants found in and around the home, was user-tested and completed. Over one million homes in Canada received a postcard with tips for a healthy home and QR code link to the Healthy Home Challenge. During that time, the site saw 39,500 views.

### CMP Engagement and Outreach Contribution Program

In 2023-2024, the CMP Engagement and Outreach Contribution Program sought to facilitate broader participation of new voices into the CMP by funding:

- "ChimiQuiz!," an interactive game on chemicals for the 2023 "Festival Eureka!" which was able to reach 1,600 youth, ages 8–12
- the development and distribution of a Teacher's Guide to French and bilingual schools outside of Quebec
- a community organization in Ontario that held 5 culturally adapted Healthy Home workshops for newcomers and created weekly social media postings on the CMP "10 Tips"
- a community organization in New Brunswick to develop web content, video clips, printable cards for homemade cleaning products, and healthy cleaning kits for Indigenous and low-income health centres
- a civil society organization (CSO) in New Brunswick that coordinated a stakeholder meeting with other CSOs across Canada to share updates on CEPA and the CMP, as well as exploring other areas for collaboration
- another CSO in Ontario that made use of its extended network to advance work in supporting childcare professionals in developing knowledge on the risks posed by toxic chemicals and pollutants
- an Indigenous organization that finalized its multi-year Inuvialuit-led research project on microplastics in drinking water

### 3.1.6 Outreach Activities for Indigenous Peoples

HC held exhibition booths providing information on air quality, radon and chemicals of concern at the First Nations Housing Conferences in Alberta and Ontario and at the First Nations Health Managers Association in Atlantic with over 300 interactions with the public. A supplementary workshop on environmental knowledge was also held in Manitoba.

Learning modules were created for use at Healthy Home Sessions for First Nations audiences to provide culturally appropriate information about exposures to, and health impacts from, CEPA toxic substances found in many First Nations' homes. These modules focused on a number of substances, such as asbestos, carbon monoxide, boric acid, lead, mercury, mould, pesticides, selenium and more. They were developed in plain language and can be translated into Indigenous languages when resources are available.

## 3.2 Animate Products of Biotechnology

### 3.2.1 Risk Assessment and Management of New Living Organisms

ECCC and HC jointly perform the assessment of living organisms that are new to the Canadian marketplace and require notification to the government prior to being imported into or manufactured in Canada.

**Table 9. Summary of Risk Assessment and Management Decisions for New Living Organisms From April 2023 to March 2024**

| **Risk Assessment decisions of living organisms** | | | | |
|---|---|---|---|---|
| **New Substance Notifications (NSN)**[1] | | **Risk Assessment Summaries** | **Waiver of Information Requirements** | **Pre-Notification Consultations** |
| **TOTAL** | 46[2] | 2 | 28 | 12 |
| **Risk Management of Living Organisms** | | | | |
| **Ministerial Conditions** | | **Number** | **Name of Substance** | **Date Published** |
| | | 21,722 | live vaccinia virus Acambis clone 2000 | March 16, 2024 |

[1] assessed under the *New Substances Notification Regulations (Organisms)*

[2] 22 were for new substances in products regulated under the FDA

#### 3.2.1.1 Public Engagement and Consultation on Certain Living Organisms New to Canada

Public consultation is now mandatory under the modernized CEPA for all notifications concerning a new vertebrate animal or a prescribed living organism or group of living organisms under the *New Substances Notification Regulations (Organisms)*.

When these obligations do not apply, the voluntary public engagement initiative of the *New Substances (NS) program* encourages the notifiers of higher organisms to voluntarily participate by disclosing summaries of their notifications for publication. Stakeholders are invited to share comments, including scientific information and test data related to potential risks to the environment or human health from the new living organisms. Information that could be shared to inform the risk assessment process includes:

- environmental fate information
- ecological effects information
- human health effects information
- exposure information (including sources and routes of exposure)

In 2023-2024:

- one voluntary public consultation was initiated in 2023 on one line of genetically modified fruit fly (insects) that was assessed under NSNR (Organisms)
- four lines of genetically modified fluorescent Rainbow Shark for use in aquaria as ornamental fish were subject to mandatory public consultation

Further information on past engagement initiatives may be found online.

### 3.2.2 Communication Activities

The following communication activities and products relating to the health and environmental risks of living organisms were published:

- Fact sheet: *New Substances Notification Regulations (Organisms)*
- What We Heard: Stakeholder pre-consultation on the review of Part 6 of the *Canadian Environmental Protection Act*, 1999 (CEPA) and the *New Substances Notification Regulations (Organisms)*

## 3.3 Air Pollutants

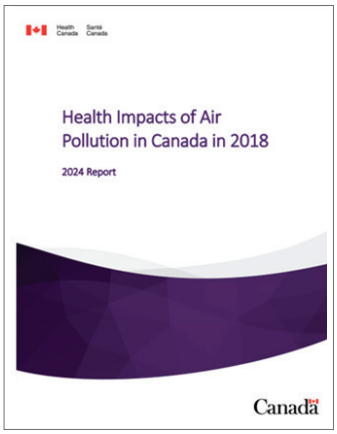
ECCC and HC are partners in implementing the federal AQP. Work under the AQP aims to reduce the impact of air pollution on human health and the environment and provide people living in Canada with the tools they need to make informed decisions to reduce their exposure to indoor and outdoor air pollutants.

Under the AQP, the federal government establishes air pollutant mitigation measures, provides guidance materials on reducing exposure to indoor and outdoor air pollution, reports on emissions, monitors ambient air, forecasts air quality to support the Air Quality Health Index (AQHI), and issues air quality alerts. The federal government collaborates with provinces and territories to implement the Air Quality Management System (AQMS), including setting the CAAQS, and works in international fora to reduce transboundary air pollution and short-lived climate pollutants. Both domestic and international work are supported by research, monitoring, modelling, and science assessments.

### 3.3.1 Air Quality Risk Assessment

In 2023-2024, HC advanced work to develop health-based air quality objectives (HBAQOs) to address pollutants in outdoor air that may not be widespread in the environment but nonetheless can be harmful to human health. For the first cycle of prioritized ambient air pollutants, HC is developing HBAQOs for arsenic, benzene, carbon monoxide, formaldehyde and $PM_{10}$ (particulate matter with a diameter of 10 microns and smaller). The HBAQOs represent safe levels of exposure that consider health risks only, and that can be used voluntarily by all levels of government and partners in managing air quality. In comparison, the CAAQS represent government commitments to continuously improve air quality, are based on health and environmental effects, and take feasibility into account.

In March 2024, HC published Health Impacts of Air Pollution in Canada in 2018. The triennial report is an update from the previous 2021 edition and provides quantitative estimates of the adverse health impacts associated with outdoor air pollution in Canada, as well as the monetized values of these health impacts. Some key facts from the report include:




- exposure to air pollution from $PM_{2.5}$, ground-level ozone and $NO_2$ contributed to 17,400 premature deaths in Canada in 2018, equal to 47 premature deaths per 100,000 people,
- non-fatal health outcomes that can be attributed to air pollution included 35 million acute respiratory symptom days, 2.7 million asthma symptom days, and 8,100 emergency room visits annually,
- the monetized value of adverse air pollution health impacts was $146 billion (2020 CAD) in 2018, and
- although air pollution affects the health of people in all regions of the country, the largest impacts are seen in the provinces with the largest populations and the highest air pollution levels, namely, Ontario, Quebec, British Columbia and Alberta.

### 3.3.2 Air Quality Risk Management

In 2023-2024, the Government continued to administer regulatory and non-regulatory instruments, under the authorities provided by CEPA, to limit and reduce emissions of air pollutants from vehicles, engines and fuels, consumer and commercial products, and industrial sectors. The government also continued to administer regulatory instruments to reduce emissions of GHGs.

The Government continued to collaborate with provincial and territorial governments to manage air pollution under the AQMS, including by working to conclude the review of the 2020 CAAQS for $PM_{2.5}$ toward finalizing updated $PM_{2.5}$ standards to be met in 2030. A retrospective stocktake of the AQMS was initiated to assess the effectiveness of the overall system after more than 10 years since its implementation. Results of this work will shape the future of the AQMS.

The Government also collaborated with international partners, such as the California Air Resources Board (Memorandum Of Understanding) and the U.S. Environmental Protection Agency (Canada-United States Air Quality Agreement), to coordinate activities, policies and regulatory measures that reduce air pollutants and GHGs.

In 2023-2024, the Ministers published 1 final regulation and various proposed risk management measures for public consultations. For each proposal, ECCC and HC engaged with partners and stakeholders, and received hundreds of public submissions (see **Table 10**).

**Table 10. Summary of Proposed or Final Risk Management Measures for Air Pollutants and Greenhouse Gas Emissions Published From April 2023 to March 2024**

| **Final Regulations** | **Date Published** |
|---|---|
| *Regulations Amending the Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations* | December 15, 2023 |
| **Proposed Regulations** | **Date Published** |
| *Regulations Respecting Reduction in the Release of Methane and Certain Volatile Organic Compounds* (Upstream Oil and Gas Sector) (60-day comment period) | December 16, 2023 |
| *Clean Electricity Regulations* (75-day comment period) | August 19, 2023<br>Public update: February 16, 2024 |
| *Reduction in the Release of Volatile Organic Compounds (Storage and Loading of Volatile Petroleum Liquids) Regulations* (60-day comment period) | February 24, 2024 |
| *Regulations Amending the Formaldehyde Emissions from Composite Wood Products Regulations* (75-day comment period) | June 17, 2023 |
| **Proposed Frameworks or Strategies** | **Date Published** |
| *Regulatory Framework for an Oil and Gas Sector Greenhouse Gas Emissions Cap* | December 7, 2023 |
| Notice of Intent to Consult on a Risk Management Strategy Respecting Benzene Emissions from Gasoline Stations | February 24, 2024 |
| **Proposed Guidelines** | **Date Published** |
| *Residential Indoor Air Quality Guideline* | September 30, 2023 |

**Table 11. Summary of Activities Carried Out Under Risk Management Measures for Air Pollutants and Greenhouse Gases From April 2023 To March 2024**

| Sector | Risk Management Activity | Activity in 2023-2024 |
|---|---|---|
| **Vehicles, Engines and Fuels** | Vehicle and Engine Emissions Program | • under the vehicle and engine regulatory administration and compliance verification programs , ECCC:<br>o received approximately 160 regulatory reports for vehicles and engines<br>o conducted testing on over 200 vehicles and engines<br>o processed 100 defect and recall notifications covering over 930,500 vehicles and engines. ECCC continues to provide basic information summarizing notices of defect and other company notifications received<br>• published two fleet performance reports for on-road vehicles:<br>o GHG emissions from new light-duty vehicles for the 2020 model year<br>o Air pollutant emissions from on-road vehicles for the 2020 model year |
| | Fuel quality regulations | • ECCC administers seven regulations related to fuel quality, with the goal of reducing air pollution by limiting benzene, lead and sulphur in fuels.<br>• the compliance program for the fuels regulations includes:<br>o analyzing fuel samples<br>o reviewing fuel supplier's production and import records<br>o verifying compliance with the regulatory prohibitions and reporting requirements |
| **Petroleum** | *Reduction in the Release of Volatile Organic Compounds Regulations (Petroleum Sector)* | • ECCC has completed the first year of its compliance program for these regulations.<br>• the compliance program includes:<br>o reviewing compliance data and third-party audits<br>o conducting targeted site inspections<br>o reviewing supporting records to verify that facilities are complying with the regulatory requirements |
| | *Clean Fuel Regulations* (CFR) | • The CFR program:<br>o approved 63 registrations, for primary suppliers, registered creators and foreign suppliers<br>o responded to over 2,300 inquiries<br>o approved 137 carbon intensity applications<br>o recognized four $CO_2e$ emission reduction projects<br>o received 308 reports, as required by the CFR |

| Sector | Risk Management Activity | Activity in 2023-2024 |
|---|---|---|
| **Consumer And Commercial Products** | *Code of practice for the reduction of VOC emissions from cutback and emulsified asphalt* | • ECCC published the third report outlining progress towards meeting the Code's objective |
| | *Volatile Organic Compound Concentration Limits for Certain Products Regulations* | • The maximum VOC concentrations and emission potentials for the manufacture and import of regulated products regulated came into effect on January 1, 2024, (except disinfectants, which come into effect on January 1, 2025)<br>• ECCC received and assessed over 200 permit applications and notifications under the compliance unit trading system<br>• Information on permits issued and companies participating in the compliance unit trading system is available online |

### 3.3.3 Communication Activities

The majority of outreach and engagement activities related to air pollutants in 2023-2024 focused on supporting the Health Portfolio's wildfire response. In addition to responding to over 50 media requests during the wildfire season, a variety of communications materials were developed and published on Canada.ca and on ECCC and HC social media channels to accompany technical and scientific documents on air pollutants. These outreach products, targeted at stakeholders and the general public, included factsheets, infographics, guides, videos, and short illustrated and empowering articles made available for publication in community papers, blogs, websites and newspapers.

The following outreach activities and products relating to air quality and health were completed:

- update of the Wildfire Smoke, Air Quality and Health web content, factsheets and infographics
- development and distribution of social media posts about wildfire smoke, air quality, health effects and protective actions
- development of wildfire smoke health messaging for ECCC's Special Air Quality Statements and Air Quality Advisories
- development and distribution of written news articles, videos and radio spots to Canadian media outlets on wildfire smoke, residential wood smoke and protecting indoor air quality
- update of web content for transportation-related air pollution
- development and distribution of web messaging, social media posts, and images in collaboration with NB Lung to raise the profile of Clean Air Day across Canada by increasing stakeholder and public engagement on topics related to air pollution and climate change, particularly where they intersect with impacts on health
- development of educational and promotional items (magnets, bookmarks) on air quality topics such as the AQHI, wildfire smoke, and preventing carbon monoxide poisoning

### 3.3.4 Air Quality Outreach Activities With Indigenous Peoples

HC engaged with Sioux Lookout First Nations Health Authority to deliver education sessions on indoor air quality to First Nations communities in Northern Ontario. Nurtured relationships with Sandy Lake and Lac Seul communities led to active engagement with the local health director, chiefs, and councils.

In partnership with Urban Society for Aboriginal Youth in Alberta (USAY), HC developed The Unit, a graphic novel with animated and augmented-reality versions, to raise awareness among Indigenous Youth about the health impacts of reduced air quality from wildfire smoke and offer practical advice on how to reduce their exposure. USAY worked with an Indigenous writer, artist, developer and Elder to create the story and artwork.


In developing the draft *Clean Electricity Regulations* (CER), ECCC undertook a distinctions-based approach throughout its engagement process and engaged with representatives from Métis, First Nations, Inuit, Modern Treaty holders, and various Indigenous-led expert organizations. Although most Indigenous and remote communities will be exempt from the CER, ECCC recognizes the importance of incorporating input from numerous Indigenous groups to understand their needs, concerns, and perspectives. The engagement included developing tailored products for different groups with a focus on relationship-building.

Furthermore, ECCC provided $85,000 in grants and contributions in 2023 for five Indigenous-led groups or rights-holders to increase their capacity to engage on the CER. ECCC has also prioritized making connections with other Government of Canada departments working in similar sectors to break down silos and allow for more streamlined responses to Indigenous input and access to federal funding. ECCC will integrate feedback from Indigenous-led groups as the CER are finalized.

## 3.4 Water Quality

Work on water quality under CEPA includes working with the provinces and territories to develop or update the Guidelines for Canadian Drinking and Recreational Water Quality and their technical documents. **Table 12** lists the water quality guidelines developed in 2023-2024 and those under development.

**Table 12. Guideline Documents for Canadian Water Quality Published From April 2023 to March 2024**

| **Finalized Guidelines** | **Date Published** |
|---|---|
| Guidelines for Canadian Recreational Water Quality: Microbiological Pathogens and Biological Hazards | October 2023 |
| Guidelines for Canadian Drinking Water Quality – Antimony | January 2024 |
| Guidelines for Canadian Recreational Water Quality: Summary Document | February 2024 |
| Guidelines for Canadian Recreational Water Quality: Microbiological Sampling and Analysis | March 2024 |
| **Proposed Guidelines Published for Consultation** | **Date Published** |
| Draft Guidelines for Canadian Recreational Water Quality: Microbiological Sampling and Analysis | April 2023 |
| Draft Guidelines for Canadian Drinking Water Quality – Iron | September 2023 |
| Draft Guidelines for Canadian Drinking Water Quality – Operational Parameters | March 2024 |

HC is in the early stages of reviewing the Guideline for Canadian Drinking Water Quality for fluoride. To support the review, HC engaged six experts to consider scientific evidence and make recommendations on fluoride exposure (in drinking water and other sources), dental fluorosis, and potential effects on neurocognitive development in children. They were also tasked with providing scientific recommendations for HC to consider deriving a health-based value for fluoride in drinking water. The experts had a panel discussion in Ottawa, ON, on June 8 and 9, 2023.

Public consultation on the draft PFAS drinking water objective concluded in April 2023 and 338 comments were received from 53 commenters.

### 3.4.1 Engagement With Indigenous Partners

HC engages with the Assembly of First Nations (AFN) through the Safe Water Management on Reserve Committee. This committee meets quarterly to discuss ongoing and planned work on the Guidelines for Canadian Drinking Water Quality, with a focus on potential impacts for First Nation drinking water supplies. In 2023-2024, the Committee discussed how PFAS, iron and physical and chemical water quality parameters affect the operation of treatment systems.

### 3.4.2 Communication Activities

Communication and outreach activities provide people in Canada with timely and credible information about the water quality program and its achievements, and information on how to protect themselves from the risks of poor water quality.

In 2023-2024, new web pages were launched to give a web-presence to technical and plain-language guidance for recreational water. In addition, new factsheets were published on the selection of filters for removing lead and cleaning aerators (to reduce exposure to lead in drinking water).

HC participated in public meetings and a media event related to PFAS contamination in the Saguenay region.

## 3.5 Waste

Waste generally refers to any material, non-hazardous or hazardous, that has no further use, and is managed at recycling, processing or disposal sites or facilities. In Canada, the responsibility for managing and reducing waste is shared between the federal, provincial, territorial and municipal governments.

ECCC exercises responsibilities with respect to plastic pollution, disposal at sea of specified materials, as well as the international and interprovincial movements of hazardous waste and hazardous recyclable materials.

### 3.5.1 Plastic Pollution

Plastic pollution is a global challenge that requires immediate action. Plastic waste and pollution burden our economy and threaten the health of our environment, including wildlife, rivers, lakes, and oceans.

#### 3.5.1.1 Plastics Registry

In 2023-2024, the Government took several steps to advance work to establish a Federal Plastics Registry that will require companies (including resin manufacturers, service providers and producers of plastic products) to report annually on the quantity and types of plastic they manufacture, import, and place on the market. On April 18, 2023, the Government published the Technical paper: Federal Plastics Registry on the CEPA registry. The publication sought feedback from interested parties on the technical details and reporting requirements being considered for a Federal Plastics Registry.

On December 30, 2023, the Government published a Notice of intent to issue a section 46 notice for the Federal Plastics Registry in the *Canada Gazette*, Part I. The Notice of intent provided a draft of the section 46 notice for the Federal Plastics Registry to gather feedback on the proposed reporting requirements.

#### 3.5.1.2 Single-Use Plastics

In 2023-2024, the prohibitions under the *Single-use Plastics Prohibition Regulations* on the manufacture and import of single-use plastic ring carriers, as well as the prohibition on the sale (including offering for free) of single-use plastic checkout bags, cutlery, foodservice ware, stir sticks, and straws, came into force.

On November 16, 2023, the Federal Court (FC) retroactively declared the Order adding "plastic manufactured items" to Schedule 1 to CEPA invalid and unlawful. The Government appealed that decision to the Federal Court of Appeal (FCA) on December 8, 2023 and on January 25, 2024, the FCA stayed the FC's decision until 60 days after the FCA renders their decision. The stay prevents the FC ruling of November 16, 2023, from taking effect while the Government's appeal of the ruling is ongoing. The Single-use Plastics Prohibition Regulations remain in force.

#### 3.5.1.3 Consultations for Future Action

On April 18, 2023, the Government published the Regulatory Framework paper for recycled content and labelling rules for plastics for a 30-day comment period to signal the Government's policy direction and seek feedback on a regulatory framework for plastic packaging and certain single-use plastics that includes recycled content requirements and labelling rules for recyclability and compostability. The Government received written submissions from 147 interested parties.

On August 1, 2023, the Government published the Consultation document: Pollution prevention planning notice for primary food plastic packaging for a 30-day comment period to signal the Government's policy direction and seek feedback on a proposed P2 planning notice for primary food plastic packaging. The Government received written submissions from 227 interested parties.

### 3.5.2 Disposal at Sea

Part 7, Division 3 of CEPA imposes a general prohibition on the disposal of substances at sea or onto sea ice. Disposal at sea activities conducted under a permit issued by ECCC are exempt from this prohibition and permits are only available for low-risk wastes outlined in Schedule 5 of CEPA. A permit is only granted after an assessment, and only if disposal at sea is the environmentally preferable and practical option. Further information about disposal at sea is available online.

#### 3.5.2.1 International Activities

The disposal at sea provisions of CEPA help Canada to meet its obligations as a Party to the 1996 London Protocol, which is a more modern version of the *Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972*. Canada reports the number of permits, quantities and types of wastes disposed, and results of disposal site monitoring to the London Protocol Secretariat each year.

At the London Protocol meetings in 2023, Canada continued to lead a group working to determine what types of marine geoengineering could be regulated by the London Protocol and supported technical assistance to bring implementation within reach of more countries. Canada continues to serve as a member of the London Protocol Compliance Group, which encourages and supports compliance and ratification of the treaty. Canada is also a member of technical working groups seeking to address marine plastic pollution, evaluate the potential environmental effects of marine geoengineering, update guidance to assess carbon capture and storage in sub-sea geological formations, and to promote the re-use of materials disposed of at sea.

### 3.5.2.2 Disposal at Sea Permits

From April 1, 2023, to March 31, 2024, 102 permits were issued in Canada for the disposal of 9.322 million tonnes of waste and other matter at sea (see **Table 13**), an increase from 100 permits and 8.594 million tonnes in the previous year. The trends in the number of permits issued over the last decade are illustrated in Figure 3 while the trends in the quantity of material permitted each year are illustrated in Figure 4.

**Table 13. Disposal at Sea Quantities Permitted (in Tonnes) and Permits Issued From April 1, 2023, To March 31, 2024**

| | Quantity by Region | | | | Permits by Region | | | |
|---|---|---|---|---|---|---|---|---|
| **Material** | Atlantic | Quebec and Prairie and Northern | Pacific and Yukon | **Total Quantity Permitted** | Atlantic | Quebec and Prairie and Northern | Pacific and Yukon | **Total Permits Issued** |
| **Dredged Material** | 1,489,800 | 184,600 | 4,030,000 | 5,704,400 | 18 | 10 | 25 | 53 |
| **Fisheries Waste** | 21,665 | 1,150 | - | 22,815 | 22 | 3 | - | 25 |
| **Inert, Inorganic, Geological Matter** | - | - | 3,594,500 | 3,594,500 | - | - | 22 | 22 |
| **Organic Matter** | 350 | - | - | 350 | 2 | - | - | 2 |
| **Vessel** | - | - | - | - | - | - | - | - |
| **Total** | | | | **9,322,065** | | | | **102** |

**Note:** Dredged material and inert, inorganic, geological matter were converted to tonnes using an assumed density of 1.3 tonnes per cubic metre.

Figure 3. Number of Disposal at Sea Permits Issued in Each Fiscal Year by Type of Material

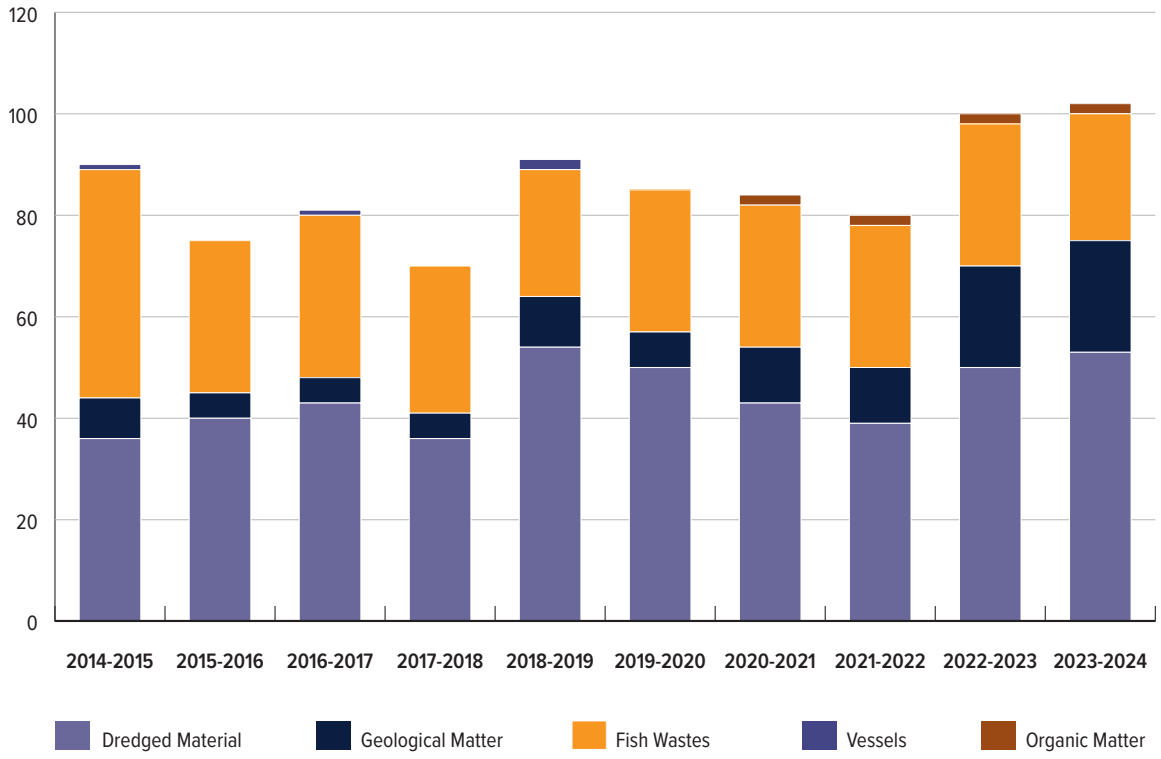
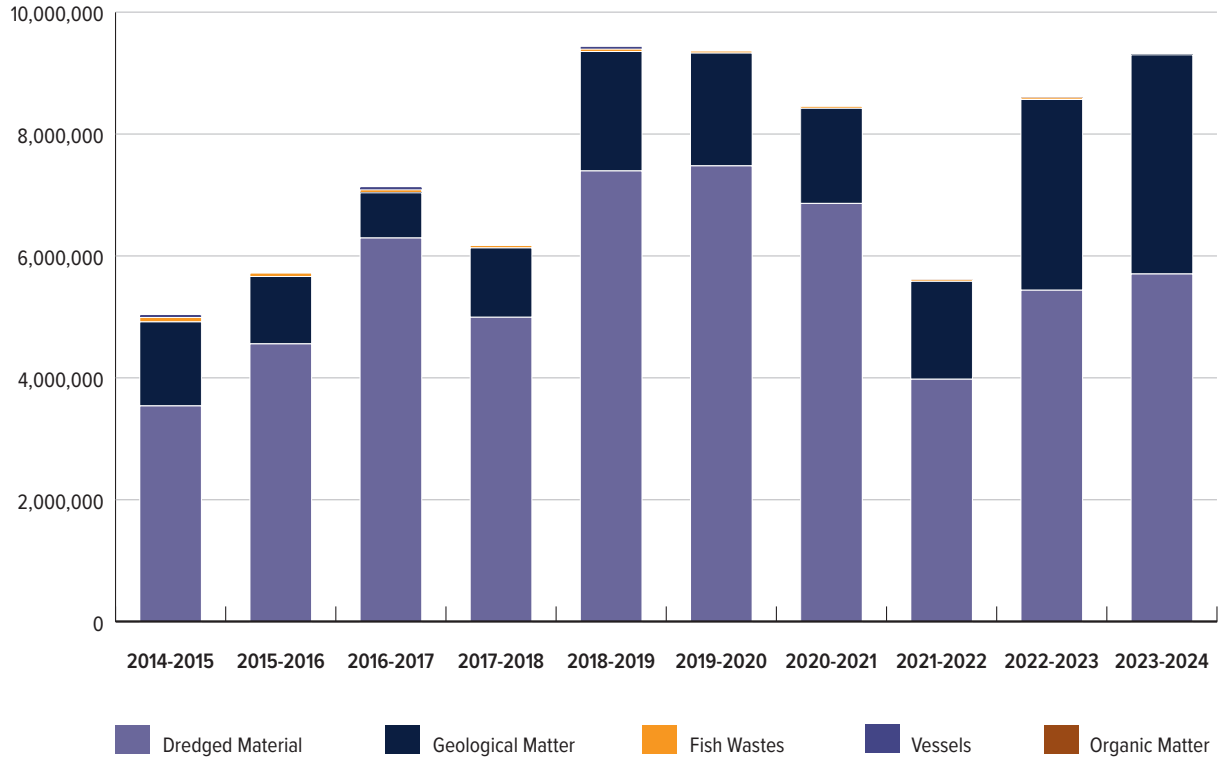



Figure 4. Annual Disposal at Sea Quantities Permitted (in Millions of Tonnes)



### 3.5.2.3 Indigenous Engagement for Disposal at Sea Program

#### Pacific Yukon Region

In 2023-2024, the Disposal at Sea Program in the Pacific region continued to work with Indigenous Nations to strengthen Nation-to-Nation relationships, advance reconciliation, achieve joint environmental priorities, support the mandate of the department, and fulfill our legal obligations. Over the course of the year, the Disposal at Sea Program engaged on a variety of environmental programs, policies, and activities. We have consulted with, and where necessary accommodated, Indigenous Nations when a decision or activity may have adversely impacted potential or established rights. As a result of these engagements, we are continually evolving, expanding, and strengthening our permitting process to address Indigenous concerns and feedback, including tailored mitigation measures and permit conditions.

Pacific region engaged with 18 different First Nations on 114 Disposal at Sea permit referrals. Concerns were raised by Nations in relation to:

- need for funds to engage in permit reviews, multi-year referrals capacity funding for Nations to meaningfully engage in the referral process
- protection of archaeological artifacts and cultural heritage during excavation and dredging
- impacts of disposal at sea on constitutional and treaty rights, adhering to the *UN Declaration on the Rights of Indigenous Peoples* (UNDRIP)
- impacts from dredging and disposal on fisheries
- greenhouse gas emissions
- cumulative effects
- beneficial use of dredged and excavated material
- toxicity testing of dredged material for disposal at sea approval
- dredging contributing to or triggering algal and/or bacterial blooms and broader up and downstream effects

Pacific region continued to operationalize the Multi-Jurisdictional Technical Review Body (MJTRB) as established under the Agreement on Collaborative Decision-Making Regarding Disposal at Sea between the Tsleil-Waututh Nation and the Minister of Environment and Climate Change. This included:

- producing a final draft of the Site Management Plan for the Point Grey disposal site and sharing with Musqueam and Squamish Nations for review and input
- initiating the Pathways of Effects study for the Point Grey disposal site to better understand and mitigate discrete and cumulative impacts of disposal
- MJTRB review of DAS permits and continuing work towards the development of a joint permit review process

#### Atlantic Region

In 2023-2024, the Disposal at Sea Program in the Atlantic region issued 18 permits for the disposal of dredged material in Nova Scotia, New Brunswick and Prince Edward Island and in Newfoundland and Labrador, 24 permits were issued for the disposal at sea of fish waste and uncontaminated organic matter. These permits met the legal duty to consult requirements, involving consultations with 16 First Nation communities in New Brunswick, 13 in Nova Scotia, and two in Prince Edward Island as well as the two Innu communities and 6 Inuit communities.

The Black Point Disposal Site Management Plan saw increased consultation and communication with two New Brunswick First Nation umbrella organizations, representing 14 First Nation rights holder communities. This included enhanced permit notification protocols for proposed Disposal at Sea permit activities and improved communication. The results of an Indigenous Land Resource Use Study from previous consultation activities were used to determine the desired level of support.

The effectiveness of the current arrangements under the management plans and any needed modifications were assessed through enhanced communication with the umbrella organizations.

### 3.5.3 Hazardous Waste and Hazardous Recyclable Material

The *Cross-border Movement of Hazardous Waste and Hazardous Recyclable Material Regulations (XBR)* establish the prior informed consent procedure for hazardous waste and hazardous recyclable material subject to transboundary movement and promote environmentally sound management of these wastes and recyclable materials.

The implementation of the XBR enables Canada to meet its obligations under the following instruments:

- The United Nations Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel Convention)
- The Decision OECD/LEGAL/0266 of the Council of the Organization for Economic Co-operation (OECD) Concerning the Control of Transboundary Movements of Wastes Destined for Recovery Operations (OECD Decision)
- The Canada-USA Agreement on the Transboundary Movement of Hazardous Wastes (Canada-US Agreement)

At the Basel Convention, in 2023-2024, Canada led a group working on the renewal of the strategic framework for 2025-2030 which sets out goals, objectives and indicators for the Convention. Canada is also an active member of several technical working groups developing guidance on the environmentally sound management of waste batteries, waste tires and waste containing POPs.

On September 30, 2023, the Department published proposed amendments to the XBR in the *Canada Gazette,* Part I as part of the proposed *Regulations Amending Certain Regulations Made by the Department of Environment* (60 day comment period). The proposed Regulations are intended to strengthen Canada's ability to meet its obligations under the Basel Convention, as well as to strengthen implementation and improve the clarity of the XBR.

#### 3.5.3.1 Hazardous Waste Permits

In the 2023 calendar year, ECCC processed 2,269 notices for proposed imports, exports and transits of hazardous wastes and hazardous recyclable materials under the XBR. Each notification requires a line-item number for each hazardous waste or hazardous recyclable material waste type. The notices received covered 37,034 distinct line-item numbers, which exhibited a range of hazardous properties such as being flammable, acutely toxic, oxidizing, corrosive, dangerously reactive and environmentally hazardous. In 2023, 2,109 permits were issued and at least 36,452 individual transboundary shipments of hazardous waste and hazardous recyclable material were reported in movement documents received by ECCC.

In 2023, almost all imports (99.8%) and exports (83.4%) of hazardous wastes and hazardous recyclable materials occurred between Canada and the United States. The remaining import exchanges occurred with Germany, the United Kingdom, the Netherlands and France, while the remaining exports occurred with the Republic of Korea, Pakistan, Malaysia, India, Germany, Mexico, Belgium and Austria.

The quantity of hazardous wastes and hazardous recyclable materials imported into Canada was 387,476 metric tonnes in 2023. Imports of all hazardous wastes and hazardous recyclable materials in 2023 were shipped to authorized facilities in five provinces: Ontario, Quebec, British Columbia, Manitoba and Alberta, ordered by weight.

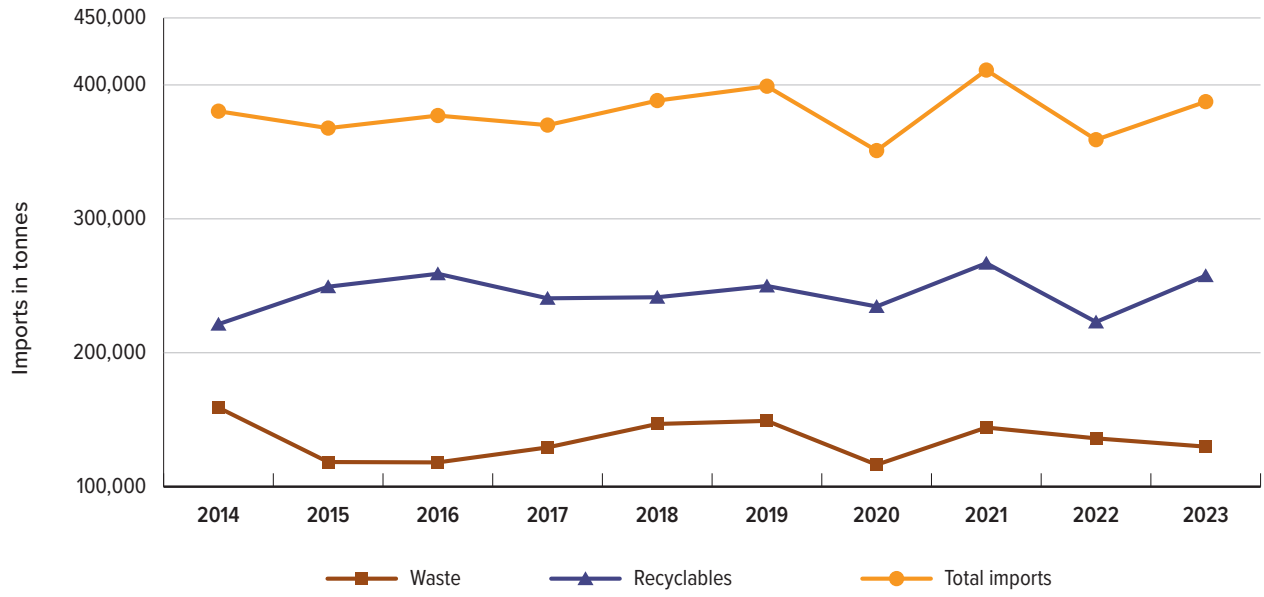
Hazardous recyclable materials imported into Canada for a recycling operation were mostly:

- lead acid batteries
- waste oils/water, hydrocarbons/water mixtures, emulsions
- waste containing metals
- flammable liquids

The remaining materials imported were hazardous wastes for a disposal operation (around 34% of the total quantity) and were mostly:

- waste halogenated or unhalogenated non-aqueous distillation residues arising from organic solvent recovery operations
- flammable liquids
- waste oils/water, hydrocarbons/water mixtures, emulsions
- acidic or inorganic corrosive liquid

**Figure 5. Trends in The Quantities of Hazardous Wastes and Hazardous Recyclable Materials Imported From 2014-2023**




The quantity of hazardous waste and hazardous recyclable materials exported was 520,932 tonnes in 2023. Exports in 2023 originated from nine provinces or territory: Ontario, Quebec, New Brunswick, British Columbia, Alberta, Saskatchewan, Manitoba, Northwest Territories and Newfoundland and Labrador, ordered by weight.

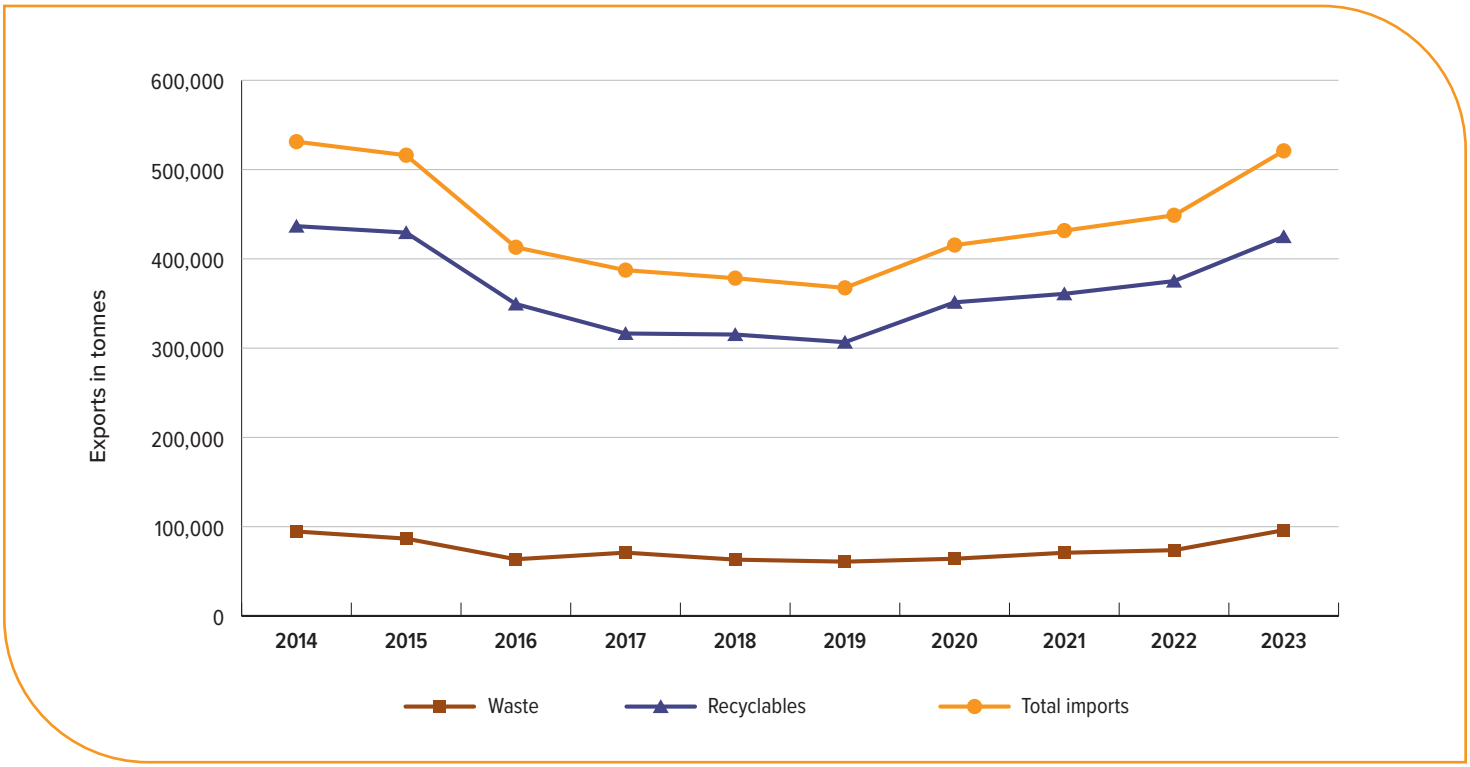
Shipments exported for recycling totaled 424,873 tonnes in 2023. Most hazardous recyclable material exported for recycling were:

- sulphuric acid
- lead acid batteries
- waste containing metal (such as aluminum remelting by-products)
- waste oils/water, hydrocarbons/water mixtures, emulsions

The remaining 96,059 tonnes exported were hazardous wastes for disposal (18%) and were mostly composed of:

- environmentally hazardous substances, solid (waste containing metal, waste from industrial pollution control devices)
- aluminum remelting by-products, including, but not limited to, aluminum dross, aluminum skimmings, spent cathodes, spent potliner and aluminum salt slags
- sulphuric acid
- clinical waste, biomedical waste, or regulated medical waste

**Figure 6. Trends in The Quantities of Hazardous Wastes and Hazardous Recyclable Materials Exported From 2014-2023**




**Note:** Data are revised periodically as new information becomes available. Therefore, information presented here may differ from information published in other reports.

## 3.6 Environmental Emergencies

Part 8 of CEPA (Environmental Matters Related to Emergencies) deals with the prevention of, preparedness for, response to, and recovery from uncontrolled, unplanned or accidental releases into the environment of substances that pose potential or immediate harm to the environment or danger to human life or health that are listed in Part 8.

In the event of a significant pollution incident, the National Environmental Emergencies Center (NEEC) oversees the response actions taken by the responsible party to repair, reduce or mitigate any negative effects on the environment or on human life or health resulting from the environmental emergency.

NEEC provides science-based expert advice 24 hours a day, seven days a week, in collaboration with other federal, provincial and territorial governments, municipalities and stakeholders to inform actions that reduce the consequences of environmental emergencies.

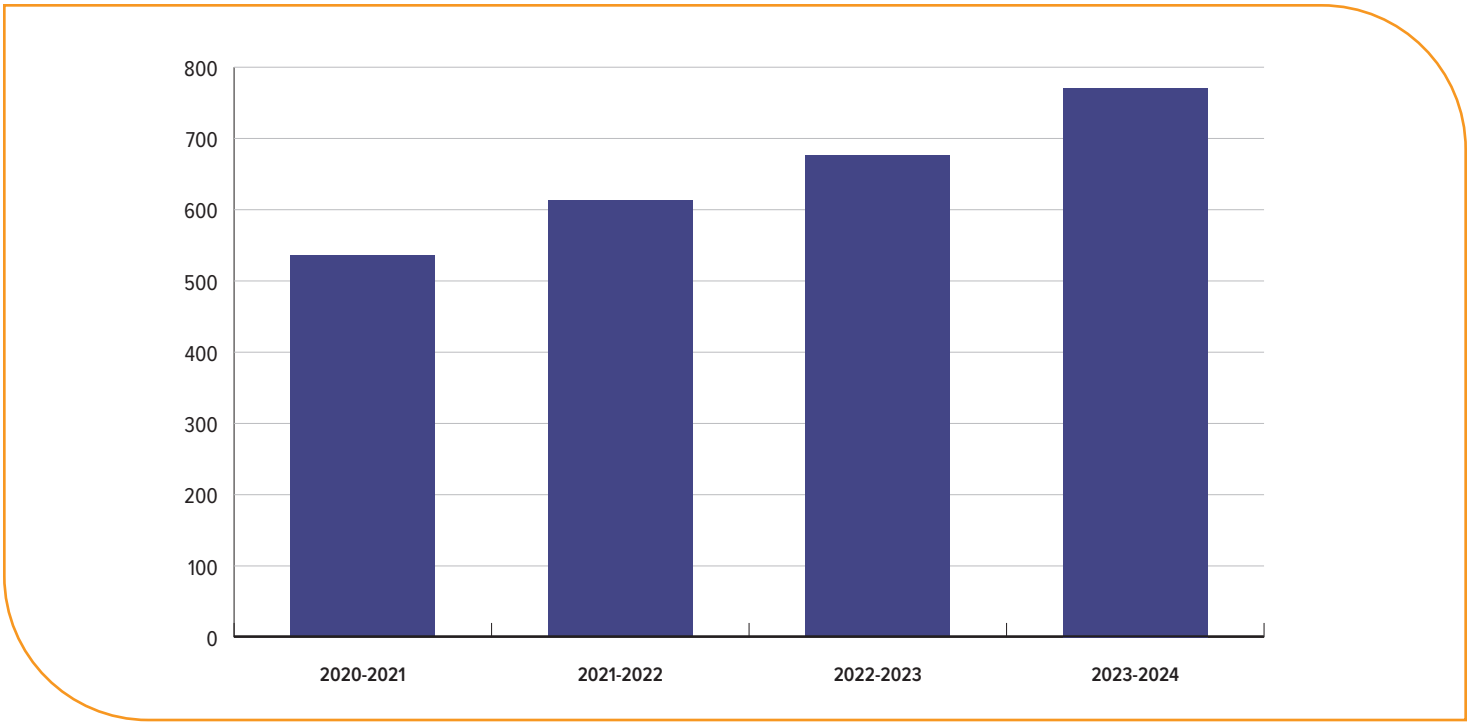
In 2023-2024, NEEC received 771 notifications of uncontrolled, unplanned or accidental releases of CEPA-regulated substances to the environment. Of these notifications:

- 62 were escalated to 1 of the Centre's Duty Officers for further assessment and to ensure that all reasonable measures were taken to protect the environment and human health
- four incidents resulted in services being provided to the lead agency to inform decisions on appropriate response actions and operations. These services included:
  - one spill trajectory model
  - two air dispersion models
  - two site-specific weather forecasts
- one incident required the on-site deployment of Environmental Emergency Officers to support the agency leading the response

On March 8, 2023, Rose Son Distributors overfilled an above-ground gasoline tank located on the Tyendinaga Mohawk Territory in Shannonville, Ontario. The original overfill was estimated at 150 litres but was later revised to 360 litres by the distributor. The spilled gasoline drained into the sump system of the on-site restaurant, where it was subsequently pumped outdoors into a small ditch that drains into a culvert that passes under the Old Highway 2 and leads into a wetland under federal ownership. An officer at Indigenous Services Canada (ISC) consulted the NEEC on March 24, 2023, to discuss reasonable measures for containing and collecting the spilled gasoline.

On April 5, 2023, the NEEC deployed two Environmental Emergency Officers (EEOs) to assess the situation, delineate the impacted area, and evaluate the impact on the wetland. The NEEC EEOs, ECCC enforcement officers and the Mohawks of the Bay of Quinte (MBQ) Environmental Service collaborated to inspect the spill area near the tank, as well as potentially impacted areas such as the wetland and the basement of a nearby building. Following the onsite deployment, the NEEC followed up with ISC and provided a response measure efficiency assessment.

**Figure 7. Number of Notifications Involving Uncontrolled, Unplanned or Accidental Release of CEPA Regulated Substances**




## 3.6.1 *Environmental Emergency Regulations*

The *Environmental Emergencies Regulations, 2019* (E2 regulations) aim to help reduce the frequency and severity of accidental releases of hazardous substances into the environment. They improve industry's readiness to deal with environmental emergencies that may occur at fixed facilities across Canada and they apply to any person who owns or has the charge, management or control of a listed substance and meet or exceed concentrations outlined in Schedule 1 of the regulation.

Since the E2 regulations came into effect, 4,421 fixed facilities from different sectors subject to the regulations have submitted notifications relating to quantities of hazardous substances, on site and container system capacity, being equal to or above regulatory thresholds. Of this amount, 2,910 higher risk facilities have developed and brought their Environmental Emergency Plan into effect.

## 3.7 Government Operations on Federal and Aboriginal Land

### 3.7.1 *Federal Halocarbon Regulations, 2022*

The *Federal Halocarbon Regulations, 2022* reduce and prevent emissions of halocarbons to the environment from refrigeration, air conditioning, fire extinguishing and solvent systems that are located on aboriginal or federal lands or are owned by federal departments, boards and agencies, Crown corporations, or federal works and undertakings.

In 2023-2024, 16 permits to charge fire-extinguishing systems with a halocarbon were issued under the regulations. These permits are valid for three years beginning on the day of issuance.

### 3.7.2 *Storage Tank Systems for Petroleum Products and Allied Petroleum Product Regulations*

The objective of the *Storage Tank Systems for Petroleum Products and Allied Petroleum Product Regulations* is to reduce the risk of contaminating soil and groundwater due to releases of petroleum products and allied petroleum products from storage tank systems (STS) under federal jurisdiction. They establish technical standards for the design and installation of storage tank systems, and include requirements for operation, maintenance, removal, reporting, and record keeping.

In July 2023, ECCC published a What we heard report: Review of the storage tank regulations that summarizes the feedback received during the 2022 engagement activities the department undertook as part of the Regulatory stock review plan.

# 4. Confidential Business Information

The recent amendments to CEPA pertaining to confidential business information are designed to strike a balance between protecting business information and ensuring public safety and transparency. They introduce stricter criteria for those requesting confidentiality under section 313 of CEPA and provide a mechanism for oversight of the submission, review and reporting of confidentiality requests. The changes also emphasize the importance of transparency, with required annual reporting on both a statistically valid representative sample of confidentiality requests granted and the disclosure of masked substance names in specific cases.

The new requirements related to receiving, assessing and reviewing confidentiality introduced changes to existing activities and processes under CEPA, as well as the addition of new activities. In 2023-2024, ECCC and HC continued work on developing new guidance and supporting tools and resources to implement these changes. Confidential business information requests received in 2023-2024 continued to be treated according to the process in place prior to these new requirements. New annual reporting requirements on confidentiality requests and the results of the first annual review of confidentiality requests subjected to the newly expanded provisions under section 313 will be presented in the 2026-2027 CEPA annual report and in reporting years moving forward.

The 2026-2027 CEPA annual report will also include the following information in accordance with new CEPA requirements:

- the number of requests received
- the number of requests reviewed
- the number of requests that, in whole or in part, were deemed not to have been made
- a summary of the information disclosed under sections 315 to 317.2 of CEPA

# 5. Compliance Promotion and Enforcement

## 5.1 Compliance Promotion

Compliance promotion relates to planned activities undertaken to increase awareness, understanding and compliance with the law and its regulations. Through these activities, regulated communities receive information on what is required to comply with the law, the benefits of compliance, and the consequences of non-compliance. The goal is to achieve desired environmental results more efficiently through education and awareness-building, which helps mitigate consequential enforcement actions.

Tools used to promote compliance include:

- information sessions
- conferences and workshops
- fact sheets
- publications
- guidelines
- reports
- *Canada Gazette* notices

### 5.1.1 Compliance Promotion Priorities

Each year, ECCC uses a risk-based approach to establish priorities for compliance promotion activities among the wide variety of CEPA's regulatory and non-regulatory instruments to address issues such as chemical management and air pollutant and greenhouse gas emissions. Activities are prioritized to address the highest risk of non-compliance by considering a number of factors, including whether an instrument is new or amended, has new requirements coming into effect, has an observed low compliance rate, or when many questions are received from regulated parties. ECCC's Compliance Promotion Program then aligns resources to priority instruments and carries out compliance promotion activities in collaboration with the managers responsible for the instruments and enforcement personnel.

### 5.1.2 Compliance Promotion Activities

In 2023-2024, 14,068 known or potential regulatees received compliance promotion material and 2,454 stakeholders contacted ECCC to obtain clarification of regulatory requirements and/or additional information. Compliance promotion activities were carried out on prioritized CEPA instruments, (see **Table 14**).

**Table 14. Compliance Promotion Activities Carried Out Under Prioritized CEPA Instruments**

| Prioritized CEPA Instrument | Key Activities Carried Out in 2023-2024 |
|---|---|
| *Chromium Electroplating, Chromium Anodizing and Reverse Etching Regulations* | • sent reminder emails about reporting and release test deadlines<br>• updated fillable forms available on the CEPA Registry web page to improve facility accessibility |
| *Clean Fuel Regulations* | • developed and shared 11 guidance materials and 10 pre-publications for consultation<br>• hosted six information sessions on various aspects of the regulations<br>• sent 62 public outreach emails, including reminders and instructions for report submissions and various information and updates |
| Code of Practice for the Environmental Management of Road Salts | • distributed an annual deadline reminder on reporting to organizations that may use more than 500 tonnes of road salts per year |
| Code of Practice for the Reduction of Volatile Organic Compound (VOC) Emissions from the Use of Cutback and Emulsified Asphalt | • published articles in association newsletters to increase awareness of the "ozone season" and its implications for paving operations |
| *Cross-border Movement of Hazardous Waste and Hazardous Recyclable Material Regulations* | • developed and distributed two online news bulletins to the regulated community informing them of requirements and updates<br>• sent email and letter campaigns to targeted stakeholders affected by changes to contamination limits affecting international shipments, as well as information on requirements related to shipments of e-waste and batteries, and other new waste streams |
| *Federal Halocarbon Regulations, 2022* | • developed tailored presentations for use at technical training workshops for Indigenous communities, with the aim of increasing awareness and understanding of requirements<br>• promoted the regulations to various stakeholders and interested parties (such as, federal departments, facility management companies, refrigeration installers, consultants) |
| *Formaldehyde Emissions from Composite Wood Products Regulations* | • sent an email to stakeholders informing them of the coming into force of the regulations<br>• updated the *Formaldehyde Emissions from Composite Wood Products Regulations* factsheet<br>• sent an email campaign to collect business information from targeted stakeholders<br>• sent an email to stakeholders once the *Regulations Amending the Formaldehyde Emissions from Composite Wood Products Regulations* were published in *Canada Gazette*, Part I and subsequently in *Canada Gazette*, Part II |
| *Microbeads in Toiletries Regulations* | • developed and published an update to the analytical method applicable to the identification of plastic microbeads in consumer products, specifically, toiletries |
| *New Substances Notification Regulations (Organisms)* | • updated four web pages and one factsheet (1st phase of web page updating) |

| Prioritized CEPA Instrument | Key Activities Carried Out in 2023-2024 |
|---|---|
| *Ozone-depleting Substances and Halocarbon Alternatives Regulations (ODSHAR)* | • updated the target audience list (new and existing stakeholders) to support future compliance promotion activities<br>• participated as a panelist in three in-person events to discuss issues related to ODSHAR<br>• delivered two webinars with the objective of increasing awareness and understanding of the controls on imports of bulk HFCs<br>• published information on authorizations (allowances and essential purpose permits) issued under the ODSHAR<br>• developed and sent compliance promotion materials related to laboratory and analytical uses of controlled substances as well as administrative requirements (for example, annual reporting) |
| *PCB Regulations* | • participated in six meetings, conferences, and tradeshows to:<br>o promote the regulations<br>o remind the regulated community of the upcoming 2025 end-of-use deadline for equipment containing PCBs<br>o provide updates on upcoming amendments<br>• developed tailored presentations for use at technical training workshops for Indigenous communities, with the aim of increasing awareness and understanding of requirements |
| *Products Containing Mercury Regulations* | • sent reminders to manufacturers and importers that had submitted reports in the past informing them that reporting requirements could apply in 2023 |
| *Prohibition of Asbestos and Asbestos Products Regulations* | • delivered two outreach campaigns targeting :<br>o the laboratory and museum sectors<br>o companies declaring imports of products containing asbestos |
| *Prohibition of Certain Toxic Substances Regulations, 2012* | • launched the following outreach campaigns to increase awareness of the regulations and to:<br>o inform cleaning product companies of the potential presence of PFAS in their products<br>o inform targeted discount stores of the potential presence of prohibited toxic substances in some of their retail products<br>o remind laboratories, and their suppliers, of the annual reporting requirements associated with the exempted use of substances for research, analysis and as analytical standards |
| *Single-use Plastics Prohibition Regulations* | • delivered the following two outreach campaigns targeting:<br>o manufacturers and importers of beverage ring carriers<br>o medical and long-term care facilities regarding the exceptions for flexible plastic straws<br>• participated in nine conferences and tradeshows targeting retailers, restaurants, municipalities, and waste management companies to increase awareness and understanding of the regulatory requirements |

| Prioritized CEPA Instrument | Key Activities Carried Out in 2023-2024 |
|---|---|
| *Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations* | • launched an email reminder campaign to regulated parties to promote awareness of the storage tank system identification requirements<br>• developed tailored presentations for use at technical training workshops for Indigenous communities, with the aim of increasing awareness and understanding of requirements |
| *Tetrachloroethylene (Use in Dry Cleaning and Reporting Requirements) Regulations* | • published articles in industry association newsletters to increase awareness among drycleaners<br>• participated in two conferences hosted by business associations in the textile industry to promote regulatory information to their members |
| *Volatile Organic Compound (VOC) Concentration Limits for Architectural Coatings Regulations* | • published articles in association newsletters to increase awareness of the "ozone season", and its implications for traffic marking<br>• participated in two trade shows to promote the regulations |
| *Volatile Organic Compound (VOC) Concentration Limits for Automotive Refinishing Products Regulations* | • responded to questions received on the regulations |
| *Volatile Organic Compound (VOC) Concentration Limits for Certain Products Regulations* | • participated in two tradeshows to promote the regulations<br>• sent a notification email campaign to manufacturers and importers to notify of the January 2024 coming into force date |

### 5.1.3 Environmental Economic Instruments Fund

The Environmental Economic Instruments Fund was established in the accounts of Canada upon Royal Assent of the *Budget Implementation Act, 2023*, No. 1 on June 22, 2023, for the purpose of administering amounts received as contributions to certain funding programs established by regulations under the responsibility of the Minister of Environment and Climate Change.

At this time, only the *Clean Fuel Regulations* (CFR) have a funding program being administered under the Environmental Economic Instruments Fund. The CFR, which require liquid fossil fuel providers to gradually reduce the amount of pollution from the fuels they produce and sell for use in Canada, include a number of mechanisms to help mitigate compliance costs while maintaining the objective of delivering real greenhouse gas emissions reductions. One of these mechanisms allows regulated parties to discharge up to 10% of their annual compliance requirement, starting January 1, 2024, through payment (that is, contribution) into a funding program that invests in, and obtains, greenhouse gas emissions reductions in the short term.

## 5.2 Enforcement

CEPA provides enforcement officers with a wide range of powers to enforce the Act, including the powers of a peace officer. Enforcement officers can carry out inspections to verify compliance with the Act; enter premises, open containers, examine contents and take samples; conduct tests and measurements; obtain access to information (including data stored on computers); stop and detain conveyances; search, seize and detain items related to the enforcement of the Act; secure inspection warrants to enter and inspect premises that are locked and/or abandoned or where entry has been refused; seek search warrants; and arrest offenders.

Enforcement activities are conducted in accordance with the Compliance and Enforcement Policy for CEPA.

### 5.2.1 Enforcement Priorities

Each year, ECCC develops an Integrated Enforcement Plan (IEP) that sets out the enforcement activities to be carried out, including activities to address non-compliance with CEPA. This risk-based approach allows the department to target entities where evidence indicates an offence is likely to occur and where significant environmental or conservation damage would result from an offence.

During 2023-2024, ECCC implemented projects related to fuels importation, siloxane D4, metallurgical and chemical industries, plastic exports and engines. Risk assessments continue to inform decision-making processes and help to better align enforcement actions and resources to protect the environment and human health. In addition to the planned inspections carried out under the IEP, enforcement activities under CEPA include a large number of unplanned inspections resulting from responses to complaints, notifications from partners, intelligence or departmental referrals, reported spills and incidents, or other information.

### 5.2.2 Enforcement Measures

Enforcement measures available to address alleged violations of CEPA and its regulations include warnings to bring an alleged violation to the attention of an alleged offender, and if applicable, return to compliance. In addition, environmental protection compliance orders (EPCOs) require action to be taken to stop an ongoing violation from continuing, or to prevent a violation from occurring, and administrative monetary penalties (AMPs) provide a financial disincentive to non compliance. Enforcement measures also include tickets, prosecutions and environmental protection alternative measures (EPAMs).

For reporting purposes, prosecutions are all instances in which charges were laid against a person (individual, corporation, or government department). The decision to prosecute ultimately rests with the Director of Public Prosecutions of Canada or their delegated agent. While reviewing the data, it should be noted that prosecutions can be time consuming and often continue through multiple fiscal years, resulting in discrepancies between the number of charges laid and prosecutions in the fiscal year.

Tickets for offences under CEPA can be issued under the *Contraventions Act*, usually where there is minimal or no threat to the environment or human health. Where an offence has taken place and this offence is designated as ticketable, enforcement officers will issue a ticket, unless they have determined that, in accordance with the criteria of the Compliance and Enforcement Policy for CEPA another enforcement measure is the appropriate response.

### 5.2.3 Environmental Damages Fund

In 2023-2024, a total of $1,525,000 was directed to the Environmental Damages Fund (EDF), which included $1,100,000 in fines from conviction and $425,000 through the issuance of AMPs. The EDF is a specified purpose account, administered by ECCC, to provide a mechanism for directing funds received from fines, penalties, court orders, and voluntary payments to priority projects that will benefit our natural environment.

### 5.2.4 Environmental Offenders Registry and Enforcement Notifications

The Environmental Offenders Registry contains information on convictions of corporations obtained under certain federal environmental laws, including CEPA, from June 18, 2009, to the present. This tool allows the media and the public to search for corporate convictions using keywords such as the name of the corporation or the legislation under which the conviction was obtained.

The Enforcement Notifications provide information regarding successful prosecutions across Canada under the acts and regulations administered by ECCC or involving ECCC enforcement officers (including CEPA).

### 5.2.5 Enforcement Activities

Enforcement activities undertaken between April 1, 2023, and March 31, 2024, are summarized in **Table 15** and **Table 16**. Only the statutory instruments used to conduct enforcement actions during the fiscal year are listed in these tables.

**Table 15. Number of Inspections, Investigations and Enforcement Measures Taken Under CEPA From April 2023 to March 2024**

| | Inspections | | | Investigations[1] | | | Enforcement Measures[2] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Statutory Instrument** | **On-site** | **Off-site** | **Total** | **Started Prior to Fiscal Year and Ongoing** | **Started During Fiscal Year** | **Ended in Fiscal Year** | **Written Warnings[3]** | **EPCOs[3]** | **AMPs[3]** | **Other Enforcement Measures[4]** | **Total** | **Number of Subjects Involved in EPCOs[5]** |
| **Total** | **1,015** | **281** | **1,296** | **25** | **15** | **22** | **207** | **49** | **213** | **17** | **486** | **53** |
| *2-Butoxyethanol Regulations* | 4 | | 4 | | | 1 | 3 | 2 | | | 5 | 2 |
| *Benzene in Gasoline Regulations* | 10 | | 10 | | | | 2 | | | | 2 | |
| *CEPA Section 46 Notices - Greenhouse Gases* | | 1 | 1 | | | | | | | | 0 | |
| *CEPA Section 56 Notices - P2 Plans* | 7 | 2 | 9 | | | | | | | | 0 | |
| *CEPA Section 71 Notices - Toxics* | 2 | 28 | 30 | | | | | | | | 0 | |
| *CEPA* – all other sections[6] | 72 | 34 | 106 | 6 | 2 | 8 | 14 | 18 | 49 | 2 | 83 | 21 |
| *Chromium Electroplating, Chromium Anodizing and Reverse Etching Regulations* | 24 | 7 | 31 | | | | 9 | | | 1 | 10 | |
| *Concentration of Phosphorus in Certain Cleaning Products Regulations* | 5 | | 5 | | | | | | | | 0 | |
| *Contaminated Fuel Regulations* | 1 | | 1 | | | | | | | | 0 | |
| *Cross Border Movement of Hazardous Waste and Hazardous Recyclable Material Regulations* | 162 | 16 | 178 | | | | 5 | | 19 | | 24 | |
| *Disposal at Sea Regulations* | 35 | 28 | 63 | | | | 3 | | | | 3 | |
| *Environmental Emergency Regulations* | 105 | 21 | 126 | 3 | | | 31 | 8 | | 1 | 40 | 8 |

| | Inspections | | | Investigations[1] | | | Enforcement Measures[2] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Statutory Instrument** | **On-site** | **Off-site** | **Total** | **Started Prior to Fiscal Year and Ongoing** | **Started During Fiscal Year** | **Ended in Fiscal Year** | **Written Warnings[3]** | **EPCOs[3]** | **AMPs[3]** | **Other Enforcement Measures[4]** | **Total** | **Number of Subjects Involved in EPCOs[5]** |
| *Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations* | 1 | | 1 | 2 | | | 1 | | | | 1 | |
| *Federal Halocarbon Regulations, 2022* | 45 | 17 | 62 | | | | 8 | | 1 | | 9 | |
| *Formaldehyde Emissions from Composite Wood Products Regulations* | 1 | | 1 | | | | | | | | 0 | |
| *Fuels Information Regulations, No. 1* | 6 | 2 | 8 | | | | 1 | | 3 | | 4 | |
| *Gasoline Regulations* | 6 | 1 | 7 | | | | 6 | | | | 6 | |
| *Interprovincial Movement of Hazardous Waste Regulations* | 1 | | 1 | | | | | | | | 0 | |
| *Marine Spark-Ignition Engine, Vessel and Off-Road Recreational Vehicle Emission Regulations* | 2 | | 2 | | | | | | | | 0 | |
| *Microbeads in Toiletries Regulations* | 31 | 1 | 32 | | 1 | 1 | 7 | 4 | | | 11 | 5 |
| *Multi-Sector Air Pollutants Regulations* | | 1 | 1 | | | | | | | | 0 | |
| National Pollutant Release Inventory | 2 | 2 | 4 | | | | | | | | 0 | |

| | Inspections | | | Investigations[1] | | | Enforcement Measures[2] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Statutory Instrument** | **On-site** | **Off-site** | **Total** | **Started Prior to Fiscal Year and Ongoing** | **Started During Fiscal Year** | **Ended in Fiscal Year** | **Written Warnings[3]** | **EPCOs[3]** | **AMPs[3]** | **Other Enforcement Measures[4]** | **Total** | **Number of Subjects Involved in EPCOs[5]** |
| *New Substances Notification Regulations (Chemicals and Polymers)* | 6 | 1 | 7 | | | | 1 | | | | 1 | |
| *New Substances Notification Regulations (Organisms)* | | 1 | 1 | | | | | | | | 0 | |
| *Off-Road Compression-Ignition Engine Emission Regulations* | 27 | 2 | 29 | | | 2 | 4 | | 83 | | 87 | |
| *Off-Road Compression-Ignition (Mobile and Stationary) and Large Spark-Ignition Engine Emission Regulations* | 65 | 12 | 77 | | 3 | 1 | 8 | | 24 | 3 | 35 | |
| *Off-Road Small Spark-Ignition Engine Emission Regulations* | 17 | 2 | 19 | | | 2 | 2 | | 8 | | 10 | |
| *On-Road Vehicle and Engine Emission Regulations* | | 3 | 3 | 1 | | 1 | | | | | 0 | |
| *Ozone-depleting Substances and Halocarbon Alternatives Regulations* | 29 | 12 | 41 | | 2 | 3 | 20 | 1 | | 2 | 23 | 1 |

| | Inspections | | | Investigations[1] | | | Enforcement Measures[2] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Statutory Instrument** | **On-site** | **Off-site** | **Total** | **Started Prior to Fiscal Year and Ongoing** | **Started During Fiscal Year** | **Ended in Fiscal Year** | **Written Warnings[3]** | **EPCOs[3]** | **AMPs[3]** | **Other Enforcement Measures[4]** | **Total** | **Number of Subjects Involved in EPCOs[5]** |
| *PCB Regulations* | 47 | 10 | 57 | 7 | | 2 | 12 | 1 | | | 13 | 1 |
| *Products Containing Mercury Regulations* | 6 | 2 | 8 | | | | 1 | | | | 1 | |
| *Prohibition of Asbestos and Products Containing Asbestos Regulations* | 4 | | 4 | | | | 2 | 1 | | | 3 | 1 |
| *Prohibition of Certain Toxic Substances Regulations, 2012* | 13 | | 13 | | 1 | 1 | 2 | 1 | | | 3 | 1 |
| *Pulp and Paper Mill Defoamer and Wood Chip Regulations* | | 1 | 1 | | | | | | | | 0 | |
| *Pulp and Paper Mill Effluent Chlorinated Dioxins and Furans Regulations* | | 11 | 11 | | | | | | | | 0 | |
| *Reduction in the Release of Volatile Organic Compounds Regulations (Petroleum Sector)* | 6 | | 6 | | | | | | | | 0 | |
| *Release and Environmental Emergency Notification Regulations* | 1 | | 1 | | | | 1 | | | | 1 | |
| *Renewable Fuels Regulations* | 7 | | 7 | | 1 | | 2 | | 10 | | 12 | |

| | Inspections | | | Investigations[1] | | | Enforcement Measures[2] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Statutory Instrument** | **On-site** | **Off-site** | **Total** | **Started Prior to Fiscal Year and Ongoing** | **Started During Fiscal Year** | **Ended in Fiscal Year** | **Written Warnings[3]** | **EPCOs[3]** | **AMPs[3]** | **Other Enforcement Measures[4]** | **Total** | **Number of Subjects Involved in EPCOs[5]** |
| *Single-Use Plastics Prohibition Regulations* | 4 | 2 | 6 | | | | 1 | | | | 1 | |
| *Solvent Degreasing Regulations* | | 2 | 2 | | | | | | | | 0 | |
| *Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations* | 136 | 51 | 187 | 4 | 4 | | 36 | 5 | 12 | 1 | 54 | 5 |
| *Sulphur in Diesel Fuel Regulations* | 18 | 2 | 20 | | | | 1 | | 4 | | 5 | |
| *Sulphur in Gasoline Regulations* | 11 | | 11 | | | | 1 | | | | 1 | |
| *Tetrachloroethylene (Use in Dry Cleaning and Reporting Requirements) Regulations* | 88 | 5 | 93 | | | | 21 | 5 | | 6 | 32 | 5 |
| *Volatile Organic Compound (VOC) Concentration Limits for Architectural Coatings Regulations* | 3 | 1 | 4 | 1 | 1 | | 1 | 3 | | | 4 | 3 |
| *Volatile Organic Compound (VOC) Concentration Limits for Automotive Refinishing Products Regulations* | 2 | | 2 | 1 | | | 1 | | | 1 | 2 | |

| | Inspections | | | Investigations[1] | | | Enforcement Measures[2] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Statutory Instrument** | **On-site** | **Off-site** | **Total** | **Started Prior to Fiscal Year and Ongoing** | **Started During Fiscal Year** | **Ended in Fiscal Year** | **Written Warnings[3]** | **EPCOs[3]** | **AMPs[3]** | **Other Enforcement Measures[4]** | **Total** | **Number of Subjects Involved in EPCOs[5]** |
| *Volatile Organic Compound Concentration Limits for Certain Products Regulations* | 3 | | 3 | | | | | | | | 0 | |

[1] Investigations are tabulated by the number of investigation files at the regulation level, based on the start or end date of the investigation. An investigation may be counted under one or more regulations.

[2] Enforcement measures issued between April 1, 2023, and March 31, 2024. Note that the initial inspection may have been conducted in a different fiscal year than when the measure was issued.

[3] Written warnings, EPCOs and AMPs are tabulated by number of measures issued at the regulation level. For example, if one warning is issued for two different regulations, the number of warnings is two.

[4] This category includes enforcement measures that were rarely issued during 2023. It includes four Prosecutions (two issued under the CEPA -all other sections[6], one under the S*torage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations, and the other under Volatile Organic Compound (VOC) Concentration Limits for Automotive Refinishing Products Regulations),* ten Tickets (one issued under the *Chromium Electroplating, Chromium Anodizing and Reverse Etching Regulations,* one under the *Environmental Emergency Regulations,* two under *Ozone-depleting Substances and Halocarbon Alternatives Regulations,* and six under *Tetrachloroethylene (Use in Dry Cleaning and Reporting Requirements) Regulations)* and three Alternative Measures issued under the *Off-road Compression-Ignition (Mobile and Stationary) and Large Spark-Ignition Engine Emission Regulations.*

[5] The number of subjects involved in EPCOs is represented by the number of regulatees issued EPCOs, regardless of the number of sections. For example, if one regulatee was issued an EPCO for three sections of the PCB Regulations, the number of subjects involved is one.

[6] Enforcement activities and measures are reported under CEPA (the Act) or an associated CEPA regulation. In some cases, enforceable provisions exist in both the Act and the regulations, meaning that a subset of activities or measures may be accounted for under the relevant regulations or the "CEPA - all other sections" statutory instrument.

**Table 16. Prosecutions, Number of Tickets and AMPs With Associated Penalty Amounts Issued Between April 2023 and March 2024**

| | Prosecutions | | | | Penalty amounts ($) | | |
|---|---|---|---|---|---|---|---|
| **Instrument** | **Number of Convicted Subjects**[1] | **Number of Guilty Counts**[2] | **Number of Tickets** | **Number of AMPs** | **Fines (Convictions and Tickets)** | **AMPs** | **Total Penalty Amount**[3] |
| **Total** | 3 | 3 | 10 | 219 | $1,107,480 | $425,000 | $1,532,480 |
| CEPA – various sections | 1 | 1 | | 55 | $5,00,000 | $101,000 | $601,000 |
| *Chromium Electroplating, Chromium Anodizing and Reverse Etching Regulations* | | | 1 | | $575 | | $575 |
| *Cross Border Movement of Hazardous Waste and Hazardous Recyclable Material Regulations* | | | | 19 | | $176,000 | $176,000 |
| *Environmental Emergency Regulations* | | | 1 | | $900 | | $900 |
| *Federal Halocarbons Regulations, 2022* | | | | 1 | | $1,000 | $1,000 |
| *Fuels Information Regulations, No. 1* | | | | 3 | | $7,000 | $7,000 |
| *Off-road Compression-Ignition (Mobile and Stationary) and Large Spark-Ignition Engine Emission Regulations* | | | | 24 | | $45,600 | $45,600 |
| *Off-Road Compression-Ignition Engine Emission Regulations* | | | | 83 | | $13,000 | $13,000 |
| *Off-Road Small Spark-Ignition Engine Emission Regulations* | | | | 8 | | $34,400 | $34,400 |

| | Prosecutions | | | | Penalty amounts ($) | | |
|---|---|---|---|---|---|---|---|
| **Instrument** | **Number of Convicted Subjects**[1] | **Number of Guilty Counts**[2] | **Number of Tickets** | **Number of AMPs** | **Fines (Convictions and Tickets)** | **AMPs** | **Total Penalty Amount**[3] |
| *Ozone-depleting Substances and Halocarbon Alternatives Regulations* | | | 2 | | $2,030 | | $2,030 |
| *Renewable Fuels Regulations*[4] | | | | 10 | | $16,000 | $16,000 |
| *Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations* | | | | 12 | | $25,000 | $25,000 |
| *Sulphur in Diesel Fuel Regulations* | | | | 4 | | $6,000 | $6,000 |
| *Tetrachloroethylene (Use in Dry Cleaning and Reporting Requirements) Regulations* | | | 6 | | $3,975 | | $3,975 |
| *Volatile Organic Compound (VOC) Concentration Limits for Automotive Refinishing Products Regulations* | 1 | 1 | | | $600,000 | | $600,000 |

[1] The number of subjects convicted during the reporting period, based on date sentenced.

[2] The number of sections of legislation or regulations, for which there was a charge or conviction during the reporting period. For example, if 1 person is charged with 2 counts under CEPA, this is considered 1 charge laid against the subject and 2 counts.

[3] A total of $1,525,000 of the CEPA penalty amounts have been directed to the EDF in 2023-2024.

[4] The result of the prosecution process under the Renewable Fuels Regulations is an Environmental Protection Alternative Measures Agreement. The agreement was entered into as an alternative to prosecution for a charge laid by ECCC. More details are explained in the ECCC's Enforcement Notifications.

### 5.2.6 Enforcement Highlights

In 2023-2024, the following two prosecutions occurred under CEPA and its regulations in 2023-2024, which resulted in $1,100,000 in fines directed to the EDF.

- ***Volatile Organic Compound (VOC) Concentration Limits for Automotive Refinishing Products Regulations***
  On November 6, 2023, Plastique Royal inc. was ordered by the Court of Québec to pay a fine of $600,000 to the EDF. The company pleaded guilty to one count of violating CEPA and one count of violating the Volatile Organic Compound (VOC) Concentration Limits for Automotive Refinishing Products Regulations.
- **CEPA, subsection 81(4)**
  On March 19, 2024, Groupe Marcelle inc. was ordered by the Court of Québec, to pay a fine of $500,000 to the EDF. The company pleaded guilty to one count of violating subsection 81(4) of CEPA.

## 5.3 Compliance Promotion and Enforcement Engagement Activities With Indigenous Peoples

Indigenous communities encounter challenges associated with compliance, which require a combination of support and compliance promotion activities tailored to the circumstances and needs of the particular community. In undertaking compliance promotion activities, ECCC makes efforts to build and maintain strong relationships with supporting organizations like Circuit Riders, Indigenous Services Canada, Technical Associations, and Tribal Councils in order to support consistency in communications and provide materials that target the distinct needs of the community.

ECCC participated in conferences, in-person visits, and remote meetings to increase the awareness and understanding of regulatory requirements for a number of CEPA instruments among Indigenous communities. The activities focused on providing tailored support and strengthening relationships with communities, and included:

- a booth at Our Gathering 2023, *kexwkexwntsút chet, tə sc̓əc̓ip ct* (Vancouver, BC, May 16-18, 2023)
- a presentation and booth at *Ontario First Nations Technical Services Corporation – Tech Nations* conference and tradeshow (Thunder Bay, ON, September, 2023)
- a presentation and booth at *Links to Learning* conference (Vancouver, BC, December, 2023)
- customized support for registration of storage tank systems and emergency plan requirements under the *Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations*

During 2023-2024, ECCC conducted enforcement activities under CEPA on First Nation reserves. These enforcement activities were conducted mostly under the *Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations*. Enforcement engagement strategies are being developed to ensure a constructive dialogue with communities during compliance verifications and when addressing non-compliance.

# 6. National Reporting Programs Under CEPA

Pursuant to section 46 authorities under CEPA, there are two mandatory programs that require facilities to report on their yearly releases or emissions of specified substances into the environment:

- Greenhouse Gas Reporting Program (GHGRP)
- National Pollutant Release Inventory (NPRI)

Data for both programs is submitted through ECCC's Single Window Information Management (SWIM) system.

## 6.1 Greenhouse Gas Reporting Program

The GHGRP tracks greenhouse gas emissions from large industrial operations and other types of facilities whose on-site activities produce and release GHGs into the air. This program contributes to ECCC's activities to monitor environmental performance and is part of ongoing efforts to maintain, in collaboration with various provinces, a nationally consistent and mandatory GHG reporting system in order to: support regulatory initiatives and the GHG reporting needs of all jurisdictions, minimize the reporting burden for industry and government, and provide the public with consistent information about GHG emissions from Canadian facilities. The GHGRP also contributes to Canada's official national greenhouse gas inventory submitted to the *United Nations Framework Convention on Climate Change*, which provides a complete inventory of Canada's annual human-caused emissions from all sources and removals by sinks since the year 1990. Under the GHGRP, facilities emitting a combined total quantity of GHGs above the equivalent of 10,000 tonnes of $CO_2$ in a given year must report their annual emissions each June.

On December 9, 2023, ECCC published a Notice setting out the GHG reporting requirements for the years 2024 and 2025.

ECCC is responsible for preparing Canada's official national inventory every year with input from numerous experts and scientists across Canada. On May 2, 2024, ECCC published the facility GHG data and summary report for the 2022 reporting year. In 2022, 1,814 facilities (**Figure 8**) reported their greenhouse gas emissions to ECCC, totaling 293 megatonnes (Mt) of $CO_2$ equivalent. Total facility-reported emissions were 1.6% greater than the reported total in 2021 (289 Mt $CO_2$) due mainly to increased emissions in the Mining, Quarrying, and Oil and Gas Extraction and Manufacturing sectors. In 2022, the GHGRP shows that emissions from the reporting facilities account for 41% of Canada's total GHG emissions (708 Mt).

Figure 8. Map of The 1,814 Facilities Reporting Greenhouse Gas Emissions in 2022

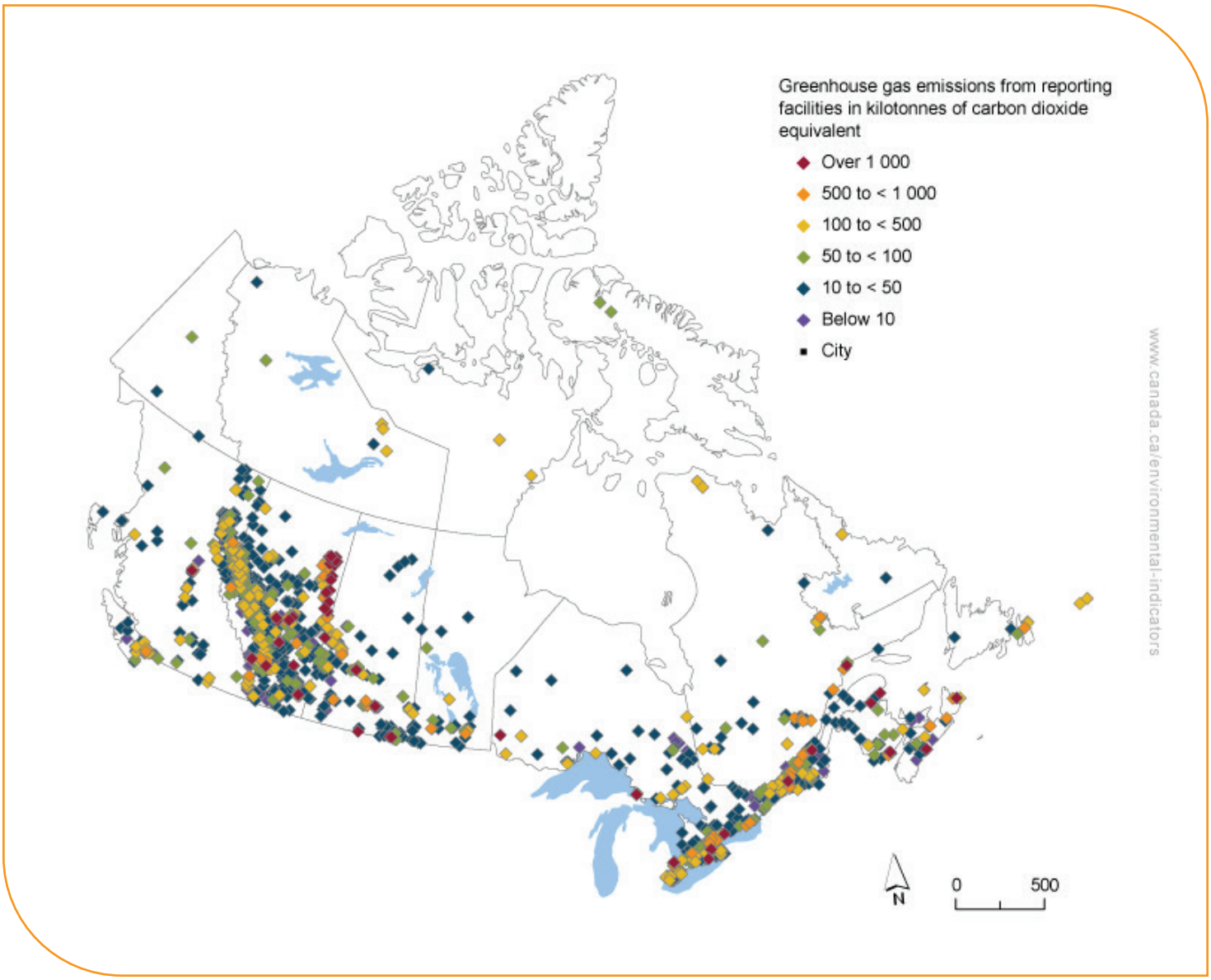
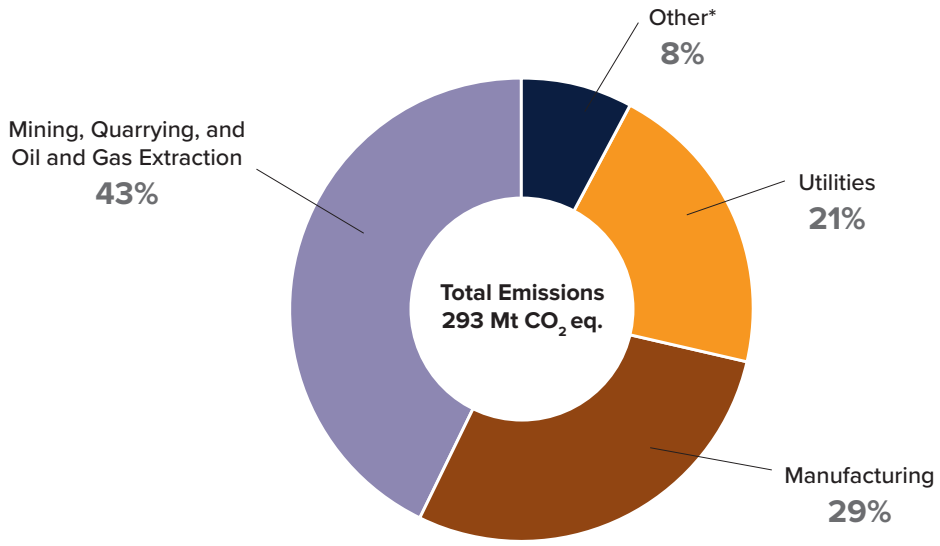


Figure 9. Facility-Reported 2022 Greenhouse Gas Emissions by Industry Sector




*Other includes facilities that fall into other industry sectors other than those already mentioned, such as natural gas transportation pipelines, solid waste landfills, universities, hospitals, and public administration buildings.

## 6.2 National Pollutant Release Inventory

The NPRI provides a publicly accessible national inventory of releases (to air, water and land), disposals, and transfers of pollutants and other substances of concern from Canadian industrial, commercial and institutional facilities. The NPRI is Canada's legislated pollutant release and transfer register (PRTR) established as per section 48 and published as per section 50 under CEPA. Information is collected annually from just under 8,000 facilities on more than 320 substances and substance groups under CEPA. Annual Data Highlights, sector and substance overviews, data integrations and Indigenous series are published annually to improve understanding of environmental data usage and potential correlations.

NPRI information is a major starting point for identifying and monitoring sources of pollution in Canada and in developing indicators for the quality of our air, water and land. Public access to the NPRI data encourages industry to prevent and reduce pollutant releases and improves public understanding about pollution and environmental performance in Canada. The NPRI also helps governments determine if regulatory or other action is necessary to ensure reductions.

Reviewed NPRI data for 2022 was published on November 23, 2023, and updated on March 28, 2024. In 2022, 7,375 facilities (**Figure 10**) reported to the NPRI approximately 4.9 million tonnes of pollutants covering over 300 substances (**Figure 11**).

- 2.87 million tonnes of pollutants were released directly to the environment
- 1.71 million tonnes were disposed to landfills, applied to land or injected underground, either on the facility site or off-site
- 343,043 tonnes were transferred off the facility site for treatment prior to final disposal or for recycling and energy recovery

Figure 10. Location of Facilities that Reported to The NPRI for the 2022 Reporting Year

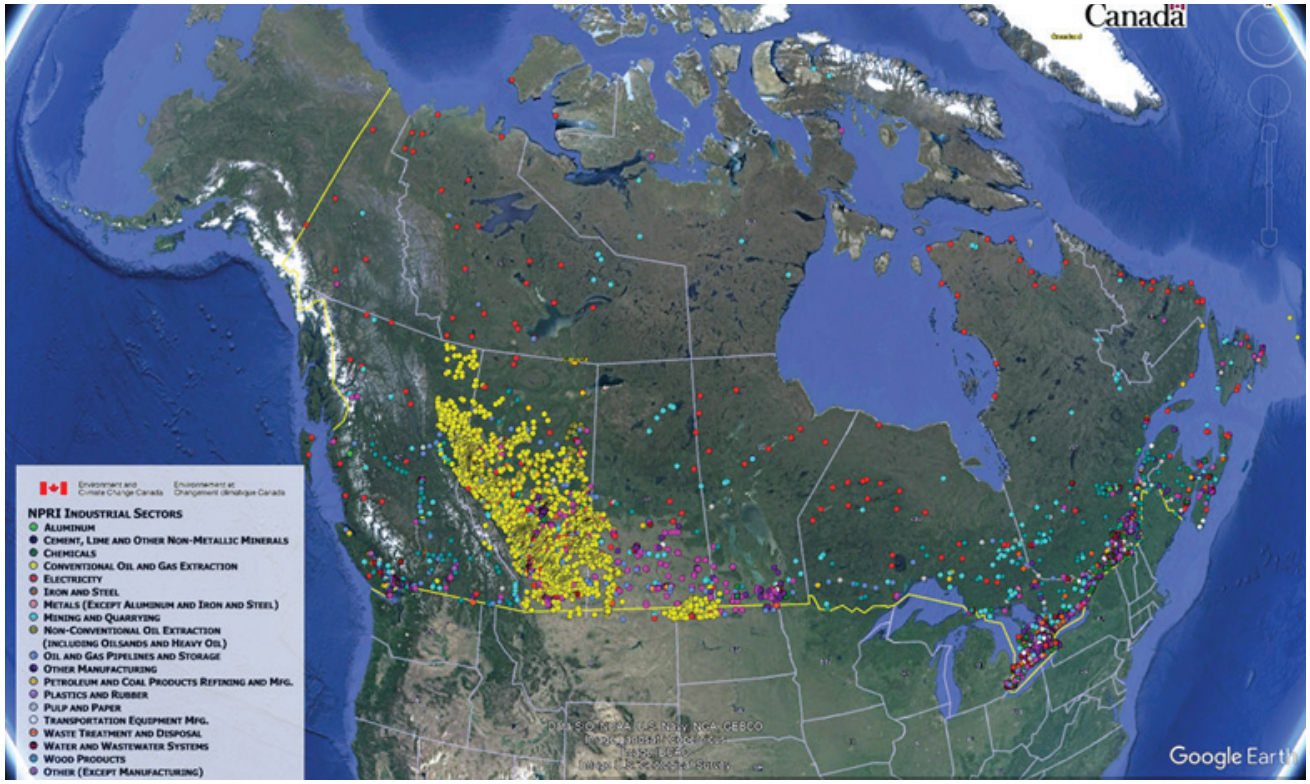
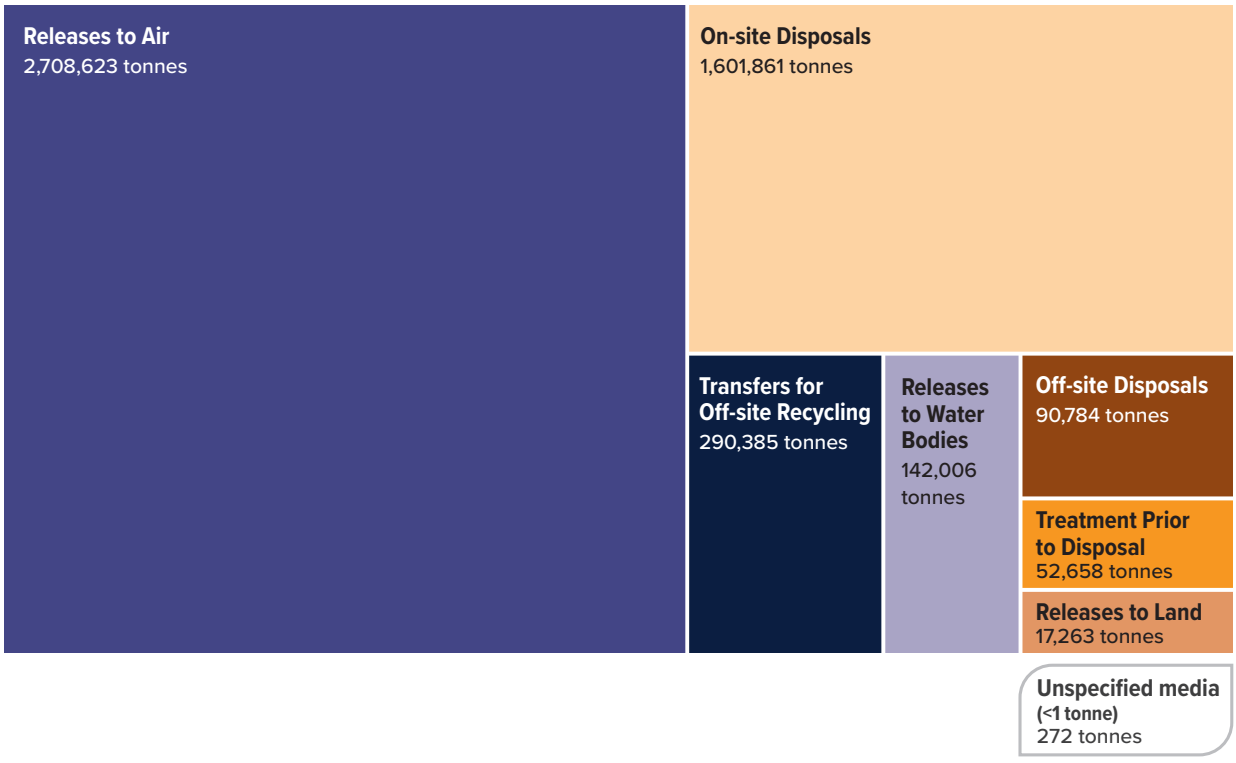



Figure 11. Breakdown of Total Quantities Reported to NPRI for 2022 by Reporting Category

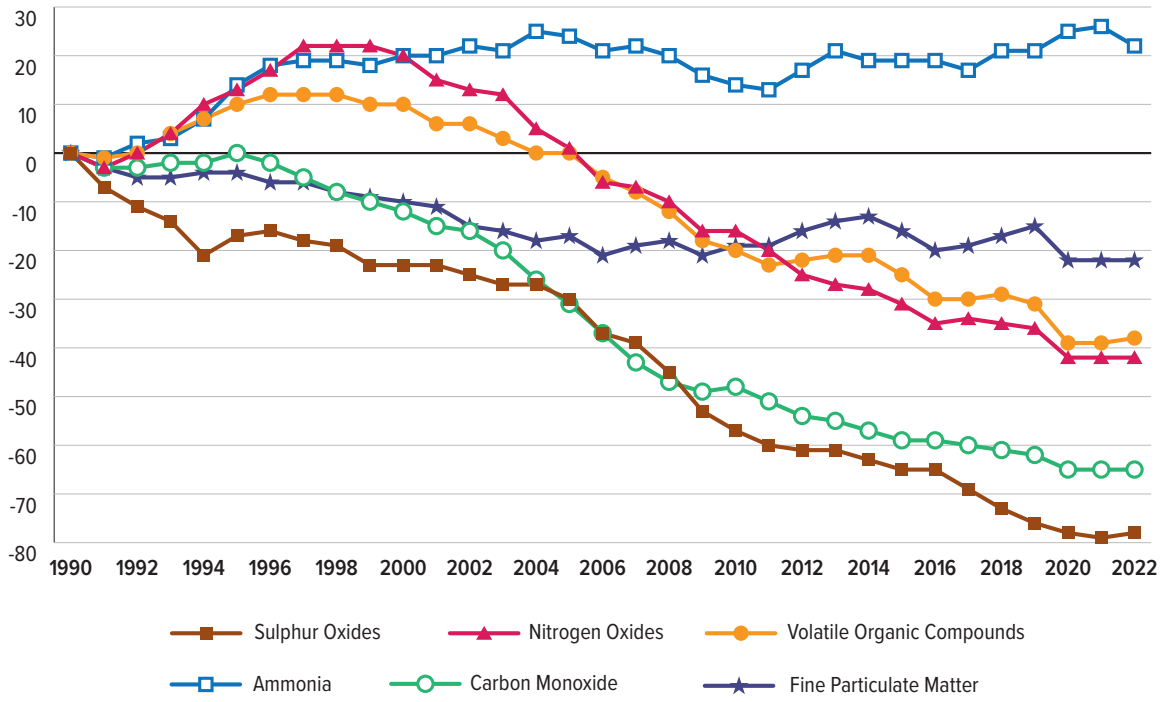


ECCC regularly consults with stakeholders and partners regarding changes to the NPRI or tools to access the data. The NPRI Multi-Stakeholder Work Group is the primary consultative body for the NPRI with representatives of the reporting community, such as industry associations, civil society organizations and Indigenous governments and organizations. It also continues to operate as part of the broader NPRI consultation process that includes all interested Canadian stakeholders and the general public. In 2023-2024, ECCC initiated consultations on several reporting requirement changes (for example, Proposed new requirements for reporting triarylmethane dyes, Proposed new requirements for reporting benzothiazoles, and Proposed new requirements for reporting long-chain aliphatic amines), continued developing future consultation documents for the subsequent year and reviewed input received during consultations that took place the previous year to develop updated NPRI requirements for 2025 to 2027.

The NPRI contributes to two other inventories required by international obligations:

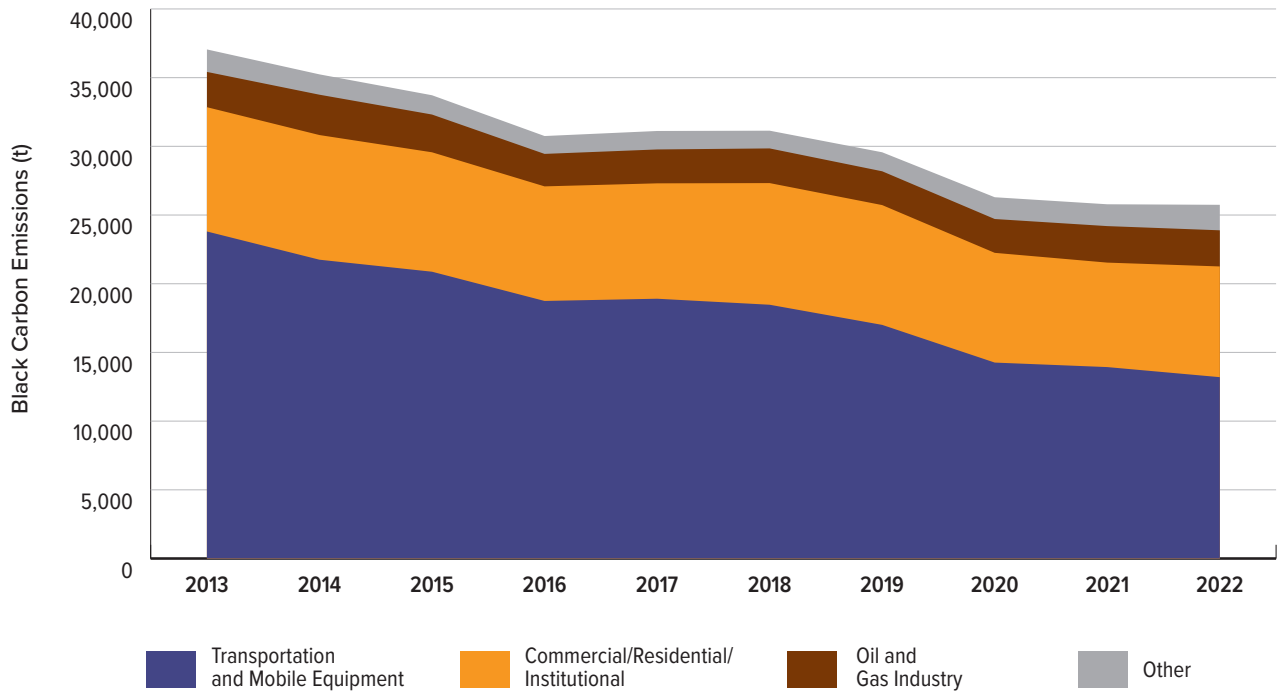
- Canada's Air Pollutant Emissions Inventory (APEI) is a comprehensive inventory of anthropogenic emissions of 17 air pollutants at the national, provincial and territorial levels. The APEI fulfills Canada's reporting obligations under the Convention on Long-range Transboundary Air Pollution and supports monitoring and reporting obligations under the Canada-U.S. Air Quality Agreement.
- In 2024, ECCC published the reviewed 2022 data in Canada's Air Pollutant Emissions Inventory Report.

**Figure 12. Emissions Trends for Selected Air Pollutants in Canada, 1990 to 2022**




The Black Carbon Inventory informs people in Canada about black carbon emissions and helps track progress towards the Arctic Council's collective goal to reduce emissions of black carbon by 25 to 33% below 2013 levels by 2025. In 2024, ECCC published the 2022 data in Canada's Black Carbon Inventory Report.

Figure 13. Trends in Canadian Black Carbon Emissions (2013 to 2022)



# 7. Administration, Engagement With Indigenous Peoples and Public Participation

## 7.1 Federal, Provincial, Territorial Cooperation

The National Advisory Committee (NAC), as described under section 6 of CEPA, provides a forum for provincial, territorial and Aboriginal governments to advise the Ministers on certain actions being proposed under the Act, enables national cooperative action, and seeks to avoid duplication in regulatory activity among governments. The committee is provided opportunities to advise and comment on initiatives under the Act. More information on the committee is available online.

To carry out its duties in 2023-2024, the CEPA NAC held a teleconference meeting on December 23, 2023.

In 2023-2024, the NAC Secretariat corresponded regularly with committee members regarding various initiatives implemented under CEPA:

- to inform of actions taken under the Act (six instances)
- to provide opportunities to comment (20 instances)
- to provide offers to consult (three instances)
- to provide opportunities to advise on proposed regulatory and policy measures (three instances)

## 7.2 Federal-Provincial/territorial Agreements

Section 9 of the Act allows the Minister to negotiate an agreement with a provincial or territorial government, or an Aboriginal people, with respect to the administration of the Act. Section 10 of the Act permits the Minister to negotiate an equivalency agreement with a provincial or territorial government, or an Aboriginal people that allows the Governor in Council to suspend the application of federal regulations in a jurisdiction that has equivalent regulatory provisions. Equivalency agreements require the relevant jurisdiction to provide an annual report to ECCC that includes information such as compliance data and regulatory activity. **Table 17** indicates the active equivalency agreements in place under section 10 of CEPA during 2023-2024.

**Table 17. Active Equivalency Agreements Between April 2023 and March 2024**

| CEPA regulations that no longer apply in jurisdiction(s) due to an equivalency agreement | Jurisdiction(s) |
|---|---|
| *Regulations Respecting Reduction in the Release of Methane and Certain Volatile Organic Compounds (Upstream Oil and Gas Sector)* | Alberta<br>British Columbia<br>Saskatchewan |
| *Reduction of Carbon Dioxide Emissions from Coal-fired Generation of Electricity Regulations* | Nova Scotia<br>Saskatchewan |
| *Pulp and Paper Mill Effluent Chlorinated Dioxins and Furans Regulations* (all sections)<br>*Pulp and Paper Mill Defoamer and Wood Chips Regulations* (Sections 4(1), 6(2), 6(3)(b), 7 and 9)<br>*Secondary Lead Smelter Release Regulations* (all sections)<br>*Vinyl Chloride Release Regulations, 1992 [Repealed]* (all sections) | Alberta |

### Memorandum of Understanding Between Canada and Quebec

In order to maximize the effectiveness of regulatory efforts and reduce the administrative burden on the pulp and paper industry, the Province of Quebec and the Government of Canada have been collaborating since 1994. The parties currently co-operate through a memorandum of understanding for data collection, whereby Quebec provides a single data-entry portal for regulatees for the following regulations made under CEPA:

- *Pulp and Paper Mill Effluent Chlorinated Dioxins and Furans Regulations*
- *Pulp and Paper Mill Defoamer and Wood Chip Regulations*

The Memorandum of Understanding continued to provide ECCC with real-time access to historical and current data during 2023-2024.

All existing and proposed equivalency and administrative agreements under CEPA may be found on the CEPA registry.

## 7.3 Engagement With Indigenous Peoples

The preamble to the modernized CEPA affirms the Government's commitment to implementing the UNDRIP, including free, prior, and informed consent. It acknowledges the importance of Indigenous Knowledge in decisions pertaining to environmental and human health protection.

Some of the opportunities taken to implement the objectives of UNDRIP in 2023-2024 are highlighted throughout this report, and include measures such as:

- providing funding to 15 Indigenous recipients to support meaningful engagement activities with their communities on the right to a healthy environment. The draft implementation framework is being informed by the input received from these activities (see s. 1.2.1)
- collaborating with Indigenous partners to identify the impacts of climate change and pollutants on Arctic seabirds (see s. 8.1.1.1, the *Climate change and plastic-related contaminants: interactive effects of multiple stressors on Arctic seabirds across their annual cycle* study)
- working with the CIER to develop the Wildfire Smoke Portal (see the Smoke Data Knowledge Exchange (SmoKE) in s. 2.6)
- interacting with Indigenous communities as part of the ICMP (see s. 2.6)
- supporting seven human biomonitoring and health projects under the NCP (see s. 2.1.2)
- consulting on disposal site monitoring plans (see s. 2.6)
- hosting an exhibition booth which provided information on air quality at several conferences (see s. 3.1.6) and delivering educational sessions to First Nation communities in northern Ontario (see s. 3.3.4)
- working with USAY to produce a graphic novel that informs Indigenous youth how to protect themselves from forest fire smoke (see s. 3.3.4)
- providing funding for five Indigenous-led groups to increase their capacity to engage on the CER (see s. 3.3.4)
- engaging with the Safe Water Management on Reserve Committee to discuss ongoing and planned work on the Guidelines for Canadian Drinking Water Quality (see s. 3.4.1)
- promoting the What we heard report: Review of the storage tank regulations through a national email campaign (see s. 3.7.2)
- developing presentations on the *Federal Halocarbon Regulations, 2022, PCB Regulations and the Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations* for use at technical training workshops for Indigenous communities (see section 5.1.2; **Table 14**)

- providing tailored support for enforcement activities through presentations and booths at conferences and tradeshows (see s. 5.3)

Other CEPA-related examples of engagement activities in 2023-2024 with Indigenous peoples include:

- engaging with the Aamjiwnaang First Nation on various matters, such as a summit with the First Nation and the Province of Ontario to hear first-hand the longstanding air quality concerns of the Aamjiwnaang First Nation and the co-development of a potential Environmental Performance Agreement for Industrial Releases of phenol, 2-(1-methylpropyl)-4,6-dinitro- (dinoseb)
- consulting with Indigenous communities located near petroleum storage and loading facilities on the draft *Reduction in the Release of Volatile Organic Compounds (Storage and Loading of Volatile Petroleum Liquids) Regulations*

## 7.4 Public Participation

### 7.4.1 CEPA Registry and Public Consultation

Part 2 of CEPA (Public Participation) provides for the establishment of an environmental registry.

The CEPA Registry was launched on ECCC's website when the Act came into force on March 31, 2000. Continuous efforts are made to increase the Registry's reliability and ease of use. The Registry encompasses thousands of CEPA-related documents and references. It has become a primary source of environmental information for the public and private sectors, both nationally and internationally, and has been used as a source of information in university and college curricula.

CEPA also has many provisions requiring consultation and public comment periods for proposed orders, regulations and other statutory instruments, and requirements to publish information to the Registry.

From April 2023 to March 2024, the CEPA Registry website had 45,491 visits and 92,430 page views. In addition, there were 37 opportunities to provide comments on proposed initiatives under CEPA posted on the Registry (e.g., screening assessments, regulations, guidelines). Please see the CEPA Registry public consultations, available online.

### 7.4.2 CMP-Related Activities

ECCC collaborated with Innovation, Science and Economic Development Canada (ISED) and government partners to support the development and testing of a digital platform for securely sharing and obtaining product information using QR code labels. This platform is linked to data from various sources, such as public-facing databases and/or websites, including public CEPA information on chemicals and other government information.

ECCC and North American trading partners collaborated on a Commission for Environmental Cooperation project to identify the best practices and tools that promote transparency of chemicals found in consumer product supply chains in 2024-2025.

The CMP continued to advance an enhanced engagement strategy to better enable equitable and meaningful engagement with CMP stakeholders and Indigenous partners. A key element in 2023-2024 of the enhanced approach to engagement was the ongoing management of the CMP Engagement and Outreach Contribution Program, designed to better equip the CMP to address program priorities (for example, reconciliation, populations that may be disproportionally impacted) and facilitate the engagement of a wider breadth of stakeholders and partners to help navigate an increasingly complex chemicals management landscape. For example, the New Brunswick Lung Association (NB Lung), a funding recipient, coordinated a bilateral meeting with Civil Society Organizations in February 2024 to present updates on CMP, S-5 implementation, and the Right to a Healthy Environment, in addition to discussing potential areas for future collaboration. Another funding recipient, the Canadian Child Care Federation, made use of its extended network to advance work in supporting child care professionals in developing knowledge on the risks posed by toxic chemicals and pollutants. Lastly, the Inuvialuit Regional Corporation, funded under the Contribution Program's Indigenous participation stream, finalized its multi-year Inuvialuit-led research project on microplastics in drinking water.

# 8. Report on Research

Scientists from ECCC and HC collaborate with Canadian and international partners to conduct a wide range of research to inform priority setting, assessment and management of risks to human health or the environment posed by various substances, and to work toward the goal of reducing, replacing or refining animal toxicity testing.

Research on substances under CEPA is primarily designed to:

- evaluate the source, toxicity, fate, exposure, impact and cumulative effects of substances and complex mixtures on the environment and human health
- develop novel methods and approaches, such as, non-target analysis screening methods to assess complex chemical signatures and reveal possible unknown contaminants

HC and ECCC also undertake research to support the development of regulations, guidelines, and other risk management instruments that aim to protect the environment and improve human health by reducing exposure to pollutants. Also, government scientists conduct outreach and consultation activities such as peer-reviewing publications, providing webinars on the results of their studies, meeting with clients, preparing reports and providing research advice.[5]

## 8.1 Chemicals

### Spotlight: Microplastics

Plastic pollution and its potential health effects is an emerging area of research. In order to advance the understanding of the impacts of plastic pollution on the environment and human health, the Science Assessment of Plastic Pollution identified key knowledge gaps which led to the prioritization of research on the health impacts of plastic pollution in Canada's Plastics Science Agenda. Microplastics are involved in every facet of our life; however, waste plastics are substances of concern based on their ubiquitous presence and complexity in terms of chemical composition (polymers).

Current ECCC research efforts involve assessing the presence, type and quantity of waste plastics in wildlife (for example, bird tissue) and our surrounding environment. This includes identifying sources (for example, waste-water and sludge) and developing research methods.

HC recently undertook three research projects to better understand the human health effects of microplastic exposure. Research results were published in peer-reviewed scientific journals and presented at conferences. Key research results include:

- the development of novel methods to produce environmentally relevant microplastics in laboratories to facilitate new studies that support human health risk assessment
- the identification of microplastics in human placentas, suggesting fetal exposure

HC also launched a new environmental health research contribution program to increase knowledge of the health impacts, exposure and research methodologies related to microplastics. After reviewing several proposals, contributions of $2.1 million over four years were made to McGill University, Memorial University of Newfoundland and the University of Toronto to undertake research related to the potential exposure to microplastics from various sources, including food, food packaging, drinking water, indoor and outdoor air, as well as dust.

[5] This section provides abstracts of some of the research published in 2023-2024. The digital object identifier (DOI) or the International Book Standard Number (ISBN) has been provided for each research publication. To obtain online access to a particular publication, copy and paste the DOI (for example, DOI:17.1019/acs.est.1q03279) or ISBN into the search bar of your search engine. A comprehensive list of all research published in 2023-2024 has been included in the Appendix.

### 8.1.1 Chemicals in The Environment, Ecosystems, and Wildlife

In 2023-2024, a two-year research cycle (2022 to 2024) was completed under the CMP research program. Research activities at ECCC were conducted as part of 19 research projects. Research topics mostly related to the fate, bioaccumulation, and effects of CMP priority substances such as flame retardants, PFAS, rare earth elements and nanomaterials. Upon completion, project reports were shared with regulatory groups to inform program decisions and activities.

In addition, three new multi-year (three years, 2021-2024) Contribution Agreements between ECCC and academia were successfully completed and expanded scientific knowledge on three priorities for risk assessment. One contribution recipient examined the fate and effects of critical minerals, including Rare Earth Elements. A second project studied the atmospheric concentrations, distribution, and toxicity of PFAS, a class of high-profile pollutants in Canada and at a global scale. Finally, a third project related to the development of analytical methods to detect specific nanoparticles in complex matrices such as wastewater and then to apply these methods to better understand the fate of nanoparticles in natural environments. ECCC has received final reports on each of these projects.

Various studies were published under the CMP research program, some of which are summarized below to provide an overview of the work undertaken to support risk assessment and management activities under CEPA associated with chemicals in the environment.

#### 8.1.1.1 Toxicity, Exposure and Impacts

**The Effects of Short-Chain Perfluoroalkyl Carboxylic Acids (PFCAs) on Northern Leopard Frog (*Rana Pipiens*) Tadpole Development**

**Summary:** The study evaluated the impact and uptake of two short-chain PFCAs as replacement compounds for the longer-chain perfluorooctanoic acid used in industrial and consumer products. Various health indices in aquatic life stages of a Canadian native frog were assessed, including effects on survival, growth, development, sexual differentiation and bioconcentration in tadpoles exposed for 30-days. In the frog *Rana [Lithobates] pipiens*, the two PFCAs increased growth compared to the water-only control. Survival and development were not affected. At environmentally relevant concentrations (0.1-10 µg/L), both PFCAs affected fitness-relevant tadpole metrics.

**Publication:** Rohonczy J, Robinson SA, Forbes MR, De Silva AO, Brinovcar C, Bartlett AJ, Gilroy EAM. 2024. *The effects of two short-chain perfluoroalkyl carboxylic acids (PFCAs) on northern leopard frog (Rana pipiens) tadpole development*. Ecotoxicology 33: 177-189 DOI: 10.1007/s10646-024-02737-z Published online 05 February 2024

**In collaboration with:** Carleton University

**Contamination of Emerging and Legacy Contaminants in the Arctic**

**Summary:** An examination of historical contaminant inputs in Frobisher Bay, Nunavut aimed to discern temporal and spatial trends of legacy and emerging contaminants – polychlorinated biphenyls, polycyclic aromatic hydrocarbons, heavy metals and polyfluoroalkyl substances (PFAS) in sediment cores. Elevated concentrations of mercury, poly-chlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs) and perfluorooctane sulfonate in Koojesse Inlet were consistent with a military presence in sediment core depths that align with the 1950-60s. In outer Frobisher Bay, concentrations of mercury and PFAS increased from depths to surface suggesting ongoing inputs via long range transport. These results demonstrate how past and current human activities leave a legacy of contaminants in Arctic sediment. As human activities escalate in the Arctic, comprehensive investigations into contaminant levels will be useful to evaluating risk.

**Publication:** Bartley, M.C., Tremblay, T., De Silva, A.O., Kamula, C.M., Ciastek, S., Kuzyk, Z Z. 2024. *Sedimentary records of contaminant inputs in Frobisher Bay, Nunavut*. Environ. Sci and Ecotechnology, Vol. 18, pp. 100313, DOI: 10.1016/j.ese.2023.100313

**In collaboration with:** The University of Manitoba

## A Review of Established and Emerging Organophosphate Esters (OPE) of Concern in the Environment

**Summary:** The review of available studies summarizes the current state of knowledge on the analysis, environmental fate, and behavior of established and emerging OPEs. OPEs are increasing in diversity and complexity and usage and are an expanding chemical issue of concern. There are 12 established OPEs and a total of 83 emerging OPEs that have been reported in human and/or biota samples. Of the emerging OPEs, more than 80% have nearly 100% detection frequencies in samples of certain environmental media including indoor air, wastewater treatment plants, sediment, and fish. Intentional / unintentional industrial use and non-industrial formation are sources of emerging OPEs in the environment. Established, and to a much lesser degree emerging OPEs, have also been shown to transform and degrade in biota and possibly alter their toxicological effects. Research on emerging OPE contaminants is presently limited and more study is warranted.

**Publication:** Ye, L., Li, J., Gong, S., Herczegh, S.M., Zhang, Q., Letcher, R.J., Su, G. 2023. *Established and emerging organophosphate esters and the expansion of an environmental contamination issue: A review and future directions*. Journal of Hazardous Materials, Vol. 459, article #132095, DOI:10.1016/j.jhazmat.2023.132095

**In collaboration with:** Nanjing University and Science and Technology, Nanjing, P.R. China

## A Review and Chemically Accurate Naming of Chlorinated Paraffins in the Environment

**Summary:** This review focused on the state of the science and knowledge as to the identification and naming of the chemical contaminant class of polychlorinated alkanes (PCAs) which are the main ingredients of chlorinated paraffins (CPs). Despite several decades of study, ambiguities persist in terms used to express environmental and biotic occurrences of PCAs, the main ingredient of CPs. This can lead to misinterpretation of data between analytical chemists, toxicologists, risk assessors/managers and regulators. The study recommends terms to harmonize reporting and reduce ambiguity of the conventional use of PCAs. For example, reporting individual chain lengths, for example, ΣPCAs-C11, ΣPCAs-C13, allows easier comparability and allows toxicology and risk assessment to consider different PCA combinations.

**Publication:** Fernendez, A., Kraetschmer, K., McGrath, T.J., Yuan, B., Brandsma, S., Brits, M., Cariou, R., Letcher, R.J., Mueller, J., Muir, D.C.G., Vetter, W., Wang, T., Yu, G., Bergman, Å. 2023. *Recommended terms and abbreviations for polychlorinated alkanes (PCAs) as the predominant component of chlorinated paraffins (CPs)*. Journal of Hazardous Materials, Vol. 169, article #117363, DOI: /10.1016/j.trac.2023.117363

**In collaboration with:** experts on PCAs (CP) from Canada, the U.K., Norway, the Netherlands, Belgium, France, Germany, Australia, Sweden and P.R. China.

## Sources of Organic Flame Retardants in the Environment

**Summary:** Concern about health and environmental impacts of synthetic chemicals used as flame retardants has led to regulations restricting or phasing out some of these chemicals. ECCC scientists conducted specific studies of emerging brominated flame retardants (BFRs) and the indirect emission of organophosphate esters (OPEs).

One study assessed that the concentration of the BFR 1,2-dibromo-4-(1,2-dibromoethyl)cyclohexane (TBECH) was significant in over 60% of air samples collected from major Canadian urban areas. It is believed that TBECH is entering the Canadian environment from its use in imported products, such as electronics, and that some re-emission into the atmosphere is occurring as microbes process these organic compounds after they are deposited in soil or water.

Another study investigated the formation of OPEs from reactions between atmospheric ozone and organophosphite antioxidants (OPAs; a group of mass-produced chemicals). The research showed that one such OPE, tris(2,4-di-tert-butylphenyl) phosphate (TDtBPP), is globally distributed from cities to the polar regions, with concentrations in the Arctic increasing since 1994. The study also suggests that regulations could consider atmospheric transformation of OPAs into OPEs.

**Publications:** Oh, J., Shunthirasingham, C., Lei, Y. D., Zhan, F., Li, Y., Dalpé Castilloux, A., Ben Chaaben, A., Lu, Z., Lee, K., Gobas, F. A. P. C., Eckhardt, S., Alexandrou, N., Hung, H., and Wania, F.: *The atmospheric fate of 1,2-dibromo-4-(1,2-dibromoethyl)cyclohexane (TBECH): spatial patterns, seasonal variability, and deposition to Canadian coastal regions*, Atmos. Chem. Phys., 23, 10191–10205, DOI:10.5194/acp-23-10191-2023, 2023

Liu, Q., Liu, R., Zhang, X., Li, W., Harner, T., Saini, A., Liu, H., Yue, F., Zeng, L., Zhu, Y., Xing, C., Li, L., Lee, P., Tong, S., Wang, W., Ge, M., Wang, J., Wu, X., Johannessen, C., & Abbatt, J. P. D. (2023). *Oxidation of commercial antioxidants is driving increasing atmospheric abundance of organophosphate esters: Implication for global regulation*. One Earth, 6(9), 1202–1212. DOI: 10.1016/j.oneear.2023.08.004

## Toxicity of Oil Sands Process-Affected Waters

**Summary:** During the process of bitumen separation, large volumes of oil sands process-affected water (OSPW) are produced in the Athabasca Oil Sands Region (AOSR) of Alberta and stored in industry-manufactured tailings ponds. The studies assessed the toxicology of Naphthenic acid fraction compounds (NAFCs) within OSPW and other waters (for example, Athabasca watershed) on yellow perch and wood frogs. Both species were impacted in a way that could reduce fitness in their respective populations.

**Publications:** Reynolds, J.S., C.K. Elvidge, I.J. Vander Meulen, C.T. Hasler, R.A. Frank, J.V. Headley, L.M. Hewitt and D. M. Orihel. 2024. *Naphthenic acid fraction compounds, produced by the extraction of bitumen from oil sands, alter survival and behaviour of juvenile yellow perch* (Perca flavescens). FACETS9: 1-12. DOI:10.1139/facets-2022-0176

Elvidge, C.K., C.E. Robinson, R.A. Caza, L.M. Hewitt, R.A. Frank and D.M. Orihel. 2023. *Chemical communication in wood frog (Rana sylvatica) tadpoles is influenced by early-life exposure to naphthenic acid fraction compounds*. Aquat. Toxicol. 106435. DOI:10.1016/j.aquatox.2023.106435

Robinson, C.E., C.K. Elvidge, R.A. Frank, J.V. Headley, L.M. Hewitt, A.G. Little, S.A. Robinson, V.L. Trudeau, I.J. Vander Meulen and D.M. Orihel. 2023. *Naphthenic acid fraction compounds reduce the reproductive success of wood frogs (Rana sylvatica) by affecting offspring viability*. Environ. Poll. 316: 120455. DOI:10.1016/j.envpol.2022.120455

**In collaboration with:** Canada's Oil Sands Innovation Alliance, McMaster University Queen's University

## Bioaccumulation in Terrestrial Ecosystems

**Summary:** Legacy persistent organic pollutants (POPs), including organochlorine pesticides (OCPs), polychlorinated biphenyls (PCBs), and polybrominated diphenyl ethers (PBDEs) and Perfluorinated alkyl substances (PFAS), persist for generations in the environment and often negatively impact endocrine functions in exposed wildlife. Protocols to assess the bioaccumulation potential of these chemicals within terrestrial systems are far less developed than for aquatic systems. However, studies have shown that some chemicals that are not bioaccumulative in aquatic food webs can biomagnify in terrestrial food webs. Thus, to better understand the bioaccumulative behaviour and develop Trophic Magnification Factors (TMFs) of chemicals in terrestrial systems, we examined trophic magnification of hydrophobic POPs in an urban terrestrial food web that included an avian apex predator, the Cooper's hawk *(Accipiter cooperii)*. Over 100 samples were collected from various trophic levels of the food web including hawk eggs, songbirds, invertebrates, and berries and analyzed for concentrations of 38 PCB congeners, 20 OCPs, 20 PBDE congeners, 7 other brominated flame retardants and PFAS listed as priorities under CMP.

**Publications:** Fremlin KM, JE Elliott, RJ Letcher, T Harner, FAPC Gobas. 2023. *Developing methods for assessing trophic magnificent of perfluoroalkyl substances within an urban terrestrial avian food web*. Environ. Sci. Technol, DOI:10.1021/acs.est.3c02361

## Changes Over Time and the Influence of Diet and Climate on Persistent Organic Pollutants in Arctic Biota

**Summary:** Approximately 33 million tonnes of PCAs have been globally produced and used. This research addresses the dynamics of PCA accumulation and temporal changes across a broad spectrum of PCA homologues in polar bears from Hudson Bay which is a climate change hot spot. Fat samples collected from just under the skin and 2014 to 2021 from adult male polar bears of the Western Hudson Bay (WHB) and Southern Hudson Bay (SHB) subpopulations were analyzed. SHB bears exhibited a decrease in PCA concentrations reflecting marine food web influences. WHB bears displayed increasing PCA levels likely due to the use of more terrestrial and human-sourced food. This study underscores the lack of longer-chain PCA data in Arctic wildlife and food web.

**Publications:** Yuan, B., Letcher, R.J. 2024. *Evolving accumulation of a complex profile of polychlorinated alkanes in Canadian polar bears*. Environmental Science and Technology Letters, Vol. 11, pp 591-597, DOI: /10.1021/acs.estlett.4c00152

**In collaboration with:** Norwegian University of Science and Technology, Trondheim, Norway

**Summary:** Polar bear and toothed whales in the Arctic exhibit orders of magnitude differences in concentrations of legacy persistent organic pollutants (POPs) for biological and ecological reasons. This study assessed interspecific variation in fat concentrations of PCBs and organochlorine pesticides (for example, DDT, CHL) among killer whale, narwhal, and pilot whale, and polar bear from East Greenland from 2012 to 2021. Killer whales exhibited the highest mean concentrations of PCBs, DDTs and CHLs, while polar bear showed the second highest concentrations for PCBs. This study confirmed that significant differences in legacy POP concentrations occur among Arctic marine mammal predators. Furthermore, the drivers of these differences are contaminant-specific, with feeding patterns primarily influencing POP concentrations.

**Publication:** Pedersen, A.F., Dietz, R., Sonne, C., Letcher, R.J., Roos, A.M., Simon, M., Rosing-Asvid, A., Ferguson, S.H., McKinney, M.A. 2024. *Feeding and biological differences induce wide variation in legacy persistent organic pollutant concentrations among toothed whales and polar bears in the Arctic.* Science of the Total Environment, Vol. 908, article #168158, DOI: /10.1016/j.scitotenv.2023.168158

**In collaboration with:** McGill University, Denmark, Greenland and Sweden

**Summary:** Persistent organic pollutants (POPs) tend to biomagnify in food chains, resulting in higher concentrations in species such as killer whales (Orcinus orca) feeding on marine mammals compared to those consuming fish. The study focused on a comprehensive assessment of different feeding habits between populations of killer whales from North America and concentrations of legacy and emerging POPs. This study assessed the concentrations of legacy and emerging POPs in 162 killer whales from across the North America and in particular the North Atlantic. Significantly higher mean levels of polychlorinated biphenyls (PCBs), organochlorine pesticides, and flame retardants in Western North Atlantic killer whales were found when compared to those of Eastern North Atlantic. The study suggests that variation in diet, and not environmental variation in POP concentrations, among locations is crucial in assessing contaminant-associated health risks in killer whales.

**Publication:** Remili, A., Dietz, R., Sonne, C., Samarra, F.I.P.. Letcher, R.J., Rikardsen, A.H., Kettemer, L.E., Ferguson, S.H., Watt, C.A., Matthews, C.J.D., Kiszka, J.J., Rosing-Asvid, A., McKinney, M.A. 2023. *Varying diet composition causes striking differences in legacy and emerging contaminant concentrations in killer whales across the North Atlantic.* Environmental Science and Technology, Vol. 57, pp 16109-16120, DOI: 10.1021/acs.est.3c05516

**In collaboration with:** McGill University, Denmark, Iceland, Greenland, Norway and the United States

## Priority Perfluoroalkyl Substances and Chlorinated Paraffins in Wildlife: Uptake, Bioaccumulation and Toxic Effects in Birds

**Summary:** The regulation of some perfluoroalkyl chemicals (for example, PFOS) resulted in the introduction and use of replacement perfluoroalkyl substances, for example, long-chain perfluoro-carboxylic acids whose environmental risk management is being determined in Canada and internationally. Another very large group of chemicals, chlorinated paraffins, are under international review involving Canada, under the UN Stockholm Convention. This ECCC research, funded by the federal CMP and its ICMP, directly supports CEPA's mandate to protect Canadians and the environment from harmful chemicals. The main goal of this research is to determine if wild birds from different ecosystems in Canada, are exposed to, accumulate, and experience any changes in their health from these two large groups of chemical pollutants. ECCC is also identifying if these chemical pollutants accumulate and magnify through bird food webs. This ECCC research identified that tree swallows are exposed to and accumulate some replacement perfluoro-chemical pollutants. These chemicals were ingested by adult mother birds and transferred to their eggs, exposing the young during embryonic and nestling development. Results also showed that sewage effluent can be an environmental source of perfluorinated chemicals for wild birds, and these perfluorinated chemicals move through the swallows' food web, magnifying in concentration at each level. Some perfluorinated chemicals moved from the air, sediment, and water to insects, and then to the birds when they ate those insects, in addition to the birds directly acquiring them by inhalation and feather preening. Some of these chemicals magnified in concentration when moving through the tree swallows' food web, from sediment to insects, and insects to the chicks. This ECCC research also involves peregrine falcons, a top predator in cities and rural areas that nearly went extinct because of chemical pollutants. The research has identified that peregrine chicks accumulate chlorinated paraffins and perfluorinated chemicals and is seeking to identify the comparative toxicity of both large groups of environmental pollutants to the wild peregrine chicks.

**Publications:** Wu, Y., Fernie, K.J., Letcher, R.J., Clark, K.E., Park, J-S., Watts, B.D., Barber, P., Chen. D. 2024. *Peregrine falcon eggs and halogenated flame retardants: a 30-year retrospective biomonitoring study across North America*. Environmental Science and Technology, Vol. 58, pp 7154-7164, DOI: 10.1021/acs.est.3c10907[a]

Hopkins, K., McKinney, M.A., Siani, A., Letcher, R.J., Karouna-Renier, N.K., Fernie, K.J. 2023. *Characterizing the flow of per- and polyfluoroalkyl substances in an avian aquatic-terrestrial food web*. Environmental Science and Technology, Vol. 57, Issue 48, pp 20249–20260, DOI: 10.1021/acs.est.3c06944[b]

**In collaboration with:** [a]Jinan University, East China Normal University, New Jersey Fish & Wildlife, California Environmental Protection Agency, The College of William and Mary, and the Pennsylvania Game Commission[b] McGill University and the U.S. Geological Survey

## Climate Change and Plastic-Related Contaminants: Interactive Effects of Multiple Stressors on Arctic Seabirds Across Their Annual Cycle

**Summary:** Working with Indigenous collaborators and those from McGill University, this ECCC-CIRNAC project (2023-2026) is identifying where and when Arctic seabirds are impacted by climate change and pollutants, in order to understand where, when, and how sea-ice conditions influence migration and contaminant impacts to Arctic seabirds. Priority pollutants, specifically microplastics, plastics-related chemicals, perfluorinated contaminants, and mercury, and possible related effects, are evaluated in seabirds breeding (Hudson Bay), migrating, and overwintering (Nunatsiavut), and that are hunted as culturally important country foods. As a result, this project also provides valuable information to Indigenous communities in Nunavut and Nunatsiavut on immediate and long-term security of country foods.

**Publications:** CIRNAC Report for Year one: Elliott KE, Fernie KJ, L Pijogge, J. Provencher, Sühring R, Choy E, Liboiron M, Patterson A, Médieu A, A McQuaid. 2024. *Climate change and plastic-related contaminants: interactive effects of multiple stressors on Arctic seabirds near their southern range limits across their annual cycle.* Northern Contaminants Program Synopsis Report, 2023-2024. 12 pp.

## Spatial and Temporal Trends in Marine Contaminants in Seabirds in the North Pacific

**Summary:** This project is part of a national seabird monitoring program. Persistent contaminants are measured in eggs of selected indicator species representative of coastal (cormorant), continental shelf (auklet) and offshore habitats (storm-petrel) from three coastal areas of Canada (Atlantic, Pacific, Arctic). The project has provided a consistent picture of trends, particularly for persistent organic pollutants (POPs) and mercury, in the marine environment since the late 1960s. The studies examined trends in marine contaminants in seabirds.

For example, one study found that the majority of perfluoroalkyl sulfonates PFSAs (including PFOS) are significantly declining in the eggs of all sampled bird species, while uptake in PFCAs seems to be slowing or levelling off. Another study found that most POPs significantly declined or showed no directional change over time. These trends are attributed to restrictions and reduced use of these contaminants.

**Publications:** Kesic, R., Elliott, J. E., Elliott, K. H., Lee, S. L., & Maisonneuve, F. (2023). *Perfluoroalkyl Substances in Seabird Eggs from Canada's Pacific Coast: Temporal Trends (1973–2019) and Interspecific Patterns. Environmental Science & Technology, 57*(29), 10792-10803, DOI:10.1021/acs.est.3c02965

van Oordt, F., Cuba, A., Choy, E. S., Elliott, J. E., & Elliott, K. H. (2024). *Amino acid-specific isotopes reveal changing five-dimensional niche segregation in Pacific seabirds over 50 years.* Scientific Reports, 14(1), 7899, DOI:10.1038/s41598-024-57339-w

Elliott, J. E., Kesic, R., Lee, S. L., & Elliott, K. H. (2023). *Temporal trends (1968–2019) of legacy persistent organic pollutants (POPs) in seabird eggs from the northeast Pacific: Is it finally twilight for old POPs?.* Science of the Total Environment, 858, 160084, DOI:10.1016/j.scitotenv.2022.160084

King, M. D., Elliott, J. E., Idowu, I., Tomy, G. T., & Williams, T. D. (2023). *Polycyclic aromatic compound and trace metal element residues in Mytilus mussels at marine wildlife hotspots on the Pacific coast of Canada.* Environmental Pollution, 316, 120624, DOI:10.1016/j.envpol.2022.120624

## In Vitro Assessment of The Genotoxicity and Immunotoxicity of Treated and Untreated Municipal Effluents and Receiving Waters in Freshwater Organisms

**Summary:** Municipal wastewater effluent is one of the largest sources of pollution entering surface waters in the Laurentian Great Lakes and has been associated with the induction of genotoxicity to aquatic animals. In this study, effluents from Hamilton Harbour and the Toronto and Region Areas of Concern were assessed for their effects on the immune response in rainbow trout (*Oncorhynchus mykiss*) white blood cells and DNA damage in freshwater mussel *(Eurynia dilatata)* hemocytes (analogous to white blood cells in mammals). ECCC also identified numerous chemicals present in the effluents.

In freshwater mussels, effluent from Hamilton Harbour AOC induced DNA damage with the most frequency. In contrast, effluent from Toronto and Region AOC induced DNA damage only infrequently. None of the extracts induced any significant effects on phagocytosis of rainbow trout white blood cells. Surprisingly, dilution did not consistently decrease the genotoxicity of the influents or effluents tested, regardless of the observed differences in chemical composition among sample types. The present study indicates that despite overall improvements to effluent quality, treatment of influent by WWTPs may not result in a corresponding improvement of the genotoxicity of effluents. In vitro bioassays are useful and cost-effective rapid-screening tools for preliminary assessments of contamination of aquatic ecosystems.

**Publication:** Gilroy ÈAM, Kleinert C, Lacaze É, Campbell SD, Verbaan S, André C, Chan K, Gillis PL, Klinck JS, Gagné F, Fournier M, de Solla SR. 2023. *In vitro assessment of the genotoxicity and immunotoxicity of treated and untreated municipal effluents and receiving waters in freshwater organisms.* Environ Sci Pollut Res Int. 30:64094-64110, DOI: 10.1007/s11356-023-26845-1

## Environmental Concentrations of The Type 2 Diabetes Medication in Surface Water and Sediment in Ontario and Quebec, Canada

**Summary:** Metformin, used to treat Type 2 diabetes, is the active ingredient of one of the most prescribed drugs in the world. In wastewater treatment plants (WWTPs), metformin can undergo microbial transformation to form the product guanylurea, which could have toxicological relevance in the environment. Surface water and sediment samples were collected from six mixed-use watersheds in Quebec and Ontario, Canada, and analyzed to determine the metformin and guanylurea concentrations at each site. The study found significant presence of these compounds in some samples at varying concentrations depending on surface water or sediment samples. The study suggests that agriculture is likely not a significant source of these compounds, while WWTPs and potentially septic leaks are the most likely source.

**Publication:** Littlejohn, C., Renaud, J.B., Sabourin, L., Lapen, D.R., Pappas, J.J., Tuteja, B., Hughes, D., Ussery, E., Yeung, K.K.-.-C. and Sumarah, M.W. (2023), *Environmental Concentrations of the Type 2 Diabetes Medication Metformin and Its Transformation Product Guanylurea in Surface Water and Sediment in Ontario and Quebec, Canada*. Environmental Toxicology and Chemistry, 42: 1709-1720. Published online 7 June 2023 DOI:10.1002/etc.5684

**In collaboration with:** Agriculture and Agri-Food Canada and HCC

### Assessing Time Trends of PFAS In Wastewater Between 2009 and 2021

**Summary:** This study looked at the results of 12 years of monitoring of PFAS in municipal wastewater treatment system. Municipal wastewater effluent discharges and land application of treated biosolids are important pathways of PFAS to the environment. Previous research has shown only partial removal of PFAS during some wastewater treatment processes. The research evaluated PFAS at different types of wastewater treatment plants (WWTPs) used in Canada and assessed time trends of PFAS in wastewater between 2009 and 2021.

**Publication:** Gewurtz, S.B., Auyeung, A.S., De Silva, A.O., Teslic, S., Smyth, S.A. 2024. *Per- and polyfluoroalkyl substances (PFAS) in Canadian municipal wastewater and biosolids: Recent patterns and time trends 2009 to 2021*. Science of the Total Environment, Vol. 912, pp. 168638, DOI: 10.1016/j.scitotenv.2023.168638

### Concentrations and Loads of Metal, Nutrients and Organic Contaminants Entering the St. Lawrence River at Wolfe Island, 2000 to 2019

**Summary:** ECCC updated the status and trends analysis of contaminants at the long-term monitoring station situated at the outlet of Lake Ontario (Wolfe Island). This station captures the quality of water leaving the Great lakes as it flows downstream into the St. Lawrence River. Overall, concentrations of metals and PAHs decreased, whereas concentration of nutrients, such as phosphorus, increased over the 20-year period ending in 2019. Except for PCBs, PFOS, and phosphorus, the rate of exceedance of the most stringent water quality guidelines were lower for most monitored contaminants in the 2015 to 2019 period than in previous time periods. Despite these exceptions, the Great Lakes are contributing less contamination to downstream ecosystems than they have in the past.

**Publication:** Graham, M., & Ng, K. 2024. *Concentrations and loads of metals, nutrients and organic contaminants entering the St. Lawrence River at Wolfe Island, 2000 to 2019*. Journal of Great Lakes Research, 50(3), 102340. DOI: 10.1016/ jglr.2024.102340

#### 8.1.1.2 Nanomaterials and Microplastics

### Toxicity of Microplastics and Nanoplastics

**Summary:** This systematic review of 124 publications provides the status of microplastic and nanoplastic toxicity to one of the most used aquatic toxicity model organisms: *Daphnia magna* (water flea). Here, acute, chronic, and multigenerational effect studies were summarized with effects from the physical particle and the leached chemicals assessed. Such a review provides essential information to understanding the toxicity of plastic pollution to aquatic invertebrates and identifies knowledge gaps requiring further research. The review also identified various confounding factors and provided recommendations for future research.

**Publication:** Pikuda, O, Roubeau Dumon E, Chen Q, Macairan J-R, Robinson SA, Berk D, Tufenkji N. 2023. *Toxicity of microplastics and nanoplastics to Daphnia magna: Current status, knowledge gaps and future directions.* Trends in Analytical Chemistry 167: 117208 DOI: 10.1016/j.trac.2023.117208 Published online 29 July 2023

### Impact of Tire-Wear Nanoplastics and Leachate on Aquatic Organisms

**Summary:** The study assessed the relative toxicity of three different fractions of tire wear particle leachate on four aquatic model species of different trophic levels: *Chlorella vulgaris* (algae), *Lemna minor* (duckweed), *Daphnia magna* (water flea) and *Silurana [Xenopus] tropicalis* (frog). The toxicity of the fractions was assessed through measures of survival and growth for all species, and malformations, swimming and feeding behaviours and brain size for tadpoles. *Daphnia magna* was the most sensitive, where all three fractions induced acute toxicity at <1% of the exposure solutions. This study showed that there are differing toxicities between the different fractions that make up tire wear leachate and that invertebrates (*Daphnia magna*) and vertebrates (*S. tropicalis*) are potentially most affected.

**Publications :** Cheong RS, Roubeau Dumont E, Thomson PE, Castaneda-Cortes DC, Hernandez LM, Gao X, Zheng J, Baesu A, Macairan JR, Smith AJ, Bui HNN, Larsson HCE, Ghoshal S, Bayen S, Langlois VS, Robinson SA, Tufenkji N. 2023. *Nanoparticle-specific and chemical-specific effects of tire wear particle leachate on amphibian early life stages.* Journal of Hazardous Materials Advances 12: 100357 DOI: 10.1016/j.hazadv.2023.100357 Published online 14 August 2023

Roubeau Dumont, E, Gao X, Zheng J, Macairan J, Hernandez LM, Baesu A, Bayen S, Robinson SA, Ghoshal S, Tufenkji N. 2023. *Unraveling the toxicity of tire wear contamination in three freshwater species: From chemical mixture to nanoparticles*. Journal of Hazardous Materials 453: 131402 , DOI: 10.1016/j.jhazmat.2023.131402 Published online 11 April 2023

#### 8.1.1.3 Methods

**Harnessing New Approach Methodologies (NAMs; for Example, Toxicogenomics) and Alternative Testing Strategies (for Example, Early-Life Stage, Non-Animal) to Support Risk Assessment Of Priority Chemicals**

**Summary:** A combination of *in vitro/*early-life stage exposures and transcriptomics analyses were conducted to A) characterize ecologically relevant NAMs and evaluate if they produce results that are protective/predictive of traditional animal-based toxicity tests, and B) screen/prioritize chemical groups and mixtures of high priority for the CMP. *In vitro* toxicology data were published on a novel bisphenol A alternative compound, diphenyl sulfone, detected in thermal receipt papers demonstrating a promising use of these NAMs to screen and prioritize novel compounds without relying on animal use.

**Publications:** Jeon, Y.S., Sangiovanni, J., Boulanger, E., Crump, D., Liu, P., Ewald, J., Basu, N., Xia, J., Hecker, M., Head, J. 2024. *Hepatic Transcriptomic Responses to Ethinylestradiol in Embryonic Japanese Quail and Double-crested Cormorant.* Environ Tox Chem 43(4): 772-783. DOI:10.1002/etc.5811

Sharin, T., Leinen, L.J., Schreiber, D., Swenson, V.A., Emsley, S.A., Trammell, E.J., Videau, P., Crump, D., Gaylor, M.O. *Description of solvent-extractable chemicals in thermal receipts and toxicological assessment of bisphenol S and diphenyl sulfone* (accepted to Bull. Envir. Contam. Toxicol on Feb 16, 2024, DOI:10.1007/s00128-024-03871-4

Crump, D., Hickey, G., Boulanger, E., Masse, A., Head, J., Hogan, N., Maguire, S., Xia, J., Hecker, M., Basu, N. 2023. *Development and initial testing of EcoToxChip, a novel toxicogenomics tool for environmental management and chemical risk assessment.* Environ. Tox. Chem. 42(8): 1763-1771, DOI:10.1002/etc.5676

Mittal, K., Ewald, J., Crump, D., Head, J., Hecker, M., Hogan, N., Xia, J., Basu, N. *Comparing Transcriptomic Responses to Chemicals Across Six Species using the EcoToxChip RNASeq database.* (accepted ET&C short communication; December 4th, 2023, DOI:10.1002/etc.5803

Lee, H., Stead, J.D.H., Williams, A., Cortés Ramírez, S.A., Atlas, E., Mennigen, J.A., O'Brien, J.M., Yauk, C. 2024. *Empirical characterization of false discovery rates of differentially expressed genes and transcriptomic benchmark concentrations in zebrafish embryos.* Environ Sci Technol. 58(14):6128-6137, DOI: 10.1021/acs.est.3c10543. Epub 2024 Mar 26

Haigis, A.C., Vergauwen, L., LaLone, C.A., Villeneuve, D.L., O'Brien, J.M., Knapen, D. 2023. *Cross-species applicability of an adverse outcome pathway network for thyroid hormone system disruption.* Toxicol Sci. 195(1):1-27, DOI:10.1093/toxsci/kfad063

## Targeted and Non-Targeted Analysis and Chemical Mixtures in Wildlife

**Summary:** Non-targeted analysis (NTA) screening for unknow per-/poly-fluoroalkyl substances (PFAS) in biota samples remains challenging. The focus of this project was to develop a new integrated approach to determine targeted legacy and screen for potentially new PFAS using NTA and then apply to model wildlife samples. This NAM was successfully applied to Hudson Bay polar bear liver and Great Lakes double-crested cormorant egg samples. Targeted analysis identified well known/established PFAS (mainly perfluoroalkyl acids) with quantification generally at very low levels, but analytical coverage of PFAS from the NTA was greater and it elucidated other PFAS present in these model apex predators.

**Publication:** Chu, S-G., Letcher, R.J. 2024. *A targeted and non-targeted discovery screening approach for poly-and per-fluoroalkyl substances (PFAS) in model environmental biota samples.* Journal of Chromatography A, Vol. 1715, article #464584, DOI:10.1016/j.chroma.2023.464584

## Wildlife Risk Assessment in the 21st Century

**Summary:** Ecological risk assessment methods for wildlife have generally remained unchanged for decades despite advances in ecotoxicological research methods and knowledge that could better inform risk assessments. A SETAC Technical Workshop 'Wildlife Risk Assessment in the 21st Century: Integrating Advancements in Ecology, Toxicology, and Conservation' is proposed.

Three publications were produced by the workshop members this year. They provide a significant contribution to methods for improving wildlife risk assessment.

**Publications:** Rattner, B. A., Bean, T. G., Beasley, V. R., Berny, P., Eisenreich, K. M., Elliott, J. E., ... & Salice, C. J. (2024). *Wildlife ecological risk assessment in the 21st century: Promising technologies to assess toxicological effects.* Integrated Environmental Assessment and Management, 20(3), 725-748, DOI: 10.1002/ieam.4806

Bean, T. G., Beasley, V. R., Berny, P., Eisenreich, K. M., Elliott, J. E., Eng, M. L., ... & Rattner, B. A. (2024). *Toxicological effects assessment for wildlife in the 21st century: Review of current methods and recommendations for a path forward.* Integrated Environmental Assessment and Management, 20(3), 699-724, DOI:10.1002/ieam.4795

van den Brink, N. W., Elliott, J. E., Power, B., Kilgour, C., & Johnson, M. S. (2024). *Integrating emerging science to improve estimates of risk to wildlife from chemical exposure: What are the challenges?*. Integrated Environmental Assessment and Management, 20(3), 645-657 DOI:10.1002/ieam.4897

## Legacy Contaminant Trends in the Great Lakes Uncovered by the Wildlife Environmental Quality Index

**Summary:** Free-ranging animals are exposed to multiple compounds consisting of complex mixtures, and these mixtures differ geographically. This makes direct comparisons of chemical exposure difficult. There are also very large differences in the toxicity among these different compounds, meaning that concentration alone does not convey the true toxicological risks to wildlife. Approaches are therefore needed that summarize the combined or cumulative risk of multiple contaminants to wildlife. To fill this gap, ECCC developed a simple integrative index (Wildlife Environmental Quality Index) to quantify the risk to wildlife from exposure to multiple contaminants. This would provide resource managers and risk assessors an improved ability to track improving or deteriorating potential for wildlife impacts in sensitive ecosystems.

**Publications :** Hammond, M.P., de Solla, S.R., Hughes, K.D., Bohannon M.E.B, Drouillard, K.G., Barrett, G.C., Bowerman, W.W. 2024. *Legacy contaminant trends in the Great Lakes uncovered by the wildlife environmental quality index.* Environmental Pollution, 2024, Vol. 343, 123119. DOI: 10.1016/j.envpol.2023.123119

**In collaboration with:** The United States Fish and Wildlife Service, Broadwing Biological Consulting, and the University of Maryland

### 8.1.2 Chemical Substances in Canadians

In 2023-2024, HC scientists conducted 55 research projects to inform the assessment and management of risks associated with various substances to human health or the environment. These projects addressed departmental and international priorities and covered a number of subjects such as the effects of chemicals in Canadians, new methods to detect chemicals and assess toxicity, new approach methodologies, data on the exposure of Canadians to chemicals, and the characterization of toxicological responses to chemicals.

#### 8.1.2.1 Toxicity, Exposure and Impacts

**The Maternal-Infant Research on Environmental Chemicals (MIREC) Research Platform)**

**Summary:** In 2023-2024, HC MIREC researchers published 12 scientific papers, with MIREC platform data used in a total of 14 papers. These publications included biomonitoring data for flame retardants, chemicals found in plastics, and toxic metals. Other publications explored key questions linking exposures to environmental chemicals and health outcomes, including pregnancy complications, birth outcomes, and child development. This work promotes an understanding of the extent and risks of exposure to environmental chemicals during uniquely susceptible life stages.

**Publications:** Goodman, C.V., Till, C., Green, R., El-Sabbagh, J., Arbuckle, T.E., Hornung, R., Lanphear, B., Seguin, J. R., Booij, L., Fisher, M., Muckle, G., Bouchard, M.F., Ashley-Martin, J. 2023. *Prenatal exposure to legacy PFAS and neurodevelopment in preschool-aged Canadian children: The MIREC cohort*. Neurotoxicology and Teratology, Vol. 98, Article 107181, DOI: 10.1016/j.ntt.2023.107181

Ashley-Martin, J., MacPherson, S., Zhao, Z., Gaudreau, É., Provencher, G., Fisher, M., Borghese, M., Bouchard, M.F., Booij, L., Arbuckle, T.E. 2023. *Descriptive analysis of organophosphate ester metabolites in a pan-Canadian pregnancy cohort.* Science of Total Environment, Vol. 883, Article 163327. DOI: 10.1016/j.scitotenv.2023.163327

Packull-McCormick, S., Ashley-Martin, J., Singh, K., Fisher, M., Arbuckle, T.E., Lanphear, B., Laird, B.D., Muckle, G., Booij, L., Asztalos, E., Walker, M., Bouchard, M. F., Saint-Amour, D., Boivin, M., Borghese, M. 2023. *Prenatal and concurrent blood mercury concentrations and associations with IQ in Canadian preschool children.* Environmental Research, Vol. 233, Article 116463, DOI: 10.1016/j.envres.2023.116463

Borghese, M.M., Huang, R., MacPherson, S., Gaudreau, E., Gagné, S., Ashley-Martin, J., Fisher, M., Booij, L., Bouchard, M.F., Arbuckle, T.E. 2023. *A descriptive analysis of first trimester urinary concentrations of 14 bisphenol analogues in the MIREC Canadian pregnancy cohort.* International Journal of Hygiene and Environmental Health, Vol 253, Article 114225. DOI: 10.1016/j.ijheh.2023.114225

Arbuckle, T. E., Gaudreau, É., MacPherson, S., Muzeyyen Kabasakal, Borghese, M. M., Fisher, M., Bouchard, M. F., Foster, W., Ashley-Martin, J., & Provencher, G. 2023. *Measurement of 24 phthalate metabolites in 1st trimester urine samples: The MIREC study*. Chemosphere, Vol. 338, Article.139603. DOI: 10.1016/j.chemosphere.2023.139603

Palaniyandi, J., Bruin, J. E., Kumarathasan, P., MacPherson, S., Borghese, M.M., Ashley-Martin, J. 2023. *Prenatal exposure to perfluoroalkyl substances and inflammatory biomarker concentrations*. Environmental Epidemiology, Vol. 7, Issue 4, e262, DOI: 10.1097/EE9.0000000000000262

Borghese, M. M., Fisher, M., Ashley-Martin, J., Fraser, W. D., Trottier, H., Lanphear, B. P., Johnson, M., Helewa, M., Foster, W. G., Walker, M., & Arbuckle, T. E. 2023. *Individual, Independent, and Joint Associations of Toxic Metals and Manganese on Hypertensive Disorders of Pregnancy: Results from the MIREC Canadian Pregnancy Cohort.* Environmental Health Perspectives, Vol.131, Article.47014, DOI: 10.1289/ehp10825

Ntantu Nkinsa, P., Fisher, M., Muckle, G., Guay, M., Arbuckle, T.E., Fraser, W.D., Boylan, K., Booij, L., Walker, M., Bouchard, M.F. 2023. *Childhood exposure to pyrethroids and neurodevelopment in Canadian preschoolers*. Neurotoxicology, Vol. 99, pp 120–128, DOI: 10.1016/j.neuro.2023.10.001

Fisher, M., Muckle, G., Lanphear, B., Arbuckle, T. E., Braun, J. M., Zidek, A., Vélez, M. P., Lupien, N., Bastien, S., Ashley-Martin, J., Youssef Oulhote, Borghese, M. M., Walker, M., Asztalos, E., Bouchard, M. F., Booij, L., Palmert, M. R., Morrison, K. M., Cummings, E. A., & Khatchadourian, K. 2023. *Cohort profile update: The Canadian Maternal–Infant Research on Environmental Chemicals Child Development study* (MIREC-CD PLUS). Paediatric and Perinatal Epidemiology, Vol. 37, pp 719–732, DOI: 10.1111/ppe.13013

Premranjith, P., King, W., Ashley-Martin, J., Borghese, M.M., Bouchard, M., Foster, W., Arbuckle, T.E., Velez, M.P. 2024. *Maternal exposure to metals and time-to-pregnancy: The MIREC cohort study.* BJOG, Vol. 131, Issue 5, pp 589–597. DOI: 10.1111/1471-0528.17759

Johnson, M., Mazur, L., Fisher, M., Fraser, W.D., Sun, L., Hystad, P., Gandhi, C.K. 2024. *Prenatal Exposure to Air Pollution and Respiratory Distress in Term Newborns: Results from the MIREC Prospective Pregnancy Cohort.* Environmental Health Perspectives, Vol 132, Issue 1, Article 17007, DOI: 10.1289/EHP$_1$2880

Ashley-Martin, J., Hammond, J., Velez, M.P. 2024. *Assessing preconception exposure to environmental chemicals and fecundity: Strategies, challenges, and research priorities.* Reproductive Toxicology, Vol. 125, Article 108578, DOI: 10.1016/j.reprotox.2024.108578

Rawn, D.F.K., Corrigan, C., Ménard, C., Sun, W.F., Breton, F., Arbuckle, T.E. 2024. *Novel halogenated flame retardants in Canadian human milk from the MIREC study* (2008-2011). Chemosphere, Vol. 350, Article 141065, DOI: 10.1016/j.chemosphere.2023.141065

**In collaboration with:** CHU Sainte-Justine Hospital Research Centre Study Coordination Site and a network of MIREC investigators across Canada and the United States

## National Biomonitoring Program Under the Canadian Health Measures Survey (CHMS)

**Summary:** In 2023-2024, the National Biomonitoring Program published two key papers. These papers looked at trends of lead, cadmium and mercury in blood among Canadians and Americans, and factors associated with lead exposure in Canada. These papers together show similar declines in Canadians and Americans in their blood levels of lead, cadmium and mercury over 2007 to 2017, but also indicate that there are many factors that lead to unequal exposure to lead in Canadians.

**Publications:** Aoki, Y., Earl S., Clarke, J., Servais, J., Karthikeyan, S. 2023. *Trends in blood lead, cadmium, and mercury: United States, 1999–2000 through 2017–2018 and Canada, 2007–2009 through 2016–2017*. National Center for Health Statistics Vital Health Statistics, Series 3, Number 49, DOI: 10.15620/cdc:123891

Nguyen, K.C., Karthikeyan, S., Lye, E.J.D., Masoud, H., Clarke, J., Yome, J.L., Vladisavljevic, D., Chan, L.H.M., St-Amand, A. 2024. *Blood lead levels in the general population and vulnerable subpopulations and related risk factors for lead exposure in Canada*. Hygiene and Environmental Health Advances, Vol 9, Article 100088, DOI: 10.1016/j.heha.2024.100088

## Bisphenols in Foods, Methodology and Surveillance

**Summary:** Bisphenol A (BPA) is an industrial chemical commonly found in containers that store food and beverages. Over the years, manufacturers have made efforts to reduce BPA levels in canned foods. The study analyzed trends in BPA levels from 2008-2020 in various composite canned foods as part of the Canadian total diet study (TDS) program. Notably, BPA levels decreased significantly in canned fish products since 2014 and in canned soups since 2017. However, no clear trends were observed for other canned foods, indicating potential ongoing use of BPA-based epoxy resins in their internal coatings. These findings suggest that BPA-based epoxy resins may still be used in the internal coatings of certain canned food products, and highlight the need for consumer awareness regarding BPA exposure through canned foods.

**Publication:** Cao, X.-L., Popovic, S., Dabeka, R.W. 2023. *Trends of bisphenol A occurrence in canned food products from 2008–2020*. Food Additives and Contaminants - Part A, 40 (6), pp. 781-786, DOI: 10.1080/19440049.2023.2209898

## Volatile Organic Compounds (VOCs) in Foods, Methodology and Surveillance

**Summary:** Chloroform, also known as trichloromethane, is one of the trihalomethanes formed during water disinfection with chlorine. Chlorine-based disinfectants (such as chlorine, chloramines, and chlorine dioxide) are commonly used in food production and processing and may be detected in food products. Chloroform is reasonably anticipated to be a human carcinogen. The study analyzed the presence of chloroform in various food products, beverages and tap water from the Canadian Total Diet Study. Overall, chloroform was detected in 37 out of 159 composite food samples (approximately 23%).

**Publication:** Cao, X.-L.; Sparling, M.; Dabeka, R. 2024. *Chloroform in Food Samples from 2014 Canadian Total Diet Study: Occurrence and Dietary Exposure*. Food Additives and Contaminants: Part A, 41(2), 143-150, published online January 9, 2024. DOI:/10.1080/19440049.2024.2302098

## Genetic Toxicity

**Summary:** HC assesses the human health effects of chemicals present in our environment to manage risk of exposures to toxic substances. To do so, HC is developing and validating novel high-throughput genome sequencing methods using cells grown in the lab, combined with bioinformatics and dose modeling to understand the mechanism by which chemicals can cause DNA damage that leads to diseases such as cancer or inherited genetic disorders. Together, these studies demonstrate that high-throughput genome sequencing-based methods may be used to generate data to conduct effective, robust and cost-saving risk assessment and risk management activities and support Canada's commitment to reduce animal models in regulatory toxicology.

**Publications:** Cho, E., Swartz, C.D., Williams, A., Rivas, M.V, Recio, L., Witt, K. L., Schmidt, E. K., Yaplee, J., Smith, T. H., Van, P., Lo, F. Y., Valentine, C. C., 3rd, Salk, J. J., Marchetti, F., Smith-Roe, S. L., Yauk, C. L. 2023. *Error-corrected duplex sequencing enables direct detection and quantification of mutations in human TK6 cells with strong inter-laboratory consistency.* Mutation research - Genetic Toxicology and Environmental Mutagenesis, Vol. 889, Article 503649, DOI: 10.1016/j.mrgentox.2023.503649

Dodge, A.E., LeBlanc, D.P.M., Zhou, G., Williams, A., Meier, M.J., Van, P., Lo, F. Y., Valentine Iii, C.C., Salk, J.J., Yauk, C. L., Marchetti, F. 2023. *Duplex sequencing provides detailed characterization of mutation frequencies and spectra in the bone marrow of MutaMouse males exposed to procarbazine hydrochloride.* Archives of Toxicology, Vol. 97, Issue 8, pp 2245–2259, DOI: 10.1007/s00204-023-03527-y

Desaulniers, D., Zhou, G., Stalker, A., Cummings-Lorbetskie, C. 2023. *Effects of Copper or Zinc Organometallics on Cytotoxicity, DNA Damage and Epigenetic Changes in the HC-04 Human Liver Cell Line*. International Journal of Molecular Sciences, Vol. 24, Issue 21, Article 15580, DOI: 10.3390/ijms242115580

Marchetti, F., Cardoso, R., Chen, C. L., Douglas, G. R., Elloway, J., Escobar, P. A., Harper, T., Jr, Heflich, R. H., Kidd, D., Lynch, A. M., Myers, M. B., Parsons, B. L., Salk, J. J., Settivari, R. S., Smith-Roe, S. L., Witt, K. L., Yauk, C. L., Young, R., Zhang, S., & Minocherhomji, S. 2023. *Error-corrected next generation sequencing - Promises and challenges for genotoxicity and cancer risk assessment*. Mutation Research - Reviews in Mutation Research, Vol. 792, Article 108466, DOI: 10.1016/j.mrrev.2023.108466

Wang, X., Rowan-Carroll, A., Meier, M. J., Williams, A., Yauk, C.L., Hales, B.F., Robaire, B. 2023. *Toxicological Mechanisms and Potencies of Organophosphate Esters in KGN Human Ovarian Granulosa Cells as Revealed by High-throughput Transcriptomics.* Toxicological Sciences, Vol. 197, Issue 2, pp 170–185. DOI: 10.1093/toxsci/kfad114

Beal, M.A., Chen, G., Dearfield, K. L., Gi, M., Gollapudi, B., Heflich, R.H., Horibata, K., Long, A.S., Lovell, D.P., Parsons, B.L., Pfuhler, S., Wills, J., Zeller, A., Johnson, G., White, P.A. 2023. *Interpretation of in vitro concentration-response data for risk assessment and regulatory decision-making: Report from the 2022 IWGT quantitative analysis expert working group meeting.* Environmental and Molecular Mutagenesis, DOI: 10.1002/em.22582.

Rose, M., Filiatreault, A., Williams, A., Guénette, J., Thomson, E. M. 2023. *Modulation of insulin signaling pathway genes by ozone inhalation and the role of glucocorticoids: A multi-tissue analysis.* Toxicology and Applied Pharmacology, Vol. 469, Article 116526, DOI: 10.1016/j.taap.2023.116526

### Firefighter Exposure

**Summary:** Firefighters have higher incidence of cancer diagnoses and cancer-related deaths compared to the general populations and other occupations. Although the exact causes of increased risks have not been characterized, exposures to combustion emissions are thought to be a risk factor. Silicon wrist bands (SWBs), placed on wrist and jacket, were used during live fire training to examine firefighters' exposures to PAHs, a group of combustion emissions. Although SWBs are a convenient approach to measure exposure to combustion emissions, the influence of sampling duration time, temperature, and air turbulence makes the data more difficult to interpret. Future work should further examine the limitations of SWBs for PAH exposures in firefighting, and other extreme environments.

**Publication:** Keir, J.L.A., Papas, W., Wawrzynczak, A., Aranda-Rodriguez, R., Blais, J.M., White, P. A. 2023. *Use of silicone wristbands to measure firefighters' exposures to polycyclic aromatic hydrocarbons (PAHs) during live fire training.* Environmental Research, Vol. 239, Article 117306, DOI: 10.1016/j.envres.2023.117306

## 8.1.2.2 Nanomaterials and Microplastics

### Impact of Nanomaterials on Respiratory Health

**Summary:** Engineered nanoparticles are increasingly used in the production of electronics, biomedicine, personal care products and foods resulting in an increased risk of human exposure to these materials, including via the pulmonary system. However, the human health impacts of exposure to these materials are not entirely understood and HC is studying nanomaterials to elucidate the cellular mechanisms by which they may negatively impact pulmonary health to identify high-risk nanomaterials. An adverse outcome pathway (a series of biological events that link exposure to a substance to a negative health effect) was developed to explain how exposure to nanoparticles may harm human lungs and lead to respiratory problems, and to help develop approaches to mitigate health risks.

**Publications:** Boyadzhiev, A., Wu, D., Avramescu, M.L., Williams, A., Rasmussen, P., Halappanavar, S. 2023. *Toxicity of Metal Oxide Nanoparticles: Looking through the Lens of Toxicogenomics.* International Journal of Molecular Sciences, Vol. 25, Issue 1, pp 529, DOI: 10.3390/ijms25010529

Halappanavar, S., Sharma, M., Solorio-Rodriguez, S., Wallin, H., Vogel, U., Sullivan, K., Clippinger, & A. J. 2023. *Substance interaction with the pulmonary resident cell membrane components leading to pulmonary fibrosis.* OECD Series on Adverse Outcome Pathways, Number 33, DOI: 10.1787/10372cb8-en

### Polystyrene Nano- and Microplastic Particles Induce an Inflammatory Gene Expression Profile in Rat Neural Stem Cell-Derived Astrocytes in Vitro

**Summary:** The brain is one of the most complex organs in the body and it comprises multiple cell types, including neurons, astrocytes and microglia, among others. Astrocytes are the most abundant cell in the central nervous system and have diverse functions which include maintenance of the blood-brain barrier as well as immune cell activation. This research assessed the toxicity of spherical micro and nano plastics on various neuronal cells in animal (rat) cell model cultures. Results show that the exposure to various types and sizes of micro- and nanoplastics led to some changes in the rat astrocytes, including the expression of genes related to inflammation. Other neuronal cells examined (neurons, neuronal stem cells and oligodendrocytes) were the least affected. More research is needed in this area.

**Publication:** Marcellus, K. A., Bugiel, S., Nunnikhoven, A., Curran, I., Gill, S. S. 2024. *Polystyrene Nano- and Microplastic Particles Induce an Inflammatory Gene Expression Profile in Rat Neural Stem Cell-Derived Astrocytes In Vitro.* Nanomaterials (Basel). Volume 27, Issue 14, page 429, DOI:10.3390/nano14050429

### 8.1.2.3 Methods

#### Development of Novel Computational Methods to Identify and Assess Chemical Toxicity

**Summary:** Computational toxicology models continue to evolve to screen and assess chemicals based on a mechanistic understanding of toxicology. Applying complementary approaches, including quantitative structure-activity relationship models, machine learning and analytical workflows to interpret high-content biology, improves prediction of the behaviour of a chemical in an intact biological system. These studies focused on the development of methods that predict chemical toxicity and potency that work toward the goal of reducing the use of animals for toxicity testing. Integrating predictive toxicology into assessment strategies under the CMP focusses resources on those substances with the greatest potential for hazard to human health and helps to inform timely risk-based decisions that are challenging due to the lack of data across Canada's DSL.

**Publications:** Collins SP, Mailloux B, Kulkarni S, Gagné M, Long AS, Barton-Maclaren TS. 2024. *Development and Application of Consensus in Silico Models for Advancing High-throughput Toxicological Predictions.* Frontiers in Pharmacology Vol 15. DOI: 10.3389/fphar.2024.1307905

Yang C, Rathman JF, Mostrag A, Ribeiro JV, Hobocienski B, Magdziarz T, Kulkarni S, Barton-Maclaren T. 2023. *High Throughput Read-Across for Screening a Large Inventory of Related Structures by Balancing Artificial Intelligence/Machine Learning and Human Knowledge.* Chemical Research in Toxicology. 2023 Jul 17;36(7):1081-1106. DOI: 10.1021/acs.chemrestox.3c00062. Epub 2023 Jul 3. PMID: 37399585[a]

Reardon, A, Farmahin, R, Williams, A, Meier, M, Addicks, G, Yauk, C, Matteo, G, Atlas, E, Harrill, J, Everett, L, Shah, I, Judson, R, Ramaiahgari, S, Ferguson, F, Barton-Maclaren, T. 2023. *From vision toward best practices: Evaluating in vitro transcriptomic points of departure for application in risk assessment using a uniform workflow.* Frontiers in Toxicology 5:1194895. DOI:10.3389/ftox.2023.1194895[b]

**In collaboration with:** MN-AM[a] and the Ohio State University.[b] the University of Ottawa, the US EPA, and the NIEHS.

#### Interpretation of *In Vitro* Concentration-Response Data for Risk Assessment and Regulatory Decision-Making

**Summary:** Quantitative risk assessments of chemicals are routinely performed in rodents; however, there is growing recognition that non-animal approaches can be human-relevant alternatives. An Expert Working Group (EWG) of the 8th International Workshop on Genotoxicity Testing (IWGT) evaluated the utility of quantitative *in vitro* genotoxicity concentration-response data for risk assessment. The EWG concluded that in vitro genotoxicity concentration-response data can be interpreted in a risk assessment context. However, prior to routine use in regulatory settings, further research will be required to address the remaining uncertainties and limitations.

**Publication:** Beal M, Chen G, Dearfield K, Gi M, Gollapudi B, Heflich R, Horibata K, Johnson G, Long AS, Lovell D, Parsons B, Pfuhler S, White P, Wills J. 2023. *Interpretation of In Vitro Dose Response Data for Risk Assessment and Regulatory Decision-making: Report from 2022 IWGT Quantitative Analysis Expert Working Group Meeting.* Environmental and Molecular Mutagenesis. DOI: 10.1002/em.22582

**In collaboration with:** the RIVM (the Dutch National Institute for Public Health and the Environment), the US EPA, Osaka Metropolitan University, the US FDA, the National Institute of Health Sciences (Japan), the University of London, Procter & Gamble, GSK, Hoffmann-La Roche Ltd, and Swansea University

### International Regulatory Uses of Acute Systemic Toxicity Data and Integration of New Approach Methodologies

**Summary:** Chemical regulatory authorities around the world require systemic toxicity data from acute exposures via the oral, dermal, and inhalation routes for human health risk assessment. To identify opportunities for regulatory uses of non-animal replacements for these tests, this study examined the way different countries around the world require and use systemic toxicity test data. The chemical sectors included in the review of each jurisdiction were cosmetics, consumer products, industrial chemicals, pharmaceuticals, medical devices, and pesticides. Where animal methods were required, animal reduction methods were typically recommended. For many jurisdictions and chemical sectors, non-animal alternatives are not accepted, but several jurisdictions, including the New Substances Notification Regulations under CEPA, provide guidance to support the use of test waivers to reduce animal use for specific applications.

An understanding of international regulatory requirements for acute systemic toxicity testing will inform the International Cooperation on Alternative Test Methods' (ICATM) strategy for the development, acceptance, and implementation of non-animal alternatives to assess the health hazards and risks associated with acute toxicity.

**Publication:** Strickland, J., Haugabrooks, E., Allen, D. G., Balottin, L. B., Hirabayashi, Y., Kleinstreuer, N. C., Kojima, H., Nishizawa, C., Prieto, P., Ratzlaff, D. E., Jeong, J., Lee, J., Yang, Y., Lin, P., Sullivan, K., Casey, W. (2023). *International regulatory uses of acute systemic toxicity data and integration of new approach methodologies.* Critical Reviews in Toxicology, 53(7), 385–411. DOI: 10.1080/10408444.2023.2240852

**In collaboration with:** Various agencies and institutions from USA, Brazil, Italy, Japan, South Korea, China, Taiwan

## 8.2 Air Pollutants

In 2023-2024, HC continued to research the health impacts of human exposure to indoor and outdoor air pollutants to inform the development of guidance for use by all levels of government, industry, other organizations, and individuals on how to address and limit exposure to air pollution. Scientists at HC published 37 articles in peer reviewed scientific journals. These publications addressed various issues, such as the effect of air quality on stress, the impact of air pollution on mortality and morbidity, and the health impacts of indoor air pollution, wildfire smoke, and climate change.

ECCC continued air quality research that helps quantify ambient air pollutants (for example, $PM_{2.5}$, ozone, $NO_x$, $SO_2$) and determine trends, improve air quality predictions, and provide evidence-based policy and regulatory development, including for the setting of CAAQS. ECCC scientists published 77 articles in peer reviewed scientific journals on air quality research. A sample of the research papers published by scientists at HC and ECCC in peer-reviewed scientific journals in 2023-2024 are provided below.

### 8.2.1 Air Pollution / Indoor Air Quality and Health Outcomes

### Unequal in Death – Imbalance in the Distribution of Deaths Due to Air Pollution

**Summary:** This study is a first-in-Canada examination of inequality in the distribution of air pollution attributable health impacts (mortality or deaths, in this case) in Canadian cities. Disparities in mortality were assessed using mortality counts and air pollution data measured from 2013 to 2015 in 7 Canadian cities and applying census data about the percentages of people identifying as low income, Indigenous and/or racialized in each census tract within the cities. Census tracts with more people with low income and Indigenous identity had significantly higher air pollution attributable mortality. The level of inequality varied from city to city. While air pollution attributable mortality was unequal, the inequality seems to have been related more to unequal baseline mortality rather than unequal levels of exposure to air pollution.

**Publications:** Stieb, D.M., Smith-Doiron, M., Quick, M., Christidis, T., Xi, G., Miles, R.M., van Donkelaar, A., Martin, R.V., Hystad, P.,Tjepkema, M. 2023. Inequality in the *Distribution of Air Pollution Attributable Mortality Within Canadian Cities.* GeoHealth, Vol. 7, Issue 9, e2023GH000816, DOI: 10.1029/2023GH000816

### Indoor Air Quality in Remote First Nations Communities in Ontario, Canada

**Summary:** Indoor air quality in residential spaces has been identified as problem in many Indigenous communities. This study provides an analysis of the housing conditions and indoor environmental quality of 101 homes in the four First Nations communities that were part of the Sioux Lookout Zone study. Dwelling characteristics were examined for associations with $PM_{2.5,}$ $CO_2$, benzene and formaldehyde concentrations and biocontaminant loadings. Twelve homes had >1% visible mold and moisture damage per unit floor area, a level which has been shown to elicit a health impact on children. Most of the heat recovery ventilators (HRVs) in the houses were not functioning and the study presents causes, consequences and recommendations related to HRVs. The paper points out that general inadequacy of the housing in this study is the result of overcrowding, moisture damage, inadequate ventilation and building and system failures.

**Publication:** Mallach G, Sun L, McKay M, Kovesi T, Lawlor G, Kulka R, Miller JD. *Indoor air quality in remote first nations communities in Ontario, Canada.* PlOS One. 2023 Nov 22;18(11):e0294040. DOI:/10.1371/journal.pone.0294040

**In collaboration with:** Lac Seul First Nation, Kasabonika Lake First Nation, Sandy Lake First Nation, and Kitchenuhmaykoosib Inninuwug First Nation Nishnawbe Aski Nation in the Sioux Lookout Zone in Ontario; HC, the Children's Hospital of Eastern Ontario, Energy Matters and Carleton University

### Using Low-Cost Air Quality Sensors and Community Science to Estimate Wildfire Smoke Infiltration Into Child Daycare Facilities in British Columbia, Canada)

**Summary:** The health risks associated with extreme events like naturally occurring and human-caused wildfires are expected to increase because of climate change. Children are particularly susceptible to experiencing adverse health effects from exposure to wildfire smoke. This study carried out $PM_{2.5}$ monitoring with low-cost sensors at 45 daycares on the BC mainland during the 2022 wildfire season. Although $PM_{2.5}$ exposure was generally lower indoors than outdoors, indoor $PM_{2.5}$ levels increased by 275% on wildfire days. There was substantial variability between daycares and the indoor/outdoor relationship was highly daycare specific.

The paper recommends that facilities that serve susceptible populations be supported in monitoring local air quality to assist decision-making and that accurate estimation of indoor exposure to wildfire smoke requires building-specific air quality data.

**Publication:** Lee MJ, Dickson JM, Greif O, Ho W, Henderson SB, Mallach G, Coker ES. *Using low-cost air quality sensors to estimate wildfire smoke infiltration into childcare facilities in British Columbia, Canada.* Environmental Research: Health. 2024 Feb 2;2(2):025002. DOI:/10.1088/2752-5309/ad1fd6

**In collaboration with:** BC Centre for Disease Control

## 8.2.2 Air Pollution From Source Sectors (transportation, Industry, Residential, Etc.)

### Transition Metal Solubility and Oxidative Potential of Fine Particulate Matter

**Summary:** Adverse health effects associated with the inhalation of fine particulate matter ($PM_{2.5}$) are thought to be related to the excess formation of reactive oxygen species (ROS) in the respiratory and cardiovascular systems. The ability of airborne chemicals to form ROS is known as oxidative potential (OP). This study found that aerosol acidity and oxalate content enhanced the solubility of transition metals, with oxalate showing a stronger association. While experimental OP metrics were primarily associated with species of primary origin such as elemental carbon, iron, and copper, predictive modelling showed ROS formation associated with secondary processes including the dissolution of iron and copperin water. The study underscores the importance of reducing transition metal emissions (for example, from vehicle brake and tire wear) to improve population health.

**Publications:** Shahpoury, P., Lelieveld, S., Johannessen, C., Berkemeier, T., Celo, V., Dabek-Zlotorzynska, E., Harner, T., Lammel, G., & Nenes, A. (2024). I*nfluence of aerosol acidity and organic ligands on transition metal solubility and oxidative potential of fine particulate matter in Urban Environments.* Science of The Total Environment, 906, 167405, DOI:10.1016/j.scitotenv.2023.167405

## Emissions of Akylated PAHs in the Athabasca Oil Sands Region

**Summary:** Alkylated polycyclic aromatic hydrocarbons (APAH) are important contaminants of crude oil production and exhibit similar toxicity to their parent compounds. This study developed an emission inventory of APAH in the Athabasca oil sands region of Alberta and validated the inventory with ambient concentration measurements through dispersion modeling. After adjusting the model to account for the concentrations of APAH measured at 17 monitoring sites in the region, it is estimated that APAH emissions in the last decade have been 431 tonnes/year. The largest source is fugitive dust from oil sands mining activities; other major sources include point sources (mining upgraders), tailings ponds, fuel consumption by mining vehicles, and local transportation. APAH emissions from wildfires were not estimated, which can periodically increase the atmospheric burden of APAH.

**Publication:** Yang, F., Cheng, I., Mamun, A. A., & Zhang, L. (2024). *Measurement constrained emission estimates of alkylated polycyclic aromatic hydrocarbons in the Canadian Athabasca oil sands region*. Environmental Pollution, 346, 123602, DOI:10.1016/j.envpol.2024.123602

## Research on Ground-Level and Tropospheric Ozone

**Summary:** The first study showed that longer-term tropospheric ozone trends above western North America have continued to increase over 1995–2021 despite an observed drop of ozone in 2020 due to the COVID-19 economic downturn. This study adds to the growing body of evidence that, despite reductions in emissions of ozone-producing pollutants in North America, transport of ozone-producing emissions from other regions are causing the overall level of tropospheric ozone in North America to increase.

The Michigan-Ontario Ozone Source Experiment (MOOSE) study identified VOC emissions as the primary driver of ozone formation in southeast Michigan and identified significant formaldehyde emissions from industrial sources that had not previously been accounted for. The study also quantified methane emissions from landfills and natural gas pipeline leaks and characterized the sources of reactive nitrogen and $PM_{2.5}$ in both eastern Michigan and southwestern Ontario.

**Publications:** Chang, K.-L., Cooper, O. R., Rodriguez, G., Iraci, L. T., Yates, E. L., Johnson, M. S., et al. (2023). *Diverging ozone trends above western North America: Boundary layer decreases versus free tropospheric increases.* Journal of Geophysical Research: Atmospheres, 128, e2022JD 038090. DOI:/10.1029/2022JD 038090

Olaguer, E.P., Su, Y., Stroud, C.A., Healy, R.M., Batterman, S.A., Yacovitch, T.I., Chai, J., Huang, Y., Parsons, M.T. *The Michigan–Ontario Ozone Source Experiment (MOOSE): An Overview.* Atmosphere. 2023; 14(11):1630. DOI:. org/10.3390/atmos14111630

## Temporal Trends of Legacy and Current-Use Halogenated Flame Retardants in Lake Ontario in Relation to Atmospheric Loadings, Sources, and Environmental Fate

**Summary:** Halogenated flame retardants (HFRs) are a concern to the environment due to their persistence and toxicity. Since the phase out of some HFRs, such as polybrominated diphenyl ethers (PBDEs), alternative halogenated flame retardants (AHFRs) have increasingly entered the marketplace. More knowledge is needed about the atmospheric loadings, sources and environmental fate of these compounds. Long term temporal trends of legacy HFRs such as PBDEs primarily showed declines in air, precipitation, bird eggs, and fish. However, trends in AHFRs were less clear. A multi-media model was constructed to simulate the transport and fate of three primary HFRs in Lake Ontario. Tributaries and wastewater effluent were the primary sources of HFRs in Lake Ontario. The model also suggested that the atmosphere is an important source of lower molecular mass HRFs to Lake Ontario. Sedimentation, burial in the sediment, and chemical transformation in the water and sediment were the primary outputs of HFRs to the lake.

**Publication:** Wen-Long Li, Tana V. McDaniel, Shane R. de Solla, Lisa Bradley, Alice Dove, Daryl McGoldrick, Paul Helm, and Hayley Hung. 2023. *Temporal Trends of Legacy and Current-Use Halogenated Flame Retardants in Lake Ontario in Relation to Atmospheric Loadings, Sources, and Environmental Fate*. Environmental Science & Technology, 57 (38), pp 14396-14406, DOI: 10.1021/acs.est.3c04876

## Transportation-Related Emissions

**Summary:** Electric transit buses sold in Canada generally include a diesel-fueled auxiliary heater for cabin heating in cold weather. A study was conducted to quantify the emissions from such a heater. The heater was tested while the bus was both stationary and being driven on roads in cold conditions. Emissions rates were determined for carbon dioxide, carbon monoxide, nitrogen oxides, hydrocarbons, methane, black carbon and total particulate matter. In the absence of Canadian limits, the results were compared to limits in California and Europe and showed that emissions were mostly within those limits.

**Publication:** Humphries, K., Rashid, H., and Araji, F., "*Diesel Fuel-Fired Heater Emissions from a Battery Electric Transit Bus in Real-World Conditions*," SAE Technical Paper 2024-01-5011, 2024, DOI:10.4271/2024-01-5011

## Evaluating the *Effectiveness of Low-Sulphur Marine Fuel Regulations* at Improving Urban Ambient $PM_{2.5}$ Air Quality

**Summary:** The North American Emissions Control Area (NA ECA), which extends up to approximately 370 km offshore along North American coasts in national territorial waters, is an area in which stringent international emission standards apply for all ships. The NA ECA low-sulphur regulations were implemented in two phases from 2012 to 2015 to reduce the sulphur content of fuel used by large vessels. This study quantitatively evaluated the effectiveness of the NA ECA regulations in improving $PM_{2.5}$-related air quality in two Canadian coastal cities by using a model that allocates $PM_{2.5}$ to multiple source types, including non-marine contributions. The Emissions Control Area regulations were estimated to have reduced $PM_{2.5}$ concentrations in both cities by approximately 1 ug/$m^3$.

**Publication:** Anastasopolos A.T., Hopke P.K., Sofowote U.M., Mooibroek D., Zhang JJ, Rouleau M, Peng H., Sundar N. *Evaluating the effectiveness of low-sulphur marine fuel regulations at improving urban ambient $PM_{2.5}$ air quality: Source apportionment of $PM_{2.5}$ at Canadian Atlantic and Pacific coast cities with implementation of the North American Emissions Control Area.* Science of the Total Environment. 2023 Dec 15;904:166965. DOI:/10.1016/j.scitotenv.2023.166965

**In collaboration with:** HC, the University of Rochester Medical Center, the Ontario Ministry of the Environment, Conservation and Parks, the Netherlands National Institute for Public Health and the Environment, and ECCC

## Attribution of Fine Particulate Matter and Ozone Health Impacts in Canada to Domestic And United States Emission Sources

**Summary:** This study was undertaken in support of a 2023 review of the Canada-United States Air Quality Agreement (AQA). The study used an atmospheric chemical transport model to attribute health impacts from ambient $PM_{2.5}$ and ozone exposure in Canada to emissions from Canadian and US sources. Relative contribution of US sources to the exposure of Canadians to ozone is larger than for $PM_{2.5}$. For health impacts, roughly one in five $PM_{2.5}$ deaths in Canada are attributable to transboundary $PM_{2.5}$ and more than one in two ozone deaths in Canada are attributable to transboundary ozone. Eighty percent of impacts occur in Ontario and Quebec, and almost all impacts occur within 300 km of the Canada-US border.

The results indicate that there are potentially substantial benefits to be gained by domestic and international strategies to reduce $PM_{2.5}$ concentrations in the transboundary region.

**Publication:** Pappin AJ, Charman N, Egyed M, Blagden P, Duhamel A, Miville J, Popadic I, Manseau PM, Marcotte G, Mashayekhi R, Racine J. *Attribution of fine particulate matter and ozone health impacts in Canada to domestic and US emission sources.* Science of The Total Environment. 2024 Jan 20;909:168529. DOI:10.1016/j.scitotenv.2023.168529

**In collaboration with:** ECCC and HC

### 8.2.3 Methods

#### Advances in Measurement of Volatile and Semi-Volatile Organic Compounds (VOCs and SVOCs)

**Summary:** Reporting emissions of organic carbon has been largely limited to certain volatile organic compounds (VOCs). A 2018 study that used aircraft-based measurements of total carbon in the atmosphere over the Athabasca oil sands found levels 19 to 64 times greater than reported values. The measured total organic carbon emissions were equivalent to that from all other sources across Canada. Most of the difference is likely due to unaccounted-for intermediate-volatility and semi-volatile organic compounds.

Ethylene oxide (EtO) is a specific VOC that is mostly released to air in Canada from its use as a sterilization agent, mainly in the healthcare and food (spice manufacturing) sectors. A novel application of tunable infrared laser direct absorption spectrometry (TILDAS) was deployed aboard a mobile air quality laboratory in Toronto to measure EtO in near real-time. The technique greatly reduced sampling and analysis times, while having detection limits comparable to the traditional method (canister samples).

**Publications:** He, M. et al., *Total organic carbon measurements reveal major gaps in petrochemical emissions reporting.* Science 383, 426-432 (2024). DOI:10.1126/science.adj6233

Galarneau, E., Yacovitch, T. I., Lerner, B., Sheppard, A., Quach, B.-T., Kuang, W., Rai, H., Staebler, R., Mihele, C., & Vogel, F. (2023). *From hotspots to background: High-resolution mapping of ethylene oxide in urban air.* Atmospheric Environment, 307, 119828, DOI:10.1016/j.atmosenv.2023.119828

#### Improving Estimates of Sulphur Dioxide Emissions and Deposition

**Summary:** In one study, ECCC scientists worked to develop a modified algorithm that could interpret satellite observations of sulphur dioxide ($SO_2$) emissions over snow/ice conditions, which are typically excluded from existing algorithms. Estimates of $SO_2$ emissions from the modified algorithm or most smelters and oil and gas sites agreed closely (within 20%) with those calculated with previous factors for snow-free conditions, while emissions from coal-fired power plants were found to be on average 25% higher than for snow-free conditions.

Another study used both continuous and passive air samplers at two forest sites downwind of emissions sources in the Athabasca oil sands to estimate $SO_2$ deposition rates. The data from these measurements found the range of deposition rates to be approximately double previous aircraft-based measurements, and more than ten times higher than model estimates. This suggests that $SO_2$ emitted in the oil sands region has a much shorter lifetime in the atmosphere than is currently predicted by models, which has implications for estimates of the contribution of sulfur to atmospheric aerosols and the health of the boreal forest ecosystem.

**Publications:** Fioletov, V. E., McLinden, C. A., Griffin, D., Krotkov, N. A., Li, C., Joiner, J., Theys, N., and Carn, S.: *Estimation of anthropogenic and volcanic $SO_2$ emissions from satellite data in the presence of snow/ice on the ground,* Atmos. Meas. Tech., 16, 5575–5592, DOI:10.5194/amt-16-5575-2023, 2023

Gordon, M., Blanchard, D., Jiang, T., Makar, P. A., Staebler, R. M., Aherne, J., Mihele, C., and Zhang, X.: *High sulfur dioxide deposition velocities measured with the flux–gradient technique in a boreal forest in the Alberta Oil Sands Region,* Atmos. Chem. Phys., 23, 7241–7255, DOI:10.5194/acp-23-7241-2023, 2023

## Mapping Nitrogen Deposition Using Satellite Data

**Summary:** Monitoring of the atmospheric deposition of reactive nitrogen is needed to understand its impact on sensitive ecosystems; however, direct measurements are relatively sparse. Satellite-derived reactive nitrogen dry deposition data can fill in the measurement gaps, but processing of these large datasets requires high-performance supercomputers. A Reactive Nitrogen Flux Mapper (RNFM) component was developed for an existing cloud-based data mapper to generate accessible data products (including maps) without the need for supercomputers.

**Publications:** Kharol, S.K., Prapavessis, C., Shephard, M.W., McLinden, C.A. and *Griffin, D. (2023) Cloud-based data mapper (CDM): application for monitoring dry deposition of reactive nitrogen*. Front. Environ. Sci. 11:1172977. DOI: 10.3389/fenvs.2023.1172977

## Screening Values for Semi-Volatile Organic Compounds

**Summary:** This study proposes a framework for the development of inhalation screening values for chemicals with minimal to no hazard data for the inhalation route. The framework was applied to derive screening values for 43 different semi-volatile organic compounds (SVOCs), and screening values were compared to exposure data in Canadian residential environments to evaluate potential for health risks. The evaluation identified SVOCs with potential increased concern in Canadian homes: dibutyl phthalates, di(2-ethylhexyl) phthalate, and polybrominated diphenyl ethers.

**Publication:** Deveau M, Wille SM. *Derivation and application of indoor air screening values for inhalation exposure to semi-volatile organic compounds*. Regulatory Toxicology and Pharmacology. 2023 Sep 1;143:105463. DOI:/10.1016/j.yrtph.2023.105463

# Appendix 1. Bibliography of Research Publications

A comprehensive list of all research published in the 2023-2024 reporting year by ECCC and HC, including the work already highlighted in section 2 and 8 of this report, appears below. Publications in the bibliography contain either the Digital Object Identifier (DOI) or International Standard Book Number (ISBN). Copy and paste the DOI or ISBN into your search browser to be directed to an online publication of the research.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