DEC 17 2021

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Dear Ms. de Leon and Co-Signatories:

As Minister of the Environment and Climate Change, I am writing in response to your Environmental Petition No. 458, concerning how protective and how transparent is the Canadian government response to the Per- and Polyfluoroalkyl Substances (PFAS) Class of 'Forever Chemicals' in water, products, and waste. Your petition was received in Environment and Climate Change Canada on August 19, 2021.

Environment and Climate Change Canada's mandate is to preserve and enhance the quality of the natural environment, including water, air, soil, flora and fauna; conserve Canada's renewable resources; conserve and protect Canada's water resources; forecast daily weather conditions and warnings, and provide detailed meteorological information to all of Canada; enforce rules relating to boundary waters; and co-ordinate environmental policies and programs for the federal government.

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Enclosed you will find the detailed response from Environment and Climate Change Canada to the petition questions that fall under its mandate. I understand that the Honourable Jean-Yves Duclos, Minister of Health, the Honourable Anita Anand, Minister of National Defence, and the Honourable Omar Alghabra, Minister of Transport, will be responding separately to the petition.

I appreciate this opportunity to respond to your petition, and I trust that you will find this information helpful.

Sincerely,

The Honourable Steven Guilbeault, P.C., M.P. (il/lui/he/him)

Enclosure

c.c.: The Honourable Jean-Yves Duclos, P.C., M.P.
The Honourable Anita Anand, P.C., M.P.
The Honourable Omar Alghabra, P.C., M.P.
Mr. Jerry DeMarco, Commissioner of the Environment and Sustainable Development

Response to Environmental Petition 458 on how protective and how transparent is the Canadian government response to the Per- and Polyfluoroalkyl Substances (PFAS) Class of 'Forever Chemicals' in water, products, and waste

Question 1:
What is the Government of Canada's timeline for reviewing existing exemptions for PFOS, PFOAs, and LC-PFCAs currently included in the Prohibition of Certain Toxics Substances Regulations? The 2018 consultation document [9] released by the government recommended removing all existing exemptions for PFOS, PFOA and LC-PFCAs. The recent Notice of Intent on PFAS published in April 24, 2021 outlined these exemptions would be finalized in Spring 2021. When will these existing exemptions be removed?

Response: The publication of the proposed regulatory amendments to the *Prohibition of Certain Toxic Substances Regulations, 2012*, in Part I of the *Canada Gazette* was delayed due to the COVID-19 pandemic and Canada's federal election. It is now expected that the proposed amended regulations will be published in winter 2022, with the final version of the Regulations approximately one year later. As outlined in the 2018 consultation document (*www.canada.ca/en/environment-climate-change/services/canadian-environmental-protection-act-registry/proposed-amendments-certain-toxic-substances-2018-consultation.html*), the proposed amended regulations would further restrict perfluorooctane sulfonate (PFOS), its salts and precursors perfluorooctanoic acid (PFOA), its salts and precursors, and long-chain perfluorocarboxylic acids (LC-PFCAs), their salts and precursors by removing or providing time limits for certain remaining exemptions. Exemptions are only considered after taking into account socio-economic factors, the demonstrated absence of suitable alternatives, and consideration of the international context and risks to the environment. The proposed amended regulations will also provide the timelines for these requirements to come into force.

Question 2: How will the Government of Canada prevent regrettable substitutes for PFOS, PFOA and LC-PFCAs? In the 2018 consultation document reference is made to the removal of exemptions due to fact that 'alternatives are available globally'. Can the government clarify if these alternatives are fluorine-free or if they are other PFAS-based substances? Does the Government of Canada intend to promote PFAS-free alternatives to the use of PFOS, PFOA and LC-PFCAs? In particular, what is the rationale for regulations permitting the use of PFOS "in aqueous film forming foam present in military vessels or military firefighting vehicle contaminated during foreign military operations" and LC-PFCAs in aqueous film forming foam used in fire fighting? How is Transport Canada promoting the use of fluorine-free firefighting foams?

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Response: On April 24, 2021, the Government of Canada published a notice of intent (*https://canadagazette.gc.ca/rp-pr/p1/2021/2021-04-24/html/notice-avis-eng.html#n15*) to move forward with activities to address the broad class of per- and polyfluoroalkyl substances (PFAS). The regulation of three PFAS subclasses (PFOS, PFOA and LC-PFCAs) addressed 94 substances listed on the *Domestic Substances List*, and prevents the introduction to Canada of other members of these subclasses. Scientific evidence to date indicates the PFAS used to replace PFOS, PFOA and LC-PFCAs may also be associated with environmental or human health effects. Considering PFAS as a class of chemicals will enable the federal government to better address situations where exposure occurs to multiple PFAS at the same time. This will improve the Government's ability to consider cumulative effects and to prevent regrettable substitutions.

The Government of Canada is still in the early stages of analyzing considerations for the PFAS class approach. If information that indicates potential harm to human health or the environment is identified, appropriate risk management measures will be considered.

The 2018 consultation document (*www.canada.ca/en/environment-climate-change/services/canadian-environmental-protection-act-registry/proposed-amendments-certain-toxic-substances-2018-consultation.html*) proposes to remove exemptions for the import, use, sale and offer for sale of PFOS, PFOA and LC-PFCAs due to fact that alternatives are available globally. For example, Environment and Climate Change Canada is not aware of any aqueous film forming foam (AFFF) in Canada containing PFOS, PFOA and/or LC-PFCAs as an ingredient. The Government of Canada does not promote any specific alternatives to the use of PFOS, PFOA and LC-PFCAs.

Data analysis by the New Substances Program at Health Canada indicates that a decrease in the introduction of LC-PFCA precursor substances to Canada began as early as 2004, and a decrease in the introduction of new PFAS to Canada has been observed since 2012.

The *Prohibition of Certain Toxic Substances Regulations, 2012*, allow the use and import of AFFF contaminated with PFOS in a military vessel or military fire-fighting vehicle returning from a foreign military operation. The rationale for permitting this was because military vessels deployed overseas for purposes such as national security, humanitarian relief and peacekeeping may need to replenish their AFFF supplies from North Atlantic Treaty Organization (NATO) member countries. These NATO supplies of AFFFs may contain PFOS and, given the nature of the deployment, Canadian military vessels would need to accept the available AFFF supplies. This provision was included in view of the extenuating circumstances when military vessels or military fire-fighting vehicles return from overseas operations.

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The Regulations also allow the import, use, sale and offer for sale of AFFF that contains PFOA or LC-PFCAs used in fire fighting. This exemption has allowed time to develop alternatives for these substances and to ensure safety of fire-fighting operations. Environment and Climate Change Canada also considered current global actions, such as those under the Stockholm Convention, in the determination of the domestic risk management measures. As outlined in the 2018 consultation document, the proposed regulations would further restrict these uses.

Question 3: Is the Government of Canada prioritizing for assessment and management the remaining PFAS in the commercial products available in Canada, including PFAS that may be used in other products such as firefighting foam and including the short chained PFAS, which are currently not included in the Prohibition of Certain Toxics Substances Regulations? What research or data has been undertaken by the Government of Canada about the risks, effects and treatment for short-chain PFAS, and how is this information considered when evaluating chemicals for inclusion in the Prohibition of Certain Toxics Substances Regulations?

Response: Aside from PFOS, PFOA, and LC-PFCAs that were assessed and managed, there remains a large number of PFAS that are commercially available. Their diverse chemical structures, combined with the lack of data on the hazards and properties of the individual substances, renders a traditional substance-by-substance assessment and management approach impractical.

The Government of Canada intends to move forward with activities to address the broad class of PFAS. Within the next two years, the Government will publish a state of PFAS report that will summarize relevant information on this class of substances, including PFAS that may be used in other products such as fire-fighting foam and the short-chain PFAS, and facilitate future discussions. In addition, the federal government will continue to invest in research and monitoring on PFAS, collect and examine information on these substances to inform a class-based approach, and review policy developments in other jurisdictions.

The Government of Canada is still in the early stages of analyzing considerations for the PFAS class approach. Should information indicating potential harm to human health and/or the environment be identified, appropriate risk management measures would be considered.

No risk assessment under the *Canadian Environmental Protection Act, 1999* (CEPA), of any short-chain PFAS on the *Domestic Substances List* has taken place. Environment and Climate Change Canada is in the process of compiling ecological

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information from the scientific literature regarding these substances as it becomes available. PFAS that are being introduced into commerce in Canada, including short-chain PFAS, are subject to evaluation of potential risk to the environment and human health under the *New Substances Notification Regulations (Chemicals and Polymers)* of CEPA.

Beyond monitoring activities identified in the response to question 8 (see below), no research on treatment of short-chain PFAS in wastewater treatment systems is being undertaken by Environment and Climate Change Canada.

Researchers in the Department's Science and Technology Branch have been studying biological effects of short chain (C4-C7) perfluoroalkyl carboxylic acids (PFCAs) and short-chain (C4-C7) perfluoroalkyl sulfonic acids (PFSAs), as well as other PFAS in aquatic organisms (Houde et al., 2013). Several projects began in the summer/fall of 2019 with Environment and Climate Change Canada funding from the Chemicals Management Plan (CMP) and the St. Lawrence Action Plan (SLAP). These projects encompass bioaccumulation, biomagnification, acute and chronic toxicity, multi-generational effects, and fish metabolism. As per the wording of question 3, the Department is responding specifically to activities around short-chain PFAS. Specific details on the projects are shown below. The projects are as follows:

1) A field-based study on the food web transfer of short-chain PFAS in fish, invertebrates, aquatic plants, water and sediment in the St. Lawrence River, upstream and downstream of a major wastewater treatment plant. Under this project, short-chain PFAS including PFCA, PFSA, fluorotelomer precursors, and novel cationic and zwitterionic PFAS are targeted.
2) A laboratory study on the toxicity and bioaccumulation of short-chain PFCA and short-chain PFSA to determine effects on amphipods such as growth, reproduction and sex, and in freshwater snails, the reproductive output, and finally in frogs, gross morphological changes associated with sex-steroid and thyroid hormone dysfunction.
3) A field-based study on the accumulation of short-chain PFAS in freshwater fish and mussels in wastewater effluent receiving environments relative to upstream locations in southern Ontario, including the Grand River watershed.
4) A total oxidizable precursor study of personal care products, enabling determination of PFAS not covered by conventional analytical methods, to identify relative contributions of short-chain PFAS precursors.
5) A study evaluating the multi-decadal deposition of short-chain PFAS to Lake Ontario using dated sediment core analysis.
6) Analysis of short-chain PFAS in wastewater influent and effluent at wastewater treatment plants across Canada.

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Outside of projects under the CMP and the St. Lawrence Action Plan, Environment and Climate Change Canada scientists are conducting research on short-chain PFAS using other sources of funding. For example, under an agreement with the Government of Ontario, a field-based analysis of groundwater for short-chain PFAS is being conducted in areas potentially contaminated with landfill leachate. The Department has had some involvement in treatment of PFAS contaminated water and soil (Yao et al., 2014) funded by the Federal Contaminated Sites Action Plan (FCSAP), but does not conduct studies on treatment technologies to remove PFAS in wastewater.

As indicated in Environment and Climate Change Canada's response to question 8, studies on PFAS monitoring (some of which include short-chain PFAS) have been led by departmental researchers under the Northern Contaminants Program (NCP), administered by Crown-Indigenous Relations and Northern Affairs Canada, and the CMP. As these projects are not focused solely on the effects of short-chain PFAS, they are described more thoroughly in the response to question 8.

References:
M. Houde, M. Douville, S.-P. Despatie, A.O. De Silva, and C. Spencer. Induction of gene responses in St. Lawrence River northern pikes (*Esox lucius*) environmentally exposed to perfluorinated compounds (*Chemosphere*, 2013, Volume 92, Issue 9, pages 1195 to 1200, *https://doi.org/10.1016/j.chemosphere.2013.01.099*).

Y. Yao, K. Volchek, C.E. Brown, A. Robinson, and T. Obal. Comparative study on adsorption of perfluorooctane sulfonate (PFOS) and perfluorooctanoate (PFOA) by different adsorbents in water (*Water Science & Technology*, 2014, Volume 70, Issue 12, pages 1983 to 1991, *https://doi.org/10.2166/wst.2014.445*).

A substance may be added to Schedule 1 to CEPA and may be subject to risk management actions when potential for harm to the environment or human health is identified by science. Science-based risk assessments generally consider multiple lines of evidence to support risk conclusions, and generally include the following steps:

1. gathering available and relevant information from multiple sources;
2. critically assessing the quality or reliability of individual studies or pieces of information;
3. assembling similar information for a parameter or endpoint to develop individual lines of evidence;
4. critically assessing each line of evidence based on overall strength or confidence in the information and its relevance to the assessment outcome; and
5. combining the lines of evidence, in consideration of their relative strengths, consistency and coherency, in order to characterize potential for exposure, potential to cause detrimental effects and potential for risk to humans or the environment, leading to determination of an assessment conclusion.

Technical and scientific information for consideration in assessments may be gathered from stakeholder submissions of information through voluntary or mandatory surveys, or information requirements for new substances notifications. Other sources can include other regulatory bodies and international organizations, the scientific literature, databases, computer models, information for similar (analogue) substances, consultation with experts, and data from stakeholders. Information on substances is also available through other programs within the federal government. For example, the Canadian Health Measures Survey prepared by Statistics Canada is a source for human biomonitoring data on several substances, including PFAS, which are being used in CMP assessments. Other federal departments and agencies such as Natural Resources Canada, the Canada Border Services Agency and Statistics Canada may have data for use in risk assessments. Measured or estimated levels of a substance in the environment (air, water, dust and biota) and the concentration of a substance found in products are also used to inform assessments.

Assessment approaches may differ depending on the amount and type of data available, and may also differ for the ecological and human health assessments. While the nature and scope of assessments may vary, all use a weight of evidence approach. Weight of evidence may be applied at various stages of the assessment and can be used to evaluate the quality of a single study, to assess similar studies for a particular parameter or endpoint, or to integrate study results and overall information to support the assessment conclusion. Greater reliance or weight is placed on stronger and more relevant information (including direct evidence for harm or causality and specifically related to Canadian situations). The consideration of the uncertainties is a significant step in evaluating the strength of the lines of evidence. Assessments apply precaution in addressing areas of uncertainty, such as that resulting from a lack of data on the substance. Substances that are listed in Schedule 1 to CEPA can then be subject to the various types of risk management actions authorized under CEPA. A variety of risk management instruments are available to achieve the environmental and risk management objectives. These may be used to control any aspect of the life cycle of a substance, from the manufacture stage to its use, handling, storage, export, transport and disposal. Selecting the most appropriate instrument(s) is a critical step in the risk management process.

The Instrument Choice Framework provides a standardized framework for selecting risk management instruments. The purpose of the Framework is to help risk managers identify what instrument or mix of instruments are best suited to address environmental and human health risks, and to help achieve the objectives on a sustained basis.

One possible risk management instrument is the imposition of controls under the *Prohibition of Certain Toxic Substances Regulations, 2012*. The substances prohibited by these regulations are among the most harmful substances.

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Question 4: How have Environment and Climate Change Canada and Health Canada given consideration to the imposition of a ban of all PFAS chemicals? Will Canada develop a PFAS Action Plan to phase out the class of PFAS by 2030 for all non-essential uses? Does Canada have an ambitious timeline to phase out the remaining uses of PFAS that currently have no available safer substitutes, similar to the approach taken by the European Commission in their Chemical Strategy for Sustainability?

Response: The Government of Canada published a notice of intent on April 24, 2021 (*https://canadagazette.gc.ca/rp-pr/p1/2021/2021-04-24/html/notice-avis-eng.html#n15*), to move forward with activities to address the broad class of PFAS.

The Notice of Intent outlines a series of planned actions to be taken in the next few years. The Government of Canada will

- continue to invest in research and monitoring on PFAS;
- collect and examine information on PFAS to inform a class-based approach; and
- review policy developments in other jurisdictions.

In addition, within the next two years, the federal government will publish a state of PFAS report that will summarize relevant information on the class of PFAS.

The Government of Canada is still in the early stages of analyzing considerations for the PFAS class approach. Should information indicating potential harm to human health and/or the environment be identified, appropriate risk management measures would be considered.

Question 5: How does the Prohibition of Certain Toxic Substances Regulations address cosmetic products containing PFAS, particularly imported products? What is the Government of Canada's plan and timeline for banning PFAS-contaminated products from entering Canada and for requiring clear labelling and consumer information on products which might contain PFAS?

Response: The *Prohibition of Certain Toxic Substances Regulations, 2012*, prohibit the manufacture, use, sale, offer for sale and import of PFOS, PFOA and LC-PFCAs, and products containing them, including cosmetic products, with a limited number of exemptions such as incidental presence. The latter is generally understood to be a residual, a trace contaminant or impurity not intentionally added to the formulation.

The Regulations apply to PFOS, PFOA and LC-PFCAs, their salts and precursors, and do not prohibit products that contain other PFAS. Products that contain other PFAS may be addressed in the future as outlined in the Notice of intent to move forward with activities to address the broad class of PFAS.

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The Government of Canada is in the early stages of analyzing considerations for the PFAS class approach as announced in the Notice of intent, which was published in the *Canada Gazette* on April 24, 2021. Should information indicating potential harm to human health and/or the environment be identified, appropriate risk management measures would be considered.

Cosmetics and other products are legislated under the *Food and Drugs Act* and the *Canada Consumer Product Safety Act*, both of which fall under the purview of Health Canada.

Question 7: How have the responsible departments – Environment Canada and Climate Change, Health Canada, Transport Canada and the Department of National Defence – identified potential sites of PFAS contamination? Please provide each Departments' criteria for investigation, and a list of sites clearly depicted on a map or with GIS coordinates which have been identified as confirmed or potential sites of PFAS contamination.

Response: The 2021 Treasury Board of Canada's Policy on the Planning and Management of Investments defines a contaminated site as "a site at which substances occur in the environment at concentrations that: (1) are above background levels and pose, or are likely to pose, an immediate or long-term hazard to human health or the environment; or (2) exceed the levels specified in policies and regulations. A real property may have more than one contaminated site." The FCSAP was established in 2005 with the objective to reduce environmental and human health risks from known federal contaminated sites and associated federal financial liabilities. It is a horizontal program currently involving 16 federal departments, agencies and consolidated Crown corporations. The FCSAP is administered through a dedicated Secretariat at Environment and Climate Change Canada with support and policy guidance from the Treasury Board of Canada Secretariat. Those departments responsible for federal contaminated sites, known as custodians, are responsible for the identification, assessment, remediation and risk management of their sites. Transport Canada and Environment and Climate Change Canada co-chair an interdepartmental working group on the management of PFAS at federal contaminated sites. Environment and Climate Change Canada is also one of four expert support departments in the FCSAP, along with Fisheries and Oceans Canada, Health Canada, and Public Services and Procurement Canada.

In its roles as Secretariat and an expert support department, Environment and Climate Change Canada provides guidance, advice, training and tools that are used by custodians in the assessment and management of federal contaminated sites. One of the key guidance documents of the FCSAP is the Decision-Making Framework (DMF). The DMF is a 10-step process that outlines the activities and requirements for federal custodians to address those sites for which they are responsible. Within the DMF, Step 1 is the identification of a potentially contaminated site, called a “suspected site,” based on past or current activities that have occurred on or near the site. This step involves compiling and reviewing past and current land uses, activities, and information about a site in order to determine whether there is a potential risk to human health and/or the environment that requires further investigation. In Step 2, a suspected site undergoes a historical review of information, also known as a Phase I environmental site assessment (ESA). The four principal components of a Phase I ESA are a records review, a site visit, interviews, and an evaluation of information and reporting. An initial testing program, also known as a Phase II ESA, is conducted in Step 3 to investigate actual site conditions, including the presence and extent of contamination. This typically includes field investigation and sampling, sample analysis, data interpretation and evaluation, and development of a conceptual site model. Based on the historical and current land use information gathered in Step 2, samples collected in Step 3 are analyzed for a broad suite of contaminants, including those most suspected to be present. For example, PFAS would be analyzed at fire-training areas where they were likely to have been used and may be present at the site. Collectively, these first three steps of the DMF are able to confirm if a site is contaminated.

The FCSAP recommends custodians consider the following guidance and guidelines when evaluating samples collected from federal sites with potential PFAS contamination:

- federal guidance on assessing and managing federal contaminated sites (*www.canada.ca/en/environment-climate-change/services/federal-contaminated-sites.html*);

- Canadian Environmental Quality Guidelines (the Canadian Council of Ministers of the Environment recently posted the Canadian Soil and Groundwater Quality Guidelines for the Protection of Environmental and Human Health: Perfluorooctane Sulfonate [PFOS] that, along with its scientific criteria document, can be found at *https://ccme.ca/en/res/pfosfactsheeten.pdf* and *https://ccme.ca/en/res/pfossoilandgroundwaterqualityguidelinesscden.pdf*, respectively);

- Federal Environmental Quality Guidelines (guidelines for water, wildlife diet, fish tissues and bird eggs are available for PFOS at *www.canada.ca/en/environment-climate-change/services/evaluating-existing-substances/federal-environmental-quality-guidelines-perfluorooctane-sulfonate.html*, and guidelines for PFOA are currently under development);

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- Health Canada's Drinking Water Quality Guidelines and screening values (*www.canada.ca/en/services/health/publications/healthy-living/water-talk-drinking-water-screening-values-perfluoroalkylated-substances.html*); and

- Health Canada's human health-based soil screening values for select PFAS (values available on request from Health Canada to assist federal custodians in managing PFAS contamination at sites for which they are responsible).

Custodians may also use guidelines from other jurisdictions in the absence of federal or Canadian guidelines.

The Treasury Board of Canada Secretariat administers the Federal Contaminated Sites Inventory, which includes information on all known or suspected federal contaminated sites. The Inventory offers a variety of search criteria, including contaminant types, and search results can be displayed as a table or a map. Please note, however, that PFAS are not a searchable contaminant in the Inventory; rather, those compounds would be included in the "other organics" category.

References:
Federal Contaminated Sites Action Plan. 2018. Decision-Making Framework Version 3.1., retrieved from Environment and Climate Change Canada's website at *www.canada.ca/en/environment-climate-change/services/federal-contaminated-sites/decision-making-framework/ten-step-process.html*.

Treasury Board of Canada. 2021. Policy on the Planning and Management of Investments, retrieved from the Government of Canada's website at *www.tbs-sct.gc.ca/pol/doc-eng.aspx?id=32593*.

Treasury Board of Canada Secretariat's Federal Contaminated Sites Inventory website at *www.tbs-sct.gc.ca/fcsi-rscf/home-accueil-eng.aspx*.

Question 8: What data is available from monitoring programs undertaken by or on behalf of Environment Canada and Climate Change, Health Canada, Transport Canada and the Department of National Defence to detect or measure the levels of PFOS, PFOA, and LC-PFCAs or any other PFAS in Canada? How do each of the departments make the data, results and findings from monitoring programs available to the public and to local health agencies? What other environmental and health monitoring has been completed on PFAS beyond those in the PFOS, PFOA and LC-PFCAs? Please provide the data, particularly for landfills, drinking water sources and wildlife monitoring. How is this data released or made available to local health agencies and to the public? Please specify if the data is publicly and freely available and how it can be accessed.

Response: Environment and Climate Change Canada has organized the response to this question under two headings (1) Monitoring and (2) Research. The references for both sections are provided at the end of the response to this question.

Monitoring

Air

Environment and Climate Change Canada conducts monitoring of PFAS (including C4-14, C16 and C18 PFCAs, C4, C6, C8 and C10 PFSAs, and their precursors) in air at the Canadian High Arctic Research Station in Alert, Nunavut. Data up to 2017 is published in open access peer-reviewed journal articles that can be downloaded for free (Wong et al., 2021, 2018) and contributed to international assessments under the Arctic Council (Arctic Monitoring and Assessment Programme, 2014, 2017). Data is made available free to the public by web access and download via the Arctic Council's Arctic Monitoring and Assessment Programme (AMAP) database of EBAS (*https://ebas.nilu.no*). Work is ongoing to provide all datasets via the portal. Any available data on PFAS collected at Alert can be requested via email to the National Atmospheric Chemistry Database and Analysis Facility at *natchem@ec.gc.ca*.

In the Great Lakes Basin, PFAS (including C4-C12 PFCAs, and C4, C6 and C8 PFSAs) have been monitored in precipitation since 2006 at Point Petre on the coast of Lake Ontario, Evansville on Lake Huron, and Sibley on Lake Superior. Data until 2018 is published in an open access peer-reviewed journal article that can be downloaded for free (Gewurtz et al., 2019). Data is made available free to the public by web access and download via Environment and Climate Change Canada's data catalogue/Open Data portal at *https://open.canada.ca/en/open-data*. Work is ongoing to provide all datasets via the portal. In addition, PFAS (including C4-14, C16, and C18 PFCAs, C4, C6, C8, and C10 PFSAs, and their precursors) have been monitored in air at Point Petre since October 2018 and at Evansville since July 2019. The data will become available free to the public via the Department's data catalogue/Open Data portal. Any available data on PFAS in precipitation in the Great Lakes Basin can be also be requested via email to the National Atmospheric Chemistry Database and Analysis Facility.

Environment and Climate Change Canada also monitors PFAS (C4-C14, C16, and C18 PFCAs, C4, C6, C8, and C10 PFSAs, and their precursors) in passive air samples under the Global Atmospheric Passive Sampling (GAPS) network (initiated in 2004) at 13 Canadian sites for which data is available for 2009, 2011, 2015 and 2017. The Department also has data for the other approximately 30 global GAPS sites for 2017. The data until 2015 is published in an open access peer-reviewed journal article that can be downloaded for free (Rauert et al., 2018).

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The list of specific PFAS compounds being monitored in air and precipitation have changed with time. The following is a current list of analytes:

Per- and Polyfluoroalkyl Substances (PFAS)	CAS Numbers[1]
Perfluoroalkyl carboxylates (PFCA)	
• Perfluorobutanoic acid (PFBA, perfluorobutanoate)	375-22-4
• Perfluoropentanoic acid (PFPeA, perfluoropentanoate)	2706-90-3
• Perfluorohexanoic acid (PFHxA, perfluorohexanoate)	307-24-4
• Perfluoroheptanoic acid (PFHpA, perfluoroheptanoate)	375-85-9
• Perfluorooctanoic acid (PFOA, perfluorooctanoate)	335-67-1
• Perfluorononanoic acid (PFNA, perfluorononanoate)	375-95-1
• Perfluorodecanoic acid (PFDA, perfluorodecanoate)	335-76-2
• Perfluoroundecanoic acid (PFUnA, perfluoroundecanoate)	2058-94-8
• Perfluorododecanoic acid (PFDoDA, perfluorododecanoate)	307-55-1
• Perfluorotridecanoic acid (PFTrDA, perfluorotridecanoate)	72629-94-8
• Perfluorotetradecanoic acid (PFTeDA, perfluorotetradecanoate)	376-06-7
• Perfluorohexadecanoic acid (PFHxDA, perfluorohexadecanoate)	67905-19-5
• Perfluorooctadecanoic acid (PFODA, perfluorooctadecanoate)	16517-11-6
Perfluoroalkyl sulfonates (PFSA)	
• Perfluorobutanesulfonic acid (PFBS, perfluorobutanesulfonate)	375-73-5
• Perfluorohexanesulfonic acid (PFHxS, perfluorohexanesulfonate)	355-46-4
• Perfluorooctanesulfonic acid (PFOS, perfluorooctanesulfonate)	1763-23-1
• Perfluorodecanesulfonic acid (PFDS, perfluorodecanesulfonate)	335-77-3

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[1] The CAS numbers provided are not meant to be exhaustive. For example, the CAS numbers for perfluorooctane sulfonic acid have been provided; however, also valid would be the CAS numbers representing the salt form of these substances.

Fluorotelomer sulfonates (FTS)	
• 1H,1H,2H,2H-Perfluorooctane sulfonic acid (6:2 FTS, 1H,1H,2H,2H-perfluorooctane sulfonate)	27619-97-2
Perfluorooctane sulfonamides	
• Perfluorooctane sulfonamide (PFOSA)	754-91-6
• N-Methyl perfluorooctanesulfonamide (N-MeFOSA)	31506-32-8
• N-Ethyl perfluorooctanesulfonamide (N-EtFOSA)	4151-50-2
Perfluorooctane sulfonamidoethanols	
• N-Methyl perfluoro-1-octanesulfonamidoethanol (N-MeFOSE)	24448-09-7
• N-Ethyl perfluoro-1-octanesulfonamidoethanol (N-EtFOSE)	1691-99-2
Fluorotelomer alcohols	
• Perfluoro hexyl-ethanol (6:2FTOH, 1H,1H,2H,2H-perfluoro-1-octanol)	647-42-7
• Perfluoro octyl-ethanol (8:2FTOH, 1H,1H,2H,2H-perfluoro-1-decanol)	678-39-7
• Perfluoro decyl-ethanol (10:2FTOH, 1H,1H,2H,2H-perfluoro-1-dodecanol)	865-86-1
Fluorotelomer acrylates	
• 1H,1H,2H,2H Perfluorooctylacrylate (FTA 6:2)	17527-29-6
• 1H,1H,2H,2H Perfluorodecylacrylate (FTA 8:2)	27905-45-9
• 1H,1H,2H,2H Perfluorododecylacrylate (FTA 10:2)	17741-60-5

Water and Fish
Environment and Climate Change Canada conducts water quality monitoring in transboundary waters, including at sites monitored for PFAS in urbanized areas of the Great Lakes and in other drainage areas as part of a national network. The sites are selected as part of the Department’s CMP.

Again, the data from the monitoring is made available free to the public by web access and download via Environment and Climate Change Canada’s catalogue/Open Data portal (*https://open.canada.ca/en/open-data*). The Department is working to provide all datasets via the portal, but as of yet not all will appear. Any data on PFAS collected by the Department’s Water Quality Monitoring and Surveillance Division (WQMSD) can also be requested via email at *wqmsinfo@ec.gc.ca*.

Sites within the geographic regions identified in this petition (i.e. Trout Lake) are not included as part of Environment and Climate Change Canada's WQMSD transboundary monitoring network. As an example of its reported results, from 2016 to 2017, 163 water samplings were conducted in eight drainage regions in Canada. The analysis found that all water samples had PFOS concentrations at least 200-fold lower than the guideline for water. PFOS was detected in 49 percent of samples and concentrations ranged from less than two nanograms per litre (ng/L) up to 26.1 ng/L.

The list of specific PFAS compounds being monitored in water have changed with time. The following is the current list of analytes and their respective Chemical Abstracts Service (CAS) numbers:[2]

Perfluoroalkyl carboxylates

- Perfluorobutanoic acid (PFBA, perfluorobutanoate) (CAS number – anion form: 45048-62-2
- Perfluoropentanoic acid (PFPeA, perfluoropentanoate) (CAS number – anion form: 45167-47-3)
- Perfluorohexanoic acid (PFHxA, perfluorohexanoate) (CAS number – anion form: 92612-52-7)
- Perfluoroheptanoic acid (PFHpA, perfluoroheptanoate) (CAS number – anion form: 120885-29-2)
- Perfluorooctanoic acid (PFOA, perfluorooctanoate) (CAS number – anion form: 45285-51-6)
- Perfluorononanoic acid (PFNA, perfluorononanoate) (CAS number – anion form: 72007-68-2)
- Perfluorodecanoic acid (PFDA, perfluorodecanoate) (CAS number – anion form: 73829-36-4)
- Perfluoroundecanoic acid (PFUnA, perfluoroundecanoate) (CAS number – anion form: 196859-54-8)
- Perfluorododecanoic acid (PFDoA, perfluorododecanoate) (CAS number – anion form: 171978-95-3)
- Perfluorotridecanoic acid (PFTrDA, perfluorotridecanoate) (CAS number – anion form: 862374-87-6)
- Perfluorotetradecanoic acid (PFTeDA, perfluorotetradecanoate) (CAS number – anion form: 365971-87-5)

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[2] The CAS numbers provided are not meant to be exhaustive. For example, the CAS numbers for the salt version of many of the substances have been provided. However, also valid would be the CAS numbers representing the acid forms.

Perfluoroalkyl sulfonates

- Perfluorobutanesulfonic acid (PFBS, perfluorobutanesulfonate) (CAS number – anion form: 45187-15-3)
- Perfluoropentanesulfonic acid (PFPeS, perfluoropentanesulfonate) (CAS number – anion form: 175905-36-9)
- Perfluorohexanesulfonic acid (PFHxS, perfluorohexanesulfonate) (CAS number – anion form: 108427-53-8)
- Perfluoroheptanesulfonic acid (PFHpS, perfluoroheptanesulfonate) (CAS number – anion form: 146689-46-5)
- Perfluorooctanesulfonic acid (PFOS, perfluorooctanesulfonate) (CAS number – anion form: 45298-90-6)
- Perfluorononanesulfonic acid (PFNS, perfluorononanesulfonate) (CAS number – anion form: 474511-07-4)
- Perfluorodecanesulfonic acid (PFDS, perfluorodecanesulfonate) (CAS number – anion form: 126105-34-8)
- Perfluorododecanesulfonic acid (PFDoS, perfluorododecanesulfonate) (CAS number – anion form: 343629-43-6)

Fluorotelomer sulfonates

- 1H,1H,2H,2H-Perfluorohexane sulfonic acid (4:2 FTS, 1H,1H,2H, 2H-perfluorohexane sulfonate) (CAS number – anion form: 414911-30-1)
- 1H,1H,2H,2H-Perfluorooctane sulfonic acid (6:2 FTS, 1H,1H,2H, 2H-perfluorooctane sulfonate) (CAS number – anion form: 425670-75-3)
- 1H,1H,2H,2H-Perfluorodecane sulfonic acid (8:2 FTS, 1H,1H,2H, 2H-perfluorodecane sulfonate) (CAS number – anion form: 481071-78-7)

Saturated fluorotelomer carboxylates

- 2H,2H,3H,3H-Perfluorohexanoic acid (3:3 FTCA, 2H,2H,3H, 3H-perfluorohexanoate) (CAS number – anion form: 1169706-83-5)
- 2H,2H,3H,3H-Perfluorooctanoic acid (5:3 FTCA, 2H,2H,3H, 3H-perfluorooctanoate) (CAS number – anion form: 1799325-94-2)
- 2H,2H,3H,3H-Perfluorodecanoic acid (7:3 FTCA, 2H,2H,3H, 3H-perfluorodecanoate) (CAS number – acid form: 812-70-4)

Perfluorooctane sulfonamides

- Perfluorooctanesulfonamide (PFOSA) (CAS number: 754-91-6)
- N-Methylperfluorooctanesulfonamide (N-MeFOSA) (CAS number: 31506-32-8)
- N-Ethylperfluorooctanesulfonamide (N-EtFOSA) (CAS number: 4151-50-2)

Perfluorooctane sulfonamidoacetic acids

- N-Methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA, N-Methylperfluoro-1-octanesulfonamidoacetate) (CAS number – acid form: 2355-31-9)
- N-Ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA, N-ethylperfluoro-1-octanesulfonamidoacetate) (CAS number – acid form: 2991-50-6)

Perfluorooctane sulfonamidoethanols

- N-Methylperfluoro-1-octanesulfonamidoethanol (N-MeFOSE) (CAS number: 24448-09-7)
- N-Ethylperfluoro-1-octanesulfonamidoethanol (N-EtFOSE) (CAS number: 1691-99-2)

Polyfluoroalkyl Ether carboxylates

- 2,3,3,3-Tetrafluoro-2-(1,1,2,2,3,3,3-heptafluoropropoxy)propionic acid (HFPO-DA) (CAS number – acid form: 13252-13-6)
- Decafluoro-3H-4,8-dioxanonoate (ADONA) (CAS number – anion form: 2127366-90-7)
- Perfluoro-3,6-dioxaheptanoate (NFDHA) (CAS number – anion form: 39187-41-2)
- Perfluoro-3-methoxypropanoate (PFMPA) (CAS number – acid form: 377-73-1)
- Perfluoro-4-methoxybutanoate (PFMBA) (CAS number – anion form: 863090-89-5)

Ether sulfonates

- 9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS) (CAS number – acid form: 756426-58-1)
- 11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS) (CAS number – acid form: 763051-92-9)
- Perfluoro(2-ethoxyethane)sulfonic acid (PFEESA) (CAS number – acid form: 113507-82-7)

PFAS are also measured in whole body homogenates of fish from water bodies across Canada. This monitoring provides additional information on presence and accumulation of PFAS in the aquatic environment. Monitoring to inform sport fish consumption

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guidance is conducted by the Government of Ontario and not Environment and Climate Change Canada. The following is a list of specific analytes currently being monitored in whole fish tissue:

- Perfluorodecanoic acid (PFDA, perfluorodecanoate) (CAS number – anion form: 73829-36-4)
- Perfluorododecanoic acid (PFDoA, perfluorododecanoate) (CAS number – anion form: 171978-95-3)
- Perfluoroheptanesulfonic acid (PFHpS, perfluoroheptanesulfonate) (CAS number – anion form: 146689-46-5)
- Perfluorononanoic acid (PFNA, perfluorononanoate) (CAS number – anion form: 72007-68-2)
- Perfluorooctanesulfonic acid (PFOS, perfluorooctanesulfonate) (CAS number – anion form: 45298-90-6)
- Perfluorooctanoic acid (PFOA, perfluorooctanoate) (CAS number – anion form: 45285-51-6)
- Perfluoroundecanoic acid (PFUnA, perfluoroundecanoate) (CAS number – anion form: 196859-54-8)

The findings for fish are released to the public as indicator reports such as the Canadian Environmental Sustainability Indicators program indicator for PFOS for fish and water (*www.canada.ca/en/environment-climate-change/services/environmental-indicators/perfluorooctane-sulfonate-fish-water.html*). The information is also included in the toxic chemicals sub-indicators assessments found in the *State of the Great Lakes 2019 – Highlights Report* (*https://binational.net/wp-content/uploads/2020/05/May-4.2020-2019-SOGL-FINAL.pdf*). These assessments include some of the binationally designated Chemicals of Mutual Concern and help support the tracking of progress on reducing these chemicals in the Great Lakes. For example, PFAS, which include three Chemicals of Mutual Concern, are currently being tracked in some components of the Great Lakes ecosystem. Recent data show that some PFAS are increasing in Lake Erie and Lake Ontario. Findings are also released via peer-reviewed science journal publications (refer to reference list below) and opportunistically upon request. For example, the Quirks and Quarks piece mentioned by the Petitioner contains Environment and Climate Change Canada’s WQMSD derived data.

Wildlife

Environment and Climate Change Canada also conducts wildlife monitoring and research using wildlife, including vertebrate and invertebrate species, in terrestrial, freshwater and marine ecosystems of Canada. These monitoring programs are described here; the research projects, under the Research heading below.

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All monitoring data is ultimately released through scientific publications when data is finalized, as well as in Government of Canada risk assessment and risk management reports (see reference list below). Data is also made available free to the public by web access and download via Environment and Climate Change Canada's Data Catalogue/Open Data Portal. Work is ongoing to provide all datasets via this portal. Summaries of some of the Ecotoxicology and Wildlife Health Division (EWHD) wildlife data have been provided and are publicly available through State of the Lake Reports (*https://binational.net/wp-content/uploads/2017/09/SOGL_2017_Technical_Report-EN.pdf*) and/or Area of Concern reports (*http://ourniagarariver.ca/wp-content/uploads/2020/12/Niagara-River-Colonial-Waterbirds-Assessment-Report.pdf*).

In support of Crown-Indigenous Relations and Northern Affairs Canada's NCP, Environment and Climate Change Canada reports data on PFAS in water, fish and wildlife to the Arctic Council's AMAP. Results from NCP monitoring and research are reported as metadata, and may be accompanied by datasets, in Crown-Indigenous Relations and Northern Affairs Canada's Polar Data Catalogue (*www.polardata.ca*). In addition, most NCP-related publications are catalogued in a database hosted by the Arctic Institute of North America (*https://arctic.ucalgary.ca/data-information-services-0*). Furthermore, summaries of current findings and research are documented in Canadian Arctic Contaminant Assessment Reports and/or in AMAP reports on the AMAP website (*www.amap.no/documents/doc/amap-assessment-2018-biological-effects-of-contaminants-on-arctic-wildlife-and-fish/1663*, *www.amap.no/documents/doc/amap-assessment-2016-chemicals-of-emerging-arctic-concern/1624*, and *www.amap.no/documents/doc/amap-assessment-2015-temporal-trends-in-persistent-organic-pollutants-in-the-arctic/1521*).

The list of specific PFAS compounds that are monitored vary among years and by study, but generally include some of the following analytes:

Analyte	**Alias**	**CAS Number[3]**
Perfluorobutanoic acid	PFBA	375-22-4
Perfluoropentanoic acid	PFPeA	2706-90-3
Perfluorohexanoic acid	PFHxA	307-24-4
Perfluoroheptanoic acid	PFHpA	375-85-9
Perfluorooctanoic acid	PFOA	335-67-1
Perfluorononanoic acid	PFNA	375-95-1

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[3] The CAS numbers provided are not meant to be exhaustive. For example, the CAS numbers for perfluorooctane sulfonic acid have been provided; however, also valid would be the CAS numbers representing the salt form of these substances.

Perfluorodecanoic acid	PFDA	335-75-2
Perfluoroundecanoic acid	PFUdA	4234-23-5
Perfluorododecanoic acid	PFDoA	307-55-1
Perfluorotridecanoic acid	PFTrDA	72629-94-8
Perfluorotetradecanoic acid	PFTeDA	376-06-7
Perfluorohexadecanoic acid	PFHxDA	67905-19-5
Perfluorooctadecanoic acid	PFODA	16517-11-6
Perfluorobutanesulfonate	PFBS	375-73-5
Perfluorohexanesulfonate	PFHxS	355-46-4
Perfluorooctanesulfonate	PFOS	1763-23-1
Perfluorodecanesulfonate	PFDS	335-77-3
Perfluoro-octanesulfonamide	PFOSA	754-91-6
N-Methyl perfluorooctane sulfonamide	N-MeFOSA	2991-50-6
N-Ethyl perfluorooctane sulfonamide	N-EtPFOSA	31506-32-8
6:2 Fluorotelomer carboxylic acid	6:2 FTCA	53826-12-3
8:2 Fluorotelomer carboxylic acid	8:2 FTCA	27854-31-5
10:2 Fluorotelomer carboxylic acid	10:2 FTCA	53826-13-4
6:2 Fluorotelomer unsaturated carboxylic acid	6:2 FTUCA	70887-88-6
8:2 Fluorotelomer unsaturated carboxylic acid	8:2 FTUCA	70887-84-2
10:2 Fluorotelomer unsaturated carboxylic acid	10:2 FTUCA	70887-94-4

Environment and Climate Change Canada monitors PFAS, among other chemicals, in wildlife across the country as part of Canada's CMP, including the Atlantic provinces, the St. Lawrence River, the Great Lakes, the Prairies, the Pacific Coast, and the sub-Arctic. Eggs from aquatic (gull species) and terrestrial wildlife (European Starlings) have been monitored for PFAS (Elliott et al,. 2021; Miller et al., 2020; Gewurtz et al., 2018; Su et al., 2017; Gewurtz et al., 2016; Letcher et al., 2015; Miller et al., 2015; and Gewurtz et al., 2013).

A short-chain PFAS, perfluoro-1-butane-sulfonamide (FBSA), was measured in fish from the Netherlands and from fish across Canada (Chu et al., 2016). Furthermore, FBSA was measured in three species of fish purchased from a supermarket in Ottawa (Chu et al., 2016).

Side-chain fluorinated polymer surfactants, which are products of commercial fabric protector products, were measured in biosolids from wastewater treatment plants from across Canada, as well as Great Lakes sediment, and soil from farm fields, some of which where biosolids were applied (Letcher et al., 2020; Chu et al., 2017).

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Landfill leachate

Landfill leachate was collected at 13 selected large (permitted to receive 40 000 tonnes of municipal solid waste annually) municipal solid waste landfills across Canada between 2008 and 2014 under the CMP's Environmental Monitoring and Surveillance program. PFAS were analyzed in the leachate samples collected between 2009 and 2011 at 12 different landfills. The PFAS included in the program were the following:

- Perfluorobutanoic acid (PFBA) (CAS number – anion form: 45048-62-2)
- Perfluorobutane sulfonate (PFBS) (CAS number – anion form: 45187-15-3)
- Perfluoropentanoic acid (PFPeA) (CAS number – anion form: 45167-47-3)
- Perfluorhexanoic acid (PFHxA) (CAS number – anion form: 92612-52-7)
- Perflurorohexane sulfonate (PFHxS) (CAS number – anion form: 108427-53-8)
- Perfluoroheptanoic acid (PFHpA) (CAS number – anion form: 120885-29-2)
- Perfluorooctane sulfonate (PFOS) (CAS number – anion form: 45298-90-6)
- Perfluoro-n-octanoic acid (PFOA) (CAS number – anion form: 45285-51-6)
- Perfluorooctane sulfonamide (PFOSA) (CAS number: 754-91-6)
- Perfluorononanoic acid (PFNA) (CAS number – anion form: 72007-68-2)
- Perfluorodecanoic acid (PFDA) (CAS number – anion form: 73829-36-4)
- Perfluoroundecanoic acid (PFUnA) (CAS number – anion form: 196859-54-8)
- Perfluorododecanoic acid (PFDoA) (CAS number – anion form: 171978-95-3)

The total concentration of PFAS measured in leachate ranged from 320 to 9400 ng/L before any treatment (median of 3227 ng/L) and from 800 to 14 201 ng/L (median of 4498 ng/L) after on-site leachate treatment. The total concentration of PFAS measured in leachate generally increased after on-site leachate treatment.

Validated data for PFOS has been published in the peer-reviewed literature, as well as in publically available reports (e.g., Gewurtz et al., 2013, Government of Canada, 2013). The monitoring of CMP substances in landfills is the first of its kind. No data management system has been established for the results to date because the program is in its early stages.

Wastewater and Biosolids

Environment and Climate Change Canada also gathers data on levels of chemical substances entering municipal wastewater treatment plants, evaluates the fate of these substances through the liquid and solids trains of typical treatment process types used in Canada, and determines levels of these substances being discharged in wastewater treatment plant effluents and solids residuals.

The Department has developed partnerships with municipalities throughout Canada to evaluate typical wastewater treatment plant types (including primary, secondary, advanced, and lagoon treatment) and geographic regions (mountain, prairie, Great Lakes/St. Lawrence River, coastal). The wastewater treatment plants participate in the Department's program on the condition of anonymity; therefore, they are described only by process type and flow (size) in departmental reports and publications. To date, more than 80 wastewater treatment plants have participated in the wastewater monitoring program.

Wastewater samples are collected annually in the spring, summer or fall months by trained Environment and Climate Change Canada personnel. Raw influent and final effluent are collected as equal-volume 24-hour composite samples at most plants. Biosolids are collected as grabs since the sludge collection and treatment process inherently composite the solids due to the retention time in clarifiers and digesters.

Validated data are made available free to the public via Environment and Climate Change Canada's data catalogue/Open Data portal. The Department aims to provide all datasets via the portal, but has a backlog to upload.

Validated data are also available in peer-reviewed literature, as well as in publically available reports (e.g., Gewurtz et al., 2013; Gewurtz et al., 2020; Government of Canada, 2013; Guerra et al., 2014; and Lakshminarasimman et al., 2021).

The list of specific PFAS compounds being monitored in wastewater and biosolids have changed with time. The following is the current list of analytes and their respective CAS numbers:[4]

Perfluoroalkyl carboxylates

- Perfluorobutanoic acid (PFBA, perfluorobutanoate) (CAS number – anion form: 45048-62-2
- Perfluoropentanoic acid (PFPeA, perfluoropentanoate) (CAS number – anion form: 45167-47-3)
- Perfluorohexanoic acid (PFHxA, perfluorohexanoate) (CAS number – anion form: 92612-52-7)
- Perfluoroheptanoic acid (PFHpA, perfluoroheptanoate) (CAS number – anion form: 120885-29-2)
- Perfluorooctanoic acid (PFOA, perfluorooctanoate) (CAS number – anion form: 45285-51-6)
- Perfluorononanoic acid (PFNA, perfluorononanoate) (CAS number – anion form: 72007-68-2)

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[4] The CAS numbers provided are not meant to be exhaustive. For example, Environment and Climate Change Canada has provided the CAS numbers for the salt version of many of the substances. However, also valid would be the CAS numbers representing the acid forms.

- Perfluorodecanoic acid (PFDA, perfluorodecanoate) (CAS number – anion form: 73829-36-4)
- Perfluoroundecanoic acid (PFUnA, perfluoroundecanoate) (CAS number – anion form: 196859-54-8)
- Perfluorododecanoic acid (PFDoA, perfluorododecanoate) (CAS number – anion form: 171978-95-3)
- Perfluorotridecanoic acid (PFTrDA, perfluorotridecanoate) (CAS number – anion form: 862374-87-6)
- Perfluorotetradecanoic acid (PFTeDA, perfluorotetradecanoate) (CAS number – anion form: 365971-87-5)

Perfluoroalkyl sulfonates

- Perfluorobutanesulfonic acid (PFBS, perfluorobutanesulfonate) (CAS number – anion form: 45187-15-3)
- Perfluoropentanesulfonic acid (PFPeS, perfluoropentanesulfonate) (CAS number – anion form: 175905-36-9)
- Perfluorohexanesulfonic acid (PFHxS, perfluorohexanesulfonate) (CAS number – anion form: 108427-53-8)
- Perfluoroheptanesulfonic acid (PFHpS, perfluoroheptanesulfonate) (CAS number – anion form: 146689-46-5)
- Perfluorooctanesulfonic acid (PFOS, perfluorooctanesulfonate) (CAS number – anion form: 45298-90-6)
- Perfluorononanesulfonic acid (PFNS, perfluorononanesulfonate) (CAS number – anion form: 474511-07-4)
- Perfluorodecanesulfonic acid (PFDS, perfluorodecanesulfonate) (CAS number – anion form: 126105-34-8)
- Perfluorododecanesulfonic acid (PFDoS, perfluorododecanesulfonate) (CAS number – anion form: 343629-43-6)

Fluorotelomer sulfonates

- 1H,1H,2H,2H-Perfluorohexane sulfonic acid (4:2 FTS, 1H,1H,2H, 2H-perfluorohexane sulfonate) (CAS number – anion form: 414911-30-1)
- 1H,1H,2H,2H-Perfluorooctane sulfonic acid (6:2 FTS, 1H,1H,2H, 2H-perfluorooctane sulfonate) (CAS number – anion form: 425670-75-3)
- 1H,1H,2H,2H-Perfluorodecane sulfonic acid (8:2 FTS, 1H,1H,2H, 2H-perfluorodecane sulfonate) (CAS number – anion form: 481071-78-7)

Saturated fluorotelomer carboxylates

- 2H,2H,3H, 3H-Perfluorohexanoic acid (3:3 FTCA, 2H,2H,3H, 3H-perfluorohexanoate) (CAS number – anion form: 1169706-83-5)

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- 2H,2H,3H,3H-Perfluorooctanoic acid (5:3 FTCA, 2H,2H,3H, 3H-perfluorooctanoate) (CAS number – anion form: 1799325-94-2)
- 2H,2H,3H,3H-Perfluorodecanoic acid (7:3 FTCA, 2H,2H,3H, 3H-perfluorodecanoate) (CAS number – acid form: 812-70-4)

Perfluorooctane sulfonamides

- Perfluorooctanesulfonamide (PFOSA) (CAS number: 754-91-6)
- N-Methylperfluorooctanesulfonamide (N-MeFOSA) (CAS number: 31506-32-8)
- N-Ethylperfluorooctanesulfonamide (N-EtFOSA) (CAS number: 4151-50-2)

Perfluorooctane sulfonamidoacetic acids

- N-Methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA, N-methylperfluoro-1-octanesulfonamidoacetate) (CAS number – acid form: 2355-31-9)
- N-Ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA, N-ethylperfluoro-1-octanesulfonamidoacetate) (CAS number – acid form: 2991-50-6)

Perfluorooctane sulfonamidoethanols

- N-Methylperfluoro-1-octanesulfonamidoethanol (N-MeFOSE) (CAS number: 24448-09-7)
- N-Ethylperfluoro-1-octanesulfonamidoethanol (N-EtFOSE) (CAS number: 1691-99-2)

Polyfluoroalkyl ether carboxylates

- 2,3,3,3-Tetrafluoro-2-(1,1,2,2,3,3,3-heptafluoropropoxy)propionic acid (HFPO-DA) (CAS number – acid form: 13252-13-6)
- Decafluoro-3H-4,8-dioxanonoate (ADONA) (CAS number – anion form: 2127366-90-7)
- Perfluoro-3,6-dioxaheptanoate (NFDHA) (CAS number – anion form: 39187-41-2)
- Perfluoro-3-methoxypropanoate (PFMPA) (CAS number – acid form: 377-73-1)
- Perfluoro-4-methoxybutanoate (PFMBA) (CAS number – anion form: 863090-9-5)

Ether sulfonates

- 9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS) (CAS number – acid form: 756426-58-1)

- 11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS) (CAS number – acid form: 763051-92-9)
- Perfluoro(2-ethoxyethane)sulfonic acid (PFEESA) (CAS number – acid form: 113507-82-7)

Research

Air
Environment and Climate Change Canada conducts research work on PFAS in air and dust (monitoring of PFAS in air is described above under the Monitoring heading). For example, PFAS were measured in indoor air and dust such as 7 neutral PFAS compounds (fluorotelomer alcohols, perfluorooctane sulfonamides, perfluorooctane sulfonamidoethanols) and 9 ionic PFAS (PFOS, and C6 to C12 and C14 PFCAs) in Ottawa and Vancouver. This includes assessment of human exposure and levels in cord and maternal blood. Data is published in peer-reviewed journal articles (Shoeib et al., 2004 and 2011). In the same dust samples, disubstituted polyfluoroalkyl phosphate esters (diPAP), perfluoroalkyl phosphonates (PFPA), and perfluoroalkyl phosphinates (PFPIA) were reported (De Silva et al., 2012) as listed below.

Per- and Polyfluoroalkyl Substances (PFAS)	**CAS Numbers**
Polyfluoroalkyl phosphate diester (diPAP)	
• Bis(1H,1H,2H,2H-perfluorobutyl) phosphate (4:2/4:2 diPAP	135098-69-0
• (1H,1H,2H,2H-Perfluorobutyl)(1H,1H,2H, 2H-perfluorohexyl)phosphate (4:2/6:2 diPAP)	
• Bis(1H,1H,2H,2H-perfluorohexyl)phosphate (6:2/6:2 diPAP)	57677-95-9
• (1H,1H,2H,2H-Perfluorooctyl)(1H,1H,2H, 2H-perfluorohexyl)phosphate (6:2/8:2 diPAP)	943913-15-3
• Bis(1H,1H,2H,2H-perfluorooctyl)phosphate (8:2/8:2 diPAP)	678-41-1
• (1H,1H,2H,2H-perfluorooctyl)(1H,1H,2H, 2H-perfluorodecyl)phosphate (8:2/10:2 diPAP)	1158182-60-5
• Bis(1H,1H,2H,2H-perfluorodecyl)phosphate (10:2/10:2 diPAP)	1895-26-7
• (1H,1H,2H,2H-perfluorodecyl)(1H,1H,2H, 2H-perfluorododecyl)phosphate (10:2/12:2 diPAP)	

Perfluoroalkyl phosphonate (PFPA)	
• Perfluorohexane phosphonate (C6 PFPA)	40143-76-8
• Perfluorooctane phosphonate (C8 PFPA)	40143-78-0
• Perfluorodecane phosphonate (C10 PFPA)	52299-26-0
Perfluoroalkyl phosphinic acid (PFPIA)	
• 6/6 PFPIA	40143-77-9
• 6/8 PFPIA	610800-34-5
• 8/8 PFPIA	40143-79-1

PFAS emissions from the waste sector (i.e. wastewater treatment plants and landfills) to air have also been investigated. This data is published in an open access peer-reviewed journal article that can be downloaded for free (Ahrens et al., 2011).

Wildlife
Environment and Climate Change Canada conducts wildlife research using wildlife, including vertebrate and invertebrate species, in Canada's terrestrial, freshwater and marine ecosystems. EWHD also conducts wildlife monitoring, as described under the Monitoring heading above.

Research data is ultimately released through scientific publications when data is finalized, as well as in reports such as the Government of Canada's risk assessment and risk management reports. Additional ways that EWHD makes data, results and findings available to the public are described above under the Monitoring heading for Wildlife.

The list of specific PFAS compounds that are included in research programs vary among year and studies, but generally include some of the following analytes listed below:

Analyte	**Alias**	**CAS Number[5]**
Perfluorobutanoic acid	PFBA	375-22-4
Perfluoropentanoic acid	PFPeA	2706-90-3
Perfluorohexanoic acid	PFHxA	307-24-4
Perfluoroheptanoic acid	PFHpA	375-85-9
Perfluorooctanoic acid	PFOA	335-67-1
Perfluorononanoic acid	PFNA	375-95-1
Perfluorodecanoic acid	PFDA	335-75-2

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[5] The CAS numbers provided are not meant to be exhaustive. For example, the CAS numbers for perfluorooctane sulfonic acid have been provided; however, also valid would be the CAS numbers representing the salt form of these substances.

Perfluoroundecanoic acid	PFUdA	4234-23-5
Perfluorododecanoic acid	PFDoA	307-55-1
Perfluorotridecanoic acid	PFTrDA	72629-94-8
Perfluorotetradecanoic acid	PFTeDA	376-06-7
Perfluorohexadecanoic acid	PFHxDA	67905-19-5
Perfluorooctadecanoic acid	PFODA	16517-11-6
Perfluorobutanesulfonate	PFBS	375-73-5
Perfluorohexanesulfonate	PFHxS	355-46-4
Perfluorooctanesulfonate	PFOS	1763-23-1
Perfluorodecanesulfonate	PFDS	335-77-3
Perfluoro-octanesulfonamide	PFOSA	754-91-6
N-Methyl perfluorooctane sulfonamide	N-MeFOSA	2991-50-6
N-Ethyl perfluorooctane sulfonamide	N-EtPFOSA	31506-32-8
6:2 Fluorotelomer carboxylic acid	6:2 FTCA	53826-12-3
8:2 Fluorotelomer carboxylic acid	8:2 FTCA	27854-31-5
10:2 Fluorotelomer carboxylic acid	10:2 FTCA	53826-13-4
6:2 Fluorotelomer unsaturated carboxylic acid	6:2 FTUCA	70887-88-6
8:2 Fluorotelomer unsaturated carboxylic acid	8:2 FTUCA	70887-84-2
10:2 Fluorotelomer unsaturated carboxylic acid	10:2 FTUCA	70887-94-4

Some specific research studies on wildlife are discussed next. PFAS were measured in the blood of nestling Peregrine Falcons, a terrestrial predator of other avian species, in southern Ontario and the north shore of Lake Superior (Sun et al., 2020; and Sun et al., 2021).

PFAS were measured in the blood of adult Thick-billed Murres in southern Hudson Bay. This marine Arctic seabird preys on fish. This research provides additional information on the presence and possible effects of PFAS on this Arctic seabird in the marine environment. Data has yet to be validated by peer review.

Perfluorinated alkyl substances were assessed in polar bears from different populations in the Hudson Bay and correlated with liver metabolites. Temporal trends were also assessed in polar bears along with their diet in the Hudson Bay region (Muir et al., 2019; Morris et al., 2019; Letcher et al., 2018; and Pedersen et al., 2016).

Perfluoroalkyl phosphinic acids, perfluoroalkyl carboxylates (PFCA) and perfluoroalkanesulfonates (PFSA) were surveyed in fish, dolphins and birds from various freshwater and marine locations in North America (De Silva et al., 2016).

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PFAS concentrations were measured in turtles, invertebrates and water samples in rural, urban environments, and downstream of an airport in southern Ontario (de Solla et al., 2012).

Aquatic Ecosystem and Groundwater Contaminants Research
Environment and Climate Change Canada scientists conduct surveillance studies of PFAS (including C4-14, C16, C18 PFCA, and C6, C8, C10 PFSA) in the Arctic and sub-Arctic locations as part of the NCP core environment monitoring and research projects. Under these projects, ringed seals and Arctic char are analyzed every year with the longest continuous temporal data set originating in the 1990s. In addition, Arctic seawater is analyzed each year with the longest continuous data set originating in 2011. Outside of the NCP projects, departmental researchers have led research projects on PFAS with typically two to three years of funding. These research projects include the exploration of short-chain and long-chain PFCA and PFSA in High Arctic ice fields (MacInnis et al., 2017; Pickard et al., 2018 and 2020), snow and glacier melt (MacInnis et al., 2019a; Cabrerizo et al., 2018), lake sediment (Lescord et al., 2015; MacInnis et al., 2019b) and lake water (Lescord et al., 2015; MacInnis et al., 2019a; Cabrerizo et al., 2018). All research collected under such programs is ultimately released through scientific peer-reviewed publications when data is finalized (see the reference list below).

Preliminary and finalized data are made available to the NCP Secretariat via annual reports and communicated to Arctic Indigenous communities through in-person visits, one page summaries, workshops and social media platforms. The annual data reports, which provide PFAS data from 2005 onwards, are publically available along with each project team leader’s full name and contact information (*https://science.gc.ca/eic/site/063.nsf/eng/h_97659.html*). Environment and Climate Change Canada researchers have also published numerous review papers on PFAS in wildlife (Houde et al., 2011; De Silva et al., 2020), ecotoxicology (Ankley et al., 2020), the Arctic (Muir et al., 2010; Muir et al., 2019), marine mammals (Fair and Houde, 2018), and oceans (Muir et al., 2021).

Under the CMP, some environmental monitoring activities have been undertaken as part of research projects. These include analysis of C4 to C16 PFCA, C4 to C10 PFSA, and novel PFAS (perfluoroalkyl phosphinic acids) in fish and birds (see above) from the Great Lakes and St. Lawrence River (De Silva et al., 2016), and in fish and beluga whales from the St. Lawrence estuary (Barrett et al., 2021). These results are published and available in scientific literature and the Government of Canada risk assessment and risk management reports (see reference list).

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More recent projects have garnered preliminary data. These include

1) a research project on LC-PFCA, PFOS, and PFOA and novel PFAS (zwitterionic and cationic PFAS) in the St. Lawrence River freshwater food web (fish, invertebrates, aquatic plants, and sediment);
2) a research project on LC-PFCA, PFOS, PFOA and other PFAS (fluorotelomer acids, perfluoropolyether carboxylates, perfluoropolyether sulfonates, chlorine-substituted perfluoroalkyl acids) in wastewater influent, effluent and Lake Ontario sediment cores; and
3) a field-based study on the accumulation of LC-PFCA, PFOS and PFOA in freshwater fish and mussels from wastewater effluent receiving environments.

In addition to the projects described above, aquatic ecosystem contaminants scientists are conducting research that involves monitoring of LC-PFCA, PFOS and PFOA. For example, under an agreement with the Government of Ontario, a field-based investigation into potential exposure to various contaminants, including some short chain PFAS, is being conducted for surface water aquatic ecosystem zones (endobenthic, epibenthic, pelagic and lotic) of a pond and stream receiving discharge from groundwater plumes contaminated with landfill leachate. In another project, LC-PFCA, PFOS, PFOA and novel PFAS were measured in St. Lawrence beluga whales (Barrett et al., 2021).

The list of specific PFAS compounds analyzed in each project vary and have changed with time. The list of PFAS analytes typically measured in a current research project and their respective CAS number include the following (Table 1):

Table 1. PFAS (full name, acronym, and CAS number) measured in analyses

Per- and Polyfluoroalkyl Substances (PFAS)	**CAS Numbers[6]**
Perfluoroalkyl carboxylates (PFCA)	
Perfluorobutanoic acid (PFBA)	375-22-4
Perfluoropentanoic acid (PFPeA)	2706-90-3
Perfluorohexanoic acid (PFHxA)	307-24-4
Perfluoroheptanoic acid (PFHpA)	375-85-9
Perfluorooctanoic acid (PFOA)	335-67-1
Perfluorononanoic acid (PFNA)	375-95-1
Perfluorodecanoic acid (PFDA)	335-76-2
Perfluoroundecanoic acid (PFUnA)	2058-94-8

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[6] The CAS numbers provided are not meant to be exhaustive. For example, the CAS numbers for perfluorooctane sulfonic acid have been provided; however, also valid would be the CAS numbers representing the salt form of these substances.

Perfluorododecanoic acid (PFDoDA)	307-55-1
Perfluorotridecanoic acid (PFTrDA)	72629-94-8
Perfluorotetradecanoic acid (PFTeDA)	376-06-7
Perfluoropentadecanoic acid (PFPeDA)	
Perfluorohexadecanoic acid (PFHxDA)	67905-19-5
Perfluorooctadecanoic acid (PFODA)	16517-11-6
Perfluoroalkyl sulfonates (PFSA)	
Perfluorobutanesulfonic acid (PFBS)	375-73-5
Perfluorohexanesulfonic acid (PFHxS)	355-46-4
Perfluorooctanesulfonic acid (PFOS)	1763-23-1
Perfluorodecanesulfonic acid (PFDS)	335-77-3
Fluorotelomer sulfonates (FTS)	
1H,1H,2H,2H-Perfluorooctane sulfonic acid (6:2 FTS)	27619-97-2
Perfluorooctane sulfonamides	
N-Methyl perfluorooctanesulfonamide (N-MeFOSA)	31506-32-8
N-Ethyl perfluorooctanesulfonamide (N-EtFOSA)	4151-50-2
Perfluorooctanesulfonamide (FOSA)	4151-50-2
Polyfluoroalkyl phosphate diester (diPAP)	
Bis(1H,1H,2H,2H-perfluorobutyl) phosphate (4:2/4:2 diPAP	135098-69-0
(1H,1H,2H,2H-Perfluorobutyl)(1H,1H,2H,2H-perfluorohexyl)phosphate (4:2/6:2 diPAP)	
Bis(1H,1H,2H,2H-perfluorohexyl)phosphate (6:2/6:2 diPAP)	57677-95-9
(1H,1H,2H,2H-Perfluorooctyl)(1H,1H,2H,2H-perfluorohexyl)phosphate (6:2/8:2 diPAP)	943913-15-3
Bis(1H,1H,2H,2H-perfluorooctyl)phosphate (8:2/8:2 diPAP)	678-41-1
(1H,1H,2H,2H-Perfluorooctyl)(1H,1H,2H,2H-perfluorodecyl)phosphate (8:2/10:2 diPAP)	1158182-60-5
Bis(1H,1H,2H,2H-perfluorodecyl)phosphate (10:2/10:2 diPAP)	1895-26-7
(1H,1H,2H,2H-Perfluorodecyl)(1H,1H,2H,2H-perfluorododecyl)phosphate (10:2/12:2 diPAP)	
Perfluoroalkyl phosphonate (PFPA)	
Perfluorohexane phosphonate (C6 PFPA)	40143-76-8
Perfluorooctane phosphonate (C8 PFPA)	40143-78-0
Perfluorodecane phosphonate (C10 PFPA)	52299-26-0
Perfluoroalkyl phosphinic acid (PFPIA)	
Bis (perfluorohexyl) phosphinic acid (6/6 PFPIA)	40143-77-9
(perfluorohexyl)Perfluorooctyl phosphinic acid (6/8 PFPIA)	610800-34-5
Bis (perfluorooctyl) phosphinic acid (8/8 PFPIA)	40143-79-1

In addition, Environment and Climate Change Canada recently completed a research project that investigated the presence of various contaminants of emerging concern within groundwater impacted by leachate from historic landfills (those closed more than 25 years; few have leachate collection systems, which would allow for collection of pure leachate) (Propp et al., 2021). A survey, which was performed in Ontario, collected 48 samples of leachate-impacted groundwater from 20 historic landfills (closing dates from the 1920s to early 1990s). The contaminants of emerging concern measured included artificial sweeteners, PFAS, organophosphate esters, pharmaceuticals, bisphenols, sulfamic acid, perchlorate, and substituted phenols. This project was supported through an agreement with the Government of Ontario's Ministry of Environment, Conservation and Parks.

The PFAS concentration data is provided in a spreadsheet with the supporting information of the manuscript, which is open access at *www.sciencedirect.com/science/article/pii/S026974912100052X*.

The list of specific PFAS compounds monitored in this study include the following:

Acronym	**CAS #[7]**	**Compound Name**	**n**	**Group**
PFBA	375-22-4	Perfluorobutanoic acid	3	PFCA
PFPeA	2706-90-3	Perfluoropentanoic acid	4	PFCA
PFHxA	307-24-4	Perfluorohexanoic acid	6	PFCA
PFHpA	375-85-9	Perfluoroheptanoic acid	7	PFCA
PFOA	335-67-1	Perfluorooctanoic acid	8	PFCA
PFNA	375-95-1	Perfluorononanoic acid	9	PFCA
PFDA	335-76-2	Perfluorodecanoic acid	10	PFCA
PFUnA	4234-23-5	Perfluoroundecanoic acid	11	PFCA
PFDoDA	307-55-1	Perfluorododecanoic acid	12	PFCA
PFTriDA	72629-94-8	Perfluorotridecanoic acid	13	PFCA
PFTeDA	376-06-7	Perfluorotetradecanoic acid	14	PFCA
PFBS	375-73-5 /59933-66-3	Perfluorobutanesulfonate	3	PFSA
PFHxS	355-46-4	Perfluorohexanesulfonate	6	PFSA
PFOS	4021-47-0 / 1763-23-1/2793-39-3	Perfluorooctanesulfonate	8	PFSA
PFDS	335-77-3 /2806-15-7/126105-34-8	Perfluorodecanesulfonate	10	PFSA

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[7] The CAS numbers provided are not meant to be exhaustive. For example, the CAS number for perfluorooctanoic acid was provided; however, also valid would be the CAS numbers representing the salt form of these substances.

PFECHS	646-83-3	Perfluoroethylcyclohexane sulfonate	8	PFSA (cyclic)
FOSA	754-91-6	Perfluorooctanesulfonamide	8	Perfluoroalkane sulfonamides

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Further information is available at *https://search.open.canada.ca/en/od/?sort=score%20desc&page=1&search_text=PFOS*.

Question 9: In how many instances have each of Environment Canada and Climate Change, Health Canada, Transport Canada and the Department of National Defence requested extensions of up to 300 days to reply to Access to Information requests from the public when those requests pertain to reports, studies or monitoring results that are complete and / or have been the subject of issued statements by that Department? Please provide specifics.

Response: Environment and Climate Change Canada has received two Access to Information requests since August 10, 2016, that identify PFAS or “forever chemicals” within the request text, and for which an extension was taken of between 1 to 300 days.

The Department’s search revealed no files referencing “forever chemicals.” Of the two voluminous requests received by Environment and Climate Change Canada, one request had an extension of 190 days and one request had an extension of 150 days. Both files are still ongoing.

Question 14: How does CEPA and its regulations apply to the movement of waste containing PFAS into Canada from US and other countries? What information is collected and made available to the public regarding the origin, quantity, frequency, treatment and disposal of these wastes? Please explain and provide supporting information.

Response: In Canada, federal and provincial/territorial governments are involved in the management of hazardous waste and hazardous recyclable material.

The federal government controls hazardous wastes and hazardous recyclable materials crossing an international boundary, and movements between provinces or territories in Canada, that are destined for disposal or recycling. The provinces and territories regulate the transportation of hazardous wastes within their borders, as well as the licensing and permitting of authorized facilities undertaking disposal or recycling operations and authorizing carriers.

Canada is a signatory to a number of international instruments. These include the United Nations Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, the Organisation for Economic Co-operation and Development’s Decision of the Council on the Control of Transboundary Movements of Wastes Destined for Recovery Operations, the Agreement Between the Government of Canada and the Government of the United States of America Concerning the Transboundary Movement of Hazardous Waste, and the Arrangement Between the

Government of Canada and the Government of the United States of America Concerning the Environmentally Sound Management of Non-Hazardous Waste and Scrap Subject to Transboundary Movement.

Environment and Climate Change Canada administered the *Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations* by which Canada implements its obligations under the international instruments mentioned above. These regulations were consolidated into the new *Cross-border Movement of Hazardous Waste and Hazardous Recyclable Material Regulations* (XBR), which came into force on October 31, 2021. The XBR apply to movements of hazardous wastes and hazardous recyclable materials crossing an international border when destined for disposal or recovery (*www.canada.ca/en/environment-climate-change/services/canadian-environmental-protection-act-registry/cross-border-movement-hazardous-waste-recyclable-material-regulations.html*).

The definitions of hazardous waste and hazardous recyclable material in the XBR do not contain specific descriptors that would identify a substance in the PFAS family. In general, PFAS and products that contain PFAS would need to trigger one of the conditions listed below in order to meet the definition of a hazardous waste or hazardous recyclable material as set out in the XBR. Therefore, Environment and Climate Change Canada does not have specific information regarding the origin, quantity, frequency, treatment and disposal of PFAS wastes.

It is the responsibility of the Canadian importer (or exporter) to determine whether a particular waste stream or recyclable material intended for disposal or recycling meets the definition of hazardous waste or hazardous recyclable material under the XBR. The Canadian importer (or exporter) must be assured that they have taken the necessary steps to determine the classification of the hazardous waste or hazardous recyclable material, and whether these regulations would apply.

In order to determine whether an import of a certain chemical is captured or not by the XBR, it is important to consult the definitions for “hazardous waste” and “hazardous recyclable material” as set out in sections 2 to 5 of these regulations. In brief, the definitions include anything that is intended to be disposed of or recycled using one of the disposal or recycling operations set out in Schedule 1 of the XBR, and that meets at least one of the following conditions, each set in Section 2 to Section 5:

a) the material is listed in Schedule 6 to the XBR;
b) the material is included in at least one of Class 2 to 6, 8 or 9 of the *Transportation of Dangerous Goods Regulations*;

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c) the material contains a substance listed in Schedule 7 to the XBR in a concentration greater than or equal to the applicable concentration set out in Column 4 of that schedule;
d) the material produces a leachate containing a constituent in a concentration equal to or greater than the applicable concentration set in Schedule 2 to the XBR, determined in accordance with the leachate test, the Toxicity Characteristic Leaching Procedure; and
e) the material is listed in Schedule 8 to the XBR, and is “pure” or the only active ingredient.

CEPA and its regulations, including the XBR, are enforced in accordance with the compliance and enforcement policy for CEPA.[8] The policy sets out the range of possible responses to alleged violations. These include warnings, directions, environmental protection compliance orders, ministerial orders, injunctions, prosecution and environmental protection alternative measures. If an Environment and Climate Change Canada enforcement officer discovers an alleged offence, the officer will choose the appropriate enforcement action based on the policy.

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[8] Canadian Environmental Protection Act: compliance and enforcement policy (*www.canada.ca/en/environment-climate-change/services/canadian-environmental-protection-act-registry/publications/compliance-enforcement-policy.html*)