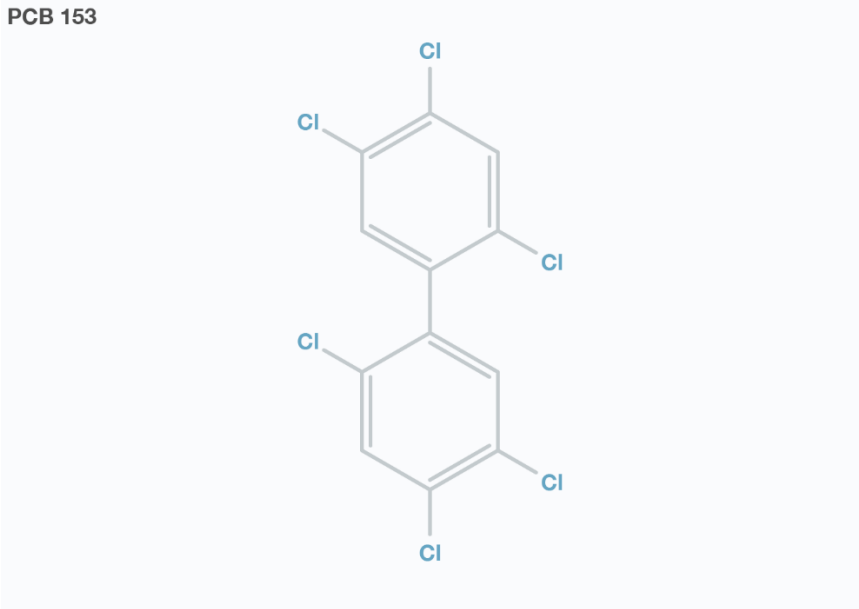
# Pollution Tracker Fact Sheet

Polychlorinated biphenyls (PCBs)

## What are they?

Polychlorinated biphenyls (PCBs) are industrial chemicals that have been used extensively as stable, heat-resistant oils in electrical transformers, capacitors, and heat exchange fluids, and as additives in paint, carbonless copy paper, and plastics. PCBs were produced commercially in the United States between 1929 and 1977 and imported to Canada. Commercial PCB formulations were sold in North America under the trade name Aroclor. Nine Aroclors were produced, each containing different mixtures of the 209 PCB congeners (or types).[1]

The import, manufacture, and sale of PCBs was made illegal in Canada and the United States in the late 1970s. In Canada, continued use of older closed electrical equipment containing PCB fluids is permitted until the end of the equipment's service life.[1]



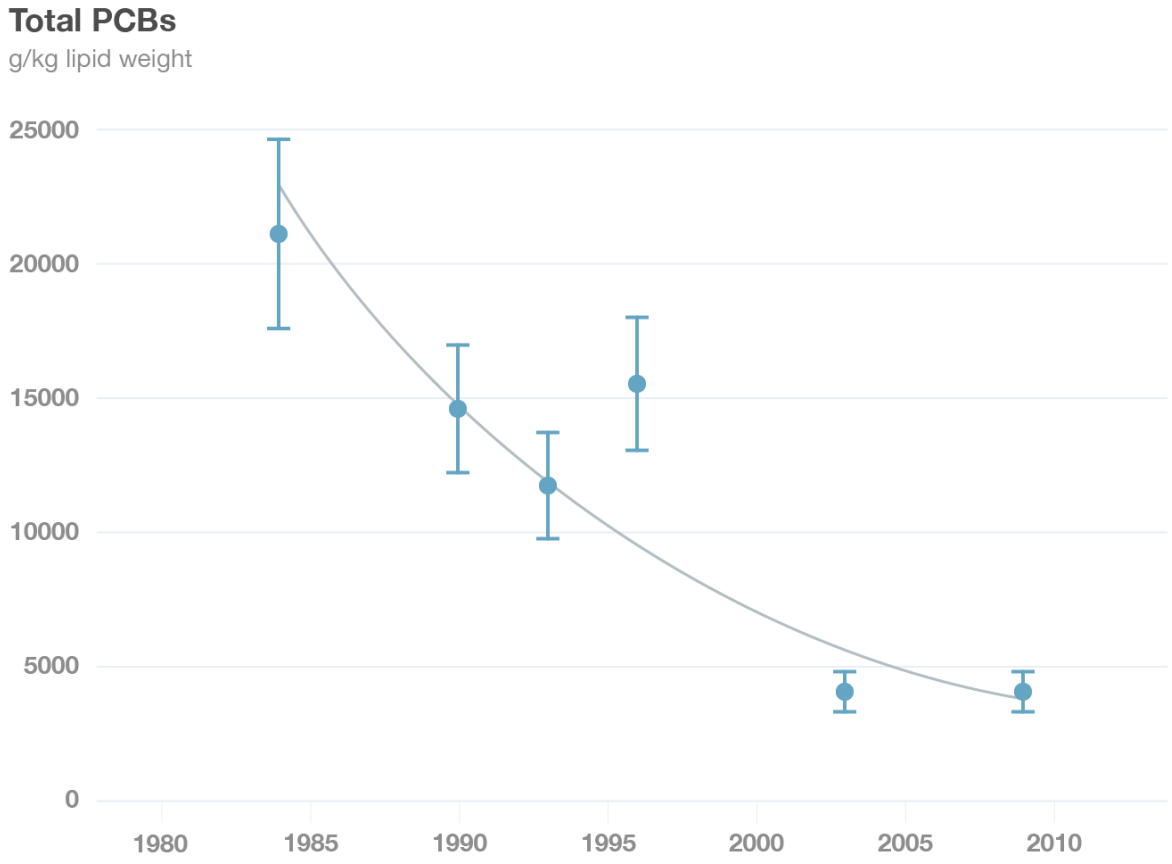

## How do they get into the ocean?

Historically, PCBs entered the marine environment through wastewater discharges, contaminated sites, landfill leachate, and incineration. Today, redistribution of PCBs that persist in soil and sediment, and atmospheric transport of PCBs from other areas of the world are the main processes affecting PCB levels in the marine environment.[2]

**FACT**: Salmon have been shown to import PCBs from their ocean habitats and deliver them to grizzly bears and freshwater environments.[3]

PCBs are persistent, remaining in the environment for several decades. PCBs also bioaccumulate in the fats of living organisms and biomagnify (or increase in concentration) up the food chain.

Despite their persistence, PCB concentrations have been declining in environmental media since regulations were put in place. For example, concentrations measured in blubber biopsies from free ranging harbour seal pups in Puget Sound, Washington declined by 81% between 1984 and 2003.[5]




*Levels of PCBs in blubber of harbour seal pups from Puget Sound decreased from the 1980s to 2000s.* [5]

## Are they a problem?

PCBs pose health risks for marine life. In fish, PCBs cause reproductive failure at relatively low doses. In marine mammals, PCBs have been associated with endocrine disruption, which can cause impairment of reproduction, development, and other hormone-related processes, as well as immunotoxicity, giving rise to increased susceptibility to infectious diseases and cancers.[2] In humans, acute exposures to very high PCB concentrations (much higher than typical environmental levels) have been associated with acne-like skin conditions in adults and neurobehavioral and immunological changes in children.[1]

**FACT**: Research has shown that the killer whales of the NE Pacific Ocean are among the most PCB-contaminated marine mammals in the world.[4]

PCBs are a major legacy contaminant of concern in killer whales of the NE Pacific [4,6], and recent research predicts that southern resident killer whales will not be safe from the effects of PCBs until 2063 to 2089.[7]

## What is being done?

Since PCBs are no longer imported or used to manufacture new materials, clean-up of contaminated sites and appropriate disposal of existing PCBs are key to prevent further marine pollution. In Canada, the storage, handling, transport, and destruction of PCBs are regulated by federal and provincial legislation. Under the *Canadian Environmental Protection Act* (1999), the *PCB Regulations* set specific dates for the destruction of PCBs in service and in storage.

The Stockholm Convention is an international treaty signed by over 150 countries with a goal of protecting human health and the environment from persistent organic pollutants, including PCBs. The Stockholm Convention hopes to end all use of PCBs by 2025.

Canadian Sediment Quality Guidelines protective of marine benthic invertebrates are available for total PCBs (Table 1). Regulatory guidelines for PCBs protective of marine mammals and birds that consume fish are also available, expressed on a toxicity equivalent (TEQ) basis (Table 1).[9] TEQs incorporate a measure of the toxicity of individual PCB compounds relative to the most toxic dioxin compound: 2,3,7,8-TCDD.

**FACT**: Total PCB levels in all Pollution Tracker sediment samples were higher than the new sediment quality guideline considered protective of killer whales.

It is important to note that most sediment guidelines are largely based on toxicity endpoints for invertebrates and, therefore, are not necessarily relevant to organisms higher up in the food web, such as marine mammals. Regulatory guidelines protective of marine mammals are not yet available for most contaminants but are currently under development in Canada for certain priority chemicals, including PCBs. A Working Sediment Quality Guideline protective of marine mammals was recently adopted by British Columbia (BC), based on the work of Alava et al. (2012) (Table 1).[10,11]

*Table 1. Federal and Provincial Sediment and Tissue Guidelines for PCBs* [9,10]

| Parameter | Sediment (µg/kg dry weight) | Wildlife Diet | |
|---|---|---|---|
| | | Mammals (ng TEQ/kg diet wet weight) | Birds (ng TEQ/kg diet wet weight) |
| Total PCBs | 21.5* / 189** / 0.0037*** | 0.79 | 2.4 |

*Notes:* * CCME Interim Sediment Quality Guideline (ISQG); ** CCME Probable Effects Level (PEL); *** British Columbia Working Sediment Quality Guideline (BC WSQG) protective of marine mammals

Tsleil-Waututh Nation and the British Columbia Ministry of Environment and Climate Change Strategy are collaboratively updating water quality objectives for Burrard Inlet in the Metro Vancouver area. As part of this process, tissue screening values for fish and shellfish protective of human health have been developed for several contaminants of concern, including PCBs. These screening values represent a suggested safe level of contaminants in fish tissue. Exceedance of screening levels may indicate that further investigation to assess human health risk is warranted but does not imply risk to human health.[12]

## What can you do?

- As individual and organizations we can:
- Learn more about PCBs and other contaminants of concern using the resource links below
- Recycle and dispose of waste responsibly
- From Health Canada [8]:

- Don't burn wood that has been treated or painted, since burning materials that contain PCBs can create dioxins and furans
- If you are at risk for exposure to PCBs in the workplace, be sure to take appropriate safety precautions and follow all prescribed decontamination procedures
- Follow regional/provincial/territorial advice about limiting your consumption of wild game and sports fish. In addition, you can prepare game and sports fish in a way that minimizes your exposure to PCBs. Discard the inner organs and remove the skin and all visible fat. Broil, bake, boil or grill the flesh, but avoid frying as this cooking method retains the fat.

# More Information?

[1] Agency for Toxic Substances and Disease Registry (ATSDR). 2000. Toxicological Profile for Polychlorinated Biphenyls (PCBs). U.S. Department of Health and Human Services. Public Health Service. Available at: https://www.atsdr.cdc.gov/toxprofiles/tp17.pdf

[2] Garrett C and Ross PS. 2010. Recovering resident killer whales: a guide to contaminant sources, mitigation, and regulations in British Columbia. *Canadian Technical Report of Fisheries and Aquatic Sciences* 2894.

[3] Christensen JR, MacDuffee M, Macdonald RW, Whiticar M, and Ross PS. 2005. Persistent organic pollutants in British Columbia grizzly bears: consequence of divergent diets. *Environmental Science and Technology* 39: 6952-6960.

[4] Ross PS. 2006. Fireproof killer whales: Flame retardant chemicals and the conservation imperative in the charismatic icon of British Columbia. *Canadian Journal of Fisheries and Aquatic Sciences* 63: 224-234.

[5] Ross PS, Noel M, Lambourn D, Dangerfield N, Calambokidis J, and Jeffries S. 2013. Declining concentrations of persistent PCBs, PBDEs, PCDEs, and PCNs in harbor seals (*Phoca vitulina)* from the Salish Sea. *Progress in Oceanography*. 115: 160-170.

[6] Ross PS, Ellis GM, Ikonomou MG, Barrett-Lennard LG, and Addison RF. 2000. High PCB concentrations in free-ranging Pacific killer whales, *Orcinus orca*: effects of age, sex and dietary preference. *Marine Pollution Bulletin* 40: 504-515.

[7] Hickie BE, Ross PS, Macdonald RW, and Ford JKB. 2007. Killer whales (*Orcinus orca*) face protracted health risks associated with lifetime exposure to PCBs. *Environmental Science and Technology* 41: 6613-6619.

[8] Health Canada. 2005. It's Your Health. PCBs. Available at: https://www.canada.ca/en/health-canada/services/healthy-living/your-health/environment/pcbs.html

[9] Canadian Council of Ministers of the Environment (CCME). 1998. Canadian sediment quality guidelines. Canadian Council of Ministers of the Environment, Winnipeg. Available at: http://cegg-rcge.ccme.ca/en/index.html#void

[10] British Columbia Ministry of Environment and Climate Change Strategy. 2021. Working Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture. Water Quality Guideline Series, WQG-08. Prov. B.C., Victoria B.C. Available at: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/bc_env_working_water_quality_guidelines.pdf

[11] Alava JJ, Ross PS, Lachmuth C, Ford JK, Hickie BE, & Gobas FA. 2012. Habitat-based PCB environmental quality criteria for the protection of endangered killer whales (*Orcinus orca*). *Environmental Science and Technology* 46: 12655-12663.

[12] Thompson HC, and Stein D. 2021. Tissue Quality Objectives Recommendations for Burrard Inlet. Prepared for Tsleil-Waututh Nation and the Province of B.C. Available at: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-objectives/burrard_inlet_water_quality_objectives_methods_tissue_rec_june_3-_2021.pdf