



Water Quality

Ambient Water Quality Criteria for Polychlorinated Biphenyls (PCBs)

Overview Report

Prepared pursuant to Section 2(e) of the Environment Management Act, 1981

Original signed by J. O'Riordan
Assistant Deputy Minister
Ministry of Environment, Lands and Parks
January 24, 1992

Summary

This report is one in a series which establishes ambient water quality criteria for British Columbia. The criteria are safe conditions or levels of a variable which have province-wide application and are set to protect various water uses. This report sets criteria for polychlorinated biphenyls (PCBs) to protect freshwater and marine aquatic life, and irrigation. Criteria for drinking water, wildlife, recreation, and livestock watering were not set in this document for two main reasons: (a) a PCB criterion for drinking water is under review by Health and Welfare Canada, and (b) there is a lack of pertinent information on effects of PCBs in waters used for wildlife, livestock watering, and primary-contact recreation. Additionally, it was noted that water was a minor source of PCB body burden for humans and animals and there was more likelihood of adverse effects from PCBs in the environment due to consumption of contaminated foods. The criteria are summarized in [Table 1](#). at the back of this report.

Aquatic life is the most sensitive water use with respect to polychlorinated biphenyls. The aquatic life (freshwater and marine) criterion recommended in this document is one (freshwater) to two (marine) orders of magnitude lower than the Canadian Water Quality Guidelines (CCREM, 1987; CCME, 1991). There are no CCREM guidelines for irrigation water use for which we have also set criteria.

A major use of the criteria is to set ambient water quality objectives. The objectives are the criteria modified or adopted to protect the most sensitive designated water use in a particular body of water. The objectives are used in the preparation of waste management Permits, Orders, or Approvals, which are the only documents to have legal standing.

TABLES

Table 1: Summary of Criteria for Polychlorinated Biphenyls (PCBs)

Ministry of Environment	Water Protection and Sustainability Branch Environmental Sustainability and Strategic Policy Division	Mailing Address: PO Box 9362 Stn Prov Govt Victoria BC V8W 9M2	Telephone: 250 387-9481 Facsimile: 250 356-1202 Website: www.gov.bc.ca/water
--------------------------------	---	---	---

Water Use	PCBs	Recommended Maximum Concentration
Drinking Water Supply	—	None proposed
Wildlife	—	None proposed
Livestock Water Supply	—	None proposed
Irrigation Water	Total	0.5 µg/L
Primary Contact Recreation	—	None proposed
Freshwater and Marine Aquatic Life	Total PCB #105 PCB #169 PCB #77 PCB #126	0.1 ng/L 0.09 ng/L 0.06 ng/L 0.04 ng/L 0.00025 ng/L
Freshwater and Marine Aquatic Life - Fish and/or Shellfish (for wildlife consumption: whole animal)	Total	0.1 µg/g wet weight
Freshwater and Marine Aquatic Life - Fish and/or Shellfish (for human consumption: edible tissue only)	Total	2.0 µg/g wet weight
Freshwater and Marine Aquatic Life - Sediment (*containing 1% organic carbon)	Total	0.02 µg/g dry weight

**If sediment organic carbon is not 1%, the criteria is =
(0.02 µg/g) x (1% organic carbon content).*

Preface

THE MINISTRY OF ENVIRONMENT, LANDS AND PARKS (now called Ministry of Water, Land and Air Protection) develops province-wide ambient water quality guidelines for variables that are important in the surface waters of British Columbia. This work has the following goals:

1. to provide guidelines for the evaluation of data on water, sediment, and biota
2. to provide guidelines for the establishment of site-specific ambient water quality objectives

Ambient water quality objectives for specific waterbodies will be based on the guidelines and also consider present and future uses, waste discharges, hydrology/limnology/oceanography, and existing background water quality. The process for establishing water quality objectives is more fully outlined in *Principles for Preparing Water Quality Objectives in British Columbia*, copies of which are available from Water Quality Section of the Water Management Branch.

Neither guidelines nor objectives which are derived from them, have any legal standing. The objectives, however, can be used to calculate allowable limits or levels for contaminants in waste discharges. These limits are set out in waste management permits and thus have legal standing. The objectives are not usually incorporated as conditions of the permit.

The definition adopted for a guideline is:

A maximum and/or a minimum value for a physical, chemical or biological characteristic of water, sediment or biota, which should not be exceeded to prevent specified detrimental effects from occurring to a water use, including aquatic life, under specified environmental conditions.

The guidelines are province-wide in application, are use-specific, and are developed for some or all of the following specific water uses:

- Raw drinking, public water supply and food processing
- Aquatic life and wildlife
- Agriculture (livestock watering and irrigation)
- Recreation and aesthetics
- Industrial (water supplies)

The guidelines are set after considering the scientific literature, guidelines from other jurisdictions, and general conditions in British Columbia. The scientific literature gives information on the effects of toxicants on various life forms. This information is not always conclusive because it is usually based on laboratory work which, at best, only approximates actual field conditions. To compensate for this uncertainty, guidelines have built-in safety factors which are conservative but reflect natural background conditions in the province.

The site-specific water quality objectives are, in most cases, the same as guidelines. However, in some cases, such as when natural background levels exceed the guidelines, the objectives could be less stringent than the guidelines. In relatively rare instances, for example if the resource is unusually valuable or of special provincial significance, the safety factor could be increased by using objectives which are more stringent than the guidelines. Another approach in such special cases is to develop site-specific guidelines by carrying out toxicity experiments in the field. This approach is costly and time-consuming and therefore seldom used.

Guidelines are subject to review and revision as new information becomes available, or as other circumstances dictate.

The guidelines apply to the ambient raw water source before it is diverted or treated for domestic use.

The Ministry of Health regulates the quality of water for domestic use after it is treated and delivered by a water purveyor.

Guidelines relating to public health at bathing beaches are the same as those used by the Ministry of Health which regulates the recreation and aesthetic use.

Recommended Guidelines

These criteria are based on information presented in a technical appendix and are summarized in Table 1.

1. DRINKING WATER SUPPLY

Criteria for PCBs in drinking water are not recommended in this document primarily because the drinking water criterion for PCBs is under review by Health and Welfare Canada. In British Columbia, PCB levels in ambient waters appear to be low (e.g., lower than the U.S. EPA advisory level of 0.5 µg/L at the cancer risk level of 10⁻⁴) and, as a result, drinking water was not considered to be a significant source of PCB body burden in humans.

CCREM (now known as CCME or the Canadian Council of Environment Ministers) did not recommend a PCB guideline for drinking water.

2. AQUATIC LIFE

2.1 Water

For the protection of freshwater and marine aquatic life and consumers of fish and shellfish (e.g., wildlife), it is recommended that the total PCB concentration in water should not exceed 0.1 ng/L.

Additionally it is recommended that the concentrations of:

- 3,3',4,4' - tetrachlorobiphenyl (PCB #77) should not exceed 0.04 ng/L*
- 2,3,3',4,4' - pentachlorobiphenyl (PCB #105) should not exceed 0.09 ng/L*
- 3,3',4,4',5,5 - hexachlorobiphenyl (PCB #169) should not exceed 0.06 ng/L*
- 3,3',4,4',5 - pentachlorobiphenyl (PCB #126) should not exceed 0.00025 ng/L*

The criteria recommended above are more restrictive than the CCREM (1987) and CCME (1991) guidelines of 1.0 ng PCBs/L (freshwater) and 10.0 ng PCBs/L (marine water) for the protection of aquatic life. The CCREM and CCME guidelines were designed to protect aquatic biota from toxic effects of PCBs, rather than to protect consumers of PCB contaminated foods; hence their guidelines are less restrictive than ours.

2.2 Fish and Shellfish

To protect wildlife dependent on aquatic life for food, it is recommended that the total concentration of PCBs in whole fish and/or shellfish should not exceed 0.1 µg/g wet weight.

To protect human consumers from PCB residue in aquatic life, it is recommended that the concentration of PCBs in the edible portion of fish and/or shellfish should not exceed 2.0 µg/g wet weight.

This is consistent with the Health and Welfare Canada guideline.

CCREM (1987) did not recommend a PCB guideline for fish or shellfish to protect wildlife dependent on aquatic life.

2.3 Sediment

To protect aquatic life and consumers of aquatic life (e.g., wildlife), it is recommended that the concentration of PCBs in freshwater and marine sediments containing 1.0%

organic carbon should not exceed 0.02 µg/g-sediment (dry weight) (or 2 µg/g-organic carbon, when expressed on an organic carbon basis).

For a sediment with organic carbon content different from the 1.0 % level, an appropriate criterion can be obtained by multiplying the recommended criterion (i.e., 0.02 µg/g-sediment) with the actual organic carbon content for the sediment.

CCREM (1987) did not recommend a PCB guideline for aquatic sediments to protect aquatic life and consumers of aquatic life.

Application of the Guidelines

1. FORMS OF PCBs

Toxicity of polychlorinated biphenyls has been expressed in terms of both total and some selected congener-specific concentrations. In general, the measurement of total concentration will provide adequate protection against adverse effects of PCBs as long as the criteria for total PCBs are met. Where adverse effects due to PCBs are suspected despite the fact that criteria for total PCBs in water are met, congener-specific analyses are recommended. The most critical PCB congeners are those listed in Table 1. Additionally, PCBs in aquatic organisms (e.g., fish) and sediment should also be measured when investigating PCB contamination problems.

2. ASSESSMENT OF EXISTING WATER QUALITY

The criteria recommended in this document are primarily based on laboratory bioassays, which are usually performed under controlled conditions. Aquatic organisms in the natural environment, however, obtain their PCB burden from both water and food. Also, PCBs associated with the sediment fraction could become available to the organisms under favourable environmental conditions. Thus a measurement of total PCBs in water alone cannot be taken as a true measure of a PCB problem in a given waterbody. Other assessment techniques include measurement of PCBs in fish and/or sediment, and long-term bioassays with resident species using local water. The guidelines for PCBs in fish and sediment can be used for the assessment of existing water quality. Long-term bioassays are complex and costly; they should be reserved for waterbodies with high fisheries values which are threatened by a controllable source.

3. SETTING WATER QUALITY OBJECTIVES

PCBs are synthetic chemicals and do not exist naturally in the environment. When concentrations of total PCBs in undeveloped waterbodies are less than the criteria levels, then the criteria, or more stringent values if justified, should apply. In some cases, socioeconomic or other factors may justify objectives which are less stringent than the criteria. Site-specific impact studies would be required in such cases.