Binational Summary Report: Polychlorinated Biphenyls (PCBs)

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 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 polychlorinated biphenyls, also known as PCBs. This report was developed with input and review of the entire ITT and the recommendations presented within were reached by a consensus of the full ITT.

With respect to PCBs, there was sufficient data and information available to effectively apply the *Binational Considerations*, and based on their application of the considerations, **the ITT has unanimously recommended that PCBs be designated as a CMC.**

The ITT has concluded that despite initial steep downward trends in the 1980s and early 90s, followed by a much slower decline in PCB concentrations in fish tissues and sediments, concentrations still routinely exceed relevant guidelines, drive fish consumption advisories in all five lakes, and therefore pose a threat to the Great Lakes environment and to human health in the basin.

The ITT has also concluded that while many risk management and science activities are ongoing for PCBs under federal and provincial/state 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 remediate PCB contaminated sediments in designated Areas of Concern (AOCs) in the US and Canada, with enhanced collaboration and coordination, particularly in binational AOCs;
- Continuing to undertake monitoring of air, water, sediment and high trophic level fish and wildlife species in the Great Lakes to: continue tracking long-term trends; provide data to protect human health through provision of fish consumption advice; and measure the efficacy of ongoing and forthcoming risk management activities; and
- Conduct research to fill knowledge gaps with respect to potential sources of PCBs from a variety of current use applications.

2. Chemical background:

Chemical Identity:

PCBs are synthetic compounds that were previously manufactured and used around the world due to their superior insulating properties, low flammability, high heat capacity, low chemical reactivity, and long-term resistance to degradation. PCBs were primarily used as coolants and lubricants in a wide variety of electrical and other equipment, in applications such as: electrical transformers, capacitors and switches, electrical components in fluorescent lighting fixtures and appliances, and hydraulic and heat transfer systems. They were also used as plasticizers in other products, such as: adhesives, caulks, flame retardants, paints, pesticide carriers, plastics and many other industrial and commercial sealants.

PCBs are persistent and bioaccumulative chemicals, sometimes also referred to as persistent, bioaccumulative toxics (PBTs). When PCBs are released into the environment, the composition of the commercial mixtures can be altered by any of the following processes, which are dependent on the degree of chlorination of the molecule.

- Partitioning to environmental media such as vegetation and soil
- Volatilization
- Chemical or biological transformation
- Bioaccumulation

Of the 209 possible congeners, approximately 113 are found in environmental media and/or biota (Henry, 2003). Highly-chlorinated PCB congeners adsorb more strongly to sediment and soil and tend to persist with longer half-lives of months to years, compared to the than lower-chlorinated PCBs. PCBs then accumulate through the food chain, mostly through diet, where they are stored by organisms due to their stability (resistance to metabolism, which increases with degree of chlorination) and lipophilicity (ATSDR, 2000b).

The types of PCBs that tend to bioaccumulate in fish and other animals and bind to sediments happen to be the most toxic components of PCB mixtures. As a result, people who ingest PCB-contaminated fish or other animal products and contact PCB-contaminated sediment may be exposed to PCB mixtures that are even more toxic than the PCB mixtures contacted by workers and released into the environment (U.S. EPA, 2011b).

When burned, PCBs can undergo reactions to form PCDDs, PCDFs, and other chlorinated by-products. The toxicity of dioxin-like PCBs, PCDDs, and PCDFs are often evaluated using a toxic equivalency factor (TEF) method, which is based on the toxicity of the individual congeners in the mixture relative to 2,3,7,8-TCDD to estimate a combined toxicity for the group. When all PCB TEFs are added together for a given sample, resulting sum is referred to as a toxic equivalent (TEQ). This expresses only the dioxin-like toxicity of PCBs and not the totality of PCB toxicity.

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:

Source: Environment Canada, 2014

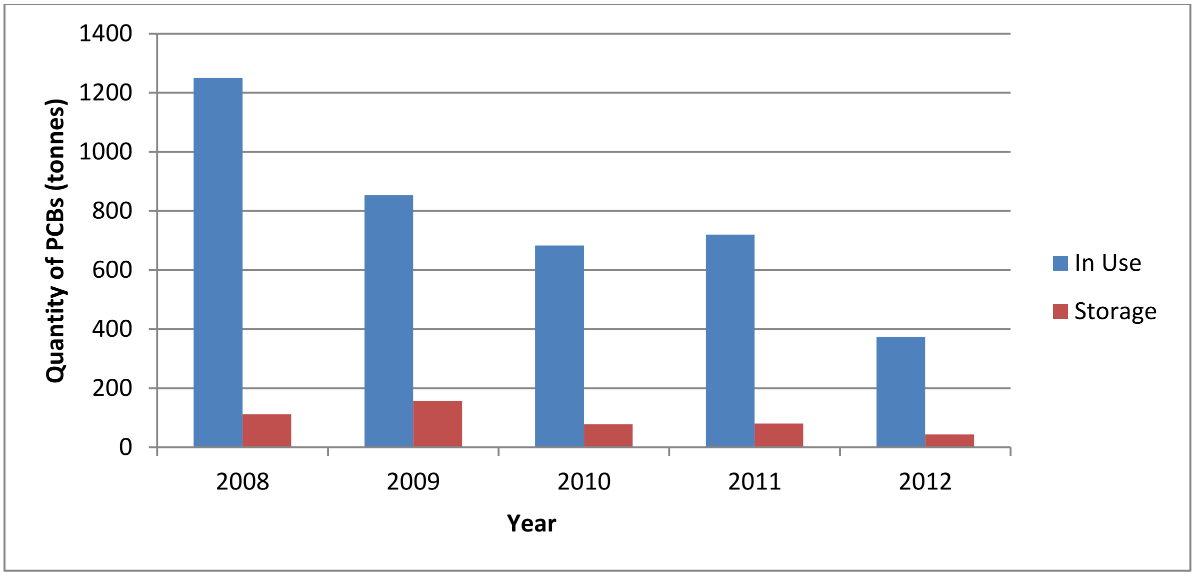
PCBs were never manufactured in Canada but were widely used in a large range of industrial activities, as dielectrics in electrical transformers and capacitors, as heat exchange fluids, as paint additives or in plastics (in sealing and caulking compounds) cutting oils and inks.

The import, manufacture and sale (for re-use) of PCBs were made illegal in Canada in 1977. The release of PCBs to the Canadian environment was subsequently made illegal in 1985. However, Canadian legislation has allowed owners of certain PCB equipment to continue using the equipment until the end of its service life. PCB owners subject to the *PCB Regulations* have to report each calendar year on their inventory of PCBs or products containing PCBs in use, in storage or destroyed. Owners of a processing facility, a transfer site or a destruction facility for PCBs must also report PCBs in their possession that are in storage or destroyed annually. The progress towards the end-of-use and destruction of PCBs is monitored using these reports.

In 2012, 466 companies responsible for 1,141 sites reported that 374.2 tonnes of PCBs remained in use (374.2.6) with 43.9 tonnes storage in Canada (Figure 1). Ontario had the largest amount of PCB materials in use and in storage (202,000kg, or 48% of total in Canada).

By the end of 2012, the total amount of PCBs in storage or in use was 30% less than when the regulations came into force in 2008. A steady downward trend in PCBs was observed for both use and storage; however the data cannot be looked at in a linear fashion as the number of companies reporting fluctuates from year to year. For instance, in 2011, there may have been companies who had PCB equipment and reported for the first time. Although companies reporting for the first time are required to report for all the years from 2008 to the year they are initially reporting, many do not.

As of 2013, the main Canadian industry sectors using PCBs and subject to the Regulations are the electric utilities; pulp and paper manufacturing; iron and steel manufacturing; and mining and mineral manufacturing. The remaining PCB inventory was owned by federal and other government departments; hospitals and schools; and other miscellaneous industry sectors and building management.



	2008	2009	2010	2011	2012
In Use	1250.3	853.7	682.5	719.6	374.2
Storage	112	156.8	78.6	80.3	43.9

Figure 1: Quantity of PCBs (in tonnes) in use and in storage in Canada from 2008 to 2012. Source: Environment Canada, 2014.

In 2012, there were 25 releases of PCBs into the environment reported under section 40 of the PCB Regulations which totaled 1.15kg of pure PCB. Of the 25 incidents, 17 were due to leaks from equipment or spills of PCB liquids, five were due to vandalism, two were due to acts of nature and one was due to human error. Six of the 2012 release incidents occurred in Ontario, resulting in a total release of 24g of pure PCB into the environment.

U.S. Releases, Sources and Uses:

PCBs were produced in the U.S. from 1929 to 1977. The Monsanto Company, the sole manufacturer of PCBs in the U.S., produced 700,000 tons (1.4 billion pounds) of pure PCBs during this period. In 1979, EPA banned the manufacture, import, export, distribution in commerce, and use except under limited circumstances (**TSCA § 6(e)**, **15 U.S.C. §§ 2605(e)** *et seq).* EPA further restricts PCB use, handling, transportation, storage and disposal options (**40 C.F.R. §§ 761** *et seq)*.

Prior to these regulations, significant quantities of PCBs were released to the environment in association with the manufacture of PCBs and products containing PCBs, as well as the use and disposal of these products. In addition, certain categories of PCB-containing materials and electrical equipment in service at the time of the bans were not required to be removed from use; the continued authorized uses of PCBs, including in these categories of electrical equipment, have been authorized by the EPA pursuant to TSCA and based on a finding that such uses do not pose an unreasonable risk to health or the environment. Some of this equipment is still in use due to a long product life, and has the potential to serve as a new source of “primary” PCBs to the environment if accidental releases were to occur. The life expectancy of electrical transformers that contain PCBs, for example, is 30 years or more. Experience of electric utilities has shown that this equipment generally is retired at the end of its useful life and disposed of according to PCB disposal regulations; in addition, as documented by EPA its 2006 Great Lakes Progress Report (U.S. EPA, 2007), several utility companies in the U.S. are engaged in proactive identification and removal of PCB-containing pieces of electrical equipment, at an accelerated pace (i.e., prior to the end of the equipment's useful life). Some of the largest direct releases to the environment have come from the use hydraulic fluids (e.g., in metal casting machines), since many hydraulic systems were designed to leak slowly to provide lubrication.

The principal known sources of PCBs in the Great Lakes Basin include:

- Release from remaining in-service items containing manufactured PCBs (accidental releases or gradual emissions);
- Release from PCB-containing sealants, paints, finishes;
- Accidental release from PCB storage and disposal facilities during the handling of PCB wastes;
- Emissions from combustion or incineration of materials containing PCBs;
- Inadvertent generation during poorly controlled combustion or certain chemical production processes
- Reservoirs of past PCB contamination and environmental cycling (including contaminated sediments, soil, and sites (e.g., National Priority List Superfund sites);
- Long range transport (regional and international);
- Others (e.g., dispersive sources).

A better overall understanding of the relative contributions of these sources and their respective pathways in the Great Lakes basin is needed;

<u>PCBs in Use in Electrical Equipment</u>

2010 PCB-Containing Transformer Inventory Estimate for USWAG
In August 2010, on behalf of the Utility Solid Waste Activities Group (USWAG), ENVIRON updated earlier estimates of the inventory of PCB-containing equipment in use by electric utilities in the United States. (ENVIRON, 2010) This information was compiled to assist USWAG in responding to an Advance Notice of Proposed Rulemaking issued by the US EPA, and in light of associated time constraints relied on extrapolation of pre-existing data rather than a detailed, industry-wide survey. The information in the ENVIRON report is nonetheless useful in evaluating nationwide trends in the existing U.S. inventory of PCB-containing electrical equipment. The 2010 ENVIRON report demonstrated an approximate 80% reduction in the amount of electrical equipment containing PCBs in regulated levels since the federal PCB ban in 1978 and the subsequent promulgation of regulations addressing the management and disposal of PCBs and PCB-containing equipment. (ENVIRON, 2010) According to the ENVIRON report, the basis for the estimate was the following:

1. In 1981, a PCB-containing equipment inventory was prepared by Resource Planning Corporation (RPC) for USWAG, the Edison Electric Institute (EEI), and the National Rural Electric Cooperative Association (NRECA). RPC conducted a survey of the 100 largest electric utilities in the United States and received responses from 98 of the 100 subjects. The results of the survey were projected to the entire industry.
2. The 1981 RPC inventory estimates were subsequently updated in 1989 on behalf of the Electric Power Research Institute (EPRI).

ENVIRON extrapolated the number of transformers estimated in the 1981 and 1989 reports to 2010 using the following assumptions:

- Askarel transformers
  - No new askarel units were added after the 1981 inventory.
  - The high rate of retirement of askarel units from distribution systems suggested by figures in the 1989 EPRI report (2,163 units or 9.6% of 1981 inventory per year on average) continued until virtually all readily-identified askarel transformers had been removed from these systems in the 1990s.
  - On average, 357 pre-1982 units are retired from other systems each year (this number is 2.1% of the askarel units in non-distribution systems inventory in 1981).
- Mineral oil transformers
  - No new PCB-contaminated units were added to the inventory after 1981.
  - Pre-1982 units are retired at a constant annual rate of 424,772 units per year (equal to the 2.1 % of the 1981 inventory).
  - Pre-1982 units are retired at the same relative rate regardless of PCB content; the 1981 inventory estimates indicate that 10.7% of pre-1982 units are PCB-contaminated and 1.09% of pre-1982 units are PCB.
  - The retirement rate for all pre-1982 and post-1982 units is 2.1% of inventory each year.

Based on these assumptions, Table 2 presents the updated equipment estimates for 2010. The ENVIRON report found that, by 2010, only approximately one-quarter of one percent of the mineral oil-filled transformers in service throughout the electric grid contained PCBs at concentrations of 500 ppm or greater. The ENVIRON report attributes this reduction to the retirement of equipment at the end of its useful life, as well as the voluntary efforts of the utility industry to remove equipment containing PCBs at regulated levels from service on an accelerated basis (i.e., before the equipment reaches the end of its useful life).

Equipment Category	**1981-1982 Inventory**	**2009-2010 Inventory**
Total askarel transformers (all > 500 ppm PCBs)	39,640	7,004
Total mineral oil-filled transformers		
Total mineral oil-filled transformers	20,227,248	34,262,098
units with ≥ 50 to < 500 ppm PCBs	2,166,159	892,458
units with ≥ 500 ppm PCBs	219,918	90,606
percentage of total with ≥ 50 to < 500 ppm PCBs	10.7%	2.6%
percentage of total with ≥ 500 ppm PCBs	1.09%	0.26%
Totals for all transformers (mineral oil and askarel)		
Total mineral oil and askarel transformers	20,266,888	34,269,102
units with ≥ 50 to < 500 ppm PCBs	2,166,159	892,458
units with ≥ 500 ppm PCBs	259,558	97,610
percentage of total with ≥ 50 to < 500 ppm PCBs	10.7%	2.6%

Equipment Category	1981-1982 Inventory	2009-2010 Inventory
percentage of total with ≥ 500 ppm PCBs	1.28%	0.28%

Table 1. Inventory Estimates for PCB-containing Transformers Owned/Operated by U.S. Electrical Utilities (ENVIRON, 2010)

Year	Fluorescent Light Ballasts		Small Capacitors		Large Capacitors	
	Number of Units	Pounds of PCBs	Number of Units	Pounds of PCBs	Number of Units	Pounds of PCB
1977[a]	800,000,000	90,000,000	75,000,000	100,000,000	28,000,000	400,000,000
1981					3,300,000[b]	
1981-1982[d]					2,800,619[c]	
1984			350,000,000[b]		2,800,000[e]	
1988					1,460,000[e] to 1,855,448[f]	45,595,000[e]
2009-2010[g]					119,207[c]	

a. Source: U.S. EPA, 1977
b. Source: DHHS, 1986
c. Source: ENVIRON, 2010
d. All >500 ppm PCBs
e. Source: EPRI, 2000
f. Source: U.S. EPA, 1989
g. PCB Capacitors are assumed to be all of uniform size (2 feet x 1 foot x 6 inches) and contain 100 percent PCBs.

Table 2. Estimated Number of Capacitors in Service by Year

ENVIRON (2010) extrapolated the number of large capacitors containing PCBs at concentrations of 500 ppm or greater (i.e., “PCB Large capacitors”) estimated in the 1981 and 1989 reports to 2010 using the following assumptions:

- No new PCB units were added after the 1981 inventory (2,800,619 units).
- Most identified large PCB Capacitors (i.e., ≥ 500 ppm PCB) were removed from electric utility distribution systems by 1988.
- On average, 51,755 units (3.3% of the units in the 1981 inventory) are retired from non-distribution systems each year.

Based on these assumptions, ENVIRON estimated the number of large capacitors containing ≥ 500 ppm PCB (i.e., PCB Large capacitors) and remaining in service in 2010 to be 119,207 as presented previously in Table 3.

Toxics Release Inventory 2000-2012

Following are Toxics Release Inventory data for 2000-2012 for total air emissions, surface water discharges, and total on- and off site disposal or other releases.

Year	Total Air Emissions	Surface Water Discharges	Total On- and Off-site Disposal or Other Releases
2000	1,153.90	28.82067	1,431,376.90
2001	1,360.46	2.802003	3,572,866.97
2002	5,200.89	30.82294	1,938,370.10
2003	435.547833	4.5113	22,295,623.67
2004	342.0846014	2.4319	1,875,801.68
2005	208.8338271	3.011276	1,138,316.10
2006	254.822738	1.530793	1,453,201.11
2007	823.0438691	0.1338	1,866,996.20
2008	593.3944476	0.2358	4,129,208.23
2009	601.2540351	0.8308422	3,272,016.17
2010	294.2100211	0.3007646	4,004,326.80
2011	578.6149781	0.2295289	5,464,925.74
2012	143.603448	0.13481	3,965,944.92

Table 3: TRI On-site and Off-site Reported Disposed of or Otherwise Released (in pounds), Trend Report for facilities in All industries, for PCBs, U.S. 2000-2012**.**

Note that every citizen is actually regulated under TSCA, and there is no sector exempt from reporting disposal of TSCA-regulated items. There is a 50ppm concentration threshold for products, but no sector exceptions. Also note that PCB-containing transformers >500ppm in PCBs need to be registered to be kept. PCB-containing equipment from 50-500ppm PCBs is allowed to be used until end of life. <50ppm PCB-containing equipment can be used in perpetuity, including recycling and reclamation.

Environmental and Human Health Data:

Although differences in exposure make it difficult to establish a clear relationship between PCB exposure (route, amount, and PCB mixture) and observed effects on human health, PCBs have been demonstrated to cause a variety of adverse health effects in both animals and humans.

Studies in humans provide supportive evidence for potential carcinogenic and noncarcinogenic effects of PCBs. The different health effects of PCBs may be interrelated, as alterations in one system may have significant implications for the other systems of the body. The potential health effects of PCB exposure are discussed below.

Overall, the human studies provide some evidence that PCBs are carcinogenic (U.S. EPA, 2011b). However, there is conclusive evidence that commercial PCB mixtures are carcinogenic in animals based on induction of tumors in the liver and thyroid (U.S. EPA, 2011b). The World Health Organization, International Agency for Research on Cancer (IARC) has declared PCBs to be carcinogenic to humans

(WHO 2011). The National Toxicology Program has stated that PCBs are reasonably anticipated to be human carcinogens (NTP, 2011). The National Institute for Occupational Safety and Health (NIOSH) indicates PCB Aroclors 1242 and 1254 are potential occupational carcinogens (NIOSH, 2011).

EPA has found clear evidence that PCBs have significant toxic effects in animals and humans, including effects on the immune system, the reproductive system, the nervous system, and the endocrine system (U.S. EPA, 2011a). The body's regulation of all of these systems is complex and interrelated, and as a result, exposure to PCBs can cause a multitude of serious adverse health effects.
Studies indicate PCBs may have negative effects on the endocrine system (ATSDR, 2011a) including impacts on estrogenic and anti-estrogenic activity, reproductive activity, and thyroid activity.

Some studies have estimated that an infant who is breast fed for 6 months may accumulate in this period 6 to 12% of the total PCBs that will accumulate during its lifetime. Because the brain, nervous system, immune system, thyroid, and reproductive organs are still developing in the fetus and child, the effects of PCBs on these target systems may be more profound after exposure during the prenatal and neonatal periods, making fetuses and children more susceptible to PCBs than adults (ATSDR, 2011a).

Environmental and Human Health Benchmarks and Guidelines:

These benchmark values are from many different sources; however, all have the ultimate goal of being protective of human and/or ecological health. Where possible, benchmark values developed specifically for the Great Lakes were considered. In general, these values are more restrictive compared to those pertaining to national levels. In the absence of values specific to the Great Lakes, either national or regional values were used.

Criteria have not been developed to assess environmental levels of PCBs in all media. As can be seen in the Table 5 below, there are variations in threshold PCB concentrations defined in many of the PCB criteria, particularly the sediment and water criteria. As a result, conclusions reported in the literature regarding criteria exceedances also varied. For the current report, a criteria exceedance was determined based on comparison of available PCB concentration from the Great Lakes basin data to the lowest criteria value available.

DATA	CRITERIA	GREAT LAKES EXCEEDANCES
Fish and other Wildlife		
USEPA Great Lakes Fish Monitoring and Environment Canada Water Quality Monitoring and Surveillance programs	U.S. EPA Wildlife Criteria (EPA 1995) 0.16 µg/g (total PCBs in fish tissue, wet weight, whole fish)	Yes
OMOECC Guide to Eating Ontario Sport Fish Consumption (2013-14)	Fish Consumption Advisory (.105 ug/g (wet weight, for edible portion)	Yes
Great Lakes Sport Fish Consumption	Great Lakes Sportfish Advisory (GLSFATF 1993) 0.05 µg/g (wet weight, for edible portion)	Yes
US EPA Great Lakes Fish Monitoring and Environment Canada Water Quality	Canadian CCME Tissue Residue Guidelines (2001b):	Yes

DATA	CRITERIA	GREAT LAKES EXCEEDANCES
Monitoring Surveillance programs	0.79 ng TEQ/kg diet (ww) – Mammal 2.4 ng TEQ/kg diet (ww) – Avian	
Sediment		
Environment Canada Water Quality Monitoring and Surveillance programs	Canadian CCME SQG for Freshwater (CCME 2002a) PEL: 277 ng/g ISQG/TEL: 34.1 ng/g Ontario SQG (OMOECC 2008) LEL 70 ng/g SEL 530 ng/g organic carbon U.S. PEC (Ingeroll 2000) 676 ng/g U.S. NOAA SQG (NOAA 1999) ERL: 22.7 ng/g ERM: 180 ng/g	Yes
Surface Water		
Great Lakes Water Quality Surveillance Program	Ontario PWQO Surface/open water: 1 ng/L U.S. NRWQC (USEPA 2009) Human Health: 14 ng/L	No
Marvin et al. (2004 data review)		No
Human Biomonitoring		
Health Canada data	Health Canada Guideline (Aroclor1260) 5 µg/l for women of child-bearing age 20 µg/l for post-menopausal women / men	No
US National Health and Nutrition Examination Survey (NHANES)	None identified	NA (all median PCB concentrations in NHANES 1999-2000 were below the level of detection)

Table 4: Benchmarks for PCBs in Great Lakes media and biota.

The Canadian Council of Ministers of the Environment (CCME) provides national environmental quality guidelines for major water uses in Canada through a consensus-based process by provincial and federal government partners. CCME has withdrawn its Canadian Water Quality Guideline for PCBs noting that water quality guidelines for highly persistent, bioaccumulative substances such as polychlorinated biphenyls (PCBs), have a high level of scientific uncertainty and limited practical management value, and are, therefore, no longer recommended. For these substances, it is more appropriate to use the respective tissue residue guidelines and/or sediment quality guidelines (CCME, Undated).

CCME has set a Canadian Tissue Residue Guideline (CTRG) for the protection of wildlife consumers of aquatic biota of 0.79 ng TEQ/kg diet (ww) for mammals and 2.4 ng TEQ/kg diet (ww) for birds (CCME 2001b). Toxic equivalency units (TEQs) as total dioxin equivalents form the basis of the PCB CTRG as individual PCB congeners vary in chemical and physical properties which affect bioaccumulation and toxicity. It has been shown that the use of TEQs improves correlation between PCB contamination and observed effects (CCME 2001b). The CCME guidance provides Toxic Equivalency Factors (compared to 2,3,7,8-TCDD) for selected PCB congeners and commercial PCB mixtures. Though this method only captures the toxicity of dioxin-like (coplanar) PCBs, it is assumed to be protective of the non-coplanar congeners (CCME 2001b).

Great Lakes Monitoring and Surveillance Data:

To evaluate the potential that residual concentrations of PCBs may be associated with adverse environmental effects, current levels were compared to available environmental benchmarks value, summarized in Table 5 above). These benchmarks include environmental quality guidelines; values developed for screening-level purposes and promulgated regulatory criteria.

Air and Atmospheric Deposition: (Reprinted from SOLEC 2011)

Total PCBs (ΣPCBs) is a suite of congeners that make up most of the PCB mass and that represent the full range of PCBs. Concentrations of gas-phase ΣPCBs have generally decreased over time at the master stations (Figure 2, Venier and Hites 2010a, Venier and Hites 2010b), but the rate of change is remarkably slow considering that the manufacture of PCBs was banned in North America over 30 years ago. Some increases are seen during the late 1990s and early 2000s that remain unexplained. There is some evidence of connections with atmospheric circulation phenomena such as North Atlantic Oscillations (NAO) or El Nino events; however, similar increases were not seen for other compounds making this perhaps an unlikely explanation (Venier and Hites, 2010b). PCB measurements in precipitation samples were stopped at the rural master stations after 2005 because concentrations were nearing levels of detection.

The Lake Erie site consistently shows relatively elevated ΣPCB concentrations compared to the other master stations. Back-trajectory analyses have shown that this is due to possible influences from upstate New York and the East Coast (Hafner and Hites, 2003). Figure 3 shows that ΣPCB concentrations at urban satellite stations in Chicago and Cleveland are about fifteen and ten times higher, respectively, than the remote master stations at Eagle Harbor (Lake Superior), Sleeping Bear Dunes (Lake Michigan) and Burnt Island (Lake Huron) and the rural master station at Point Petre (Lake Ontario).

In comparison to other PBT chemicals measured by IADN, PCBs have a long halving time (13 to 17 years) and are generally showing the slowest rate of decline (Venier and Hites 2010a, Venier and Hites 2010b). The slow rate of decline, despite PCBs being banned in the US in 1976, is likely due to large amounts of PCBs still in transformers, capacitors, and other electrical equipment and in storage and disposal facilities (Venier and Hites 2010a, Hsu et al. 2003, Diamond et al. 2010). This conclusion is supported by the finding, at the city scale, of elevated PCB air concentrations coincident with their use in large electrical equipment (Melymuk et al. 2013). At a regional scale, PCB air concentrations are proportional to population density, again suggesting that large electrical infrastructure is a likely source.

It is assumed that PCB concentrations will continue this slow decline in the future.

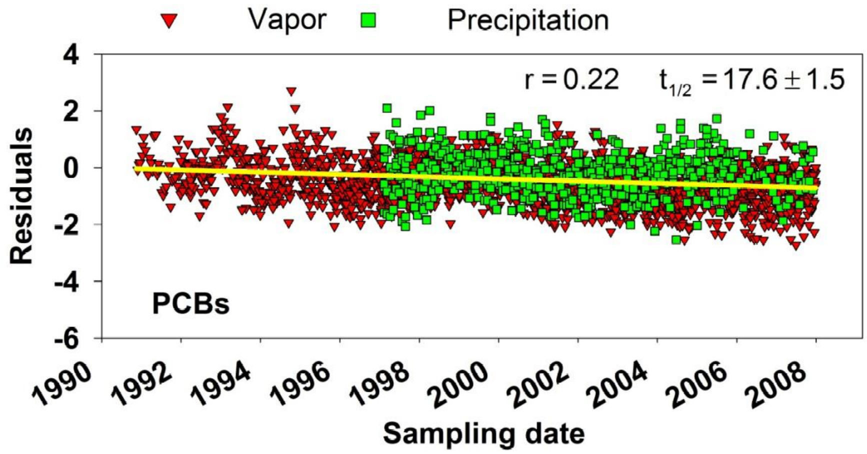


Figure 2. Partial residuals versus sampling date for vapor and particle phase PCBs. (The partial residual analysis identifies the relationship between time and the natural logarithm of concentration.)
Source: Venier and Hites 2010b.

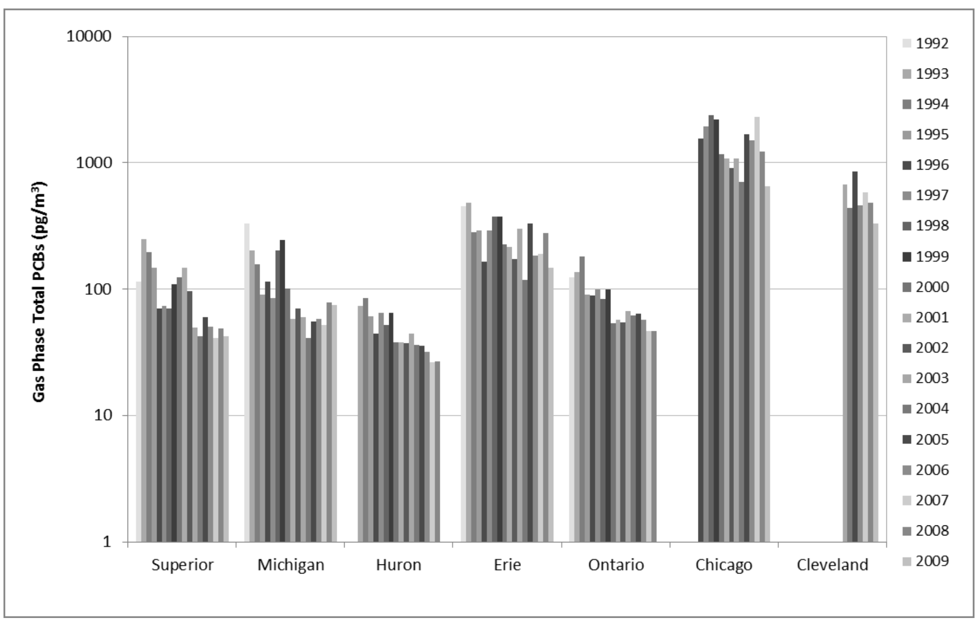


Figure 3. Annual average gas phase concentration of total PCBs at rural and urban IADN stations.
Source: IADN Steering Committee, unpublished, 2011.

Recent evidence has pointed to the importance of PCB emissions from the technosphere. Examples here include PCB emissions from Chicago and Toronto to Lakes Michigan and Ontario, respectively (Hornbuckle et al. 2006 *inter alia*, Persoon 2009, Diamond et al. 2010, Rodenburg & Meng 2013). Diamond et al. (2010) calculated PCB emissions in 2006 from Toronto of~100-900 kg yr-1 which they proposed were released from an existing stock of 437 tonnes. A more sophisticated, spatially resolved mass balance model applied to Toronto and region generated similar emission estimates of 230 (40-480) kg y^{-1} (Csiszar et al. 2013). Further calculations suggested that the in-use and stored stock of PCBs is the main source of continuing emissions from Toronto to Lake Ontario because regional environmental or "recycled" emissions are insufficient to account for current total PCB emissions (Csiszar et al. 2014). Others have attributed PCBs emissions from PCB contaminated sites (e.g., Du et al. 2007).

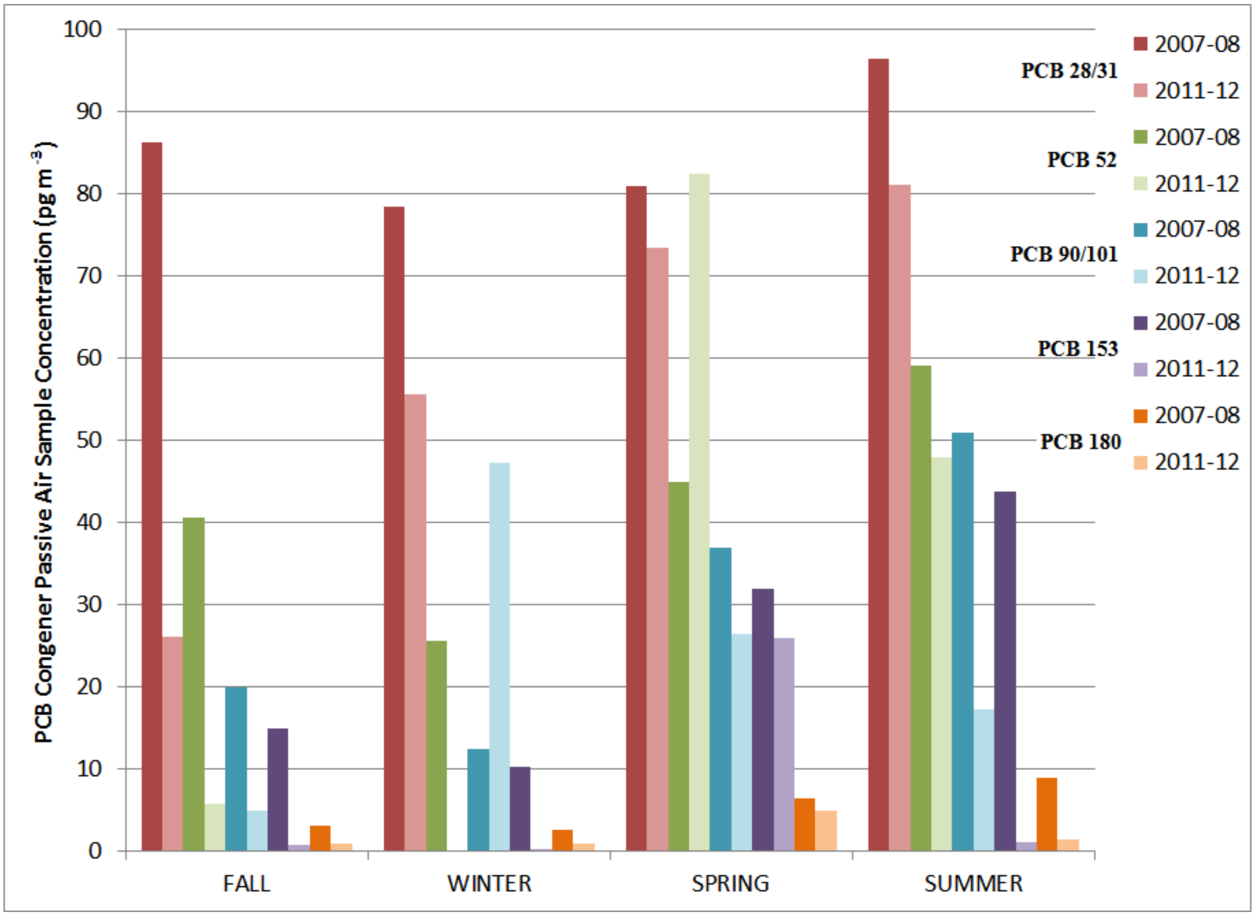


Figure 4: Comparison of PCB (28/31, 52, 90/101, 153, 180) Air Concentrations Measured Using PUF Passive Samplers Deployed at 2 downtown locations in Toronto during 2007/08 and 2011/12 (PG. M-3). Concentrations measured in 2008 from Melymuk et al. (2012). (Reprinted directly from SOLEC 2011 Indicator Report on Contaminants in Whole Fish)

In summary, PCBs are declining in the atmosphere over the Great Lakes, but at a slow rate, due to residual sources such as transformers and capacitors. This rate of decline is expected to continue into the future. Concentrations in urban areas are an order of magnitude greater than in rural areas.

Surface Water: (Reprinted with permission from Environ. Sci. Technol. 2014, 48, 9563−9572, Venier et al, 2014)

Both the U.S. and Canadian federal governments conduct water quality measurements in the Great Lakes. Since about 1986, contaminants have been measured by Environment Canada as part of the Great Lakes Surveillance Program (GLSP). Results from this program establish spatial distributions and temporal trends and are reported through the SOLEC indicator for pollutants in offshore waters. These measurements have focused on legacy compounds (i.e., PCBs, PAHs, and organochlorine pesticides).

On a lake wide basis, the highest concentrations of total PCBs were measured in Lake Ontario (623 ± 113 pg/L), and the lowest were in Lake Superior (average 117 ± 18 pg/L). Lake Erie showed an average concentration of 582 ± 127 pg/L, followed by Lake Michigan and Lake Huron with an average of 267 ± 36 pg/ L and 304 ± 83 pg/L, respectively. A one-way ANOVA on the log transformed data (to account for the log-normal distribution of the concentrations) showed that these differences were statistically significant at a 95% confidence level with concentrations indicating the following trend: Ontario ≈ Erie > Huron ≈ Michigan > Superior ($P < 0.001$).

For individual samples, the highest total PCB concentrations were found in the western basin of Lake Erie (889 pg/L), as expected given the higher contamination noted previously in this region (Burniston, 2012). Concentrations were lower in the central (274 pg/L) and eastern (354 pg/L) basins. In Lake Michigan, the highest concentration was measured in Green Bay (342 pg/L) and the lowest was at the midlake station (185 pg/L). The PCB concentrations in the water sample collected near Chicago (233 pg/L) were lower than in Green Bay and the northern basin. This finding suggests that Milwaukee and Chicago might no longer be sources of PCBs to the lake (or a minor one), while PCBs contamination in Green Bay is still present (U.S. EPA, 2004). In Lake Superior, the highest concentration was measured at station 23 (165 pg/L) in Whitefish Bay; PCB levels at the other stations (even near urban centers) were lower. In Lake Huron, the highest levels were measured at the Saginaw Bay station (591 pg/L), and the levels decreased from south to north within the main body of the lake.

Streets et al. (2006) reported a total PCB concentration of 150 ± 11 pg/L in water samples collected in 2004 from Lake Michigan, which is lower than reported in this and in other previous studies. The Lake Michigan Mass Balance Study reported mean dissolved phase PCB concentrations ranging from 104 pg/L at an open lake station to 653 pg/L at a station in Green Bay (U.S. EPA 2004). Totten et al. reported PCB levels similar to those we report here for Lake Michigan in 1994−1995, with concentrations ranging from 48 to 300 pg/L (Totten, 2003). Modeled lakewide average concentrations for total-PCBs ranged from 59 pg/ L for Lake Superior to 380 pg/L for Lake Ontario (Meng, 2007). Similar concentrations for total PCBs were reported in water samples from Southern Ontario by Ueno et al. (2008), ranging between 190−980 pg/ L. Reported concentrations of PCBs in Lake Ontario's tributaries varied widely, ranging from 310 pg/L to 42 800 pg/ L (Oliveira, 2011). Generally, concentrations reported in this study are higher than those reported in the literature, although similar to values measured in 16−24 L dissolved phase water samples by Environment Canada (Environment Canada and the U.S. Environmental Protection Agency, 2014 and other unpublished data). Melymuk et al. (2014) estimated PCB loadings of 7.5 ± 1.1 kg/y from Toronto tributaries to nearshore Lake Ontario.

In Summary, PCB concentrations in open water are below the U.S. EPA water quality criteria (14 ng/l), and below Ontario provincial water quality objectives (1 ng/L).

Sediments: (Paragraphs 1-4, including Figure 5 and Table 6, reprinted with permission from Environ.Sci.Technol.2005, 39, 5600-5605, An Li, et al, 2005)

Sediment cores were taken in 2002 in Lakes Ontario and Erie at four locations. A total of 48 sediment samples were characterized, dated using ^{210}Pb, and analyzed for 39 congeners of polychlorinated biphenyls (PCBs). The trends of PCB concentration vs sediment depth are shown in Figure 5. In Lake Erie, the PCB concentrations fluctuate over the whole sediment core at ER09, while a gross broad elevation of PCB concentration appears in the middle of the sediment core at ER37. The complication of PCB concentration patterns at ER09 and ER37 indicates sediment disturbance and mixing at both sites. The surficial PCB concentrations are given in Table 6. Organic carbon normalized surficial PCB concentrations are 940, 880, 905, and 1051 ng g^{-1} OC at ON30, ON40, ER09, and ER37, respectively. Similar to PBDEs concentrations in Lakes Ontario and Erie, OC normalization brings the surficial PCBs concentrations in the two lakes fairly close, as observed for Lakes Michigan and Huron. The maximum PCBs concentrations are 255, 215, 37, and 70 ngg^{-1} dry weight at ON30, ON40, ER09, and ER37, respectively.

Spatial and chronological distributions of PCBs in the sediments of Lakes Ontario and Erie were reported (Marvin et al., 2003, 2004). For Lake Ontario, the lake wide average concentration of total PCBs (103 congeners) in 1998 was 100 ng g^{-1}, while in 1981 the total concentrations ranged from 510 to 630 ng g^{-1}. For Lake Erie, lakewide average sums of 24 dominant congeners in surficial sediment concentrations in 1971 and 1997 were reported to be 136 and 43 ng g^{-1}. Taking into account of the different number of PCB congeners analyzed in this work, our results are comparable with the literature values, except for ER09 where the sediment core was severely disturbed. A comparison among all five Great Lakes was made based on 11 PCB congeners with IUPAC No. 8, 18, 28, 44, 52, 66, 153, 180, 187, 195, and 206. The result shows that, on dry weight basis, average surficial PCBs concentrations in Lakes Erie and Ontario are about three and nine times that in Lake Superior, respectively. The surficial PCBs concentrations are in the order of ON>ER≈LM>HU>SU, in agreement with spatial distribution of PCBs in Lake trout (Oliver 2008).

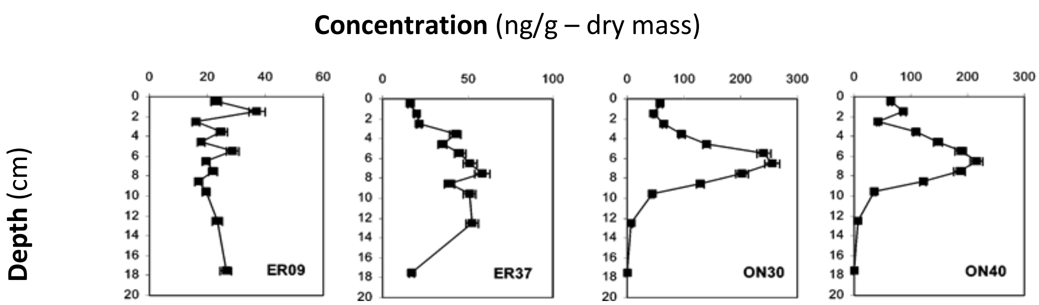


Figure 5: Concentrations vs depth in Lakes Erie and Ontario.; gray square, Σ_{39}PCBs.

As indicated in Table 6, the concentrations and inventories of PCBs are lower at ER09 (eastern basin) than at ER37 (central basin), in agreement with the decreasing trend of PCB levels from west to central and to east basins (Marvin 2002). The PCBs contamination levels at ON30 and ON40 are close and are higher than those in Lake Erie. The inventories in Lakes Ontario and Erie are about four and six times those in Lake Michigan (Song 2005). Many areas of concern in the region, as well as the Detroit River and the Niagara River, have been proved to be important sources for PCBs contaminations historically and currently in Lakes Erie and Ontario, respectively (Marvin, Severko, et al.).

Sampling Station	Surface Concentration (ng/g)	Inventory (ng/cm2)	Surface Flux (ng/cm2year)
Erie 9	23.0	169.2	3.71
Erie 37	28.3	196.5	2.09
Ontario 30	58.3	262.9	1.79
Ontario 40	63.6	255.2	1.92

Table 6: Surface Concentration, Surface Flux, and Inventory of PCBs in the Sediments of Lake Erie and Ontario

As illustrated in Figure 5, the peak fluxes of Σ_{39}PCBs at ON30 and ON40 are 7.9 and 6.5 ng cm^{-2} $year^{-1}$, respectively, both during the period from the 1960s to the 1970s. Lake Ontario responded more quickly to the ban of PCBs than the other Great Lakes (Song 2005), although a slight but noticeable rise-up appears in recent years at ON40). The ban on PCB production and usage led to a rapid decrease of large-scale direct release of PCBs, which could be sensitively recorded in sediments contaminated mainly by direct local input. However, when direct discharge comes down to a certain level, residuals of historic discharges and nonpoint sources such as air deposition may make it difficult for the PCB concentration in the sediment to decrease further (Wania, 1996). Fluvial input of PCBs from tributaries continues to date. For example, water samples from Niagara River collected in 2001 still contained about 100 ng g^{-1} of PCBs in the particulate phase (Williams, 2003).

The Environment Canada Great Lakes Fact Sheet: Contaminants in Sediments of Canadian Tributaries and Open Water Areas of the Lower Great Lakes (2007) illustrates the spatial distribution of PCB contamination in sediments in Lake Ontario, Lake Erie and Lake St. Clair.

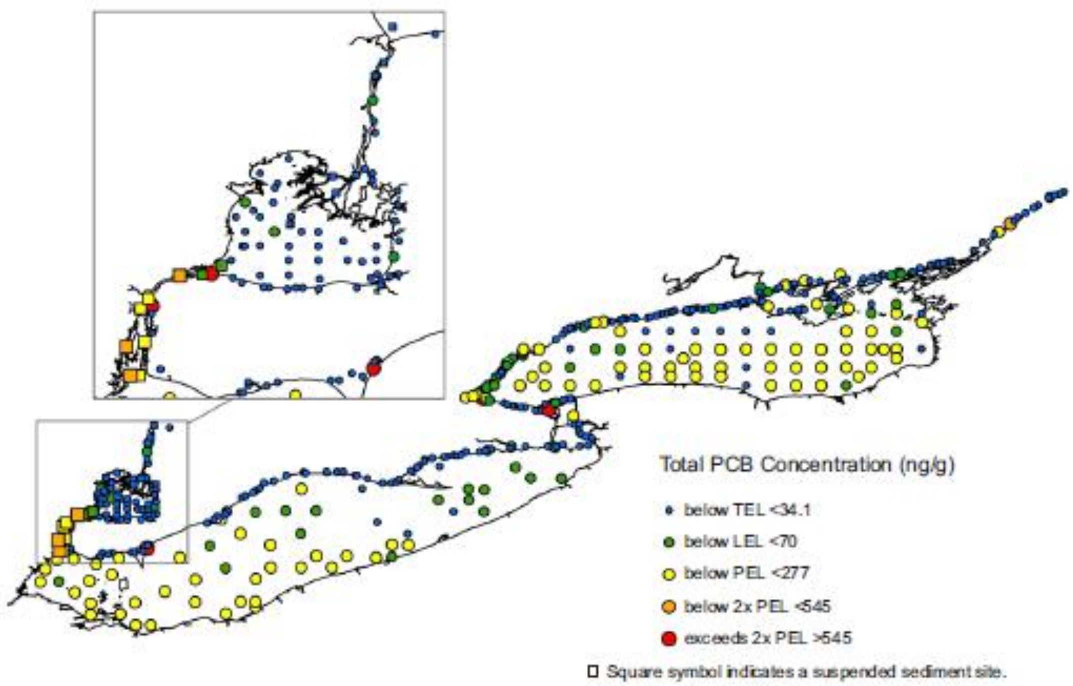


Figure 6: Spatial distribution of total PCB concentrations (ng/g) in Lake Ontario, Lake Erie and Lake St. Claire. Source: Environment Canada, 2007

Burniston et al. (2012) examined trends in pollutants in the Great Lakes and reported reductions in PCB concentrations in sediment cores between 1968 and 2002. Reductions of 37%, 40%, 45% and 15% were found in Lakes Ontario, Erie, Huron and Superior, respectively.

In summary, PCB concentrations in sediments in Lake Erie and Ontario peaked in the 1960s and early 70s. The southern lakes are higher in PCBs than the northern lakes. While some levels remain above the most conservative guidelines, concentrations of PCBs are generally below guidelines in the Great Lakes and slowly declining.

<u>**Fish and other Wildlife:**</u>

Fish (Reprinted from SOLEC 2011, including Figure 7 and Table 7)

Total PCB concentrations in Great Lakes top predator fish have continuously declined since their phase-out in the 1970s (Figure 6). Median PCB concentrations in Lake Trout in Lakes Superior, Huron, and Ontario and Walleye in Lake Erie continue to decline; however, they are still above the target of 0.16 µg/g ww in the GLWQA (Table 5). Log-linear regression of Environment Canada data show the continued long-term annual declines of 5% in Lake Trout from Lake Superior and 7% in Lakes Huron and Ontario while PCBs in Lake Erie Walleye are declining by 3% per year. Similar analyses of U.S. EPA data show no significant annual declines of total PCB in Lake Trout from Lake Superior and 4%, 6%, 7%, and 4% annual declines in total PCB in Lake Trout from Lakes Huron, Michigan, Ontario, and Lake Erie Walleye, respectively.

Data collected since the last SOLEC indicator report (2006-2009), show that total PCB concentrations in composited Rainbow Smelt measured by Environment Canada were all less than 0.16 µg/g ww in Lakes Superior and Huron. In Lake Erie, total PCB measured in 83% of Rainbow Smelt were below 0.1 µg/g ww, compared to only 34% of measurements in smelt from Lake Ontario. In Lake Ontario, total PCB concentrations in Rainbow Smelt are declining by ~8% per year since monitoring began in 1977. Recent studies have suggested that rates of decline of PCB residues in fish are slowing or have stopped in some lakes in recent years (Bhavsar et al. 2007). Despite potential changes in annual rates of decline, first-order log-linear regression models are still a good fit to observed concentrations in the lakes through time (Figure 5). Results generated in the next few years of monitoring should clarify whether or not the rates of decline are slowing and statistical methods to assess trends will be altered as required.

	N	Median (IQR) µg/g ww
<u>Lake Superior</u>[1]		
Env. Canada	324	0.21 (0.08 – 0.41)
U.S. EPA	35	0.37 (0.18 – 0.55)
<u>Lake Michigan</u>[1]		
Env. Canada	-	-
U.S. EPA	40	0.92 (0.78 – 0.99)
<u>Lake Huron</u>[1]		
Env. Canada	101	0.20 (0.16 – 0.26)
U.S. EPA	40	0.73 (0.50 – 0.85)
<u>Lake Erie</u>[2]		
Env. Canada	142	0.77 (0.53 – 1.3)
U.S. EPA	40	0.49 (0.38 – 0.79)
<u>Lake Ontario</u>[1]		
Env. Canada	324	0.85 (0.66 – 1.1)
U.S. EPA	38	0.87 (0.74 – 1.0)

* whole body Lake Trout
** whole body Walleye

Table 7. Summary of total PCB concentrations for individual (Env. Canada; Aroclor 1254) and composited (U.S. EPA; total congeners) whole body Lake Trout or Walleye collected from each of the Great Lakes measured since the last SOLEC indicator report (2006-2009). (Reprinted directly from SOLEC 2011 Indicator Report on Contaminants in Whole Fish)

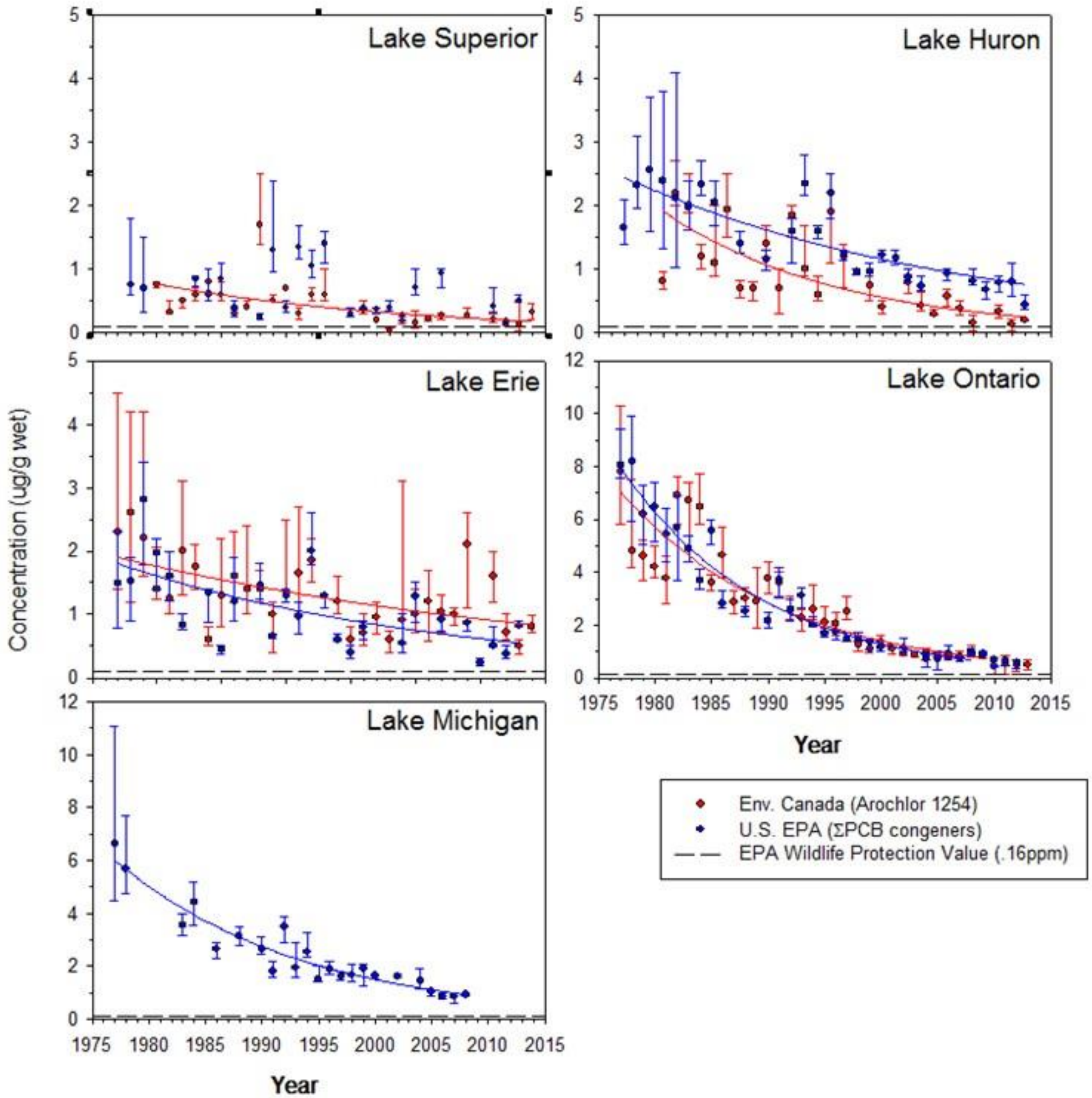


Figure 7. Total PCB concentrations (median & IQR) for individual (Environment Canada) and composited (U.S. Environmental Protection Agency) whole body Lake Trout or Walleye (Lake Erie) collected from each of the Great Lakes. Dashed lines show log-linear regression model if annual change is significantly different from zero ($\alpha = 0.05$). Source: Environment Canada and U.S. Environmental Protection Agency

Other Wildlife:

Many studies on PCB concentrations in eggs and other tissues in other wildlife in the Great Lakes including in herring gull eggs, snapping turtles and mink.

A very quick synopsis of Canadian studies:

- De Solla et al. (2007) shows that PCBs are the dominant organic contaminant in snapping turtles in the Great Lakes;
- similarly Weseloh et al. (2006) demonstrated that not only do PCBs contribute the most to egg burdens for herring gulls, but when using the fish flesh criteria for the protection of fish eating wildlife (similar to the CCME guidelines) as weighting factors, when the gull colonies were ranked from most to least contaminated, PCBs dominated the ranking; and
- De Solla et al. (In press) calculate the half lives in PCBs in gulls, and illustrate the most recent trend data up to 2013, showing significant declines 1970 – 2000, with a stabilization occurring post-2000. See Figures 8,9 and 10 below;

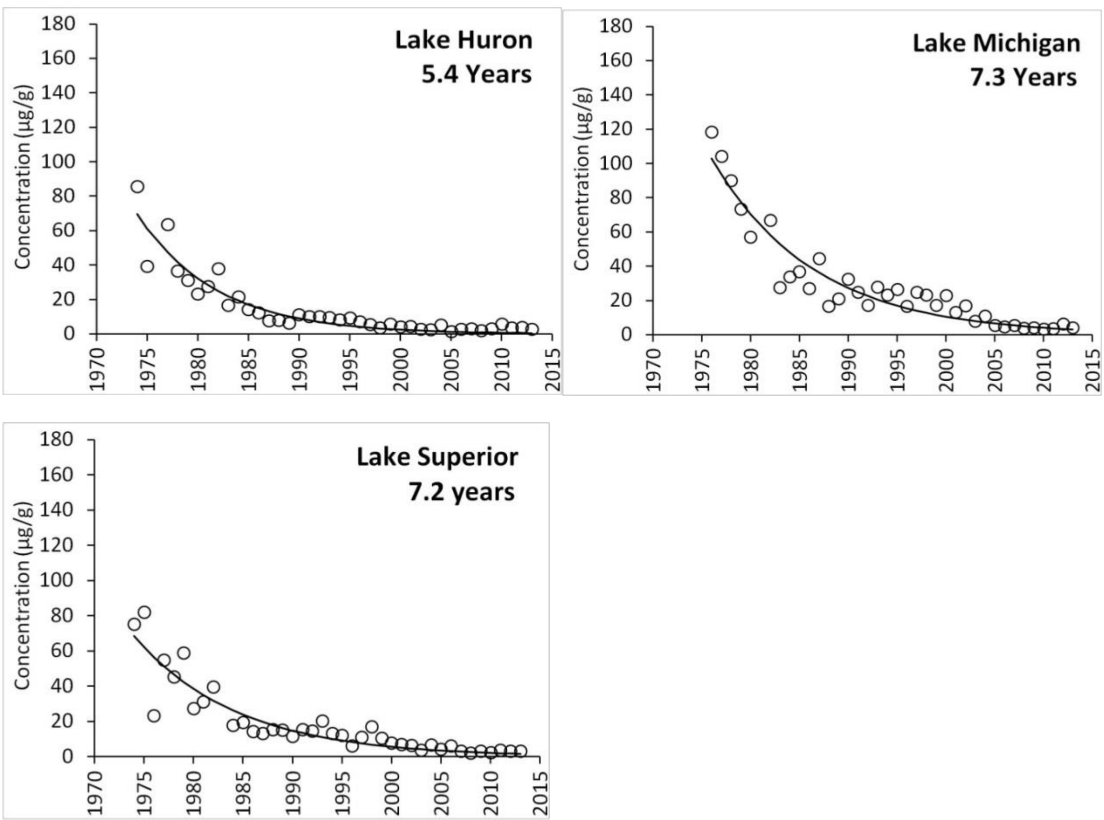


Figure 8. Temporal changes (exponential models) in the concentrations (µg/g, wet weight) of PCB Aroclor 1254:1260 in herring gull eggs from colonies on each of the five Great Lakes, 1974 - 2013. Colonies correspond to Toronto Harbour (Lake Ontario), Middle Island (Lake Erie), Chantry Island (Lake Huron), Big Sister Island (Lake Michigan) and Granite Island (Lake Superior). Half-lives are provided for each colony. De Solla et al. In press.

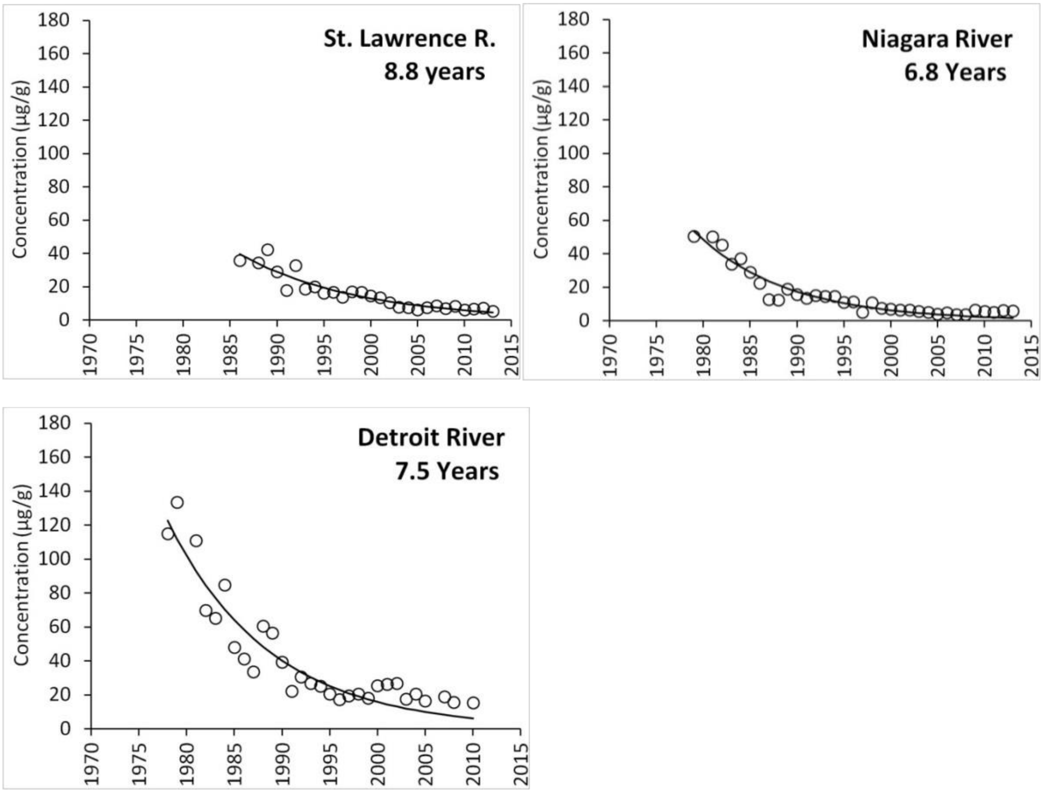


Figure 9. Temporal changes (exponential models) in the concentrations (µg/g, wet weight) of PCB Aroclor 1254:1260 in herring gull eggs from colonies on each of the three Great Lakes connecting channels, 1978 - 2013. Colonies correspond to Strachan Island (St. Lawrence River), Weseloh Rocks (Niagara River), and Fighting Island (Detroit River). Half-lives are provided for each colony. De Solla et al. In Press.

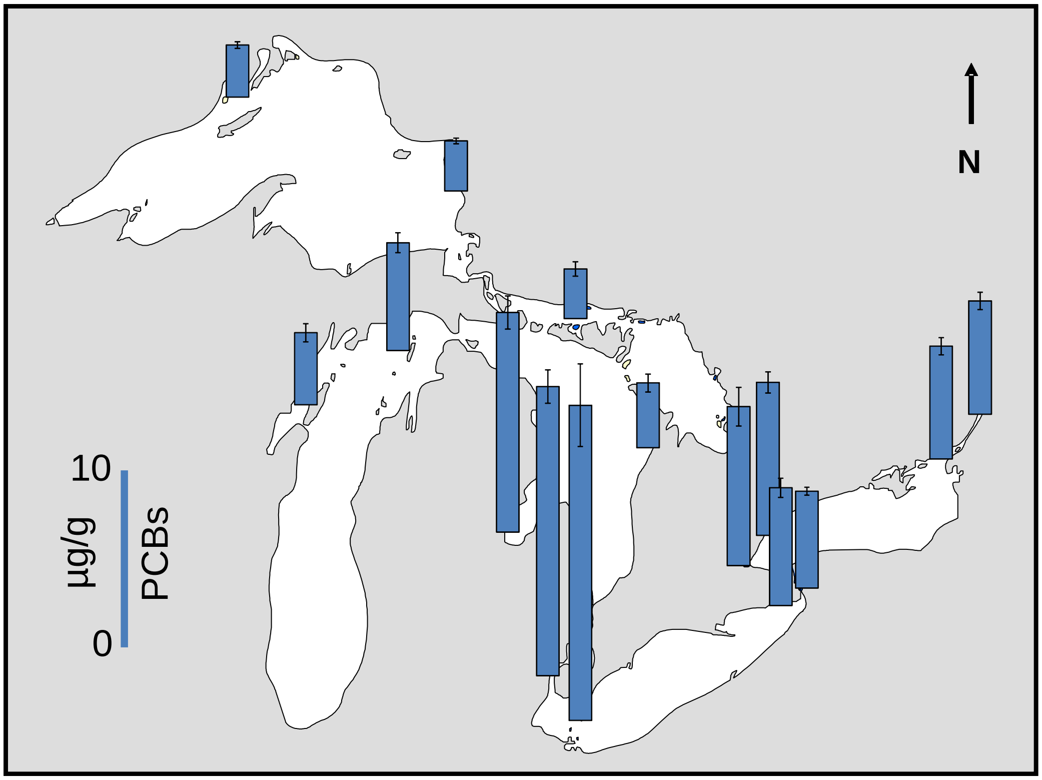


Figure 10. Mean concentrations (SE) of PCBs (µg/g, wet weight) in herring gull eggs from colonies from the Great Lakes and connecting channels, 2009 - 2013. De Solla et al. In Press.

In summary, PCB concentrations in whole fish and other wildlife have declined significantly from the 1970s to the early 1990s, after which rates of decline slowed and in some cases may have leveled off. Concentrations in fish remain above the EPA Wildlife protection value of 0.16 ug/g.

Fish Consumption:

Historically, PCBs have been the contaminant that most frequently limited the consumption of Great Lakes sport fish. In some areas, dioxins/furans, mercury, and toxaphene (Lake Superior) do contribute to restrictive fish consumption advisories. Differences in advisories within and between lakes reflect different levels of contaminant concentration in the air and sediment as well as differences in sampling regimes and locations between the states and Ontario. PCBs continue to drive most fish advisories despite the fact that they were banned in the U.S. and Canada in the 1970s.

Contaminants Responsible for Advisories							
Lake	**State/Province**	**PCB**	**Dioxin**	**Mercury**	**Chlordane**	**Mirex**	**Toxaphene**
Superior	Michigan	x		x	x		
	Wisconsin	x	x	x			
	Minnesota	x		x			
	Ontario	x	x	x			x
Huron	Michigan	x	x				
	Ontario	x	x	x			
Erie	New York	x					
	Ohio	x					
	Pennsylvania	x					
	Michigan	x					
	Ontario	x	x	x			
Ontario	New York	x	x			x	
	Ontario	x	x	x			
Michigan	Illinois	x			x		
	Michigan	x	x		x		
	Indiana	x					
	Wisconsin	x					

Table 8. Contaminants Responsible for Advisories (Reprinted from SOLEC 2011)

In 2010, EPA conducted a human health fish tissue study along the shoreline of the Great Lakes. 157 fish tissue sample were analyzed for the full complement of 209 PCB congeners, and results were summarized as total PCB concentrations (calculated as the sum of the concentrations of detected congeners). PCBs were detected in 100% of the participants in the Great Lakes Human Health Fish Tissue Study samples. Total PCB concentrations in fillets ranged from 6 to 2,379 ppb, and the median concentration was 179 ppb. A human health screening value based on cancer risk for total PCBs was applied to the fillet tissue results to identify the number (and percentage) of the sampled population of nearshore Great Lakes area that exceed the risk-based threshold. EPA consumption advisory guidance published in 2000 lists a cancer health threshold of 0.012 ppm (12 ppb) PCBs (wet weight) in fish tissue (http://water.epa.gov/scitech/swguidance/fishshellfish/techguidance/risk/upload/2009_04_23_fish_advice_volume2_v2cover.pdf).

Statistical results showed that fish fillets in 98.7% of the sampled human population of the nearshore Great Lakes had total PCB tissue concentrations that exceeded the 12 ppb human health threshold for risk of cancer, representing a total area of 10,947 km^2. Additional fish consumption guidance for PCBs set by the Great Lakes Sport Fish Advisory Task Force in 1993 identified a one meal per week threshold of 60 ppb (http://www.health.state.mn.us/divs/eh/fish/consortium/pastprojects/pcbprotocol.html). Based on this PCB human health screening value for non-cancer health impacts (for example, reproductive effects), a total of 81.7% of the nearshore Great Lakes sampled population (or the human population living in the nearshore area of 9,061 km^2) exceeded the one meal per week consumption limit.

In summary, PCBs continue to drive fish consumption advisories in all five Great Lakes. While levels have declined significantly since the ban in the 1970s, recent rates of decline have slowed or leveled off. Further declines toward unrestricted consumption may rely upon the continuous removal of potential sources to the Great Lakes environment.

Human Biomonitoring:

At present, there are no routine Great Lakes specific human biomonitoring programs to monitor human exposure to persistent chemicals. Therefore, nationwide studies and the results of individual epidemiological studies undertaken in the Great Lakes are used as a means to evaluate PCB concentrations in humans in the Great Lakes basin. As such, spatial and/or temporal trends across the Great Lakes basin cannot be defined.

Health Canada’s Canada Health Measures Survey (CHMS) has recently examined the mean blood concentrations of total PCBs in Canadians.

CHMS results show that the geometric mean blood total PCB concentration (measured as Aroclor 1260) of Canadians aged 20 – 79 is 0.9μg/L. The corresponding 95th percentile value for total PCBs in blood for Canadians aged 20-79, is 4.17 ug/l, which is below the Health Canada blood guidance value of 5μg/L established for sensitive populations (i.e. women of childbearing age and children) (Health Canada 2010).

The First Nations Biomonitoring Initiative (FNBI) examined the concentration of PCBs in the blood of Canadian First Nations populations in 2011 (AFN 2013). First Nations geometric mean blood concentrations (measured as Aroclor 1260) for those 20 and older (0.64 µg/L) were lower than those measured under the CHMS (0.9 µg/L) (AFN 2013). The analysis also included a breakdown by ecozone, one of which was the Great Lakes: concentrations in the Great Lakes ecozone (0.01 – 0.03 µg/L) were lower than those of the general First Nations populations and those of the general Canadian population. However, these FNBI summary results should be used with caution, as there is a high coefficient of variability (16.6% - 33.3%) associated with the survey estimates (AFNI 2013)

In summary, blood levels of PCBs in the Canadian general population are beneath both Health Canada guidelines for the general public (20 ug/l) as well as for sensitive populations (5 ug/l). While data is limited, concentrations in the Great Lakes First Nation population are also below these guidelines.

Conclusions:

As summarized in Table 5 above, evaluation of relevant criteria against available data and information is sufficient to conclude that PCBs have a continued adverse impact on the Basin.

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:

(From Environment Canada, 2014)

Strong and effective action has been taken on PCBs under the Canadian Environmental Protection Act, 1999 (CEPA 1999) and other laws, since 1977, when the import, manufacture and sale for re-use were made illegal. PCBs are listed as a toxic substance under Schedule 1 of CEPA 1999.

The release of PCBs to the Canadian environment was made illegal in 1985 and the storage of PCBs in Canada has been regulated since 1988. Furthermore, the handling, transport and destruction of PCBs are also regulated, mostly under provincial regulations.

In 2008, Environment Canada published the new *PCB Regulations*, under which the manufacture, export, import, offer for sale, sale, use, processing, storage and release continue to be controlled under this legislation. These regulations, in addition to strengthening controls, set deadlines for ending the use of PCBs, eliminating PCBs currently in storage and limiting the storage time period before PCBs are destroyed.

The new *PCB Regulations* were amended in 2010 in order to provide additional flexibility to the industry by allowing on-site destruction in accordance with provincial and territorial legislation.
The amendments did not change the deadlines for the destruction of PCBs or delay their elimination from use and storage in Canada. The end-of-use deadlines in the present PCB Regulations are listed in Table 9 below.

Item Containing PCBs	PCB Concentration	End-of-Use Deadline
Liquids for servicing PCB equipment	500 mg/kg or more	December 31, 2009 or up to December 31 2014, if extension granted
Lamp ballasts and pole top transformers	Any	December 31, 2025
All other equipment	500 mg/kg or more	December 31, 2009 or up to December 31 2014, if extension granted
Equipment	50 mg/kg to less than 500 mg/kg	December 31, 2025
Equipment	Less than 50 mg/kg	No end-of-use date
Equipment in prescribed locations	50 mg/kg to less than 500 mg/kg	December 31, 2009 or up to December 31 2014, if extension granted

Table 9. End of use deadlines in the *PCB Regulations*. (Environment Canada, 2014)

Regulations Amending the PCB Regulations and Repealing the Federal Mobile PCB Treatment and Destruction Regulations (SOR/2014-75) are proposed to extend the end-of-use deadline for high concentration electrical equipment (i.e. current transformers, potential transformers, circuit breakers reclosers and bushings) that contain PCBs in a concentration of 500 mg/kg or more (~ 1% of all equipment containing PCBs in Canada). The previous deadline for this equipment was December 1st, 2009; however, some companies who have met certain conditions were given an extension up to December 31st, 2014.However, under the amended regulations, these companies were given until 2025 to phase out use, as this will allow for sufficient time to identify and remove from use all high concentration electrical equipment, while avoiding the negative implications of unscheduled power outages.

The *Export and Import of Hazardous Waste and Hazardous Recyclable Materials Regulations* (2005) control the import of waste containing PCBS in a concentration of 50 mg/kg or more.

The *PCB Waste Export Regulations* (1996) prohibit the export of wastes containing PCBs in a concentration of 50 mg/kg or more to any country other than the US.

The *Federal Mobile PCB Treatment and Destruction Regulations* (1990) prescribed the approval process required for undertaking the treatment and destruction of PCBs on federal land in Canada. As part of the regulatory proposal *Regulations Amending the PCB Regulations and Repealing the Federal Mobile PCB Treatment and Destruction Regulations,* these regulations will be repealed. They are no longer required as the operation of permanent hazardous waste (including PCBs) treatment and destruction facilities is now regulated and authorized by provincial governments and therefore there is no longer a need for Canada to contract the use of mobile PCB treatment and destruction facilities.

The Enforcement Branch of Environment Canada identified the PCB Regulations as a priority regulation for the fiscal years 2010-11, 2011-12 and 2012-13. As a result of the 514 inspections carried out in 2012-13, 55 written warnings and 14 environmental protection compliance orders (EPCOs) were issued. This is a significant reduction in the number of warnings and EPCOs issued in the previous fiscal year. Notably in 2012, the highest number of violations related to incorrect reporting, while the number of prohibited activities and equipment use without an extension were also found to be high.

The federal *PCB Regulations* were developed to enable Canada to meet its international obligations. Canada is party to both the United Nations Environment Programme's *Stockholm Convention on Persistent Organic Pollutants* (Stockholm Convention) and the United Nations Economic Commission for Europe's *Persistent Organic Pollutants* Protocol (2003) to the *1979 Convention on Long Range Transboundary Air Pollution* (LRTAP).

The Stockholm Convention requires Parties to the Convention to make determined efforts to identify, label and remove from use equipment that contain PCBs in various concentrations by 2025. The LRTAP requires parties to make determined efforts to remove from use equipment containing high concentration PCBs in specific volumes by a specific date as well as to destroy PCB liquids in an environmentally sound manner. Since the PCB Regulations came into force (2008) timelines in LRTAP have been changed to align with the Stockholm Convention.

U.S. Federal Risk Management Activities:

Regulatory programs include compliance with and enforcement of existing regulations and the development of new regulations.

In the U.S., PCBs are regulated primarily by TSCA, which has one section (Section 6(e), 15 U.S.C. § 2605(e)) devoted solely to PCBs. TSCA regulations, set forth at 40 C.F.R. Part 761, define: (1) how PCBs may be used, processed, distributed, manufactured, exported, and/or imported; (2) how PCBs may be stored and disposed; (3) PCB spill clean-up and environmental remediation requirements, and (4) how owners of PCB equipment (or “articles”) must keep track of their equipment. Under TSCA Section 6(e), all uses or other activities involving PCBs are banned unless they are specifically allowed as a totally enclosed activity or are a specifically authorized use (<u>*see*</u>, **40 C.F.R. Part 761**; <u>*see also*</u>, **40 C.F.R. § 761.30** for specific allowances). The most significant remaining authorized use of PCBs is as a dielectric fluid in electrical equipment, such as transformers, capacitors and switches.

Provincial and State - Level Actions:

Minnesota regulates PCBs as a listed waste under their Resource Conservation and Recovery Act (RCRA) Subtitle C hazardous waste program.

Wisconsin manages PCB spills, releases and remediation activities through a *One Clean-up* Memorandum of Agreement with U.S. EPA.

Indiana regulates PCBs under their Resource Conservation and Recovery Act (RCRA) Subtitle D solid waste program.

The States of Illinois, Michigan and Ohio, and all tribes currently do not have collateral or authorized PCB management programs and defer to the Federal TSCA program.

Identification of Gaps in Management and/or Science Activities

1) Are environmental levels below applicable benchmarks?

No. Concentrations of ∑PCBs in the eatable portion of fish are still above concentrations which are cause for restrictive fish consumption advisories. Concentrations of PCBs still exceed applicable guidelines in sediment, and whole fish, as well.

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

As the primary source of human exposure to PCBs is through the consumption of fish and other seafood, and the present concentrations of PCBs in most sport fish across the Great Lakes warrant fish consumption advisories, it is reasonable to expect that there are still exposures of concern, from a human health perspective, across the Great Lakes basin, especially when vulnerable populations are considered (e.g. aboriginal peoples and pregnant women etc.)

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

No. PCBs still cause the majority of fish consumption advisories published by the Ontario Ministry of Environment and Climate Change, and all eight Great Lakes States. Furthermore, concentrations in fish appear to be stabilizing after decades of decline, and still exceed guidelines developed for the other aquatic wildlife that consume fish (e.g. mink, herring gull, snapping turtle etc.).

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

Yes. There have been significant declines in all media since 1970’s; however, trends in the environment may be stabilizing.

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

Continued remediation of contaminated site (e.g. AOCs) will reduce locations acting as point sources of PCBs. Canadian PCB regulations will have eliminated all PCBs in use / storage in Canada by 2025.

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:***

The ongoing authorized use of high-concentration PCBs in the US in electrical equipment (e.g. as dielectric fluid) and other applications remains a potentially significant source of atmospheric loading of PCBs to the Great Lakes.

Conclusions:

Following their ban in 1979, PCBs declined precipitously in the Great lakes environment through the 1980s and into the early 1990s. Subsequently, rates of decline have slowed and in many cases have stabilized, while some continue in a general downward trajectory, albeit with increasing variability. There is some evidence which points to ongoing emissions from “in use” and “in storage” PCBs that are geographically concentrated in urban areas. Other sources are previously released PCBs, such as PCBs in contaminated sediments, that are cycling and recycling in the environment due to their persistence. PCBs will continue to drive fish consumption advisories in all Great Lakes for the foreseeable future.

As such, PCBs remain a threat to the environment and human health in the Great Lakes. While concentrations in environmental biota are slowly declining, much work remains to be done, particularly including the control of existing uses in the US as well as the remediation of contaminated sediments in AOCs, before fish consumption advisories may be lifted. monitoring of PCBs in air, water, sediment and high trophic level fish and wildlife species in the Great Lakes in order to continue tracking long-term trends and concentrations in the environment; provide data to protect human health through provision of fish consumption advice; and measure the efficacy of ongoing and forthcoming risk management activities;

5. Final Recommendation:

With respect to PCBs, there was sufficient data and information available to effectively apply the *Binational Considerations*, and based on their application of the considerations, **the ITT has unanimously recommended that PCBs be designated as a CMC**.

6. References

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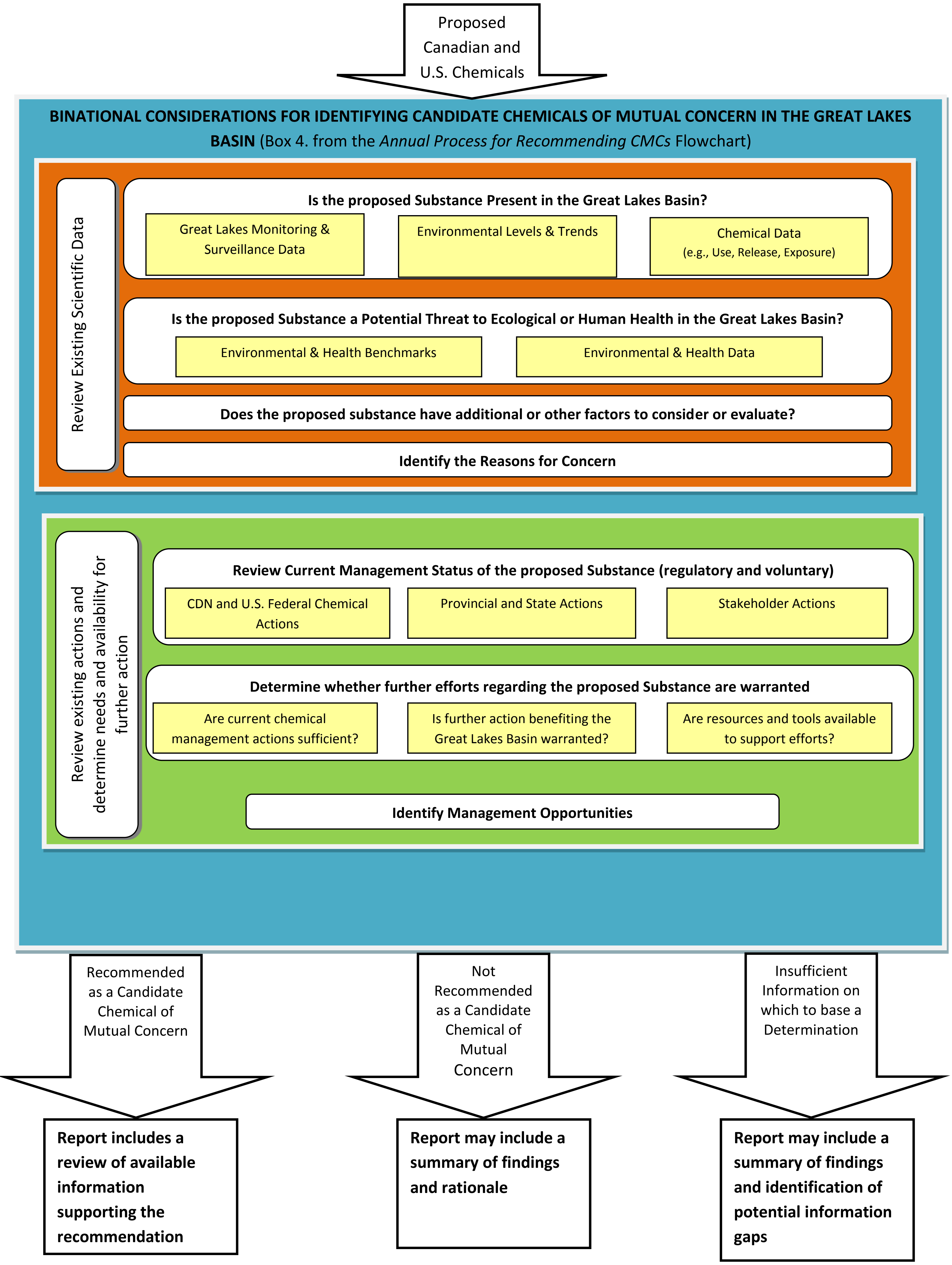
Appendix A:

Binational Considerations When Evaluating Candidate Chemicals of Mutual Concern


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)
Review Existing Scientific Data
Is the proposed Substance Present in the Great Lakes Basin?
Great Lakes Monitoring & Surveillance Data
Environmental Levels & Trends
Chemical Data (e.g., Use, Release, Exposure)
Is the proposed Substance a Potential Threat to Ecological or Human Health in the Great Lakes Basin?
Environmental & Health Benchmarks
Environmental & Health Data
Does the proposed substance have additional or other factors to consider or evaluate?
Identify the Reasons for Concern
Review existing actions and determine needs and availability for further action
Review Current Management Status of the proposed Substance (regulatory and voluntary)
CDN and U.S. Federal Chemical Actions
Provincial and State Actions
Stakeholder Actions
Determine whether further efforts regarding the proposed Substance are warranted
Are current chemical management actions sufficient?
Is further action benefiting the Great Lakes Basin warranted?
Are resources and tools available to support efforts?
Identify Management Opportunities
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

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