

Binational Summary Report: Perfluorinated Chemicals (PFOS, PFOA and Long-Chain PFCAs)

1. Overview:

Annex 3 - Chemicals of Mutual Concern commits the Parties to identify and designate, on an on-going basis, Chemicals of Mutual Concern (CMCs) in the Great Lakes, which originate from anthropogenic sources and that are agreed to by both Parties as being potentially harmful to the environment or human health.

As such, the Annex 3 Subcommittee (C3) has charged an Identification Task Team (ITT) with reviewing and critically evaluating relevant existing data and information, in accordance with the *Binational Considerations* developed by the C3, in order to determine which of a suite of seven candidate chemicals / classes should be recommended as CMCs.

This *Binational Summary Report* documents the application of the *Binational Considerations* to the candidate CMC Perfluorinated Chemicals (PFCs), which include perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA) and long-chain perfluorocarboxylic acids (PFCAs). This report was developed with input and review of the entire ITT and the recommendations presented within were reached by consensus decision making of the full ITT.

With respect to PFOS, PFOA and long-chain PFCAs, there was sufficient data and information available to effectively apply the *Binational Considerations*, and based on their application of the considerations, **the ITT has recommended, by a 2/3 majority decision, that PFOS, PFOA and long-chain PFCAs and their salts and precursors all be designated as CMCs.**

The ITT has concluded that PFOS concentrations in top-predator fish species and herring gull eggs exceed relevant guidelines, derived for the protection of avian and mammalian predators / consumers of fish and wildlife. Furthermore, increasing concentrations of PFOS and PFOA, and to a lesser extent long-chain PFCAs, have been observed in sediment, with long-term concentration trends in both top-predator fish (Lake Erie and Ontario) and herring gull eggs (all locations) showing stabilizing trends. Therefore, PFOS, PFOA and long-chain PFCAs have been identified to pose a threat to the environment and to human health in the basin.

The ITT has concluded that while many risk management and science activities are ongoing for PFOS and to a lesser extent PFOA and long-chain PFCAs under Canadian and US federal programs, there are still needs and opportunities for additional activities, many of which would benefit from enhanced Canada – U.S. coordination and collaboration in the Great Lakes, including:

- Continuing to undertake monitoring of air, sediment, wastewater, top-predator fish species and herring-gull eggs in the Great Lakes in order to continue tracking long-term environmental concentration and atmospheric loading trends and to measure the performance of ongoing and forthcoming risk management activities;

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- Develop environmental quality guidelines for PFOA and LC-PFCAs in order to interpret environmental occurrence data and evaluate the performance of regulatory and voluntary control measures;
- Implement and measures the performance of existing and future activities activities to control existing uses of PFOS, PFOA and long-chain PFCAs in Canada and the US;
- Conduct research on the issue of PFCs in imported products (e.g. quantities imported and estimated releases etc.) for measuring performance of existing activities and/or informing the development and implementation of additional activities if warranted.

2. Chemical background:

Chemical Identities:

- PFOS, its Salts and its Precursors
- PFOA, its Salts, and its Precursors
- Long-Chain (C9–C20) PFCAs, their Salts and their Precursors
 - The expression, C#, is used to define the carbon chain length of the PFCA in question, e.g., C9 is a nine carbon PFCA.

PFOS is of anthropogenic origin with no known natural sources. It is a synthetic substance belonging to a larger class of organic fluorochemicals that are partially or completely saturated with fluorine. PFOS belongs to the class of long-chain perfluoroalkane sulfonic acids (PFSAs) that are part of the broader class of perfluoroalkyl acids (PFAAs) that belong to the non-polymeric PFASs (per- and polyfluoroalkyl substances). PFOS has been used as a surfactant in many different applications, most notably in aqueous film-forming foam (AFFF) to fight fuel fires and in fume suppressants used in metal plating processes and in the semiconductor industry. PFOS-related substances were commonly used as water, oil, soil and grease repellents for paper and packaging, carpets, and fabrics. These substances can be released into the environment both directly and indirectly (through degradation of its precursors) during manufacture, use and/or disposal of products containing them. PFOS is exceptionally persistent and subject to long-range transport, and is ubiquitous in the environment.

The PFOS synthetic fluorocarbon molecule contains eight carbon atoms in which all of the carbon-hydrogen (C-H) bonds are replaced by carbon-fluorine (C-F) bonds. The C-F bond is one of the strongest chemical bonds known in nature, which makes this compound extremely persistent in the environment. PFOS also contains a reactive sulfonyl group (SO_3H). PFOS can exist in anionic, acid and salt forms. However, under normal environmental conditions of approximately neutral pH, the anionic form (i.e., $\text{C}_8\text{F}_{17}\text{SO}_3^-$) dominates, resulting in very low volatility, high water solubility and the ability to repel both oil and water. PFOS also belongs to a larger family of fluoro-organic compounds that includes PFOA and long-chain PFCAs, as well as more volatile precursor compounds that are commonly used in consumer and industrial products and ultimately degrade to compounds such as PFOS and PFOA.

Owing to its chemical and physical properties, PFOS is typically found at higher concentrations in water compared with air, and can travel long distances by oceanic currents. In contrast, PFOS precursors are more volatile and can be transported through air to areas far from initial release, where they subsequently degrade to PFOS. PFOS is bioaccumulative and is readily taken up by aquatic and terrestrial animals. However, in contrast to well-known legacy contaminants such as polychlorinated biphenyls (PCBs) and dichlorodiphenyltrichloroethane (DDT), which are stored predominantly in the fatty tissues of organisms, PFOS binds to proteins in blood and the liver.

PFOA is an anthropogenic substance belonging to a class of chemicals known as PFCAs. PFCAs, in turn, belong to the broader class of perfluoroalkyl acids (PFAAs) that belong to the non-polymeric PFASs (per- and polyfluoroalkyl substances). PFOA and other PFCAs are fluorocarbon-based chemicals (consisting of fluorine bound to carbon atoms), containing a carboxyl group (COOH). It is the strength of the carbon-fluorine bonds that contributes to the extreme stability and unique properties of these substances.

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The PFOA molecule contains 8 carbon atoms and the other long-chain PFCAs contain between 9 and 20 carbon atoms. PFOA may refer to the acid, its conjugate base or its principal salt forms; precursors to PFOA are substances where the perfluorinated alkyl moiety has the formula C_nF_{2n+1} (where $n = 7$ or 8) and is directly bonded to any chemical moiety other than a fluorine, chlorine or bromine atom. Long-chain perfluorocarboxylic acids (PFCAs) and their salts are a homologous series of substances with the molecular formula of $C_nF_{2n+1}CO_2H$ (where $8 \leq n \leq 20$); precursors to long-chain PFCAs are any substance where the perfluorinated alkyl moiety has the formula C_nF_{2n+1} (where $8 \leq n \leq 20$) and is directly bonded to any chemical moiety other than a fluorine, chlorine or bromine atom.

These substances may be formed from the degradation or transformation of their precursors, which include parent compounds and chemical products containing PFOA or PFCAs.

Canadian and US Domestic Program Status:

Canada:

PFOS has been detected in animals worldwide and, in Canada, has been detected in species such as fish, fish-eating birds and Arctic marine mammals far from known sources or manufacturing facilities.

On July 1, 2006, the Ministers of the Environment and of Health published, in Part I of the *Canada Gazette*, their final decision on the assessment of PFOS, its salts and certain other compounds (EC, 2008). The screening assessment concluded that PFOS, its salts and certain other compounds are or may be entering the environment in a quantity or concentration or under conditions that have or may have an immediate or long-term harmful effect on the environment or its biological diversity. The assessment also concluded that current levels of PFOS exposure are below levels which might affect human health (EC, 2006a).

On December 27th, 2006, based on the conclusions of the assessment of PFOS, an Order was published in Part II of the *Canada Gazette* adding PFOS, its salts and certain other compounds that contain the groups $C_8F_{17}SO_2$, $C_8F_{17}SO_3$ or $C_8F_{17}SO_2N$ to the List of Toxic Substances in Schedule 1 under the Canadian Environmental Protection Act, 1999 (CEPA 1999) (EC, 2006b).

In addition, based on available data, it was concluded that PFOS and some of its precursors are persistent in the Canadian environment with the environmental half-life for PFOS exceeding the half-life criteria for persistence as defined by the *Persistence and Bioaccumulation Regulations* of CEPA 1999 (EC, 2006a). While there is scientific evidence that PFOS and its salts are extremely persistent and can bioaccumulate and biomagnify in mammals and fish-eating birds, PFOS does not meet the numeric criteria for bioaccumulation as defined in the *Persistence and Bioaccumulation Regulations* because these criteria were derived from bioaccumulation data for aquatic species and for substances which preferentially partition to lipids (EC, 2006a). PFOS partitions preferentially to proteins, liver and blood rather than to lipids. However, in January 2009, PFOS was added to the *Virtual Elimination List*, as a result of a private members bill, to demonstrate the Government of Canada's continuing commitment to virtually eliminate PFOS.

As such, in 2008, the *Perfluorooctane Sulfonate and Its Salts and Certain Other Compounds Regulations* came into force to protect Canada's environment from the use and release of PFOS, its salt and its precursors (EC, 2008). Those regulations prohibit the manufacture, use, sale offer for sale and import of PFOS, as well as manufactured products containing PFOS unless incidentally present, with certain exemptions. They align with existing controls in the United States and the EU, as well as internationally (e.g. the Stockholm Convention on Persistent Organic Pollutants and the Protocol on Persistent Organic Pollutants to the Convention on Long-range Transboundary Air Pollution).

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Final Screening Assessment Reports (SAR) for PFOA, its salts and its precursors (EC & HC, 2012a), as well as for long-chain (C9-C20) PFCAs, their salts and their precursors (EC, 2012) have been completed. The final reports and conclusions of these assessments were published on August 25th, 2012 (EC, 2012; EC & HC, 2012a).

These final SARs conclude that PFOA and other long-chain PFCAs are entering or may be entering the environment in a quantity or a concentration or under conditions that have or may have an immediate or long-term harmful effect on the environment or its biological diversity. In addition, they conclude that both PFOA and other long-chain PFCAs are extremely persistent and meet the criteria for persistence, but do not meet the criteria for bioaccumulation as set out in the *Persistence and Bioaccumulation Regulations*. The assessments state the weight of evidence is sufficient to conclude that both PFOA and other long-chain PFCAs and their salts accumulate and biomagnify in terrestrial and marine mammals. The Screening Health Assessment concluded that PFOA and its salts are not entering the environment in a quantity or concentration or under conditions that constitute or may constitute a danger in Canada to human life or health. Long-chain PFCAs were not assessed from a human health perspective.

As PFOS, PFOA and long-chain PFCAs have been assessed as meeting the criteria for toxicity to the environment under CEPA 1999; they are subject to a number of federal risk management activities in Canada, including (see Section 4 for additional details):

- PFOS is subject to the *Perfluorooctane Sulfonate and its Salts and Certain Other Compound Regulations* (EC, 2008).
- The Environmental Performance Agreement Respecting Perfluorinated Carboxylic Acids (PFCAs) and their Precursors in Perfluorinated Products Sold in Canada is an agreement between the Government of Canada and five companies to phase out PFOA and long chain PFCA and their precursors in perfluorochemical products sold in Canada by 2016 (EC, 2010).
- A prohibition on the manufacture, use, sale and offer for sale of PFOA and long-chain PFCAs is being considered in Canada and was described in a Consultation Document that was published in January 2014 for a 30-day public comment period (EC, 2014).

United States:

Both PFOS and PFOA were manufactured in the USA for several decades before production ceased in the early 2000s for PFOS and in 2013 for PFOA. PFOS is present in the environment as a result of human activity, such as its manufacturing, its use in aqueous film-forming foams, in surfactants in the semiconductor and metal plating sectors and in manufacturing products. PFOS has been detected in animals worldwide and has been detected in species such as fish, fish-eating birds and Arctic marine mammals far from known sources or manufacturing facilities. PFOA is present in the environment primarily because of emissions from its manufacturing and use as a polymerization processing aid in fluoropolymer manufacture. Long-chain fluorotelomer-based products may contain PFOA as a minor unintended byproduct and may contain precursor chemicals that can degrade to form PFOA.

Under the Toxic Substances Control Act (TSCA), EPA finalized two Significant New Use Rules (SNURs) in 2002 for 88 PFOS-related substances, which require companies to notify the EPA 90 days before starting to manufacture or importing these substances for a significant new use; this pre-notification allows time to evaluate the new use. In 2007, the SNURs were amended to include 183 additional PFOS-related substances.

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PFCs are identified in the US as Action Plan Chemicals (US EPA, 2015a). Based on US EPA's 2009 screening-level review of hazard and exposure information, US EPA (2009) outlined the following activities to reduce risk from long-chain PFCs in a chemical action plan:

- Consider initiating rulemaking under section 6 of TSCA to manage long-chain PFCs.
- Consider other regulatory approaches under TSCA, such as the SNURs, to manage long-chain PFCs.
- Evaluate the potential for disproportionate impact on children and other sub-populations.
- Continue with the 2010/15 PFOA Stewardship Program to work with companies toward the elimination of long-chain PFCs from emissions and products by the end of 2015.
- EPA will also continue to evaluate alternatives under EPA's New Chemicals Program and collaborate with other countries on managing PFCs

On September 30, 2013, the EPA issued a SNUR requiring companies to report 90 days in advance of all new uses of long-chain perfluoroalkyl carboxylic (LCPFAC) chemicals for use as part of carpets or to treat carpets, including the import of new carpet containing LCPFAC.

On January 15, 2015, EPA published a proposed Significant New Use Rule (SNUR) to ensure that perfluorinated chemicals that have been phased out do not re-enter the marketplace without review. In the same notice, EPA proposed to amend a SNUR for perfluoroalkyl sulfonate (PFAS) chemical substances that would make inapplicable the exemption for persons who import PFAS chemical substances as part of carpets.

The concentrations of PFOA, PFOS and several other PFCs/PFAAs are currently being monitored in drinking water under the US EPA Office of Water's third Unregulated Contaminant Monitoring Rule (UCMR). US EPA uses the UCMR program to collect data for contaminants suspected to be present in drinking water, but that do not have health-based standards set under the Safe Drinking Water Act. The latest results from the UCMR can be examined online as they become available (US EPA, 2013).

PFOA and PFOS are listed on the third Contaminant Candidate List (CCL3). The CCL3 is a list of contaminants that are currently not subject to any proposed or promulgated national primary drinking water regulations, that are known or anticipated to occur in public water systems, and which may require regulation under the Safe Drinking Water Act. In the October 20, 2014 Federal Register Notice, EPA announced that PFOS and PFOA were not advanced to Phase 3 (regulatory determination assessment) and therefore no regulatory determination was made for either of those chemicals.

Agency for Toxic Substances and Disease Registry (US DOHHS, 2009): Minimal risk levels (MRL) were not derived for perfluoroalkyl compounds due to the fact that human studies to date are insufficient to determine with a sufficient degree of certainty that the effects in animal studies are either exposure-related or adverse. Some argument is made for current human blood plasma levels to be considered a no effect concentration however the uncertainty in pharmacokinetics is too great.

US EPA (2009): The US EPA Office of Water states that epidemiological studies of exposure to PFOS and PFOA, and adverse health outcomes in humans are inconclusive at present. However, existing studies are used with uncertainty factors to generate provisional health advisories for drinking water.

US EPA (2014a): The USEPA Emerging Contaminants Fact Sheet summarizes PFOS and PFOA information on environmental impact, routes of exposure, and regulation but does not present any novel assessment of risk.

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In April 2014, the US EPA Office of Water released draft health effects documents for PFOA and PFOS for public comment and peer review (US EPA 2014b). Once the health effect documents are finalized, they will be used to develop lifetime health advisories for each chemical and replace the provisional health advisories.

3. Review of existing scientific data and a qualitative evaluation of their significance:

Is the candidate chemical present in the Great Lakes ecosystem and does it present a potential threat to ecological or human health in the Great Lakes Basin?

Canadian Releases, Sources and Uses:

PFOS

From: EC, 2006a

Sources:

PFOS and its salts are of anthropogenic origin with no known natural sources;

Results from the 2000 CEPA 1999 s.71 survey indicated that PFOS and its precursors are not manufactured in Canada, and imports of PFOS and its precursors accounted for 43% (258,000 kg) of the 600,000 kg of PFASs imported between 1997 – 2000.

Uses:

It is estimated that the majority of all perfluorinated alkyl compounds imported into Canada were used in applications involving water, oil, soil and grease repellents for fabric, packaging and rugs and carpets; and surfactants/detergents, emulsifiers, wetting agents, dispersants and fire-fighting foams. It is expected that PFOS and its precursors are present in many of these use applications.

Releases:

Releases from the legacy of consumer articles containing PFOS (e.g., it is estimated that vacuuming and cleaning of carpets create releases; final disposal of treated carpets is generally to landfills).

PFOA

From: EC & HC, 2012b

Sources:

PFOA and its salts are of anthropogenic origin with no known natural sources. Results from the 2000 CEPA 1999 s.71 survey indicated that PFOA and its salts were not manufactured in Canada. Between 1997 and 2000, imports of PFOA and its salts were reported by one company, with the import of PFOA and its salts (<1,000 kg) representing a very small proportion of the total PFASs (600,000 kg) imported and consisting almost exclusively of the ammonium salt used in industrial applications.

Results from the 2004 CEPA 1999 S.71 survey confirmed that there is no known manufacture of PFOA and its salts in Canada and that the PFOA ammonium salt was imported into Canada in quantities ranging between 100 – 100 000 kg . The volumes reported under the 2000 and 2004 surveys do not include quantities possibly imported in manufactured items. **Uses:**

The reported uses for PFOA and its salts included use as a component of a formulation and other uses (i.e., batteries, coatings, and lubricants). PFOA ammonium salt (APFO) is used primarily as a commercial

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polymerization aid in the manufacture of fluoropolymers such as polytetrafluoroethylene (PTFE) and polyvinylidene fluoride, which are used in various sectors, including the automotive, electronics, construction and aerospace industries. APFO is also used as a constituent in aqueous fluoropolymer dispersions, which are formulated into paints, inks, photographic film additives and in the architectural fabric industry. Aqueous fire-fighting foams may also contain APFO as a component. PFAS that are potential PFOA precursors are used in the treatment of food packaging materials to enhance their properties as a barrier to moisture and grease. Thus, although APFO is typically not intended to remain in manufactured articles, trace amounts may be present as a contaminant or degradation product.

Releases:

Releases to the environment may occur during manufacturing and processing operations and throughout the service life and subsequent disposal of articles containing PFOA. Potential point sources thus include direct releases from manufacturing or processing facilities. Indirect releases may result, for example, from the degradation or transformation of precursors through wastewater treatment processes and at landfills. There are no published data on direct releases to air, water or land from Canadian industrial facilities

Long-chain PFCAs

From: EC, 2012

Sources:

Results from the 2004 CEPA 1999 S. 71 survey of perfluoroalkyl and fluoroalkyl substances found long-chain PFCAs were not reported to be manufactured or imported in Canada. An earlier CEPA 1999 S.71 survey from the year 2000 found the same result. However, under both surveys, between 1000 and 100 000kg of precursors to long-chain PFCAs were reported to be imported into Canada.

Uses:

Long-chain PFCAs are used for surfactant applications and in the production of fluoropolymers, primarily polyvinylidene fluoride. Based on available information, long-chain PFCAs are rarely used intentionally in products. Commonly used precursors which are present in commercial products, such as long-chain fluorotelomers, e.g., substances derived from long-chain fluorotelomer alcohols (FTOHs), or other long-chain fluorotelomer-based substances, can degrade to long-chain PFCAs.

Releases:

There are no available data on the direct release through industrial use/manufacturing of long-chain PFCAs to the Canadian environment.

There is empirical evidence available regarding the degradation of long-chain fluorotelomer-based polymers into long-chain PFCAs.

Wastewater treatment (effluent and biosolids) could be a source of long-chain PFCAs. Simple primary treatment did not have releases of long-chain PFCAs; however, WWTPs that included secondary treatment increased the presence of long-chain PFCAs suggesting rapid biological or chemical degradation of precursors during secondary treatment.

US Releases, Sources and Uses:

PFOS

Sources:

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US EPA data shows that production of PFOS and its direct precursors, while extensive from approximately 1970 through 2002 (100,000 tons total), began declining in 2003, after its principle manufacturer stopped production, and is expected to near zero production by 2015, based on other voluntary agreements with US EPA and the full use of inventories of other regulated PFAS chemicals not in articles.

As PFOS- and PFSA-containing chemicals become more heavily regulated, production has continued to move to developing countries where US EPA cannot track production volumes

PFOS and PFSA-containing articles are not tracked by US EPA. Therefore, PFOS- and PFAS-containing articles may still be present in commerce

PFOS and PFSA chemicals may still be imported into the US for almost all uses in quantities less than 10,000 lbs, and for certain established uses at any quantity.

Uses:

Uses of PFOS in US are extremely limited.

Releases:

PFOS is not listed on the Toxics Release Inventory nor is it listed as an EPA hazardous waste nor does it have water quality criteria within the Great Lakes Basin. As a result, there are no federal data available on the direct release through industrial use / manufacturing of PFOS to the American environment.

PFOA

From: US EPA, 2015b

Sources:

PFOA was manufactured in the US for several decades. Furthermore, certain types and grades of fluoropolymers have been manufactured using PFOA as a polymerization processing aid. Total U.S. demand for fluoropolymers in 2004 was between 50,000 and 100,000 metric tons. The United States accounted for less than 25 percent of the world consumption of PTFE in 2007, and between 25 and 50 percent of the world consumption of other fluoropolymers. PTFE is the most commonly used fluoropolymer, and the United States consumed less than 50,000 metric tons of PTFE in 2008.

Uses:

PFCA's are synthetic chemicals that do not occur naturally in the environment. PFOA is manufactured for use primarily as an aqueous dispersion agent [as the ammonium salt] in the manufacture of fluoropolymers, which are substances with special properties that have thousands of important manufacturing and industrial applications.

Fluoropolymers, such as PTFE, which may contain some PFCA contamination, or that use PFOA as an emulsion stabilizer in aqueous dispersions, have a large U.S. market. The wire and cable industry is one of the largest segments of the fluoropolymer market, accounting for more than 35 percent of total U.S. fluoropolymer use. Apparel makes up about 10 percent of total fluoropolymer use, based on total reported production volume.

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Fluoropolymers are used in a wide variety of mechanical and industrial components, such as plastic gears, gaskets and sealants, pipes and tubing, O-rings, and many other products.

Participating companies in the US EPA 2010/15 PFOA Stewardship Program have already ceased manufacturing and use of PFOA as a polymerization processing aid or are scheduled to do so by the end of 2015.

PFOA may also be produced unintentionally by the degradation of some long-chain fluorotelomers, which are not manufactured using PFOA but could degrade to PFOA. Fluorotelomers are used to make polymers that impart soil, stain, grease, and water resistance to coated articles. Some fluorotelomer based products are also used as high performance surfactants in products where an even flow is essential, such as paints, coatings, cleaning products, and fire-fighting foams for use on liquid fuel fires. Fluorotelomer-based products can be applied to articles both at the factory and by consumers and commercial applicators in after-market uses such as carpet treatments and water repellent sprays for apparel and footwear.

Participating companies in the US EPA 2010/15 PFOA Stewardship Program have already ceased manufacturing of long-chain fluorotelomers or are scheduled to do so by the end of 2015.

However, the entire industry is not committed to phasing out manufacture and use of long-chain PFCAs and their precursors as was expressed recently: In mid-October 2014, US EPA issued its TSCA Work Plan for Chemical Assessments 2014 Update, which established that the US EPA remains concerned about PFCs being produced by companies not participating in the stewardship program. Currently, the Agency is interested in gathering additional data regarding use of PFCs in imported articles before determining if these chemicals should be candidates for the assessment process.

Releases:

PFOA is not listed on the Toxics Release Inventory, nor is it listed as an EPA hazardous waste, nor does it have water quality criteria within the Great Lakes Basin. As a result, there are no data readily available on the direct release through industrial use / manufacturing of PFOA to the American environment. However, the companies participating in the U.S. EPA 2010/15 PFOA Stewardship Program provide their facilities emissions data to the U.S. EPA. Those data are summarized and made public on the stewardship program's website.

Long-chain PFCAs

From: US EPA, 2015a

Uses:

Fluoropolymers are used in a wide variety of mechanical and industrial components, such as plastic gears, gaskets and sealants, pipes and tubing, O-rings, and many other products. Total U.S. demand for fluoropolymers in 2004 was between 50,000 and 100,000 metric tons. The United States accounted for less than 25 percent of the world consumption of PTFE in 2007, and between 25 and 50 percent of the world consumption of other fluoropolymers. PTFE is the most commonly used fluoropolymer, and the United States consumed less than 50,000 metric tons of PTFE in 2008.

Releases:

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Long-chain PFCAs, like PFOS and PFOA, are not listed on the Toxics Release Inventory nor are they listed as an EPA hazardous waste nor does it have water quality criteria within the Great Lakes Basin. As a result, there are no data available on the direct release through industrial use / manufacturing of long-chain PFCAs to the American environment. Some data on releases through manufacturing and industrial use is available in the 2010/2015 PFOA Stewardship Program reports.

Environmental and Human Health Benchmarks Guidelines:

Canada:

In the absence of a Canadian Drinking Water Quality Guideline (CDWQG), Health Canada may develop Drinking Water Guidance Values (DWGVs). Drinking Water Guidance Values are developed on an as needed basis, and are based on an evaluation of readily available health studies. DWGVs are not subject to the same development process as the Guidelines for Canadian Drinking Water Quality which are peer-reviewed and undergo national consultation before being approved by the Federal-Provincial-Territorial Committees on Drinking Water and on Health and the Environment. DWGVs provide sound guidance related to the compound(s) of concern with respect to human health. DWGVs can be used as a screening tool on drinking water monitoring data. Where monitoring concentrations are well below the DWGV, no risk to human health is anticipated.

In 2008, the Ontario Ministry of Environment requested DWGV be developed by Health Canada for PFOS and PFOA to assess a spill of aqueous firefighting foam that had contaminated groundwater. These values were reaffirmed by Health Canada in 2012 (Fletcher, pers comm).

The DWGV for PFOS of 0.3 ug/L (300 ng/L) was based on a study with monkeys that assessed serum level changes of thyroid hormones, decreases in high density lipids and cholesterol, decrease in bilirubin levels in males, and thymus atrophy in females.

The DWGV for PFOA of 0.7 ug/L (700 ng/L) was based on a study with monkeys that assessed liver weight and body weight as a function of dose.

Environment Canada has developed Draft Canadian Federal Environmental Quality Guidelines (FEQGs) for PFOS for aquatic life (water), fish tissue, wildlife diet, bird egg (Environment Canada 2013a).

Air	Sediment	Water (ng/L)	Fish Tissue (ng/g wet weight)	Wildlife Diet (ng/g wet weight food)		Bird Egg (ng/g wet weight)
				Mammalian	Avian	
N/A		6000	8300	4.6	8.2	1900

Table 1: Draft Federal Environmental Quality Guidelines (FEQGs) for PFOS (Environment Canada, 2013a)

United States:

PFOS and PFOA:

- EPA Region 4 calculated a residential soil screening level of 6 milligrams per kilogram (mg/kg) for PFOS and 16 mg/kg for PFOA
- Various states have established drinking water and groundwater guidelines, including the following:

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- (a) Minnesota has established a chronic health risk limit of 0.3 µg/L for PFOS and PFOA in drinking water;
- (b) New Jersey has established a preliminary health-based guidance value of 0.04 µg/L for PFOA in drinking water;

(c) North Carolina has established an interim maximum allowable concentration (IMAC) of 2 µg/L for PFOA in groundwater. In 2010, the North Carolina Secretary's Science Advisory Board (NCSAB) on Toxic Air Pollutants recommended that the IMAC be reduced to 1 µg/L based on a review of the toxicological literature and discussions with scientists conducting research on the health effects associated with exposure to PFOA. As of February 2014, the NCSAB's recommendation was still pending review by the North Carolina Division of Water Quality.

(d) In March of 2014, Maine established a Maximum Exposure Guideline (MEG) for PFOA in drinking water of 0.1µg/L. [<http://www.maine.gov/dhhs/mecdc/environmental-health/eohp/wells/documents/pfoameg.pdf>]

The EPA Office of Water has developed Provisional Health Advisory values for PFOA and PFOS to assess potential risk from exposure to these chemicals through drinking water. The Provisional Health Advisory values for PFOA and PFOS are 0.4 and 0.2 ug/L, respectively.

FROM: EPA. 2009. Provisional health advisories for perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS). U.S. Environmental Protection Agency. http://media.timesfreepress.com/docs/2009/01/EPA_provisional_health_advisory_PFOA.pdf. May 19, 2009.

Great Lakes Monitoring and Surveillance Data:

Air and Atmospheric Deposition:

PFOS is found in air samples from across Canada including in the Great Lakes Basin (see Figure 1). Concentrations of PFCAs in air using high volume sampling were less than PFOS. The highest concentrations of PFCAs in air were found in the Toronto area as shown in Figure 2 (Gewurtz et al. 2013).

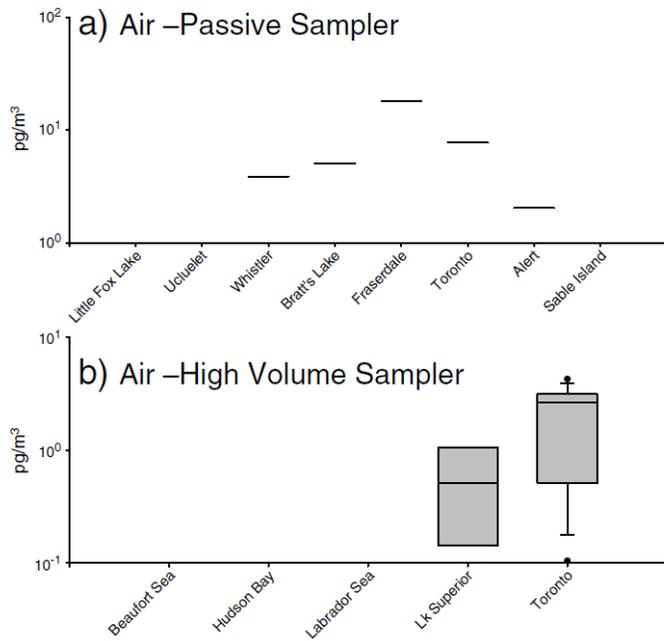


Figure 1: Box and whisker plots of PFOS concentrations a) air passive sampler b) air high volume sampler sum of gas and particle phase. (Source: Gewurtz et al.2013)

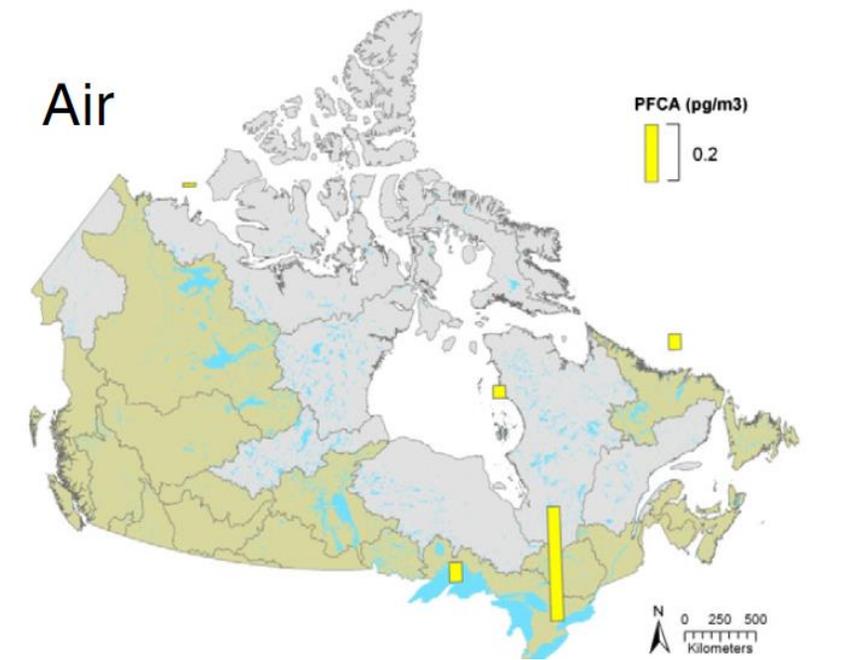


Figure 2: PFCAs (sum of PFOA, PFNA, PFDA, PFUnA, PFDoA) in air concentrations are either for passive or high volume samplers (denoted as HV). (Source: Gewurtz et al. 2013).

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Environment Canada examined the potential for the WWTPs and landfills to emit PFOS to the atmosphere. Air sampling at one Ontario WWTP and two landfill sites were monitored for PFOS and volatile PFOS precursor compounds between June and September 2009. For the WWTP, concentrations of PFOS and the PFOS precursor compounds were seven and four times higher, respectively, compared with upwind and downwind background locations. Similarly, for the landfills, the concentrations of PFOS and PFOS precursor compounds were approximately three and two times greater, respectively, than the upwind sites (Environment Canada 2013b).

Temporal Trend

Although there is no temporal trend data for PFC concentrations in air within the Great Lakes Basin, the Alert station in Nunavut has been showing an oscillating but declining trend of PFOs concentrations in air (Environment Canada 2013b).

Surface Water:

Surface water from Lakes Ontario, Huron, Erie, Michigan and Superior was analyzed in order to evaluate the spatial distribution of perfluorinated compounds (See Table 2 below). PFOA and PFOS were detected in all samples at a maximum concentration of 6.7 and 37.6 ng/l, respectively, in Hamilton Harbor samples.

Compound	Matrix	Location	Concentration	Frequency	Reference
Heptadecafluorooctane sulfonamide	Surface water	Laurentian Great Lakes	ND-0.6 ng/l	17/23	Furdui et al. (2008)
Perfluorodecanoic acid	Surface water	Laurentian Great Lakes	ND-2.4 ng/l	9/23	Furdui et al. (2008)
Perfluorododecanoic acid	Surface water	Laurentian Great Lakes	ND-2.6 ng/l	12/23	Furdui et al. (2008)
Perfluoroheptanoic acid	Surface water	Laurentian Great Lakes	ND-2.1 ng/l	5/23	Furdui et al. (2008)
Perfluorononanoic acid	Surface water	Laurentian Great Lakes	ND-2 ng/l	18/23	Furdui et al. (2008)
Perfluorooctanoic acid	Surface water	Laurentian Great Lakes	0.1-6.7 ng/l	23/23	Furdui et al. (2008)
Perfluorooctanoic sulfonate	Surface water	Laurentian Great Lakes	0.1-37.6 ng/l	23/23	Furdui et al. (2008)
Perfluoroundecanoic acid	Surface water	Laurentian Great Lakes	ND-1.4 ng/l	10/23	Furdui et al. (2008)
Potassium perfluorohexane sulfonate	Surface water	Laurentian Great Lakes	ND-1.8 ng/l	11/23	Furdui et al. (2008)

Table 2: The occurrence of perfluorinated surfactants in natural waters in the Great Lakes Basin (Source: State of the Great Lakes, 2011)

Boulanger et al. 2004 were among the first to analyze for perfluorinated compounds in waters of the Great Lakes. Surface water samples were collected in August 2003 from four locations in Lake Erie and four locations in Lake Ontario. Concentrations reported by Boulanger et al. for PFOS and PFOA in Lake Erie and Lake Ontario ranged from 11 to 47 ng/L and 15 to 121 ng/L which is higher than the maximum concentrations reported by Furdui et al. in 2008.

The timing of the Furdui sampling is unknown and there are insufficient years of data to determine temporal trends in surface water.

From 2007 through 2010, the Ontario Ministry of Environment and Climate Change (OMOEC) conducted monitoring surveys for PFAS as part of the Toronto Tributaries Assessment (TTA) project (MOECC, unpublished). Etobicoke Creek had the highest water concentrations of the sites sampled in the TTA, followed by Mimico Creek. The higher concentrations in Etobicoke Creek is consistent with the use and accidental release of fire-fighting foams containing PFASs at Pearson International Airport. However, the airport is also adjacent to the headwaters of Mimico Creek and may be an influence on concentrations in this creek as well. The other urbanized sites (Humber, Don, Highland, and Rouge) had

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PFOS and PFOA concentrations within the range of values from Mimico Creek and generally greater concentrations than the rural and background sites (except King). This suggests that widespread use of these compounds and their pre-cursors in populated areas influences surface water concentrations. The urban stream concentrations are also higher than concentrations found in water from Lake Ontario (Myers et al., 2012) and the other Great Lakes (Furdui et al., 2008), indicating that urban tributaries are a source of PFASs to the Great Lakes.

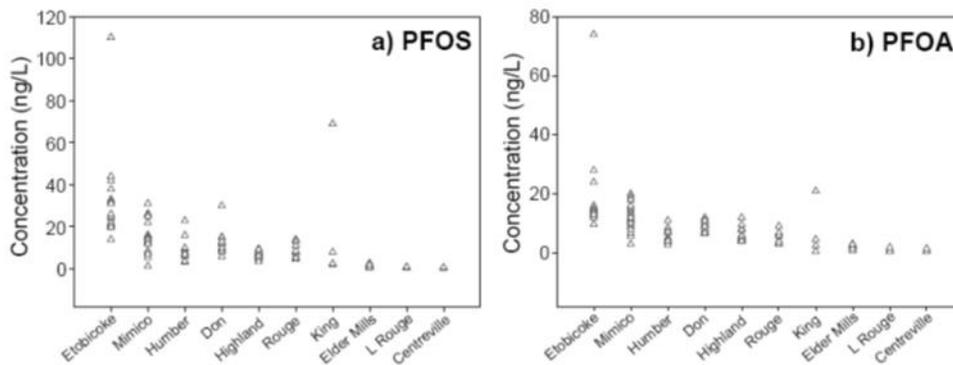


Figure 3: Concentrations of a) PFOS and b) PFOA in water samples collected at Toronto Tributary Assessment sites periodically between 2007 and 2009 (Source: OMOECC, unpublished)

Sediments:

Historical trends of PFASs in Sediments

Sediment core samples from the Mississauga basin show increasing concentrations of PFOS over time up to 2.5 ng/g dw in 2010 (Canada and US State of the Great Lakes 2011 report). As shown in Figure 4 similar increasing temporal trends were observed in sediment cores from Lake Ontario for PFCs but at greater concentrations of up to 12 ng/g dw for PFOs in the western most sample (Meyers et al. 2012). Greater PFCs concentrations were measured in sediment cores from the western end of Lake Ontario (core site 1004) than in the central (core site 1034) or eastern core samples (core site 1046). There is some variation between the core samples with respect to which PFC substances increased the most over time which may indicate the influence of local sources or tributaries. While the greatest increases overall are seen for PFOS, with respect to PFCAs there are some variations with the western sample showing PFOA increasing the fastest and the central and eastern samples observed PFUnDA increasing at the greatest rate.

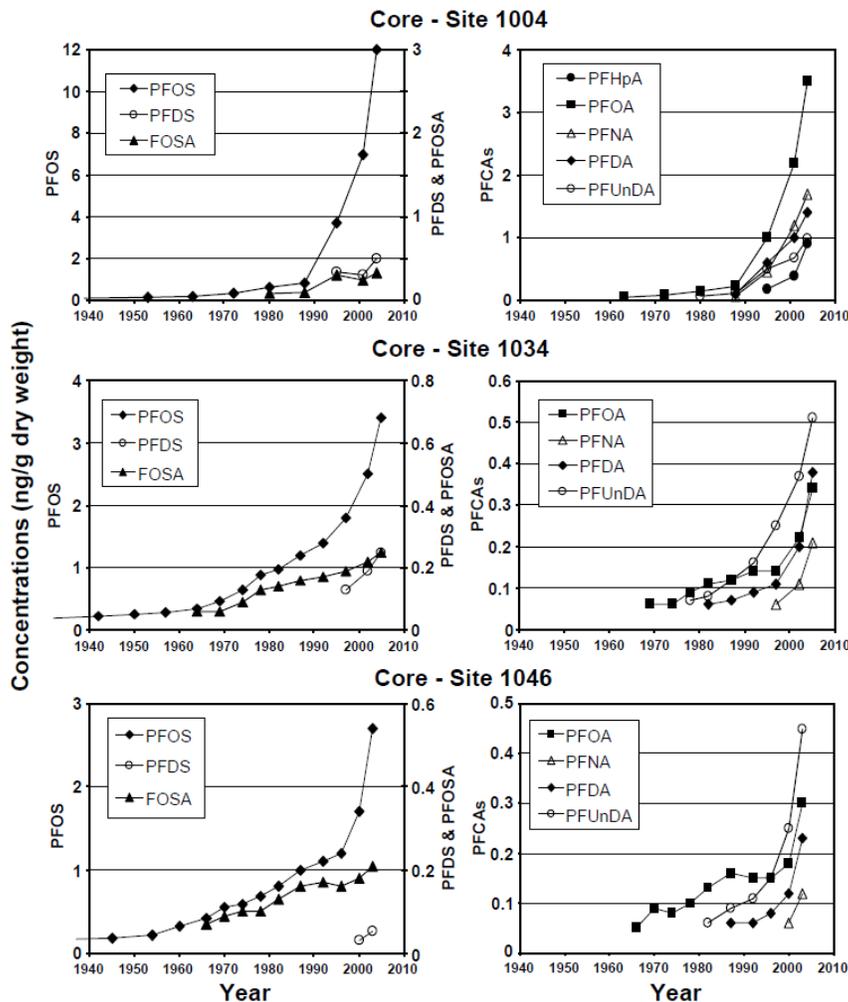


Figure 4: Levels of selected Perfluorinated Compounds in Lake Ontario sediment (1940-2010). (Source Meyers et al. 2012)

Data presented are for Lake Ontario and >MDL. PFTeDA was not detected, and PFHxS and PFDoDA (not shown) were >MDL in the surface slice only (0.27 and 0.1 ng/g, respectively) of 1004. PFDoDA (not shown) was >MDL in the surface slice only of core 1046 (0.1 ng/g). PFHxS and PFHpA were not detected in 1034 and 1046.

Niagara river suspended sediment concentration trends in spring composite suspended solids from 1981 to 2006 show increases especially from about 2000 onward for most PFCAs but not PFSAs, although generally concentration were less than 1 ng/g dwt (also Meyers et al. 2012).

Distribution of PFASs in Sediments

PFSAs and PFOS were determined in sediment samples from across the Great Lakes Basin as seen in Figures 5, 6 and 7 (data does not include US tributaries or Lake Michigan). Greater concentrations are generally measured near population centers and industrial areas such as the Toronto, Hamilton Harbour

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and Bay of Quinte areas of Lake Ontario and near the St. Clair River/southern Lake Huron area.

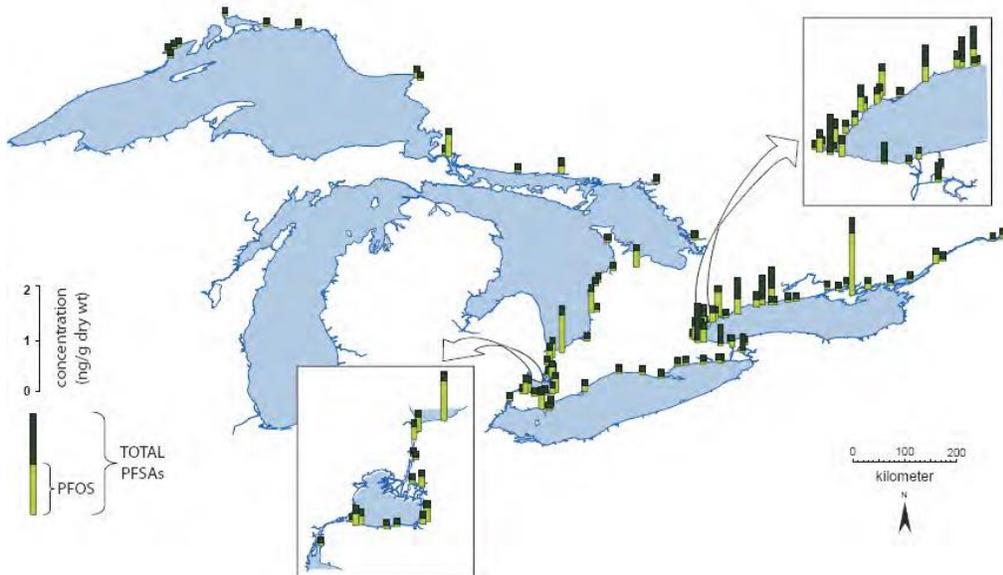


Figure 5: Total PFASs perfluoroalkyl sulfonate acids (PFASs) and perfluorooctane sulfonate (PFOS) concentrations in surficial sediments in tributaries of the Great Lakes. (Source: State of the Great Lakes 2011)

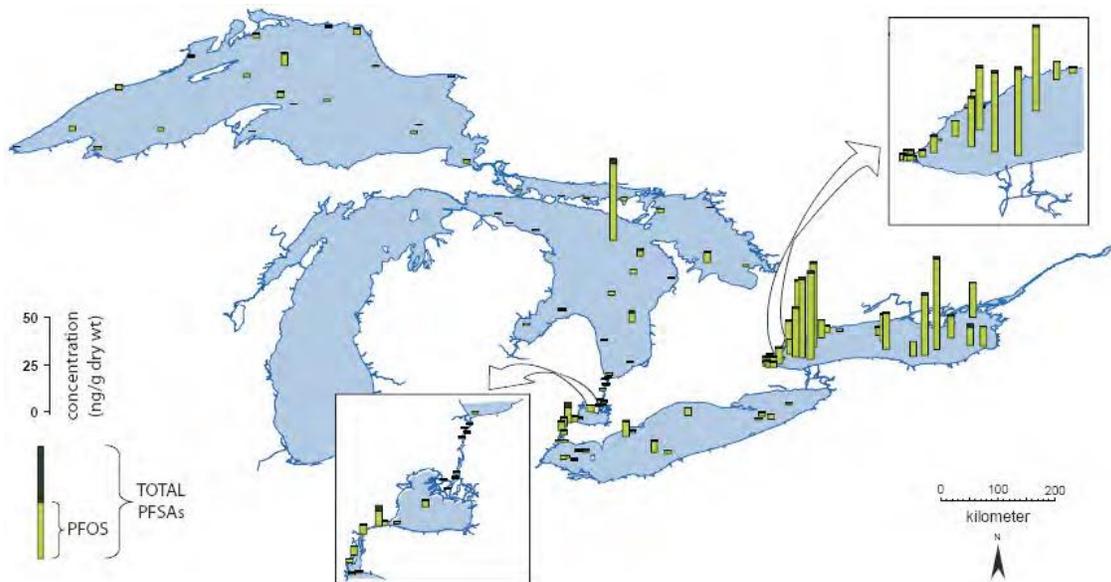
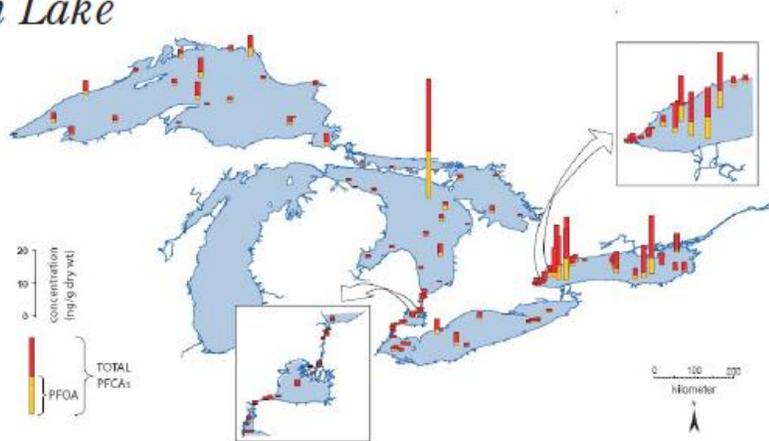


Figure 6: Total PFASs: perfluoroalkyl sulfonate acids (PFASs) and perfluorooctane sulfonate (PFOS) concentrations in surficial sediments of open-water areas of the Great Lakes (Source: State of the

Great Lakes, 2011)

Total Perfluorocarboxylates and Perfluorooctanoic Acid (PFOA)

Open Lake



Tributaries

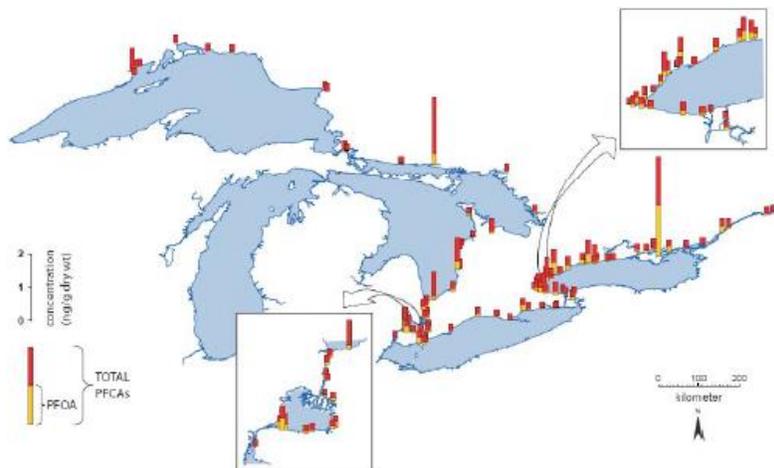


Figure 7: PFOA concentrations in surficial sediments in open water areas and tributaries of the Great Lakes (Source: Environment Canada PFC Factsheet, 2009)

Fish and other Wildlife:

Sufficient fish biomonitoring in the Great Lakes has been conducted to produce a dataset that indicates both spatial and temporal trends. Overall, between 1979 and 2010 the temporal trend of perfluoroalkyl and polyfluoroalkyl substance levels in Great Lakes lake trout have been an increase of until about 2010 followed by a potential stabilization. The dataset of Crimmins (2014) further indicates both stabilizations

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with some continuing decreasing trend in PFC concentrations in fish tissues in some of the Great Lakes over 2004 – 2012 (Figure 8).

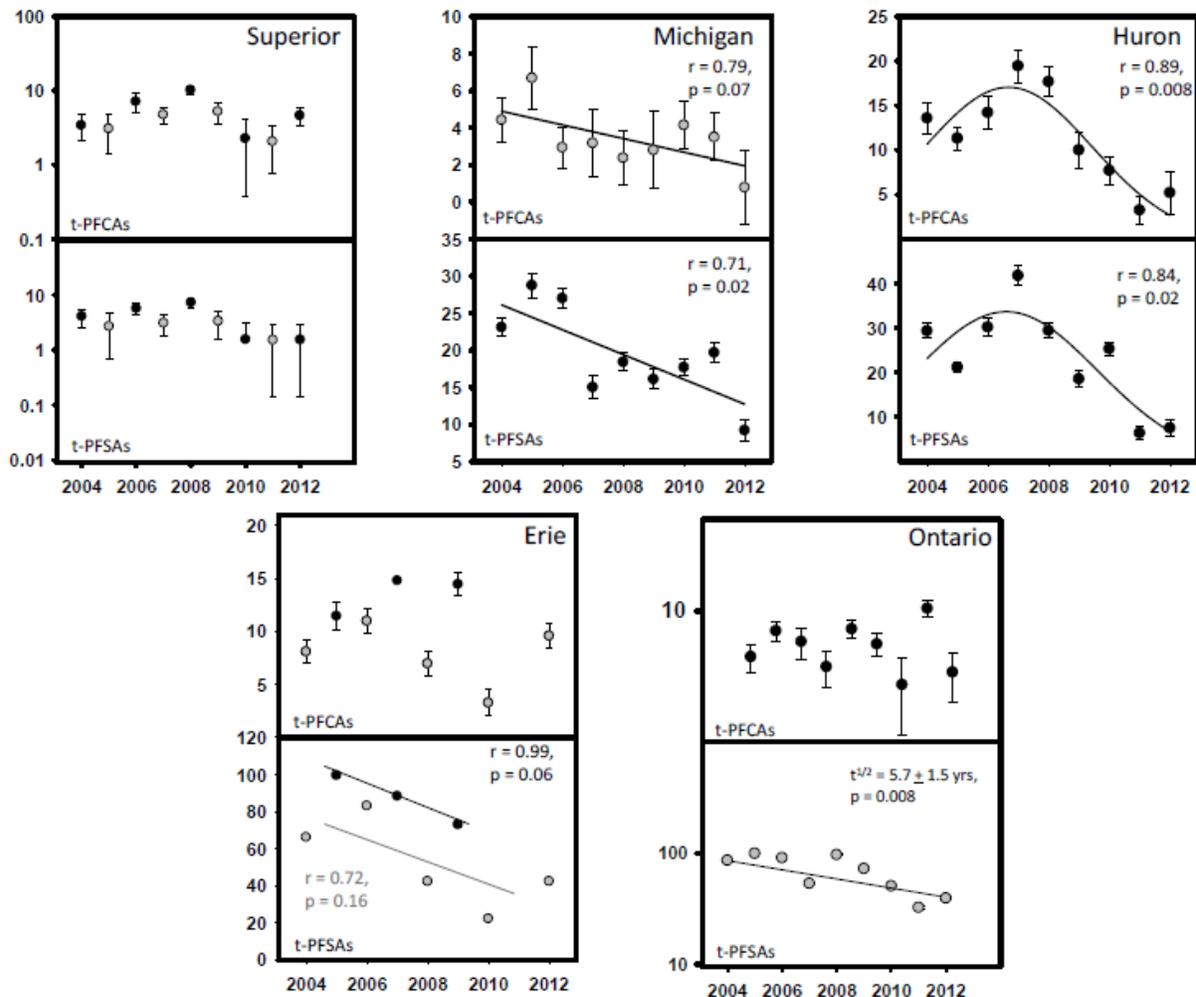


Figure 8: Total perfluoroalkyl sulfonic acid (t-PFSA) and perfluoroalkyl carboxylic acid (t-PFCA) geometric mean concentrations (ng/g) in fish tissues for Great Lakes from 2004-2012. Data points and error bars represent the yearly mean and standard deviation. Gray and black points represent different collection sites. (Source: Crimmins 2014)

From *Perfluorooctane Sulfonate in the Canadian Environment*, Environment Canada, 2013:
<http://ec.gc.ca/toxiques-toxics/default.asp?lang=En&n=7331A46C-1>

To provide a long-term perspective of PFOS in Lake Ontario lake trout, annual measurements made by Environment Canada (1997–2010) were combined with PFOS concentrations that Furdai and co-workers determined in archived lake trout samples (1979–2004). These archived samples were also collected in Lake Ontario by Environment Canada and the Department of Fisheries and Oceans and were analyzed for PFOS by the Ontario Ministry of the Environment. PFOS concentrations in Lake Ontario lake trout showed an overall increase between 1979 and 2000 (Figure 9 below). However, after this time, concentration trends stabilized, with geometric mean levels oscillating between 44 and 109 ng/g wet weight. These results suggest that although PFOS in Lake Ontario lake trout may have stopped

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increasing in response to the 2002 PFOS production phase-out by the primary supplier, corresponding concentration declines in fish have not been observed. The lack of recent decline may be a result of the large number of processes, in addition to chemical loadings, that affect the accumulation of PFOS in biota such as lake trout. For example, the amount of PFOS in fish is dependent on its diet, the accumulation rate of PFOS and its precursors from water and food, and the rate at which precursors are transformed to PFOS in the fish, its food and the environment. As such, the voluntary and regulatory measures may not be reflected in PFOS concentrations in Lake Ontario lake trout for years to come. In all years, observed concentrations in lake trout were at least an order of magnitude below the draft FEQG for fish tissue (8300 ng/g wet weight), but were between 1.5- and 27-fold higher than the draft FEQG for wildlife diet. Therefore, although PFOS does not represent a risk to the Lake Ontario lake trout themselves, it is present at levels that are potentially hazardous to the wildlife consumers of the fish.

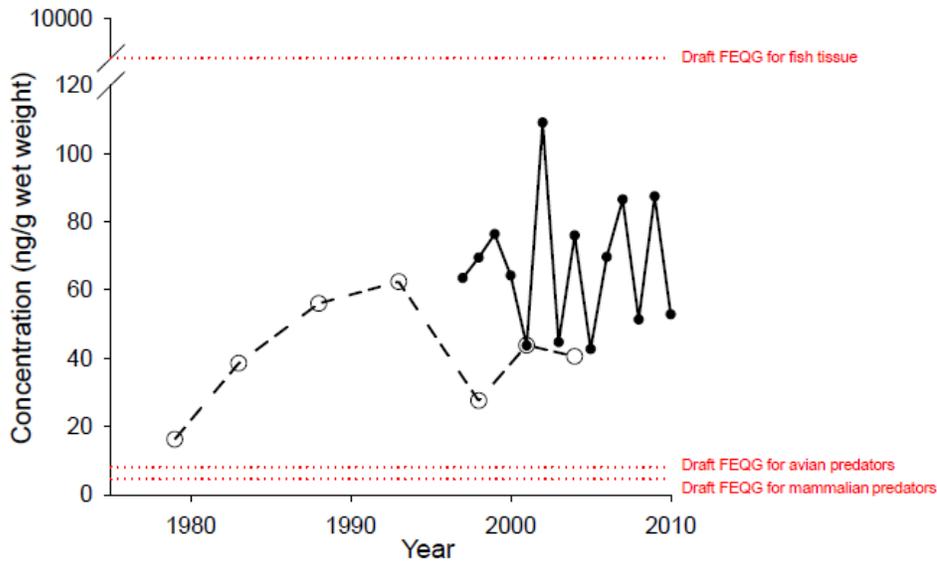


Figure 9: Geometric mean concentrations of PFOS in Lake Trout (ng/g ww) from Lake Ontario, 1979-2010. The dashed line represents data reported by Furudi et al. 2007 and 2008, and the solid line represents Environment Canada data. The draft Canadian FEQGs for fish tissues and for avian and mammalian wildlife diet are shown for comparison, with red dotted lines. (Source: Environment Canada, 2013)

Chemical	Matrix	Year	Location	Concentration	Citation
Sum of perfluoroalkyl and polyfluoroalkyl substances (PFAS)	Lake trout	2001	Lake Superior	13 ng/g	Furdui 2007
Sum of PFAS	Lake trout	2001	Lake Ontario	60 ng/g	Furdui 2007
Sum of PFAS	Lake trout	2001	Lake Huron	58 ng/g	Furdui 2007
Sum of PFAS	Lake trout	2001	Lake Erie	152 ng/g	Furdui 2007
PFOS	Lake trout	2006-2010	Lake Erie	90 ng/g	Environment Canada 2013
PFOS	Lake trout	2006-2010	Lake Ontario	62 ng/g	Environment Canada 2013
PFOS	Lake trout	2006-2010	Lake Superior	< 3 ng/g	Environment Canada 2013

Table 3: Other published fish tissue concentrations for PFCs.

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EPA has been conducting the National Coastal Condition Assessment (NCCA), a statistical survey of the ecological condition of U.S. coastal waters every five years since 2000. In 2010, EPA expanded the NCCA to include ecological assessment of the Great Lakes, which includes evaluations of toxic chemicals in sediments and whole fish. EPA analyzed fillet tissue prepared from each fish sample for 13 PFAAs.

All of the fish samples contained detectable levels of one or more PFAAs and frequency of occurrence was dominated by PFOS, which was detected in 100% of 157 samples. Concentrations of PFOS in fillets ranged from 2 to 80 ppb, and the median concentration was 15 ppb. (Stahl 2014).

In the absence of a final reference dose to develop national human health screening values, EPA applied Minnesota Department of Health (MDH) values that were published in 2008 as part of their statewide Fish Consumption Advisory Program

(<http://www.health.state.mn.us/divs/eh/fish/eating/mealadvicetables.pdf>) to interpret the PFOS results. The MDH guidance includes meal advice categories based on levels of PFOS in fish. Their sport fish advisory levels recommend consumption of only one meal of fish per week if PFOS concentrations are >40-200 ppb (ng/g, wet weight), one meal per month if levels are >200-800, and no consumption at levels greater than 800 ppb.

The application of these PFOS human health screening values (SVs) to study results indicated that no samples were in the no consumption (“do not eat”) category; however, 9.0% of the Great Lakes sampled population had PFOS tissue concentrations that exceeded the 40 ppb SV recommending that fish consumption be restricted to no more than one meal per week.

Since 2007, the MOECC has monitored for PFCs in fish tissue through the Fish Contaminant Monitoring Program which provided advice for choosing Ontario fish to minimize exposure to toxins. The guide compiles information for more than 2,300 locations around the province, including many locations in the Great Lakes. MOECC has set consumption restrictions for PFOS that begin at 0.02 parts per million for changing advice from 32 to 16 meals per month, 0.080 parts per million for 8 to 4 meals per month with complete restriction advised for levels above 0.160 parts per million for the sensitive population and 0.640 parts per million for the general population. Currently, there are five locations where concentrations have resulted in consumption restrictions. Four of these locations are in tributaries that lead to the Great Lakes. The restrictions were attributed to elevated levels of PFOS released from historic use in firefighting foam.

Since 2007, the MOECC has collected nearly 3500 data points for PFCs in fish tissues and eggs in the Great Lakes, connecting channels and major tributaries feeding the Lakes. Data for eleven PFCs (Table 4), 29 species of fish and six “portions” (whole fish composite, multiple fish composites, eggs, skinless boneless filets of sportfish, young fish composites and eviscerated/headless small fish) are available.

The highest concentration detected was for PFOS in Chinook Salmon eggs at 560 ng/g. Eggs from a number of salmonid species collected in the Credit River (discharging to Lake Ontario) had elevated concentrations of PFOS. Maximum concentration detected for each PFC is summarized in Table 5.

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PFDA	Perfluorodecanoic acid
PFDOA	Perfluorododecanoic acid
PFDS	Perfluorodecane sulfonate
PFHPA	Perfluoroheptanoic acid
PFHXS	Perfluorohexane sulfonate
PFNA	Perfluorononanoic acid
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctane sulfonate
PFOSA	Perfluorooctane sulfonamide
PFTEA	Perfluorotetradecanoic acid
PFUNA	Perfluoroundecanoic acid

Table 4: PFCs analyzed in Fish (Source: OMOECC, Unpublished)

PFC	Location	Sample Year	Species	Portion Type	Maximum Concentration (ng/g)
PFDA	Credit River	2007	Rainbow trout	Egg	16
PFDOA	Credit River	2007	Brown trout	Egg	15
PFDS	Credit River	2007	Rainbow trout	Egg	11
PFHPA	Credit River	2007	Coho Salmon	Egg	1.2
PFHXS	Credit River	2007	Brown Trout	Egg	7
PFNA	North Channel	2009	Lake Trout	Composite	6.6
PFOA	Lake Ontario	2009	Atlantic Salmon	Fillet	1.6
PFOS	Credit River	2007	Chinook Salmon	Egg	560
PFOSA	North Channel	2009	Walleye	Composite	2.8
PFTEA	Credit River	2007	Brown Trout	Egg	4.0
PFUNA	Ausable River	2007	Chinook Salmon	Egg	21

Table 5: Maximum concentration of PFCs detected in OMOECC fish surveys (OMOECC, Unpublished)

The most comprehensive dataset for PFC concentrations in wildlife tissues is presented by Environment Canada (2013). Herring gull eggs were monitored for PFOS in 1990 and 1997 – 2010 at seven colonies throughout the Great Lakes. The data for gulls collected from the more urbanized regions of southern Ontario are shown in Figure 10. Likewise; Figure 11 shows PFOS levels in gull eggs collected from three more remote colonies in lakes Huron and Superior. In the more urbanized areas, consistent with the trends of Lake Ontario lake trout, PFOS concentrations oscillated and have not shown a consistent decline in response to the 2002 PFOS production phase out by the primary supplier. In contrast, an overall decline was evident in gull eggs from the more remote colonies on lakes Huron and Superior.

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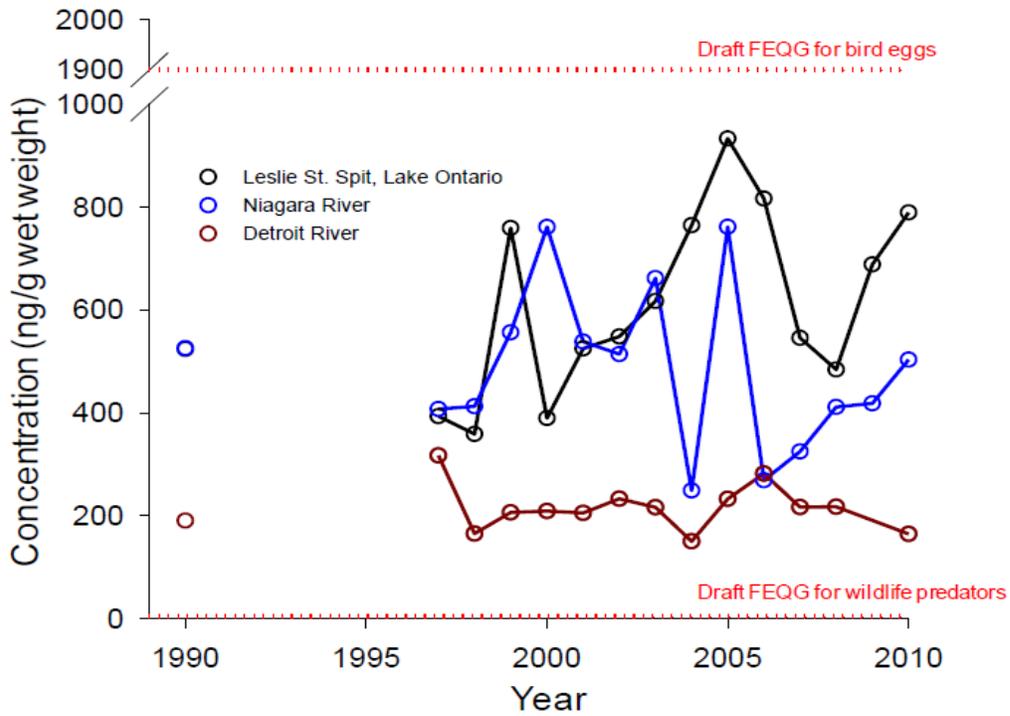


Figure 10: PFOS concentrations in Herring Gull eggs (ng/g wet weight) from Lake Ontario (Leslie Street Spit), Niagara River and Detroit River (Fighting Island), from 1990 to 2010. The draft Federal Environmental Quality Guidelines (FEQGs) for bird eggs and wildlife diet are shown for comparison (red dotted lines). (Source: Environment Canada 2013)

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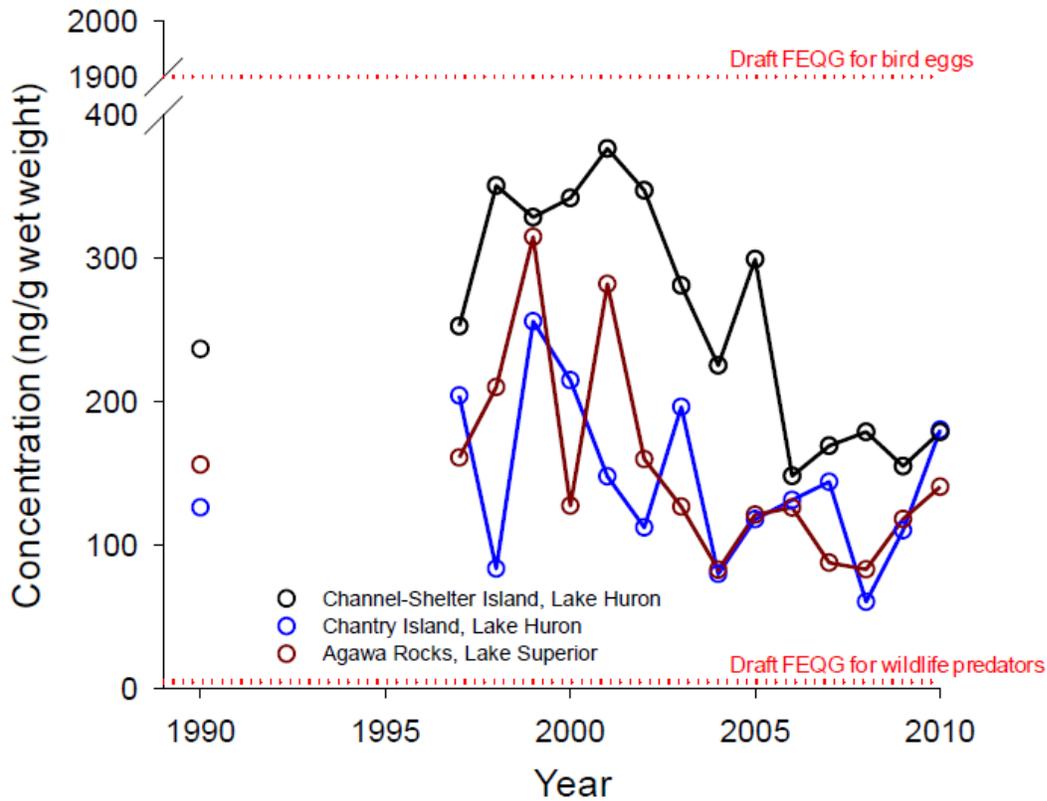


Figure 11: PFOS concentrations in Herring Gull eggs (ng/g wet weight) from Lake Huron (Channel-Shelter and Chantry Islands) and Lake Superior (Agawa Rocks), from 1997 to 2010. The draft Federal Environmental Quality Guidelines (FEQGs) for bird eggs and wildlife diet are shown for comparison (red dotted lines). (Source: Environment Canada 2013)

Chemical	Matrix	Year	Location	Concentration	Citation
Perfluorooctanesulfonate (PFOS)	Great blue heron eggs	1993	Lake Michigan, Indiana dunes National Lakeshore	245 ng/g	Custer 2009
Sum of perfluorinated compounds (PFC)	Great blue heron eggs	1993	Lake Michigan, Indiana dunes National Lakeshore	279 ng/g	Custer 2009
PFOS	Double-crested cormorant egg yolk	Pre-2001	Lake Huron	170 ng/g	Giesy and Kannan 2001
PFOS	Ring-billed gull eggs	Pre-2001	Lake Huron	67 ng/g	Kannan 2001

Table 6: Other published tissue concentrations for PFCs in bird eggs.

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PFC residues in bald eagle nestling blood plasma were measured at two locations on Lake Superior from 2006 to 2011 (Table 5).

Analyte	Apostle Island National Lakeshore (n=37)		Lake Superior South Shore (n=11)	
	(µg/mL)	Probability of decline ¹	(µg/mL)	Probability of decline ¹
Sum PFCs	552	90	490	83
Perfluorooctanesulfate (PFOS)	265	76	425	73
Perfluorodecanesulfonate (PFDS)	13.6	98	13.7	92
Perfluorodecanoic acid (PFDA)	12.6	48	11.3	39
Perfluoroundecaenoic acid (PFUnA)	17.5	100	11.8	100
Perfluorododecanoic acid (PFDoA)	7.03	98	5.81	94
Perfluorononanoic acid (PFNA)	8.13	18	4.93	52
Perfluorotridecanoic acid (PFTrDA)	3.87	0	3.01	0
Perfluoroheptanesulfonate (PFHpS)	1.88	99	1.97	92
Perfluorohexanesulfonate (PFHxS)	2.25	98	1.8	95
Perfluorotetradecanoic acid (PFTeDA)	1.49	0	1.42	0
Perfluorooctanoic acid (PFOA)	1.01	100	0.64	100
Perfluorobutanoic acid (PFBA)	0.31	20	0.43	36

¹The probability that levels are declining, calculated as the percentage of trend estimates from the posterior distribution that are below zero.

Table 7: Estimated geometric mean (ng/mL) and probability of decline in concentrations of 12 PFCs in blood plasma of bald eagle nestlings inclusive of 2006 through 2011 (Source: Route et. al 2014).

Temporal trends demonstrate declines in bald eagle nestling plasma between 2006 and 2011 for sum PFCs and select individual PFCs while demonstrating no declining trend in other PFCs. In addition to sum PFC there are 6 PFCs including PFOS and PFOA that have a probability >90 for a declining temporal trend. Four PFC have a probability <20 for a declining temporal trend.

The PFOS residue concentrations in plasma did not exceed the toxicity reference value of 1700 ng PFOS/mL blood-plasma that was calculated by Newsted (2005) to be protective of a level IV fish-eating bird such as an eagle. In addition the investigators found no effects of PFOS on bald eagle productivity (Route et al 2014).

Waste Water:

In a 2013 report the IJC summarized some of the research on PFCs in sewage treatment plant effluent. Levels of PFOA and PFOS were the highest at STP effluents (up to 54.7 and 208.5 ng/l) in southern Ontario. (See Table 8).

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Compound	Matrix	Location	Concentration	Frequency	Reference
Heptadecafluorooctane sulfonamide	STP effluents	Southern Ontario	ND-3.8 ng/l	5/7	Furdui et al. (2008)
Perfluorodecanoic acid	STP effluents	Southern Ontario	0.8-4.9 ng/l	7/7	Furdui et al. (2008)
Perfluorododecanoic acid	STP effluents	Southern Ontario	ND-8.1 ng/l	5/7	Furdui et al. (2008)
Perfluoroheptanoic acid	STP effluents	Southern Ontario	1.9-6.5 ng/l	7/7	Furdui et al. (2008)
Perfluorononanoic acid	STP effluents	Southern Ontario	1.6-5.4 ng/l	7/7	Furdui et al. (2008)
Perfluorooctanoic acid	STP effluents	Southern Ontario	0.1-54.7 ng/l	7/7	Furdui et al. (2008)
Perfluorooctanoic acid	STP effluents	Windsor	27-141 ng/l	8/8	Tabe et al. (2009)
Perfluorooctanoic sulfonate	STP effluents	Southern Ontario	8.6-208.5 ng/l	7/7	Furdui et al. (2008)
Perfluorooctanoic sulfonate	STP effluents	Windsor	9-82 ng/l	8/8	Tabe et al. (2009)
Perfluoroundecanoic acid	STP effluents	Southern Ontario	ND-5.7 ng/l	5/7	Furdui et al. (2008)
Potassium perfluorohexane sulfonate	STP effluents	Southern Ontario	3-10.7 ng/l	7/7	Furdui et al. (2008)

Table 8: The occurrence of perfluorinated surfactants in sewage treatment plans in the Great Lakes Basin. (Source: State of the Great Lakes, 2011)

Drinking Water:

The OMOECC has carried out two studies looking at perfluorinated compounds in source and finished drinking water in Ontario. In 2005/2006, 33 samples (16 untreated source water and 17 finished drinking water) were collected at 8 Drinking Water Systems (DWS). Samples of untreated source water (2 lake, 5 river and 1 groundwater) were taken at the intake of the DWSs.

Compound	Sample Type	% Detection	Detection limit (ng/L)	Maximum (ng/L)
PFOS	Source	81	0.5	6.5
	Finished	76		6.4
PFOA	Source	88	0.5	6.0
	Finished	71		6.0
PFHxS	Source	50	1.0	1.8
	Finished	36		1.7
PFNA	Source	31	0.5	1.1
	Finished	24		1.0

Note: PFDoA, PFUnA, PFOSA and PFDS were not detected in any sample.

Table 9: Summary of results from 2005-2006 Ontario drinking water monitoring (source and finished). (Source: OMOECC)

Maximum concentrations detected in finished drinking water for PFOS (0.0064 ug/L) and PFOA (0.006 ug/L) were well below the Health Canada DWGVs, indicating little risk to human health.

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In 2012, OMOECC carried out a second survey of Perfluorinated Compounds in drinking water. 113 samples (59 untreated, 54 finished) were taken from 17 DWS. PFDoA, PFDS, PFOSA and PFUnA were not detected in any samples.

Compound	Sample Type	Number and Percent Detections (%)	Detection Limit (ng/L)	Maximum (ng/L)
PFDA	Raw	3 (5%)	0.5	0.7
	Treated	2 (4%)		0.6
PFHpA	Raw	5 (8%)	1	1.7
	Treated	4 (7%)		2
PFHxS	Raw	10 (17%)	1	1.7
	Treated	15 (28%)		1.8
PFNA	Raw	17 (29%)	0.5	0.9
	Treated	13 (24%)		0.8
PFOA	Raw	42 (71%)	0.5	4.5
	Treated	40 (74%)		4.6
PFOS	Raw	31 (53%)	0.5	4.2
	Treated	24 (44%)		3.6

Table 10: Summary of results from 2012 Ontario drinking water monitoring (source and finished). (Source: OMOECC)

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Compound	Sample Type	2006	2012
PFHxS	Raw	1.8	1.7
	Treated	1.7	1.8
PFNA	Raw	1.1	0.9
	Treated	1.0	0.8
PFOA	Raw	6.0	4.5
	Treated	6.0	4.6
PFOS	Raw	6.5	4.2
	Treated	6.4	3.6

Table 11: Comparison of 2012 Results to 2005/2006 Results: In general, maximum concentrations in drinking water were lower in 2012. All concentrations were well below relevant Health Canada Drinking Water Guideline Values. (Source: OMOECC)

PFOS in the influents and effluents of drinking water treatment facilities in Detroit and Windsor show similar frequency of detection and concentration ranges (See Table 12).

Compound	Matrix	Location	Concentration	Frequency	Reference
Perfluorooctanoic acid	DWTF influent	Windsor-Detroit	2-22 ng/l	20/22	Tabe et al. (2009)
Perfluorooctanoic sulfonate	DWTF influent	Windsor-Detroit	2-16 ng/l	18/22	Tabe et al. (2009)
Perfluorooctanoic acid	DWTF effluent	Windsor-Detroit	2-32 ng/l	30/32	Tabe et al. (2009)
Perfluorooctanoic sulfonate	DWTF effluent	Windsor-Detroit	2-12 ng/l	31/32	Tabe et al. (2009)

Table 12: The occurrence of perfluorinated surfactants in drinking water treatment facilities in the Great Lakes basin.

UCMR3 program - a comprehensive drinking water monitoring program - was launched in 2012 for monitoring between 2013 through December 2015.

For the October 2014 update, 18,873 results from 3,091 Public Water Systems were reported for PFOS and 18,874 results (also from 3,091 Public Water Systems) were reported for PFOA. 166 results (for PFOS) at 56 locations and 192 results (for PFOA) at 62 locations were above the MRL (minimum reporting level for PFOS = 0.04 µg/L and for PFOA = 0.02 µg/L). For PFOS, 24 results at 12 Public Water Systems were above the Reference Concentration of 0.2 µg/L, whereas for PFOA none of results were above the Reference Concentration of 0.4 µg/L.

Human Biomonitoring:

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In 2006 Health Canada concluded in a human health assessment that the levels of PFOS exposure were below levels which might affect human health however biomonitoring studies have been conducted to track levels in human blood plasma.

Canadian Health Measures Survey 2 (CHMS 2) conducted from 2009-2011 detected six of the nine PFCs tested for in the blood plasma of Canadians (Health Canada, 2013). Most frequently detected were PFOS, PFOA and PFHxS with detection frequencies ranging from 100 to 98 percent. An earlier survey from 2007 - 2009 (CHMS 1) tested for PFOS, PFOA and PFHxS and found levels slightly higher than the 2009-2011 survey but detection frequencies were about the same (Health Canada, 2013).

The First Nations Biomonitoring Initiative (FNBI) found lower concentrations than the CHMS 2 study conducted during the same time frame, but the Great Lakes First Nation subpopulation of the FNBI study had PFC concentrations in plasma greater than the mean but about the same as those found in CHMS 2 (Assembly of First Nations, 2013).

Substance ¹	CHMS 1 (2007-2009) µg/L	CHMS 2 (2009-2011) µg/L	FNBI (2011) µg/L	FNBI (2011) Great Lakes sub pop µg/L
PFOS	8.9	6.9	3.12	7.45
PFOA	2.5	2.0	1.39	1.96
PFHxS	2.3	1.7	0.86	1.91
PFBA	N/A	ND	ND	ND
PFHxA	N/A	ND	ND	ND
PFNA	N/A	0.82	0.72	0.75
PFDA	N/A	0.2	0.16	0.26
PFUnDA	N/A	0.12	0.11	0.16
PFBS	N/A	ND	ND	ND

Note: CHMS 1 and CHMS 2 data are for ages 20-79 years except for PFNA, PFDA, PFUnDA and PFBS which are for ages 12-79 years. The FNBI data are for ages 20 and older.

Table 13: Comparison of values reported under the Canada Health Measures Survey and the First Nations Biomonitoring Initiative. (Source: Health Canada, 2013 and Assembly of First Nations, 2013)

US Centre for Disease Control reports several PFAAs (including PFOS, PFOA, PFHxS or perfluorohexane sulfonic acid, and PFNA or perfluorononanoic acid) in the serum of nearly all of the Americans tested, indicating widespread exposure to these PFCs in the U.S. population (CDC PFCs Factsheet). The data are published in the National Report on Human Exposure to Environmental Chemicals (NHANES). Updated data tables for the 2011-2012 NHANES data have been published in August 2014.

<http://www.cdc.gov/exposurereport/>

¹ Some of these substances referred to in the biomonitoring studies may not be part of this review. The highlighted substances are considered PFCAs salts or precursors when compared to Table 1 of the EC Ecological Screening report. For reference: Perfluorohexane sulfonate (PFHxS), Perfluorohexane acid (PFNA) Perfluorobutane sulfonate (PFBS) Perfluorohexanoic acid (PFHxA), Perfluorodecanoic acid (PFDA), and Perfluoroundecanoic acid (PFUDA)

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Great Lakes Biomonitoring Studies

CHMS II reported on a study in 2004–2005 of perfluoroalkyl acids in pregnant women and their babies in Hamilton, Ontario. PFOS and PFOA were detected in all 101 maternal serum samples and all 105 umbilical cord serum samples. The maternal mean PFOS levels were 18.3 µg/L at 24–28 weeks gestation, and 16.2 µg/L at delivery. The PFOS umbilical cord mean was 7.2 µg/L. The maternal PFOA mean levels were 2.5 µg/L at 24–28 weeks gestation, and 2.2 µg/L at delivery; and in all 105 umbilical cord serum samples with a mean of 1.9 µg/L. PFHxS was also detected in about 45% of maternal samples and 20% of umbilical cord samples (Monroy et al. 2008).

Relevance of Biomonitoring Data

Biomonitoring data represent integrated exposures from multiple routes including diet, indoor and outdoor environments and occupational and recreational exposure. The data indicate exposure but at this point it is not possible to identify major route of exposure.

Conclusions:

PFOS concentrations in air are highest near populated areas and the highest concentrations of PFCAs in air from across Canada were identified in Toronto. Although there is no temporal trend data for PFC concentrations in air within the Great Lakes Basin, data from Alert station in Nunavut shows an oscillating but declining trend in air.

PFASs are found in sediment samples from across the Great Lakes basin with greater concentrations near population centers. Sediment core samples from Lake Ontario show increasing PFASs concentrations over time.

PFASs are detected in the tributaries and open water sediments across the Great Lakes basin with the highest levels of PFASs generally found in areas of Lake Ontario, the western end of Lake Erie and the Detroit River corridor. A temporal trend of PFASs in surface water samples could not be determined.

PFOA and PFOS are found in wastewater plant effluent. PFOS has been detected at drinking water plant treatment facilities in source and treated waters.

Concentrations of PFOS are found in fish from the Great Lakes at concentrations which exceed the draft Canadian federal environmental quality guidelines established for the protection of avian and mammalian predators, but below fish tissue guidelines established for the protection of fish themselves. No Canadian environmental quality guidelines exist for PFOA so monitoring data could not be compared for PFOA. PFASs in Great Lakes fish generally showed an overall increase between 1980 and 2000. However since this time, concentration trends have started to stabilize across the Great Lakes.

PFOS concentrations in Herring Gull eggs in the Great Lakes show large inter-annual variability. In urban colonies, PFOS concentrations have not shown consistent declines, while in remote colonies, a decline was evident. PFOS concentrations in Herring Gull eggs were below the Canadian draft guideline for bird eggs; but were 10-to-200-fold higher than the draft guideline for wildlife predators. Therefore similar to Great Lakes fish, although PFOS does not represent a risk to the gulls themselves, it is present at levels that are potentially hazardous to the gull's wildlife predators.

Human biomonitoring studies found high frequency of detection of PFOS, PFOA and PFHxS in blood plasma. In a First Nation study the Great Lakes population had slightly higher concentrations of PFAAs

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than the national average. While national biomonitoring studies about three years apart show decreases in PFOS, PFOA and PFHxS in blood plasma more testing would be needed to confirm this as a trend.

4. Review of past, present and/ or planned science and risk management actions:

Is there a need for additional risk management and/or science activities and are there resources and/or tools available to support the delivery of such activities?

Canadian Federal Risk Management Activities:

PFOS

On December 16, 2006, the proposed *Perfluorooctane Sulfonate and Its Salts and Certain Other Compounds Regulations* were published in the *Canada Gazette*, Part I. The final Regulations were published in Part II of the *Canada Gazette* on June 11, 2008.

The purpose of the Perfluorooctane Sulfonate and Its Salts and Certain Other Compounds Regulations is to protect Canada's environment from the use and release of PFOS, its salts and its precursors. The Regulations prohibit the manufacture, use, sale, offer for sale and import of PFOS and products containing PFOS. Five year exemptions were provided for the use, other than for training and testing purposes, of existing stocks of PFOS based AFFF and the use sale, offer for sale and import of PFOS based fume suppressants used in the metal plating industry. Other exemptions provide for the use, sale and offer for sale of manufactured products, manufactured or imported prior to the coming into force of these Regulations, as well as the manufacture, import, sale, offer for sale and use of products containing PFOS used as photoresists or anti-reflective coatings for photolithography processes and photographic films, papers and printing plates.

On January 13, 2009, the Regulations Adding Perfluorooctane Sulfonate and its Salts to the Virtual Elimination List were published in the *Canada Gazette*, Part II. The Regulations add PFOS and its salts to the Virtual elimination List compiled under subsection 65(2) of CEPA 1999. The Regulations demonstrate the Government of Canada's continuing commitment to virtually eliminate PFOS.

Canada is party to two international agreements that restrict and ultimately target the elimination of the production, use, trade, release and storage of PFOS: the Stockholm Convention on Persistent Organic Pollutants and the Protocol on Persistent Organic Pollutants (POPs) of the United Nations Convention on Long-range Transboundary Air Pollution (LRTAP). The objective of these international agreements is to protect human health and the environment from POPs.

PFOA and Long-chain PFCAs

On March 30, 2010, Environment Canada and Health Canada signed a Performance Agreement with participating companies who sell perfluorochemical products that contain PFOA, long-chain (C₉-C₂₀) PFCAs and their precursors in Canada. The purpose of the Agreement is to work towards elimination of residual PFOA, long-chain (C₉-C₂₀) PFCAs and their precursors in those products by December 31, 2015, as well as to collect and report information on the products sold in Canada.

Final regulations respecting the four fluorotelemer-based precursor substances assessed separately under the New Substances Program were published on October 31st, 2010 – this effectively added these four substances to Schedule 1 of the *Prohibition of Certain Toxic Substances Regulations* which are used to prohibit the manufacture, use, sale, offer for sale or import of certain toxic substances listed in

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Schedule 1 and 2 of the Regulations, as well as products containing these substances with a limited number of exemptions.

The proposed Government of Canada risk management objective for PFOA and long-chain PFCAs is to minimize their release to the environment to the greatest extent practicable that is technically and economically feasible. As such, the risk management being considered for both PFOA and long-chain PFCAs is prohibition through regulation. A prohibition regulation would prohibit the manufacture, use, sale, offer for sale, import and export of PFOA and long-chain PFCAs and products containing PFOA and long-chain PFCAs. Publication of the final risk management instrument is expected no later than January, 2016;

- Government of Canada. January 2013. *Prohibition of Certain Toxic Substances Regulations, 2012*. (Schedule 1, Part 2; Fluorotelemer-based substances)

U.S. Federal Risk Management Activities:

- US Environmental Protection Agency. 2009. Long-Chain Perfluorinated Chemicals (PFCs) Action Plan.

PFOA and other long-chain PFCs in the U.S. are being reduced under the 2010/2015 PFOA Stewardship Program, which seeks to eliminate PFOA and other long-chain PFC sources in the U.S. by 2015.

Under TSCA, EPA finalized two Significant New Use Rules (SNURs) in 2002 for 88 PFOS-related substances, which require companies to notify the EPA 90 days before starting to manufacture or importing these substances for a significant new use; this pre-notification allows time to evaluate the new use.

In 2007, the SNURs were amended to include 183 additional PFOS-related substances.

PFCs are identified in the US as Action Plan Chemicals. Based on EPA's 2009 screening-level review of hazard and exposure information, EPA outlined the following activities to reduce risk from long-chain PFCs:

- Consider initiating rulemaking under section 6 of the Toxic Substances Control Act (TSCA) to manage long-chain PFCs.
- Consider other regulatory approaches under TSCA, such as the SNURs, to manage long-chain PFCs.
- Evaluate the potential for disproportionate impact on children and other sub-populations.
- Continue with the 2010/15 PFOA Stewardship Program to work with companies toward the elimination of long-chain PFCs from emissions and products by the end of 2015.
- EPA will also continue to evaluate alternatives under EPA's New Chemicals Program and collaborate with other countries on managing PFCs

On September 30, 2013, the EPA issued a SNUR requiring companies to report 90 days in advance of all new uses of long-chain perfluoroalkyl carboxylic (LCPFAC) chemicals for use as part of carpets or to treat carpets, including the import of new carpet containing LCPFAC.

On January 15, 2015, EPA published a proposed Significant New Use Rule (SNUR) to ensure that perfluorinated chemicals that have been phased out do not re-enter the marketplace without review. In the same notice, EPA proposed to amend a SNUR for perfluoroalkyl sulfonate (PFAS) chemical substances that would make inapplicable the exemption for persons who import PFAS chemical

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substances as part of carpets. <http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OPPT-2013-0225-0001>

Other Activities

- Baltic Marine Environmental Protection Commission. 2013. Control of hazardous substances in the Baltic Sea region (COHIBA).
- PFOS, its salts and PFOS-F was listed in Annex B of the Stockholm Convention with specific exemptions and acceptable purposes in 2009.
- Under EU REACH, an Annex XV Restriction Proposal for PFOA, PFOA-salts and PFOA-related substances has been published.

Identification of Gaps in Management and/or Science Activities

(1) Are environmental levels below applicable benchmarks and are there any discernable environmental trends?

The most relevant benchmarks identified are the draft Canadian Federal Environmental Quality Guidelines for PFOS (Environment Canada 2013). There are no known PFC guidelines for air or sediment however significant increasing trends in sediment concentrations of PFOS and other PFCs have been observed.

PFOS concentrations in water are well below the draft Canadian guideline in addition to the chronic health risk limit developed in Minnesota (300 ng/L for PFOS and PFOA in drinking water).

PFOS concentrations in fish tissue (lake trout) and bird's eggs (e.g. herring gull) are below the draft Canadian Federal Environment Quality Guidelines for fish tissue and bird egg but exceed the draft mammalian and avian wildlife diet guidelines. There are no known benchmarks or guidelines for other PFCs.

Concentrations of PFOS and PFOA in Lake Trout (Lake Huron and Lake Michigan) have shown recent declines while Lake Trout in the other lakes and Herring Gull eggs from all lakes have shown to be generally stable, with some inter-annual variability. It is unclear what is causing these recent trends and whether this represents a change in the long-term trend or simply short-term variability.

(2) Is the GLB-relevant human health exposure being adequately addressed?

Human biomonitoring studies found high frequency of detection of PFOS, PFOA and PFHxS in blood plasma. In a First Nation study the Great Lakes population had slightly higher concentrations of PFCs than the national average. While national biomonitoring studies about three years apart show decreases in PFOS, PFOA and PFHxS in blood plasma more testing would be needed to confirm this as a trend. No multiyear data is available for the other PFCs detected in human plasma. It is recommended that PFCs levels in plasma continue to be tracked to examine trends and the effectiveness of phase out and management measures at reducing exposures.

While no fish consumption advisories are in effect in the Great Lakes specifically due to PFCs, as advisories are generally made based on the most restrictive contaminant (most commonly PCBs), there is evidence to suggest that if considering only PFCs, there would be some consumption advisories (e.g. 1

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meal / month) in some locations of the Great Lakes, based on Ontario and Minnesota's guideline values; however, there would be no complete restrictions.

(3) Are applicable/available objectives for the substances being met?

Monitoring data shows PFOS concentrations decreasing in air and human plasma but oscillating in herring gull eggs and increasing in sediment. Therefore it is likely that Canada and the U.S will need to continue existing risk management activities and/or take further actions to reduce the releases of PFCs and their concentrations in the Great Lakes. In addition to regulatory and other risk management activities currently in place and forthcoming, monitoring and surveillance should be undertaken (long-chain PFCAs) or continued (PFOS and PFOA), in order to track their concentrations and trends in the Great Lakes basin, measure the performance of risk management and evaluate transboundary sources.

The Government of Canada is committed to the virtual elimination of PFOS through regulatory steps commenced in 2008. Further steps may be necessary to meet the national objective of virtual elimination, for example compliance promotion and enforcement with respect to PFOS in products and imported articles. In the US, additional action will be needed to address existing uses of PFOS, as presently only new uses are managed through the Significant New Use Rules.

Canada has an environmental performance agreement with specific industries to phase out the use of PFOA and long-chain PFCAs and their precursors by 2016 in an effort to manage the risk posed by these substances to the Canadian environment by reducing their use by industry. In addition, further actions, specifically prohibition, are being considered for PFOA and LC-PFCAs.

In 2006, former US EPA Administrator Stephen L. Johnson invited the eight major fluoropolymer and telomer manufacturers to join in a global stewardship program with two goals:

- To commit to achieve, no later than 2010, a 95% reduction, measured from a year 2000 baseline, in both facility emissions to all media of PFOA, precursor chemicals that can break down to PFOA, and related higher homologue chemicals, and product content levels of these chemicals.
- To commit to working toward the elimination of these chemicals from emissions and products by 2015.

PFCA concentrations have been decreasing in fish from some locations, and minor decrease were observed in human plasma, but PFOA and PFCA concentrations have been increasing in sediment. Additional reductions of PFOA and PFCA releases could be obtained through initiatives at various levels of government targeting wastewater management, including biosolids management, waste management (e.g. landfills) and recycling facilities that are ongoing sources of legacy items containing PFCs. Further investigation is needed in releases due to the degradation or transformation of precursors in wastewater treatment plants and landfills.

(4) If no objectives exist for the substance, is progress being made towards reducing levels in the environment, generating needed data, etc.?

N/A

(5) If progress is not being made, are actions in place to expect progress (e.g., regulations that have yet to take effect)?;

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Progress is being made. Actions are in place to expect further progress and environmental monitoring is ongoing.

Canada has published the *Perfluorooctane Sulfonate and Its Salts and Certain Other Compounds Regulations*, which prohibit the manufacture, use, sale, offer for sale and import of PFOS as well as manufactured products containing PFOS. Five year exemptions were provided for the use, other than for training and testing purposes, of existing stocks of PFOS based AFFF and the manufacture, use sale, offer for sale and import of PFOS based fume suppressants used in the metal plating industry. These exemptions expired in 2013.

Canada is in the process of developing a final risk management instrument for PFOA and long-chain PFCAs. The risk management instrument being considered for both PFOA and long-chain PFCAs is prohibition through regulation. A prohibition regulation would prohibit the manufacture, use, sale, offer for sale, import and export of PFOA and long-chain PFCAs and products containing PFOA and long-chain PFCAs. Publication of the final risk management instrument is expected no later than January, 2016;

(6) Gaps in risk management, research or monitoring for the substance (e.g., ongoing releases of concern, knowledge needs, lack of monitoring data) and possible actions that would fill these gaps:

Monitoring has demonstrated stabilizing trends in the GLB for PFC with the exception of more industrialized areas such as Lake Ontario where concentrations in biota have oscillated rather than declined. Hence, continued monitoring and control efforts should focus on these areas.

Additionally, with the impending voluntary reduction in production to near zero in 2015 in response to regulations, monitoring is required to assess the effectiveness of the implemented regulations at reducing the environmental concentrations to inform further actions should they be required (Adaptive Management).

As items containing PFCs are disposed, measures are needed to target releases from the waste sector (landfills, recycling plants). WWTP effluents and biosolids contain PFCs as products containing PFCs breakdown and release chemicals. Further research of the dynamics and environmental fate of degradation or transformation of PFC precursors in wastewater treatment plants and landfills should be considered.

Additionally, further research should be considered with respect to mammalian and avian toxicity to PFCs, as presently, relevant guidelines and benchmarks rely extensively on extrapolation from lab studies and the application of significant safety factors.

Apart from voluntary initiatives (Canada and the US) and restrictions on new uses (US) comprehensive risk management of PFOA and long-chain PFCAs has not yet been initiated in Canada or the US. The same can be said with respect to PFOS in the US; however, in Canada existing management for PFOS is sufficient and efforts should shift to compliance promotion (e.g. imported products) and performance measurement.

5. Final Recommendation:

With respect to PFOS, PFOA and long-chain PFCAs, the ITT has concluded by consensus that there was sufficient data and information available to effectively apply the *Binational Considerations*. Therefore, based on their application of the considerations, **the ITT has recommended, by 2/3rd majority, that PFOS, PFOA and long-chain PFCAs all be designated as CMCs.**

While a 2/3 majority was reached, there were minor dissenting views. Some members felt that given the information available and considering existing and forthcoming management actions, PFOS should be designated Not a CMC and that PFOA and long-chain PFCAs should be designated as insufficient information on which to base a determination.

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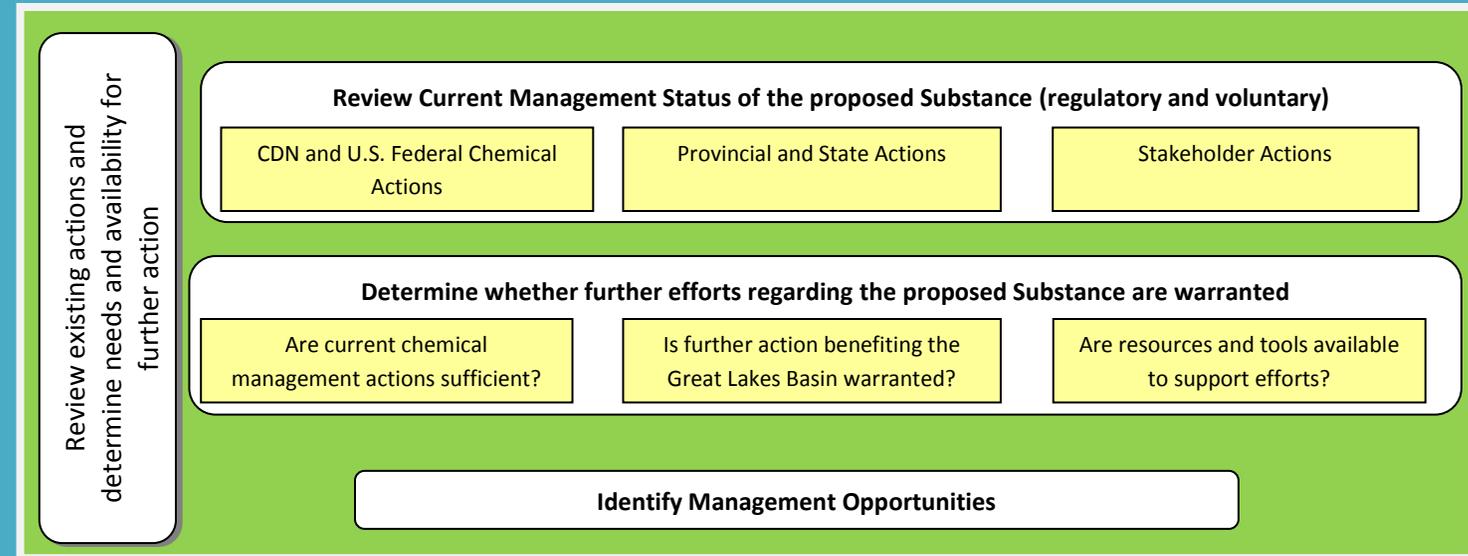
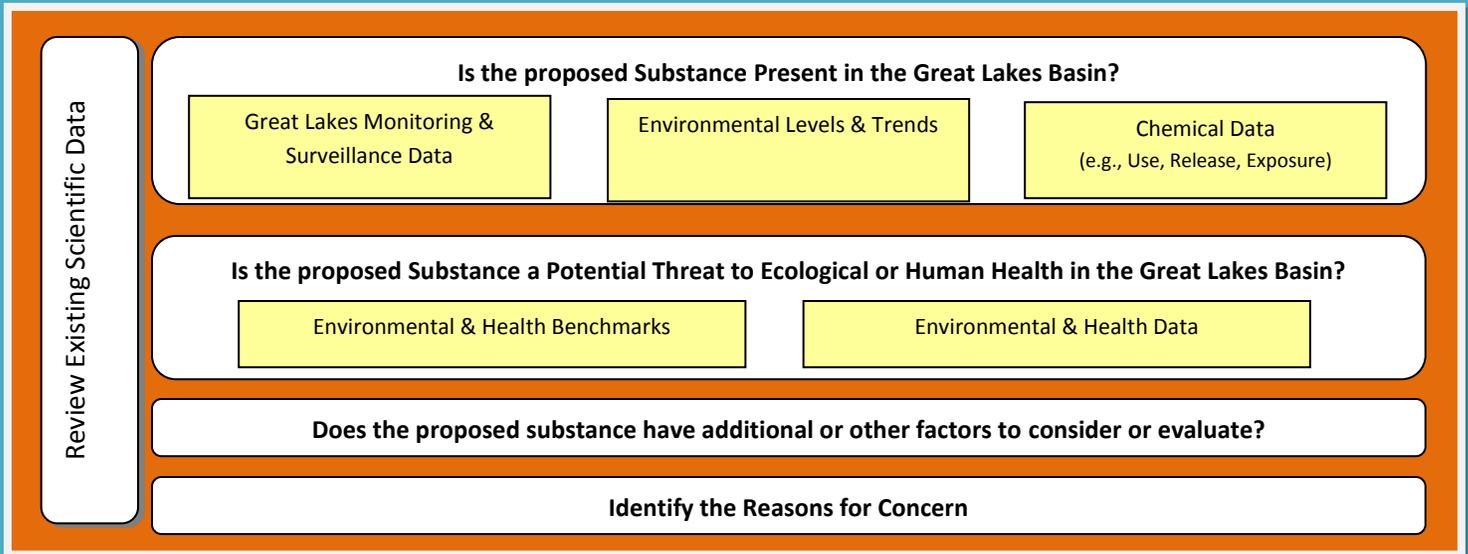
Vierke, L., Ahrens, L., Shoeib, M., Palm, W-U., Webster, E., Ellis, D., Ebinghaus, R. and Harner, T. 2013. In situ air-water and particle-water partitioning of perfluorocarboxylic acids, perfluorosulfonic and perfluorooctyl sulfonamide at a wastewater treatment plant. *Chemosphere* 92(8): 941-948.

Appendix A:
Binational Considerations When Evaluating Candidate
Chemicals of Mutual Concern

DRAFT DOCUMENT OF THE IDENTIFICATION TASK TEAM

Proposed
Canadian and
U.S. Chemicals

BINATIONAL CONSIDERATIONS FOR IDENTIFYING CANDIDATE CHEMICALS OF MUTUAL CONCERN IN THE GREAT LAKES BASIN (Box 4. from the *Annual Process for Recommending CMCs* Flowchart)



Recommended as a Candidate Chemical of Mutual Concern

Not Recommended as a Candidate Chemical of Mutual Concern

Insufficient Information on which to base a Determination

Report includes a review of available information supporting the recommendation

Report may include a summary of findings and rationale

Report may include a summary of findings and identification of potential information gaps

DRAFT

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