



Appendix B

HISTORY OF LAKE ONTARIO PRIORITY CONTAMINANTS

**Table B-1.
History of Lake Ontario Priority Contaminants**

	Priority Toxics in 1989 LOTMP	Priority Toxics in 1991 LOTMP	Proposed to be Included in LaMP
Mirex	X	X	X
PCBs	X	X	X ¹
DDT & Metabolites	X	X	X ¹
Dioxins and Furans	X	X	X ¹
Dieldrin	X	X	X ²
Octachlorostyrene	X	X	-
Hexachlorobenzene	X	X	-
Mercury	X	X	X ²
Chlordane	X	X	-
Iron	X	-	-
Aluminum	X	-	-
Heptachlor/Heptachlor Epoxide	-	-	-
Total	11	9	6

¹Found to impair beneficial uses on a lakewide basis

²Likely to impair beneficial uses due to exceedances of criteria

HISTORY

Priority Toxics in the 1989 Lake Ontario Toxic Management Plan

To implement a chemical-by-chemical approach to control toxics in the lake, the Lake Ontario Toxics Committee developed a comprehensive system to categorize toxic chemicals and established a work group (Lake Ontario Categorization Work Group) to take a preliminary cut at categorizing the chemicals. There are two major groups of chemicals: those for which acceptable ambient data are available (Category 1), and those chemicals for which ambient data are not available (Category 2). Ambient data were available for 42 chemicals. Of these 42, 7 chemicals exceeded enforceable water quality or fish tissue standards, or both, and 4 chemicals exceeded more stringent, but unenforceable, criteria or guidelines in the water column, fish tissue, or both. These “11 Priority Toxics”, as shown in the above table, became the focus of the LOTMP.

Although water quality/fish tissue numbers may be referred to as a standard, objective, criteria, or guideline, the term criteria is used in this discussion to represent any of these terms.

Priority Toxics in the 1991 LOTMP Update

The 1991 LOTMP Update removed iron and aluminum from the 1989 list for two reasons:

1. Iron and aluminum may not be reliable indicators of toxicity. No single number is ideal because of the variety of forms of these metals that may be present in ambient waters; and
2. It is difficult to determine whether loadings of these metals originate from natural or human sources.

LaMP Critical Pollutants/Lakewide Contaminants of Concern

Subsequent to the 1991 LOTMP Update, the Categorization Work Group was charged with updating the categorization of chemicals. Based on data from this analysis, as well as more recent data, three chemicals were removed from the list (octachlorostyrene, hexachlorobenzene, and chlordane). The reasons for these changes are summarized below:

Octachlorostyrene (OCS)

- # OCS was identified as a LOTMP priority contaminant based on lake trout samples collected in 1988, 1989, and 1990. Other lake trout data sets for the same years showed fish tissue levels to be below the lowest Four Party criterion. Data sets for chinook salmon, coho salmon, brown trout, white sucker, and smallmouth bass were also below the lowest criterion. U.S. and Canadian fish monitoring experts for Lake Ontario do not regard OCS as a significant problem in Lake Ontario.
- # There are no water quality criteria for OCS. The Niagara River Upstream-Downstream Monitoring Program measured mean levels of OCS on suspended solids of 0.004 ng/L (equivalent water concentration) in 1992-1993. Preliminary results of dated sediment cores collected in Lake Ontario in 1995 indicate that OCS is not detected in recent stratum.

Hexachlorobenzene (HCB)

- # Levels of HCB in fish tissue are one to two orders of magnitude below the most stringent Four Party criterion of 0.22 ppm for the protection of piscivorous fish.
- # HCB was identified in the 1989 LOTMP report as exceeding water quality criteria due to a typographical error which presented the most stringent criterion (i.e., USEPA guidance value) as 0.072 ng/L instead of the correct value of 0.72 ng/L. As stated in the first report, the 90 percent upper confidence level for lakewide concentrations of 0.1 ng/L were well below the 0.72 ng/L criterion.
- # HCB has not been detected in Lake Ontario waters at concentrations above the most stringent Four Party water quality criterion. Lakewide sampling programs found mean levels of HCB in Lake Ontario to be approximately one order of magnitude lower than the most stringent water quality criterion of 0.75 ng/L or the new Great Lakes Initiative (GLI) water quality criterion of 0.45 ng/L. HCB has not been identified as exceeding water quality standards by the Niagara River Upstream-Downstream Monitoring Program.

Appendix B

Chlordane

- # Chlordane was identified in the 1989 LOTMP as exceeding the 0.037 ppm fish criterion for protection of human health. This was based on 1985 samples of 5 to 10 year old lake trout taken from Stony Island in the eastern basin that had levels of total chlordane ranging from 0.2 to 0.61 ppm. Sampling results of 5 to 8 year old lake trout in 1987 found chlordane levels to be below the criterion, except for one of the older lake trout. Criteria exceedances have not been observed in any fish species since 1987.
- # Chlordane has not been detected in Lake Ontario waters at concentrations above the most stringent Four Party criterion. Lakewide sampling in 1986 and 1988 found total chlordane concentrations of approximately 0.05 ng/L, which are below the most stringent water quality number of 0.25 ng/L and the most stringent criterion of 0.5 ng/L for the protection of human health. Sampling in 1990 indicates chlordane levels are less than 0.11 ng/L, and chlordane has not been identified as exceeding water quality standards by the Niagara River Upstream-Downstream Program.

Revisions to Critical Pollutants List as Proposed in April 1997 Draft Stage I LaMP

The following is a summary of changes made to the Critical Pollutants List subsequent to the public comment period, and the reasons for these changes:

Heptachlor/Heptachlor Epoxide

- # Heptachlor and its breakdown product heptachlor epoxide were proposed in earlier drafts of this document as critical pollutants due to the presence of heptachlor epoxide in open waters lakewide at concentrations above the most stringent water quality standard (0.1 ng/L). Data from 1986, 1988, and 1990 showed the average concentrations varied between 0.1 and 0.3 ng/L. 1993 concentrations which were evaluated after the April 1997 draft were approximately 0.03 ng/L, well below the 0.1 ng/L criteria. Steady declines of these contaminants are attributed to product bans in the U.S. and Canada. Heptachlor and heptachlor epoxide were not included on the current list of critical pollutants based on this new information. These contaminants will continue to be monitored as part of a variety of ongoing environmental monitoring programs.

Dieldrin

- # Dieldrin had been proposed as a critical pollutant in earlier drafts of this document based on studies that suggested that dieldrin could limit the recovery of bald eagle populations due to its potential to poison adult eagles. Comments received during the public comment period questioned if current levels of dieldrin in the environment posed a hazard and if dieldrin warranted the same level of concern as PCBs, dioxins, and the other critical pollutants. Bald eagle experts agreed that, although dieldrin had been a concern in the 1970s and early 1980s, it is no longer considered to be a significant concern for eagle populations.
- # Dieldrin was used extensively as a seed treatment and a soil insecticide for vegetables and lawns in Ontario until the early 1970s (Frank *et al.*, 1975) when restrictions on use came into effect (Agriculture Canada, 1976b). Historically, dieldrin was used extensively and, because of its high toxicity, caused numerous mortalities in wildlife.

Appendix B

- # Currently, there are no data to support the hypothesis that environmental levels of dieldrin are affecting the health of Lake Ontario herring gull populations. Levels of dieldrin in herring gull eggs collected from several breeding colonies on Lake Ontario since 1974 never approached the 1.0 ppm effect level (Environment Canada, 1997). Initially, egg concentrations were in the 0.5 ppm range and have since declined to approximately 0.1 ppm or less at the two monitoring sites on Lake Ontario in 1996.
- # A bald eagle egg which was not going to hatch was collected in the Lake Ontario basin in 1995 from a nest approximately 10 kilometers from the lake shore. This egg was found to have dieldrin concentrations of 0.13 ppm, well below the 1.0 ppm threshold effects level. While herring gull eggs analyzed from Lake Ontario are well below the 1.0 ppm threshold value, bald eagles, which are higher on the food chain, may produce eggs with higher concentrations of dieldrin. This would be possible in the future if they breed on the Lake Ontario shoreline where their diet would contain more contaminated fish than at more inland locations.
- # Dieldrin remains on the LaMP list of critical pollutants because its concentration in water and fish tissue exceeds the U.S. Great Lakes Water Quality Initiative (GLI) criteria throughout the lake. The GLI criterion for water is 0.006 parts per billion and Lake Ontario water averages 0.6 parts per billion. The corresponding GLI fish tissue criterion is 0.0025 parts per million. Most Lake Ontario fish clearly exceed this criterion as dieldrin is detectable at concentrations ranging from approximately 0.005 to 0.030 parts per million.

Mercury

- # Mercury was not proposed to be a Critical Pollutant in earlier drafts of this document, since estimates of the water quality concentrations, based on fish tissue observations, indicated that lake levels were below that of the GLI water quality criterion of 3.3 ng/L. As noted in the draft document, the Four Parties agreed to continue their assessment based on recent environmental data. The Four Parties reviewed recent fish tissue contaminant concentrations and found mercury concentrations in smallmouth bass and walleye to exceed Ontario's 0.5 ppm guideline for fish consumption throughout the lake. Therefore, although mercury is not causing lakewide impairments of beneficial uses, this contaminant will be included as a LaMP critical pollutant given the lakewide nature of these criteria exceedences. More details regarding this analysis is provided at the end of this Appendix.

CONSIDERATION OF RECENT U.S. GREAT LAKES WATER QUALITY INITIATIVE CRITERIA

As indicated above, reviews of existing information had suggested that OCS, HCB, chlordane, and mercury were no longer a concern in the open waters of Lake Ontario. To confirm this position, a second review was performed which considered the new, generally much lower, water quality criteria contained in the U.S. Great Lakes Water Quality Initiative (Table B-2). The results of this second review continued to support removing three of these chemicals from the list of lakewide contaminants of concern. The following provides a brief summary of the results of this second evaluation.

**Table B-2.
GLI Human Health WQC and Fish Flesh Values Used**

Substance	GLI WQC (ug/L)	Fish Tissue Value (ppm) (based on 3.1% lipid content)
Chlordane	0.00025*	0.04
Dieldrin	0.0000006	0.0025
HCB	0.00045*	0.03
Mercury	0.0033**	0.37
OCS	0.000054***	0.11

* Tier I human health cancer criterion, which was published in the March 23, 1995 GLI.

** Tier I human health non-cancer criterion which was updated subsequent to the March 23, 1995 GLI, based on an updated RfD.

*** Tier I human health non-cancer criterion, which was derived subsequent to the March 23, 1995 GLI, using the Tier methodology and all available data.

Data Used

Water Quality: Lake Ontario ambient water quality was compared to the GLI human health-based water quality criteria (WQC) using the most recently published Niagara River Upstream/Downstream monitoring data (1990 & 1993), as well as Environment Canada's most recent lakewide sampling information (1992-93 & 1993-94).

Fish Tissue: The fish tissue data used for this assessment were collected through New York State and Ontario fish tissue monitoring programs (1986 - 1993). Fish known to inhabit and range throughout the open waters of Lake Ontario were selected (brown trout, lake trout, rainbow trout, coho salmon and chinook salmon) in order to characterize lakewide conditions.

In addition, in order to be consistent with the GLI methodology, decisions were made to: compare the mean fish tissue concentrations to the GLI-based fish flesh values to accurately account for the life long exposure to contaminants over a wide range of concentrations (consistent with USEPA policy and both NYSDEC and NYSDOH techniques); and the fish tissue lipid content, whenever possible, was normalized to 3.1 percent, (based on the GLI criteria).

Appendix B

Findings/Conclusions

The most current information indicates that lakewide concentrations of chlordane, HCB, and OCS do not exceed the applicable GLIWQC or GLI-derived fish flesh values on a lakewide basis. Chlordane, HCB, and OCS concentrations are approximately one order of magnitude below the applicable GLIWQC. Mean fish tissue concentrations of OCS, chlordane, and HCB (normalized to 3.1% lipid concentration) are, with the exception of one data set, well below the GLI-derived values for these contaminants.

Although there are no reliable water quality data for mercury, mercury levels in fish tissue provide a qualitative indication that water column mercury levels are also below the GLIWQC. An assessment of mercury in fish tissue found no exceedences of the GLI fish flesh criteria for “open water” fish such as lake trout and salmon. However, mercury is problematic with some near shore species such as smallmouth bass and walleye exceeding Ontario’s 0.5 ppm criterion. Other nearshore species also exceed the lower (0.37 ppm) GLI criterion. Dieldrin was found to exceed both water quality and fish flesh criteria throughout the lake.

Based upon the results of this evaluation, OCS, chlordane, and HCB are not considered to be exceeding GLIWQC on a lakewide basis. Mercury and dieldrin are considered to be exceeding GLIWQC and are, accordingly, considered LaMP Critical Pollutants.

Future Actions

It is recommended that future evaluations be used to compare Lake Ontario surface water quality and fish tissue data to all of the GLI BCC WQC and associated fish tissue values in order to identify any, as yet unrecognized, contaminant problems that should be considered for special priority actions on a lakewide basis.

MERCURY ANALYSIS

Comparison of Ontario and New York data for mercury in fish was conducted using as a basis the following rules:

- # Use only mercury data for fish collections from 1990 through the present time for all species, except walleye. For walleye, data from 1987 through the present time was used due to the similarity of the data between locations and over time, and to obtain an adequate data base for evaluation;
- # Use only data from Lake Ontario, Bay of Quinte, and the lower Niagara River;
- # A classification of mercury as a lakewide chemical of concern may be made when a species of fish exceeds either 500 ng/g or 1000 ng/g mercury in edible tissues at nearly all sites sampled on both sides of the lake;
- # A classification of mercury as a regional chemical of concern may be made when a species of fish exceeds either 500 ng/g or 1000 ng/g mercury in a given area of the lake; and
- # No classification of a species as either a lakewide or regional chemical of concern will be made where the data: (1) demonstrate that mercury concentrations for a fish species at all locations are below 500 ng/g, (2) are inconsistent for either the entire lake or regions of the lake, or (3) are lacking from both sides of the lake.

Data Available

- The entire shoreline of Lake Ontario is represented, plus the lower Niagara River and Bay of Quinte.
- Ontario mercury data from 1990 through 1995 for 21 species of fish representing 19 locations (in some instances, data from several locations may be combined for evaluation due to the regional proximity of the locations). In addition, for walleye, mercury data for the period from 1987 through the present is used to better represent the species throughout the lake.
- New York mercury data from 1993 through 1996 for 28 species of fish representing seven locations.

Conclusions

- None of the species contain mercury at concentrations sufficient to be considered either a lakewide or regional chemical of concern when a mercury criterion of 1000 ng/g is used.
- When a mercury criterion of 500 ng/g is used, mercury is a lakewide chemical of concern for smallmouth bass and walleye only. Smallmouth bass greater than about 380 mm and walleye greater than about 550 mm are likely to contain mercury concentrations greater than 500 ng/g.
- When a mercury criterion of 500 ng/g is used, mercury is a regional chemical of concern for largemouth bass (south shore), northern pike (eastern lake), channel catfish (Bay of Quinte and Oswego), and freshwater drum (south shore and lower Niagara River). Some of the largest fish of each species listed contain mercury concentrations greater than 500 ng/g. Specific comments on the data base for each species follows:

Appendix B

- Largemouth bass - there were little recent data for the species from Ontario waters of Lake Ontario; the species is adequately represented on the south shore.
- Northern pike - Sufficient data were available for all Ontario waters of the lake but, in New York waters, only the eastern lake is represented. The Ontario data suggest elevated mercury concentrations are limited to large fish in the eastern end of the lake for this species.
- Channel catfish - There is limited representation by this species on both the north and south shores of the lake. For large individuals of this species, only the Bay of Quinte and Oswego can be indicated as having mercury concentrations in excess of 500 ng/g.
- Freshwater drum - The New York waters are adequately represented in the data base but the only Ontario waters represented by this species are the lower Niagara River and Bay of Quinte.
- Inconsistent data were available for white perch and white sucker so they were not classified; however, occasional detection of mercury at concentrations greater than 500 ng/g were found in large fish as reported by Canadian authorities. Similar findings were not reported by New York.
- All other fish species examined contained mercury concentrations which were below 500 ng/g.

Health Advisory Criteria

-- Health advisories issued by New York or Ontario have differing criteria for determining the advice to be issued to the public. The criteria and the corresponding advice is summarized below. The advice may be tailored to represent regions of a waterbody and to reflect size-mercury concentration relationships for a species of fish.

Mercury Concentration (F g/g)	Health Advisory	
	New York	Ontario
<0.5	One meal per week	Eight meals per month
0.5 to 1.0	One meal per week	One meal per week
1.0 to 1.5	One meal per month; women of childbearing age and children under 15 years should not consume fish	Two meals per month for all populations
>1.5	Eat none	Eat none

-- New York considers a health advisory based on mercury concentrations in fish to be an impairment of water usage when the mercury concentration exceeds 1.0 F g/g. Ontario considers a health advisory based on mercury concentrations in fish to be an impairment of water usage when the mercury concentration exceeds 0.5 F g/g.

Authors: Lawrence C. Skinner, New York State Department of Environmental Conservation, and Alan



Appendix B

Hayton, Ontario Ministry of the Environment, September 10, 1997.