

**FISH CONSUMPTION ADVISORIES  
IN THE LOWER FOX RIVER/GREEN BAY  
ASSESSMENT AREA**

*Final Report*

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U.S. Department of Interior  
U.S. Department of Justice

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# CHAPTER 1

## INTRODUCTION

This report describes injuries to fishery resources resulting from the accumulation of polychlorinated biphenyls (PCBs) in fish tissue and the subsequent issuance of fish consumption advisories in the Lower Fox River/Green Bay/northern Lake Michigan system. The objective of this report is to determine and quantify these injuries and to provide relevant background information. This report was prepared as part of the Lower Fox River/Green Bay Natural Resource Damage Assessment (NRDA) pursuant to the approaches outlined in the NRDA assessment plan at 61 FR 43558. The purpose of this report is to present a detailed examination of the injuries to fishery resources associated with fish consumption advisories and exceedences of U.S. Food and Drug Administration (FDA) tolerances for PCBs. This report does not present data and information related to the releases of PCBs, transport/exposure pathways, or biological/toxicological effects; that information will be presented in other NRDA injury assessment reports.

### 1.1 BACKGROUND

The assessment area for the Lower Fox River/Green Bay NRDA includes the Lower Fox River (from Little Lake Butte des Morts to Green Bay), Green Bay, Lake Michigan, and other areas containing natural resources potentially injured by hazardous substances released to the Lower Fox River. The hazardous substances released into the assessment area include, but may not be limited to, PCBs (including Aroclor 1242). The greatest releases of PCBs into the Lower Fox River occurred from paper mills during the deinking and repulping of carbonless copy paper that was manufactured with PCBs (Sullivan et al., 1983). Although PCB use in carbonless paper was discontinued in 1971, resuspension of previously contaminated sediments continues to expose fish to PCBs.

The highest concentrations of PCBs (on a wet weight basis) are found in fish with relatively high lipid (fat) levels, such as salmon, lake trout, carp, and catfish (Kleinert, 1976). Historically, carp have had the highest tissue concentrations of all species tested. Elevated PCB concentrations in fish from the assessment area have been documented since 1976 by the Wisconsin Department of Natural Resources (DNR) (Jensen et al., 1982; Sullivan et al., 1983; Wisconsin DNR, 1995a). Since 1976, PCB fillet concentrations have been sufficiently high to trigger fish consumption advisories by the Wisconsin Department of Health and Human Services (WDHHS) for many sport and commercially exploited fish species. Michigan has issued similar advisories for the assessment area since 1977 (Michigan DNR, 1977-1997). Fish consumption advisories are still in effect for specified sizes of many species (Wisconsin Division of Health and Wisconsin DNR, 1997).

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PCB contamination sufficient to trigger fish consumption advisories prompted the closure of commercial fisheries. The large-scale commercial carp fishery in Green Bay was suspended for interstate commerce in 1975, and closed entirely in 1984 because of PCB contamination (Kleinert, 1976; Allen et al., 1987).

## 1.2 RELEVANT INJURY DEFINITIONS

The U.S. Department of Interior (DOI) promulgated regulations for conducting NRDA's at 43 CFR Part 11. The DOI regulations define a number of specific injury tests for different natural resources. These specific injury definitions include two different injury tests related to the effects of chemical contamination on human use and consumption of fish. According to these definitions, "injury to a biological resource has resulted from the . . . release of a hazardous substance if concentration of the substance is sufficient to . . .":

- ▶ exceed action or tolerance levels established under section 402 of the Food, Drug and Cosmetic Act, 21 U.S.C. 342, in edible portions of organisms [43 CFR § 11.62 (f)(1)(ii)]
- ▶ exceed levels for which an appropriate State health agency has issued directives to limit or ban consumption of such organism [43 CFR § 11.62 (f)(1)(iii)].

This report presents an evaluation of injury to fishery resources for both of these regulatory tests.

## 1.3 DATA SOURCES

The two specific injury tests above require comparing concentrations of hazardous substances in organisms to relevant standards. To make these comparisons, fish contaminant data were obtained from separate databases maintained by the Wisconsin DNR and by the Michigan DNR. From the Wisconsin DNR, data were obtained for the Lower Fox River (from Lake Winnebago downstream to Green Bay), the Wisconsin waters of Green Bay (including samples collected at the mouths of tributaries), and the Wisconsin waters of Lake Michigan (Wisconsin DNR, 1971-1995). From the Michigan DNR, data were obtained for the Michigan waters of Green Bay (including samples collected at the mouths of tributaries, Little Bay de Noc, and Big Bay de Noc) (Michigan DNR, 1983-1995). For these locations, data were requested for all species, all dates, and all contaminants in the two databases. The Wisconsin data contained samples collected from 1971 to 1995. The Michigan data contained samples collected from 1983 to 1995. Data from samples collected in 1996 and 1997 were not available at the time this report was written.<sup>1</sup>

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1. Data from the Wisconsin fish contaminant monitoring database were obtained from Jim Amrhein, Wisconsin DNR. Data from the Michigan fish contaminant monitoring database were obtained from Robert Day, Michigan Department of Environmental Quality.

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## 1.4 ANALYTICAL PROCEDURES FOR FISH CONTAMINANTS

All of the analyses and contaminant data presented in this report are based on wet weight concentration data. No data for whole fish samples are included in the report with the exception of rainbow smelt, which were analyzed by Michigan as gutted whole fish. All other samples were skin-on fillets, skin-off fillets, edible portions, or skin-off steaks (for lake sturgeon only).

Over 99% of the contaminant data in the Wisconsin DNR database were analyzed at the Wisconsin State Laboratory of Hygiene (WSLH). The analytical procedures for pesticides and PCBs are documented in the WSLH Organic Chemistry Unit Methods Manual Section 1410 (Wisconsin State Laboratory of Hygiene, 1997). These procedures are an adaptation of the FDA methods and the U.S. Fish and Wildlife Service (USFWS) methods for analyzing PCBs and other organic contaminants.

Currently, WSLH methods are to extract organic compounds from the fish tissue with dichloromethane and then separate them using gel permeation, Florisil, and silica gel column chromatography. The PCB fraction and the dieldrin fraction are analyzed on a packed column chromatograph equipped with an electron capture detector, and the other organic pesticide fractions are analyzed on a capillary column gas chromatograph also equipped with an electron capture detector. Before the early 1980s, organic compounds were extracted with hexane, gel-permeation chromatography was not used, and all of the compounds were analyzed on a packed column chromatograph. Except for these modifications, analytical procedures have changed little since the WSLH first started analyzing fish tissue in the 1970s (Tom Gibson, WSLH Organics division, personal communication). However, analytical instrumentation has improved significantly. As a result of this improvement, the WSLH changed their PCB reporting limit from 0.2 to 0.04  $\mu\text{g/g}$  in 1993 (Tom Gibson, WSLH Organics division, personal communication).

The analytical procedures for total mercury analysis are documented in WSLH Inorganics Division standard operating procedure (SOP) 540.4: Digestion of Tissues for Cold-Vapor Atomic Absorption and SOP 540.1: Instrument Operating Procedure. These methods are similar to the U.S. Environmental Protection Agency's (U.S. EPA) methods for analyzing mercury. Before 1980, the WSLH did not have their own method and used U.S. EPA methods (Al Clary, WSLH Inorganics division, personal communication).

Contaminant data in the Michigan database since 1987 are from analyses done at the Health Risk Assessment Laboratory. Before 1987, fish samples were analyzed at the Michigan DNR Laboratory. Information on analytical procedures before 1987 is not readily available (Bob Day, Michigan Department of Environmental Quality, personal communication). Analytical procedures from the Health Risk Assessment laboratory are documented in the Quality Assurance Manual for the Health Risk Laboratory (Michigan Department of Community Health, 1997). This manual also includes the laboratory's quality assurance and quality control processes.

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Currently, Michigan DNR methods are to extract PCBs and other organic contaminants using ethyl ether/petroleum ether 1:1 (v:v), and then separate them using silica gel column chromatography. The PCB and pesticide fractions are analyzed on a packed column chromatograph equipped with an electron capture detector. To analyze for mercury, fish samples are first digested with nitric and sulfuric acid and then analyzed on an atomic absorption spectrophotometer. When requested, samples are analyzed for dioxins and furans using capillary column gas chromatography-high resolution mass spectrometry.

## **1.5 REPORT ORGANIZATION**

The remainder of this report is organized as follows: Chapter 2 discusses injuries associated with exceedences of FDA tolerances, including a review of FDA's tolerances for PCBs in fish tissue and an analysis of the nature and extent of exceedences. Chapters 3 through 5 address injuries associated with the imposition of advisories designed to limit fish consumption. Specifically, Chapter 3 discusses injuries related to fish consumption advisories in waters of the State of Wisconsin. Chapter 4 discusses injuries related to fish consumption advisories in waters of the State of Michigan. Chapter 5 compares several different approaches used for establishing consumption advisories. Chapter 6 presents an overall quantification of injury. Chapter 7 contains references cited in this report.

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## **CHAPTER 2**

### **FDA TOLERANCES FOR PCBs**

#### **2.1 INTRODUCTION**

Fishery resources are injured if they contain concentrations of a hazardous substance sufficient to exceed action levels or tolerances established by the FDA [43 CFR § 11.62 (f)(1)(ii)]. The FDA established a tolerance of 5 parts per million (ppm) for PCBs in fish and shellfish in 1973. This tolerance was reduced to 2 ppm in 1984.

To evaluate this injury for the Lower Fox River/Green Bay NRDA, PCB concentrations in fish from the Lower Fox River, Green Bay, and Lake Michigan were compared to the FDA tolerance for PCBs in edible fish tissue. Because the tolerance level was reduced in 1984, we evaluated injury to fish by comparing PCB concentrations in fish to the 5 ppm tolerance for samples collected through 1984. For fish tissue samples collected after 1984, we evaluated injury to fish by comparing PCB concentrations to the 2 ppm tolerance. The results of this evaluation demonstrate that the FDA tolerance for PCBs has been and continues to be exceeded in multiple fish species in the Lower Fox River, Green Bay, and Lake Michigan. These exceedences have occurred throughout the entire period for which data are available.

This chapter is organized as follows. First, we present a description of FDA's authority for establishing tolerances, a timeline of FDA activities regarding the PCB tolerances, and a description of FDA's justification for setting PCB tolerances in fish and shellfish. This information is presented to provide additional perspective on the FDA tolerances. We then present an analysis of the nature and extent of exceedences of these PCB tolerance levels in fish from the Lower Fox River, Green Bay, and Lake Michigan.

#### **2.2 BACKGROUND ON FDA TOLERANCES FOR PCBs**

The Food, Drug, and Cosmetic Act (21 U.S.C. 301 et seq.) authorizes the FDA to protect the public health by regulating food shipped in interstate commerce. Sections 402 and 406 of the act prohibit food from interstate commerce if the food contains any added poisonous or deleterious substance that is unsafe, unless the presence of the poisonous or deleterious substance cannot be avoided. A primary purpose of Section 406 is to enable the FDA to regulate levels of environmental contaminants that can enter food. Section 406 authorizes the FDA to limit the quantities of such substances by using formal rulemaking to set legal limits called tolerances. The tolerances are to be set at the level necessary to protect the public health, taking into account the

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extent to which the substance is unavoidable and the ways that a consumer may be affected by the same or other deleterious substances (44 FR 38330).<sup>1</sup>

Regulatory activities associated with the establishment of PCB tolerances took place from 1972 to 1984 (Table 2-1). In 1972, the FDA proposed to set tolerances for PCBs in animal feed, food, and food-packaging materials as well as to limit potential sources of PCB contamination (37 FR 5705). The FDA acknowledged that there was limited knowledge of the toxicological effects of PCBs, but that PCBs appeared to be of moderate acute toxicity. The FDA commented that the chronic toxicity of PCBs was not well defined but was potentially of greater concern than acute toxicity. The proposed temporary tolerances included a tolerance of 5 ppm for fish (edible portion) and for poultry (fat basis). The FDA stated that it was promulgating the temporary tolerances for unavoidable PCB residues in food “for a sufficient period of time to permit elimination of such residues at the earliest practicable time” (37 FR 5705). In addition, the FDA proposed tolerances for PCBs in milk, manufactured dairy products, poultry, eggs, animal feed, infant and junior foods, and paper food-packaging materials (21 CFR § 109.30). In the notice of proposed rulemaking, the FDA determined that the then current dietary level of PCBs was not considered an immediate hazard to the public health, but that the sources and levels of PCBs in food and animal feed should be significantly reduced or eliminated “to minimize the overall long-term human exposure to PCB’s” (37 FR 5705).

In 1973, the FDA issued regulations setting temporary tolerances for PCBs in food and food-packaging material (38 FR 18096). In setting the tolerances, the FDA analyzed animal and human toxicological data as well as data on the occurrence of PCBs in the food supply (38 FR 18097). The FDA presented an analysis based on long-term animal studies that would set allowable PCB ingestion levels at 175  $\mu\text{g}/\text{day}$  for a 70 kg individual. The FDA also presented an analysis, based on long-term studies of PCB poisoning in Japan, that would set allowable PCB ingestion levels at 70  $\mu\text{g}/\text{day}$  for a 70 kg individual. The FDA conducted total diet studies for 1970-1972 and determined that average PCB intake was equivalent to 0.06  $\mu\text{g}/\text{kg}/\text{day}$  (4.2  $\mu\text{g}/\text{day}$  for a 70 kg individual), and concluded that the PCB levels in food did not represent an immediate hazard. However, the FDA stated that “the possibility of potential long-term hazards necessitates reduction of the levels of PCB’s in food as soon as possible.” The FDA called the PCB tolerances “temporary” because “new data may justify a further downward revision of the tolerances” (42 FR 17493).

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1. As an alternative to setting a tolerance, the FDA may regulate unavoidable added poisonous or deleterious substances in food and animal feed by setting action levels or by setting regulatory limits. In response to a 1987 court ruling, the FDA changed the wording of its regulations to clarify that action levels are general statements of policy that are not binding on the courts, the public, or the agency. Regulatory limits for added poisonous or deleterious substances are established through notice and comment (informal) rulemaking (55 FR 20782).

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**Table 2-1  
Timeline of FDA Activities for Establishing PCB Tolerances**

<b>Year</b>	<b>Action</b>	<b>Citation</b>
1972	Proposal to limit PCB levels in animal feed, food, and food-packaging as well as to limit potential sources of PCB contamination. The FDA proposed to establish a temporary tolerance for fish (edible portion) of 5 ppm.	37 FR 5705
1973	Issuance of regulations setting temporary tolerances for PCBs in food and food-packaging material, including tolerance of 5 ppm for fish and shellfish.	38 FR 18096
1977	Proposal to reduce the temporary tolerance levels for PCBs in several classes of food. For fish and shellfish, the FDA proposed reducing the tolerance level for PCBs from 5 ppm to 2 ppm.	42 FR 17487
1979	Issuance of final rule reducing tolerance levels for PCBs. The reduction for fish and shellfish was stayed by the request for a hearing.	44 FR 38330, 44 FR 57389
1981	Formal evidentiary hearing held on the issue of the magnitude of the food loss caused by reducing the PCB tolerance from 5 ppm to 2 ppm in fish and shellfish.	46 FR 24551
1984	Issuance of final decision resolving the issues raised in the hearing and reducing the PCB tolerance for fish and shellfish from 5 ppm to 2 ppm.	49 FR 21514

In 1977, the FDA proposed reducing the tolerance for PCBs from 5 ppm to 2 ppm in fish and shellfish and from 5 ppm to 3 ppm in poultry fat. In proposing these reductions, the FDA stated that it needed to balance protecting public health with avoiding excessive losses of food. This judgment included an analysis of new toxicity data for PCBs, as well as an evaluation of levels of PCB contamination in food (42 FR 17487).

The proposal in 1977 to reduce the PCB tolerance for fish and shellfish from 5 ppm to 2 ppm contained an extensive discussion of the basis for this decision (42 FR 17487). The FDA proposed reductions in PCB tolerances for specific foods because of the determination that PCB contamination had become more avoidable and because of new toxicity data on PCBs. The FDA

evaluated the new toxicity data to determine what tolerance would protect consumers adequately (42 FR 17488).

The FDA also performed a risk assessment to compare the human health risks associated with PCB exposure at different levels (44 FR 38332; Cordle et al., 1982). For the risk assessment, the FDA estimated:

- ▶ daily consumption of each species or family of fish most highly contaminated with PCBs
- ▶ mean PCB levels for each species or family of fish, given four different tolerances (1 ppm, 2 ppm, 5 ppm, and no tolerance)
- ▶ risk thresholds extrapolated from animal studies.

The FDA used the daily consumption and mean PCB levels to estimate exposure to PCBs through fish consumption, given different tolerances. Exposure levels were compared to risk thresholds to estimate lifetime risks for cancer and reproductive problems (Cordle et al., 1982).

For heavy consumers of contaminated fish, the FDA estimated in its risk assessment that a reduction in tolerance from 5 to 2 ppm would significantly reduce exposure and would reduce lifetime cancer risk. Because of difficulties in extrapolating from animal studies to humans, and because of gaps and uncertainties in the data, the FDA concluded that the risk assessment did not provide a precise quantification of risk reduction but illustrated the toxicological rationale for reducing the PCB tolerance (44 FR 38333). The FDA stated that because of these uncertainties, “perhaps an equally compelling argument could be made for the establishment of either a 2 ppm or a 1 ppm tolerance” (Cordle et al., 1982).

Based on the FDA Total Diet Study for 1971 to 1975, the FDA Commissioner determined that PCB levels in all food classes had declined to no detectable level in the composite samples, except in the meat-fish-poultry composites. The FDA stated that “the remaining significant PCB residues occur predominantly in freshwater fish.” Higher levels in foods other than fish would generally be due to avoidable sources of contamination (such as the use of PCBs in silos). The Commissioner concluded that “in light of these findings of reduced levels of PCB’s in foods, it is appropriate to lower the tolerances for unavoidable residues of PCB’s” (42 FR 17487).

In setting PCB tolerances, the FDA is required to balance adequate public health protection and excessive loss of food (44 FR 38331). The FDA determined that a tolerance of 1 ppm for PCBs in fish (the lowest reliable enforcement level) would have a “substantially adverse impact” on the fishing industry, whereas the economic impact of a 2 ppm tolerance would be much less (42 FR 17492). A tolerance higher than 2 ppm would be economically desirable, but would add to the risk for consumers. Thus, the FDA concluded that a 2 ppm tolerance for PCBs in fish represented proper balance between public safety and economic criteria (42 FR 17487).

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The FDA received extensive public comment on the proposed tolerance reduction for fish and shellfish. Most of the comments related to the question of whether the degree of risk reduction accomplished by reducing the tolerance justified the increased loss of food. In responding to comments, the FDA reaffirmed its position that the 2 ppm tolerance represented the proper balance between public health protection and loss of food. However, the FDA acknowledged that “its decision to set the fish tolerance for PCB’s at 2 ppm, rather than leaving it at 5 ppm or reducing it further to 1 ppm, is inherently judgmental in character” (44 FR 38336).

On June 29, 1979, the FDA issued a final rule reducing tolerances for PCBs (44 FR 38330). The FDA also removed the designation “temporary” from the tolerances, because the word “temporary” does not have legal significance under Section 406 of the Food, Drug, and Cosmetic Act. The FDA responded to public comments on the proposed rule and presented additional justification for the tolerance reductions. Most of the public comments concerned the reduction of the fish tolerance. The FDA announced that the regulations would become effective after August 28, 1979, except for those provisions stayed by a request for a hearing (44 FR 38330).

On October 5, 1979, the National Fisheries Institute, Inc. (NFI) filed an objection to the final rule and requested a hearing on the contention that the FDA grossly underestimated the loss of food that would result from lowering the PCB tolerance for fish and shellfish. As a result of NFI’s request, the effective date for implementing the PCB tolerance reductions for fish and shellfish was stayed (44 FR 57389).

In 1981, the FDA announced a formal evidentiary hearing on NFI’s objection to the proposed tolerance reduction for PCBs (46 FR 24551). The hearing was limited to the issue of the magnitude of the food loss that would be caused by reducing the PCB tolerance from 5 ppm to 2 ppm in fish and shellfish. Interested persons were invited to submit additional information or briefs relevant to the reduction of PCB tolerance levels. In addition to the parties to the hearing, information or briefs were submitted by the National Marine Fisheries Service, the Environmental Defense Fund, the Chemical Manufacturers Association, the General Electric Company, and the State of Michigan (49 FR 21514).

In 1982, an administrative law judge (Daniel Davidson) issued an initial decision on the hearing in which he made detailed findings about the value of the food loss resulting from reducing the PCB tolerance to 2 ppm. The FDA and the NFI both filed exceptions to parts of the initial decision (49 FR 21514).

In 1984, the FDA issued a final decision resolving the issues raised in the hearing and issued a final order reducing PCB tolerances in fish and shellfish from 5 ppm to 2 ppm (49 FR 21514). The final decision responded to each of the points raised in the exceptions to the initial decision as well as to additional information submitted concerning the toxicity of PCBs. On August 20, 1984, the reduction of the PCB tolerance level for fish and shellfish from 5 ppm to 2 ppm took effect. This reduction was codified at 21 CFR 109.30 (a)(7).

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### 2.3 INJURY DETERMINATION: EXCEEDENCES OF THE FDA PCB TOLERANCE

This section presents an analysis of injuries to fishery resources resulting from exceedences of the FDA tolerance levels. We compared PCB concentrations measured in edible portions of fish from the Lower Fox River, Green Bay, and northern Lake Michigan<sup>2</sup> with applicable FDA tolerances for PCBs. Data from the Wisconsin and Michigan fish contaminant monitoring databases were used for this analysis. Injury to fish through 1984 was evaluated by comparing PCB concentrations to the 5 ppm tolerance. Injury to fish beginning in 1985 was evaluated by comparing PCB concentrations to the 2 ppm tolerance.

Comparison of the maximum, mean, and median PCB concentrations for a given species and time period to the FDA tolerance indicates that the FDA tolerance has been and continues to be exceeded in multiple fish species in the Lower Fox River, Green Bay, and northern Lake Michigan (Tables 2-2 to 2-5). The frequency of exceedences of the FDA tolerance in catchable size fish may be higher than indicated in Tables 2-2 through 2-5 because data from all age and size classes were included in the tables. Older and larger fish tend to have higher PCB concentrations than young, small fish because PCBs accumulate in fatty tissue over time (Oliver and Niimi, 1988; Niimi and Oliver, 1989). Thus, the percent of samples exceeding the FDA tolerance is likely to be higher for large size classes and lower for small size classes.

In the Lower Fox River upstream of the DePere dam, samples from 8 out of 18 species tested between 1976 and 1994 exceeded the FDA tolerance at least once during this time period (Table 2-2). In the Lower Fox River downstream of the DePere dam, samples from 11 out of 17 species tested between 1977 and 1994 exceeded the FDA tolerance at least once (Table 2-3). In Green Bay, including both Wisconsin and Michigan waters, samples from 23 out of 29 species tested between 1971 and 1994 exceeded the FDA tolerance at least once (Table 2-4). In northern Lake Michigan, samples from 6 out of 11 species tested between 1974 and 1995 exceeded the FDA tolerance at least once (Table 2-5).

Appendix A presents maximum, mean, and median PCB concentrations and frequency of exceedences of the FDA tolerance for each species and year. Data are presented for the Lower Fox River upstream of the DePere dam, the Lower Fox River downstream of the DePere dam, Green Bay, and northern Lake Michigan (Tables A-1 to A-4).

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2. Northern Lake Michigan was defined as Wisconsin waters north of the latitude line that forms the southern boundary of Green Bay (approximately 44°33').

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**Table 2-2  
Summary of PCB Tissue Concentrations (ppm)  
and Frequency of Exceedences of FDA Tolerance for Fish  
in the Lower Fox River upstream of the DePere Dam, 1976-1994**

<b>Species</b>	<b>Parameter</b>	<b>1976-1979</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Black Bullhead	Number of Samples	-	-	1	-
	Maximum PCB Conc.	-	-	0.3	-
	Mean PCB Conc.	-	-	0.3	-
	Median PCB Conc.	-	-	0.3	-
	% of Samples Exceeding FDA Tolerance*	-	-	0.0	-
Black Crappie	Number of Samples	-	3	-	-
	Maximum PCB Conc.	-	2.3	-	-
	Mean PCB Conc.	-	1.1	-	-
	Median PCB Conc.	-	0.6	-	-
	% of Samples Exceeding FDA Tolerance*	-	0.0	-	-
Bluegill	Number of Samples	-	-	-	1
	Maximum PCB Conc.	-	-	-	0.2
	Mean PCB Conc.	-	-	-	0.2
	Median PCB Conc.	-	-	-	0.2
	% of Samples Exceeding FDA Tolerance*	-	-	-	0.0
Brown Bullhead	Number of Samples	4	8	3	-
	Maximum PCB Conc.	13.6	4.2	3.4	-
	Mean PCB Conc.	5.7	2.2	2.1	-
	Median PCB Conc.	4.0	2.0	1.8	-
	% of Samples Exceeding FDA Tolerance*	50.0	0.0	33.3	-
Carp	Number of Samples	15	24	19	8
	Maximum PCB Conc.	57.0	30.0	31.0	7.9
	Mean PCB Conc.	20.4	7.8	6.2	3.5
	Median PCB Conc.	17.0	5.8	3.8	3.8
	% of Samples Exceeding FDA Tolerance*	80.0	66.7	63.2	62.5
Channel Catfish	Number of Samples	-	-	1	5
	Maximum PCB Conc.	-	-	1.6	4.0
	Mean PCB Conc.	-	-	1.6	1.7
	Median PCB Conc.	-	-	1.6	1.1
	% of Samples Exceeding FDA Tolerance*	-	-	0.0	20.0

**Table 2-2 (cont.)  
Summary of PCB Tissue Concentrations (ppm)  
and Frequency of Exceedences of FDA Tolerance for Fish  
in the Lower Fox River upstream of the DePere Dam, 1976-1994**

<b>Species</b>	<b>Parameter</b>	<b>1976-1979</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Flathead Catfish	Number of Samples	-	-	2	4
	Maximum PCB Conc.	-	-	0.7	1.2
	Mean PCB Conc.	-	-	0.5	0.5
	Median PCB Conc.	-	-	0.5	0.4
	% of Samples Exceeding FDA Tolerance*	-	-	0.0	0.0
Green Sunfish	Number of Samples	1	-	-	-
	Maximum PCB Conc.	3.1	-	-	-
	Mean PCB Conc.	3.1	-	-	-
	Median PCB Conc.	3.1	-	-	-
	% of Samples Exceeding FDA Tolerance*	0.0	-	-	-
Northern Pike	Number of Samples	6	9	5	3
	Maximum PCB Conc.	11.0	4.3	1.6	1.2
	Mean PCB Conc.	3.9	2.1	0.9	1.0
	Median PCB Conc.	2.2	1.9	1.0	1.0
	% of Samples Exceeding FDA Tolerance*	33.3	0.0	0.0	0.0
Rock Bass	Number of Samples	-	3	-	1
	Maximum PCB Conc.	-	0.7	-	0.2
	Mean PCB Conc.	-	0.5	-	0.2
	Median PCB Conc.	-	0.4	-	0.2
	% of Samples Exceeding FDA Tolerance*	-	0.0	-	0.0
Sauger	Number of Samples	-	2	-	-
	Maximum PCB Conc.	-	1.7	-	-
	Mean PCB Conc.	-	1.6	-	-
	Median PCB Conc.	-	1.6	-	-
	% of Samples Exceeding FDA Tolerance*	-	0.0	-	-
Sheepshead/ Drum	Number of Samples	-	2	-	-
	Maximum PCB Conc.	-	6.1	-	-
	Mean PCB Conc.	-	5.2	-	-
	Median PCB Conc.	-	5.2	-	-
	% of Samples Exceeding FDA Tolerance*	-	50.0	-	-

**Table 2-2 (cont.)  
Summary of PCB Tissue Concentrations (ppm)  
and Frequency of Exceedences of FDA Tolerance for Fish  
in the Lower Fox River upstream of the DePere Dam, 1976-1994**

Species	Parameter	1976-1979	1980-1984	1985-1989	1990-1994
Smallmouth Bass	Number of Samples	-	2	2	11
	Maximum PCB Conc.	-	1.8	0.6	0.8
	Mean PCB Conc.	-	1.8	0.5	0.3
	Median PCB Conc.	-	1.8	0.5	0.2
	% of Samples Exceeding FDA Tolerance*	-	0.0	0.0	0.0
Walleye	Number of Samples	4	24	23	34
	Maximum PCB Conc.	8.0	14.0	2.3	2.8
	Mean PCB Conc.	3.9	2.3	0.8	0.5
	Median PCB Conc.	3.2	1.0	0.6	0.4
	% of Samples Exceeding FDA Tolerance*	25.0	8.3	4.3	2.9
White Bass	Number of Samples	-	1	6	10
	Maximum PCB Conc.	-	3.8	2.2	3.6
	Mean PCB Conc.	-	3.8	0.6	1.2
	Median PCB Conc.	-	3.8	0.3	0.7
	% of Samples Exceeding FDA Tolerance*	-	0.0	16.7	20.0
White Perch	Number of Samples	-	-	-	3
	Maximum PCB Conc.	-	-	-	0.9
	Mean PCB Conc.	-	-	-	0.7
	Median PCB Conc.	-	-	-	0.6
	% of Samples Exceeding FDA Tolerance*	-	-	-	0.0
White Sucker	Number of Samples	6	26	-	-
	Maximum PCB Conc.	9.2	4.1	-	-
	Mean PCB Conc.	4.2	1.5	-	-
	Median PCB Conc.	3.6	1.2	-	-
	% of Samples Exceeding FDA Tolerance*	16.7	0.0	-	-
Yellow Perch	Number of Samples	8	18	3	1
	Maximum PCB Conc.	1.4	1.1	0.2	0.2
	Mean PCB Conc.	0.8	0.5	0.2	0.2
	Median PCB Conc.	0.8	0.3	0.2	0.2
	% of Samples Exceeding FDA Tolerance*	0.0	0.0	0.0	0.0

\* Fish collected through 1984 were compared to the FDA tolerance of 5 ppm; fish collected after 1984 were compared to the revised FDA tolerance of 2 ppm.

Sources: Wisconsin DNR (1971-1995).

**Table 2-3  
Summary of PCB Tissue Concentrations (ppm)  
and Frequency of Exceedences of FDA Tolerance for Fish  
in the Lower Fox River downstream of the DePere Dam, 1977-1994**

<b>Species</b>	<b>Parameter</b>	<b>1977-1979</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Black Bullhead	Number of Samples	-	1	3	-
	Maximum PCB Conc.	-	1.2	1.8	-
	Mean PCB Conc.	-	1.2	0.8	-
	Median PCB Conc.	-	1.2	0.5	-
	% of Samples Exceeding FDA Tolerance*	-	0.0	0.0	-
Black Crappie	Number of Samples	-	-	5	2
	Maximum PCB Conc.	-	-	1.3	1.7
	Mean PCB Conc.	-	-	0.7	1.3
	Median PCB Conc.	-	-	0.6	1.3
	% of Samples Exceeding FDA Tolerance*	-	-	0	0
Bluegill	Number of Samples	-	-	3	2
	Maximum PCB Conc.	-	-	0.2	0.6
	Mean PCB Conc.	-	-	0.2	0.5
	Median PCB Conc.	-	-	0.2	0.5
	% of Samples Exceeding FDA Tolerance*	-	-	0.0	0.0
Bowfin	Number of Samples	1	-	-	-
	Maximum PCB Conc.	0.5	-	-	-
	Mean PCB Conc.	0.5	-	-	-
	Median PCB Conc.	0.5	-	-	-
	% of Samples Exceeding FDA Tolerance*	0.0	-	-	-
Carp	Number of Samples	1	2	5	-
	Maximum PCB Conc.	2.5	11.0	50.0	-
	Mean PCB Conc.	2.5	8.9	15.3	-
	Median PCB Conc.	2.5	8.9	7.6	-
	% of Samples Exceeding FDA Tolerance*	0.0	100	100	-
Channel Catfish	Number of Samples	-	-	15	-
	Maximum PCB Conc.	-	-	14.0	-
	Mean PCB Conc.	-	-	5.2	-
	Median PCB Conc.	-	-	3.9	-
	% of Samples Exceeding FDA Tolerance*	-	-	73.3	-

**Table 2-3 (cont.)  
Summary of PCB Tissue Concentrations (ppm)  
and Frequency of Exceedences of FDA Tolerance for Fish  
in the Lower Fox River downstream of the DePere Dam, 1977-1994**

<b>Species</b>	<b>Parameter</b>	<b>1977-1979</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Chinook Salmon	Number of Samples	3	-	-	-
	Maximum PCB Conc.	12.0	-	-	-
	Mean PCB Conc.	10.2	-	-	-
	Median PCB Conc.	9.4	-	-	-
	% of Samples Exceeding FDA Tolerance*	100	-	-	-
Flathead Catfish	Number of Samples	-	-	2	-
	Maximum PCB Conc.	-	-	2.4	-
	Mean PCB Conc.	-	-	1.8	-
	Median PCB Conc.	-	-	1.8	-
	% of Samples Exceeding FDA Tolerance*	-	-	50.0	-
Gizzard Shad	Number of Samples	-	2	-	-
	Maximum PCB Conc.	-	6.6	-	-
	Mean PCB Conc.	-	6.2	-	-
	Median PCB Conc.	-	6.2	-	-
	% of Samples Exceeding FDA Tolerance*	-	100	-	-
Northern Pike	Number of Samples	3	-	13	8
	Maximum PCB Conc.	3.2	-	2.8	1.4
	Mean PCB Conc.	2.9	-	1.3	0.8
	Median PCB Conc.	3.0	-	1.1	0.8
	% of Samples Exceeding FDA Tolerance*	0.0	-	23.1	0.0
Rock Bass	Number of Samples	-	-	4	2
	Maximum PCB Conc.	-	-	0.6	0.5
	Mean PCB Conc.	-	-	0.5	0.5
	Median PCB Conc.	-	-	0.4	0.5
	% of Samples Exceeding FDA Tolerance*	-	-	0.0	0.0
Sheepshead/ Drum	Number of Samples	-	-	10	-
	Maximum PCB Conc.	-	-	4.6	-
	Mean PCB Conc.	-	-	2.6	-
	Median PCB Conc.	-	-	3.1	-
	% of Samples Exceeding FDA Tolerance*	-	-	60	-

**Table 2-3 (cont.)  
Summary of PCB Tissue Concentrations (ppm)  
and Frequency of Exceedences of FDA Tolerance for Fish  
in the Lower Fox River downstream of the DePere Dam, 1977-1994**

<b>Species</b>	<b>Parameter</b>	<b>1977-1979</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Smallmouth Bass	Number of Samples	-	-	-	8
	Maximum PCB Conc.	-	-	-	1.6
	Mean PCB Conc.	-	-	-	1.0
	Median PCB Conc.	-	-	-	1.0
	% of Samples Exceeding FDA Tolerance*	-	-	-	0.0
Walleye	Number of Samples	7	2	34	21
	Maximum PCB Conc.	6.8	8.1	3.1	4.6
	Mean PCB Conc.	3.8	5.2	1.6	1.4
	Median PCB Conc.	3.3	5.2	1.6	0.9
	% of Samples Exceeding FDA Tolerance*	14.3	50.0	23.5	28.6
White Bass	Number of Samples	-	2	13	6
	Maximum PCB Conc.	-	4.8	8.4	4.8
	Mean PCB Conc.	-	4.8	4.1	2.5
	Median PCB Conc.	-	4.8	3.8	2.2
	% of Samples Exceeding FDA Tolerance*	-	0.0	76.9	66.7
White Perch	Number of Samples	-	-	-	2
	Maximum PCB Conc.	-	-	-	2.2
	Mean PCB Conc.	-	-	-	1.8
	Median PCB Conc.	-	-	-	1.8
	% of Samples Exceeding FDA Tolerance*	-	-	-	50.0
White Sucker	Number of Samples	5	4	13	-
	Maximum PCB Conc.	4.4	2.9	3.7	-
	Mean PCB Conc.	3.1	2.3	1.3	-
	Median PCB Conc.	3.2	2.2	1.3	-
	% of Samples Exceeding FDA Tolerance*	0.0	0.0	7.7	-
Yellow Perch	Number of Samples	2	2	-	-
	Maximum PCB Conc.	5.3	2.4	-	-
	Mean PCB Conc.	3.2	1.6	-	-
	Median PCB Conc.	3.2	1.6	-	-
	% of Samples Exceeding FDA Tolerance*	50.0	0.0	-	-

\* Fish collected through 1984 were compared to the FDA tolerance of 5 ppm; Fish collected after 1984 were compared to the revised FDA tolerance of 2 ppm.

Sources: Wisconsin DNR (1971-1995).

**Table 2-4  
Summary of PCB Tissue Concentrations (ppm) and Frequency of Exceedences  
of FDA Tolerance for Fish in Green Bay, 1971-1994**

<b>Species</b>	<b>Parameter</b>	<b>1971-1974</b>	<b>1975-1979</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Alewife	Number of Samples	-	2	4	-	-
	Maximum PCB Conc.	-	4.6	5.4	-	-
	Mean PCB Conc.	-	4.4	3.9	-	-
	Median PCB Conc.	-	4.4	3.8	-	-
	% of Samples Exceeding FDA Tolerance*	-	0.0	25.0	-	-
Black Bullhead	Number of Samples	-	-	3	-	-
	Maximum PCB Conc.	-	-	1.9	-	-
	Mean PCB Conc.	-	-	1.6	-	-
	Median PCB Conc.	-	-	1.7	-	-
	% of Samples Exceeding FDA Tolerance*	-	-	0.0	-	-
Black Crappie	Number of Samples	-	2	-	-	-
	Maximum PCB Conc.	-	1.1	-	-	-
	Mean PCB Conc.	-	0.8	-	-	-
	Median PCB Conc.	-	0.8	-	-	-
	% of Samples Exceeding FDA Tolerance*	-	0.0	-	-	-
Brook Trout	Number of Samples	-	-	1	7	2
	Maximum PCB Conc.	-	-	0.2	3.4	0.2
	Mean PCB Conc.	-	-	0.2	1.4	0.2
	Median PCB Conc.	-	-	0.2	0.9	0.2
	% of Samples Exceeding FDA Tolerance*	-	-	0.0	14.3	0.0
Brown Bullhead	Number of Samples	-	11	7	-	-
	Maximum PCB Conc.	-	9.4	1.8	-	-
	Mean PCB Conc.	-	2.8	0.8	-	-
	Median PCB Conc.	-	1.3	0.5	-	-
	% of Samples Exceeding FDA Tolerance*	-	18.2	0.0	-	-
Brown Trout	Number of Samples	-	-	12	68	40
	Maximum PCB Conc.	-	-	7.5	5.7	3.6
	Mean PCB Conc.	-	-	3.8	2.6	1.4
	Median PCB Conc.	-	-	3.5	2.5	1.1
	% of Samples Exceeding FDA Tolerance*	-	-	16.7	66.2	20.0

**Table 2-4 (cont.)  
Summary of PCB Tissue Concentrations (ppm) and Frequency of Exceedences  
of FDA Tolerance for Fish in Green Bay, 1971-1994**

<b>Species</b>	<b>Parameter</b>	<b>1971-1974</b>	<b>1975-1979</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Burbot	Number of Samples	-	15	2	-	9
	Maximum PCB Conc.	-	4.6	0.2	-	0.6
	Mean PCB Conc.	-	1.5	0.2	-	0.2
	Median PCB Conc.	-	1.5	0.2	-	0.2
	% of Samples Exceeding FDA Tolerance*	-	0.0	0.0	-	0.0
Carp	Number of Samples	-	19	15	46	8
	Maximum PCB Conc.	-	51.6	16.0	34.0	2.8
	Mean PCB Conc.	-	12.7	9.0	5.8	1.8
	Median PCB Conc.	-	7.4	9.3	4.0	2.8
	% of Samples Exceeding FDA Tolerance*	-	73.7	80	76.1	62.5
Channel Catfish	Number of Samples	-	-	-	-	5
	Maximum PCB Conc.	-	-	-	-	2.5
	Mean PCB Conc.	-	-	-	-	1.2
	Median PCB Conc.	-	-	-	-	1.2
	% of Samples Exceeding FDA Tolerance*	-	-	-	-	20
Chinook Salmon	Number of Samples	-	-	12	12	23
	Maximum PCB Conc.	-	-	38.0	2.2	2.0
	Mean PCB Conc.	-	-	5.6	0.8	0.8
	Median PCB Conc.	-	-	2.4	0.8	0.7
	% of Samples Exceeding FDA Tolerance*	-	-	16.7	8.3	0.0
Cisco/Lake Herring	Number of Samples	-	4	-	1	-
	Maximum PCB Conc.	-	13.0	-	0.2	-
	Mean PCB Conc.	-	6.5	-	0.2	-
	Median PCB Conc.	-	5.6	-	0.2	-
	% of Samples Exceeding FDA Tolerance*	-	50.0	-	0.0	-
Coho Salmon	Number of Samples	-	1	-	-	-
	Maximum PCB Conc.	-	6.2	-	-	-
	Mean PCB Conc.	-	6.2	-	-	-
	Median PCB Conc.	-	6.2	-	-	-
	% of Samples Exceeding FDA Tolerance*	-	100	-	-	-

<p align="center"><b>Table 2-4 (cont.)</b>  <b>Summary of PCB Tissue Concentrations (ppm) and Frequency of Exceedences</b>  <b>of FDA Tolerance for Fish in Green Bay, 1971-1994</b></p>						
<b>Species</b>	<b>Parameter</b>	<b>1971-1974</b>	<b>1975-1979</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Gizzard Shad	Number of Samples	-	1	-	-	-
	Maximum PCB Conc.	-	12.0	-	-	-
	Mean PCB Conc.	-	12.0	-	-	-
	Median PCB Conc.	-	12.0	-	-	-
	% of Samples Exceeding FDA Tolerance*	-	100	-	-	-
Lake Sturgeon	Number of Samples	-	-	-	1	-
	Maximum PCB Conc.	-	-	-	3.9	-
	Mean PCB Conc.	-	-	-	3.9	-
	Median PCB Conc.	-	-	-	3.9	-
	% of Samples Exceeding FDA Tolerance*	-	-	-	100	-
Lake Trout	Number of Samples	13	27	16	-	-
	Maximum PCB Conc.	29.1	19.5	9.0	-	-
	Mean PCB Conc.	21.4	11.3	3.6	-	-
	Median PCB Conc.	22.1	11.3	2.8	-	-
	% of Samples Exceeding FDA Tolerance*	100	96.3	18.8	-	-
Lake Whitefish	Number of Samples	-	40	16	6	10
	Maximum PCB Conc.	-	17.3	2.5	1.5	0.7
	Mean PCB Conc.	-	4.7	1.3	1.0	0.4
	Median PCB Conc.	-	3.5	1.2	0.9	0.4
	% of Samples Exceeding FDA Tolerance*	-	30.0	0.0	0.0	0.0
Largemouth Bass	Number of Samples	-	1	-	-	-
	Maximum PCB Conc.	-	1.0	-	-	-
	Mean PCB Conc.	-	1.0	-	-	-
	Median PCB Conc.	-	1.0	-	-	-
	% of Samples Exceeding FDA Tolerance*	-	0.0	-	-	-
Longnose Sucker	Number of Samples	-	-	-	10	11
	Maximum PCB Conc.	-	-	-	3.2	3.9
	Mean PCB Conc.	-	-	-	1.4	1.9
	Median PCB Conc.	-	-	-	0.8	1.9
	% of Samples Exceeding FDA Tolerance*	-	-	-	30.0	45.5

**Table 2-4 (cont.)  
Summary of PCB Tissue Concentrations (ppm) and Frequency of Exceedences  
of FDA Tolerance for Fish in Green Bay, 1971-1994**

<b>Species</b>	<b>Parameter</b>	<b>1971-1974</b>	<b>1975-1979</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Northern Pike	Number of Samples	-	16	16	12	-
	Maximum PCB Conc.	-	6.4	7.3	1.3	-
	Mean PCB Conc.	-	2.4	1.9	0.3	-
	Median PCB Conc.	-	2.1	1.8	0.2	-
	% of Samples Exceeding FDA Tolerance*	-	6.2	6.2	0.0	-
Pumpkinseed	Number of Samples	-	2	-	-	-
	Maximum PCB Conc.	-	0.5	-	-	-
	Mean PCB Conc.	-	0.3	-	-	-
	Median PCB Conc.	-	0.3	-	-	-
	% of Samples Exceeding FDA Tolerance*	-	0.0	-	-	-
Rainbow Smelt	Number of Samples	-	-	3	-	-
	Maximum PCB Conc.	-	-	0.4	-	-
	Mean PCB Conc.	-	-	0.3	-	-
	Median PCB Conc.	-	-	0.4	-	-
	% of Samples Exceeding FDA Tolerance*	-	-	0.0	-	-
Rainbow Trout	Number of Samples	-	-	-	2	15
	Maximum PCB Conc.	-	-	-	2.2	1.2
	Mean PCB Conc.	-	-	-	1.8	0.6
	Median PCB Conc.	-	-	-	1.8	0.6
	% of Samples Exceeding FDA Tolerance*	-	-	-	50.0	0.0
Smallmouth Bass	Number of Samples	-	1	3	3	6
	Maximum PCB Conc.	-	1.3	7.1	1.0	0.4
	Mean PCB Conc.	-	1.3	3.1	0.8	0.3
	Median PCB Conc.	-	1.3	1.9	0.8	0.3
	% of Samples Exceeding FDA Tolerance*	-	0.0	33.3	0.0	0.0
Splake	Number of Samples	-	-	-	68	16
	Maximum PCB Conc.	-	-	-	3.7	3.3
	Mean PCB Conc.	-	-	-	2.0	1.7
	Median PCB Conc.	-	-	-	2.0	1.7
	% of Samples Exceeding FDA Tolerance*	-	-	-	48.5	37.5

**Table 2-4 (cont.)  
Summary of PCB Tissue Concentrations (ppm) and Frequency of Exceedences  
of FDA Tolerance for Fish in Green Bay, 1971-1994**

<b>Species</b>	<b>Parameter</b>	<b>1971-1974</b>	<b>1975-1979</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Walleye	Number of Samples	-	4	13	60	24
	Maximum PCB Conc.	-	0.7	8.1	5.5	3.5
	Mean PCB Conc.	-	0.6	3.4	1.4	0.5
	Median PCB Conc.	-	0.6	3.4	1.2	0.4
	% of Samples Exceeding FDA Tolerance*	-	0.0	15.4	15.0	4.2
White Bass	Number of Samples	-	1	2	-	-
	Maximum PCB Conc.	-	8.0	2.4	-	-
	Mean PCB Conc.	-	8.0	2.2	-	-
	Median PCB Conc.	-	8.0	2.2	-	-
	% of Samples Exceeding FDA Tolerance*	-	100	0.0	-	-
White Perch	Number of Samples	-	-	-	-	16
	Maximum PCB Conc.	-	-	-	-	5.5
	Mean PCB Conc.	-	-	-	-	2.9
	Median PCB Conc.	-	-	-	-	2.6
	% of Samples Exceeding FDA Tolerance*	-	-	-	-	93.8
White Sucker	Number of Samples	-	11	1	9	-
	Maximum PCB Conc.	-	5.1	1.5	1.1	-
	Mean PCB Conc.	-	2.8	1.5	0.4	-
	Median PCB Conc.	-	2.9	1.5	0.1	-
	% of Samples Exceeding FDA Tolerance*	-	9.1	0.0	0.0	-
Yellow Perch	Number of Samples	-	14	11	-	9
	Maximum PCB Conc.	-	5.6	1.0	-	0.3
	Mean PCB Conc.	-	1.4	0.6	-	0.2
	Median PCB Conc.	-	0.7	0.5	-	0.2
	% of Samples Exceeding FDA Tolerance*	-	7.1	0.0	-	0.0

\* Fish collected through 1984 were compared to the FDA tolerance of 5 ppm; fish collected after 1984 were compared to the revised FDA tolerance of 2 ppm.

Sources: Wisconsin DNR (1971-1995); Michigan DNR (1983-1995).

**Table 2-5  
Summary of PCB Tissue Concentrations (ppm) and Frequency of Exceedences  
of FDA Tolerance for Fish in Northern Lake Michigan, 1974-1995**

<b>Species</b>	<b>Parameter</b>	<b>1974</b>	<b>1975- 1979</b>	<b>1980- 1984</b>	<b>1985- 1989</b>	<b>1990- 1995</b>
Bloater Chub	Number of Samples	-	5	7	2	1
	Maximum PCB Conc.	-	1.9	1.1	0.8	0.5
	Mean PCB Conc.	-	1.5	0.9	0.8	0.5
	Median PCB Conc.	-	1.7	1.0	0.8	0.5
	% of Samples Exceeding FDA Tolerance*	-	0.0	0.0	0.0	0.0
Brook Trout	Number of Samples	-	-	2	17	-
	Maximum PCB Conc.	-	-	0.9	2.1	-
	Mean PCB Conc.	-	-	0.8	0.8	-
	Median PCB Conc.	-	-	0.8	0.8	-
	% of Samples Exceeding FDA Tolerance*	-	-	0.0	5.9	-
Brown Trout	Number of Samples	5	-	13	30	25
	Maximum PCB Conc.	6.6	-	34.0	5.8	3.2
	Mean PCB Conc.	4.0	-	4.3	1.9	0.9
	Median PCB Conc.	4.8	-	1.6	1.4	0.7
	% of Samples Exceeding FDA Tolerance*	40.0	-	7.7	26.7	12.0
Burbot	Number of Samples	-	1	-	-	-
	Maximum PCB Conc.	-	0.2	-	-	-
	Mean PCB Conc.	-	0.2	-	-	-
	Median PCB Conc.	-	0.2	-	-	-
	% of Samples Exceeding FDA Tolerance*	-	0.0	-	-	-
Chinook Salmon	Number of Samples	8	13	83	90	36
	Maximum PCB Conc.	17.0	9.2	6.9	4.6	2.4
	Mean PCB Conc.	11.7	6.5	3.2	2.0	1.5
	Median PCB Conc.	12.8	7.2	2.9	1.9	1.4
	% of Samples Exceeding FDA Tolerance*	87.5	76.9	7.2	45.6	5.6
Coho Salmon	Number of Samples	17	-	6	-	-
	Maximum PCB Conc.	10.5	-	0.7	-	-
	Mean PCB Conc.	5.2	-	0.4	-	-
	Median PCB Conc.	6.2	-	0.5	-	-
	% of Samples Exceeding FDA Tolerance*	52.9	-	0.0	-	-

**Table 2-5 (cont.)  
Summary of PCB Tissue Concentrations (ppm) and Frequency of Exceedences  
of FDA Tolerance for Fish in Northern Lake Michigan, 1974-1995**

<b>Species</b>	<b>Parameter</b>	<b>1974</b>	<b>1975-1979</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1995</b>
Lake Trout	Number of Samples	28	41	27	20	-
	Maximum PCB Conc.	43.8	37.0	27.0	17.0	-
	Mean PCB Conc.	16.1	8.6	6.7	4.1	-
	Median PCB Conc.	11.0	4.8	3.7	3.4	-
	% of Samples Exceeding FDA Tolerance*	71.4	48.8	44.4	95.0	-
Lake Whitefish	Number of Samples	-	17	5	13	16
	Maximum PCB Conc.	-	12.0	1.6	6.2	1.7
	Mean PCB Conc.	-	1.9	1.0	1.4	0.4
	Median PCB Conc.	-	1.0	0.9	0.8	0.3
	% of Samples Exceeding FDA Tolerance*	-	5.9	0.0	15.4	0.0
Pink Salmon	Number of Samples	-	-	2	-	-
	Maximum PCB Conc.	-	-	0.2	-	-
	Mean PCB Conc.	-	-	0.2	-	-
	Median PCB Conc.	-	-	0.2	-	-
	% of Samples Exceeding FDA Tolerance*	-	-	0.0	-	-
Rainbow Trout	Number of Samples	-	-	7	2	-
	Maximum PCB Conc.	-	-	2.1	1.1	-
	Mean PCB Conc.	-	-	0.9	0.8	-
	Median PCB Conc.	-	-	0.5	0.8	-
	% of Samples Exceeding FDA Tolerance*	-	-	0.0	0.0	-
Yellow Perch	Number of Samples	-	2	-	1	9
	Maximum PCB Conc.	-	5.0	-	0.2	0.2
	Mean PCB Conc.	-	3.3	-	0.2	0.2
	Median PCB Conc.	-	3.3	-	0.2	0.2
	% of Samples Exceeding FDA Tolerance*	-	0.0	-	0.0	0.0

\* Fish collected through 1984 were compared to the FDA tolerance of 5 ppm; fish collected after 1984 were compared to the revised FDA tolerance of 2 ppm.

Sources: Wisconsin DNR (1971-1995); Michigan DNR (1983-1995).

## **2.4 SUMMARY**

The results of the injury determination indicate that the FDA tolerance for PCBs in fish has been and continues to be exceeded in edible portions of multiple fish species in the Lower Fox River, Green Bay, and northern Lake Michigan. Table 2-6 summarizes the results of the injury determination for fish species that have exceeded the FDA tolerance at least once. Thirteen species in the Lower Fox River have exceeded the FDA tolerance for PCBs. Twenty-three species in Green Bay and six species in northern Lake Michigan have also exceeded the FDA tolerance for PCBs. For several species in each location, more than 50% of the samples exceeded the FDA tolerance. These data confirm that numerous fish species have been injured throughout the assessment area over the period 1971 through the present.

**Table 2-6**  
**Summary of Comparison of Assessment Area Fish PCB Concentrations**  
**with the FDA Tolerance\* for PCBs, 1971-1995**

	1971-1974	1975-1979	1980-1984	1985-1989	1990-1995
<b>Lower Fox River upstream of the DePere Dam</b>					
Brown Bullhead	○	●●	⊗	●	○
Carp	○	●●	●●	●●	●●
Channel Catfish	○	○	○	⊗	●
Northern Pike	○	●	⊗	⊗	⊗
Sheepshead/Drum	○	○	●●	○	○
Walleye	○	●	●	●	●
White Bass	○	○	⊗	●	●
White Sucker	○	●	⊗	○	○
<b>Lower Fox River downstream of the DePere Dam</b>					
Carp	○	⊗	●●	●●	○
Channel Catfish	○	○	○	●●	○
Chinook Salmon	○	●●	○	○	○
Flathead Catfish	○	○	○	●●	○
Gizzard Shad	○	○	●●	○	○
Northern Pike	○	⊗	○	●	⊗
Sheepshead/Drum	○	○	○	●●	○
Walleye	○	●	●●	●	●
White Bass	○	○	⊗	●●	●●
White Perch	○	○	○	○	●●
White Sucker	○	⊗	⊗	●	○
Yellow Perch	○	●●	⊗	○	○
<b>Green Bay</b>					
Alewife	○	⊗	●	○	○
Brook Trout	○	○	⊗	●	⊗
Brown Bullhead	○	●	⊗	○	○
Brown Trout	○	○	●	●●	●
Carp	○	●●	●●	●●	●●
Channel Catfish	○	○	○	○	●
Chinook Salmon	○	○	●	●	⊗
Cisco/Lake Herring	○	●●	○	⊗	○
Coho Salmon	○	●●	○	○	○
Gizzard Shad	○	●●	○	○	○
Lake Sturgeon	○	○	○	●●	○

**Table 2-6 (cont.)  
Summary of Comparison of Assessment Area Fish PCB Concentrations  
with the FDA Tolerance\* for PCBs, 1971-1995**

	1971-1974	1975-1979	1980-1984	1985-1989	1990-1995
<b>Green Bay (cont.)</b>					
Lake Trout	●●	●●	●	○	○
Lake Whitefish	○	●	⊗	⊗	⊗
Longnose Sucker	○	○	○	●	●
Northern Pike	○	●	●	⊗	○
Rainbow Trout	○	○	○	●●	⊗
Smallmouth Bass	○	⊗	●	⊗	⊗
Splake	○	○	○	●	●
Walleye	○	⊗	●	●	●
White Bass	○	●●	⊗	○	○
White Perch	○	○	○	○	●●
White Sucker	○	●	⊗	⊗	○
Yellow Perch	○	●	⊗	○	⊗
<b>Northern Lake Michigan</b>					
Brook Trout	○	○	⊗	●	○
Brown Trout	●	○	●	●	●
Chinook Salmon	●●	●●	●	●	●
Coho Salmon	●●	○	⊗	○	○
Lake Trout	●●	●	●	●●	○
Lake Whitefish	○	●	⊗	●	⊗

\* = Fish collected through 1984 were compared to the FDA tolerance of 5 ppm; fish collected after 1984 were compared to the revised FDA tolerance of 2 ppm.

●● = More than 50% of samples exceeded FDA tolerance.

● = At least one sample exceeded FDA tolerance.

⊗ = Measured samples did not exceed FDA tolerance.

○ = Not measured during this time period.

Sources: Wisconsin DNR (1971-1995); Michigan DNR (1983-1995).

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## **CHAPTER 3**

### **WISCONSIN FISH CONSUMPTION ADVISORIES**

#### **3.1 INTRODUCTION**

Fishery resources are injured if they contain concentrations of a hazardous substance sufficient to exceed levels for which an appropriate state health agency has issued directives to limit or ban consumption of such organism [43 CFR § 11.62 (f)(1)(iii)]. Injuries pursuant to this injury definition were determined by summarizing fish consumption advisories issued by the State of Wisconsin for the Lower Fox River, Green Bay, and Lake Michigan.

This chapter presents an overview of the Wisconsin advisory program in the assessment area (Section 3.2), describes the trigger levels used by Wisconsin to set advisories (Section 3.3), discusses the contaminants responsible for the advisories (Section 3.4), presents a list of the advisories issued by Wisconsin (Section 3.5), and presents a comparison of measured PCB concentrations to thresholds used to trigger advisories (Section 3.6). A more detailed description of the procedures used by Wisconsin to set advisories is found in Appendix B.

#### **3.2 OVERVIEW OF WISCONSIN'S ADVISORY PROGRAM**

Since 1971, the Wisconsin DNR has recommended that consumers restrict consumption of contaminated fish. Between 1971 and today, fish consumption advisories have changed to reflect current data on fish contaminant levels and on the toxicity of contaminants (Table 3-1). This section presents an overview of Wisconsin's fish consumption advisories in the assessment area.

In 1971, the Wisconsin DNR issued a press release with the notice that the State Division of Health recommended restrictions on consumption of Lake Michigan fish. Specifically, the notice recommended that people eat "no more than one meal of Lake Michigan lake trout and salmon per week because these fish contain excess amounts of DDT and PCB's" (Wisconsin DNR, 1971). This same advisory was issued annually from 1972 to 1974 (J. Amrhein, Wisconsin DNR, personal communication). The 1971 press release also stated that DNR wardens were confiscating fish taken in commercial nets. The basis for confiscating fish was not given in the press release.

In 1975, a press release was issued that noted the health warning for restricting fish consumption applied to Lake Michigan, Green Bay, and two other locations. People were advised to limit their consumption of Lake Michigan trout or salmon to one meal per week and to reduce the PCB content of fish by removing fat during cleaning and cooking. (Wisconsin DNR, 1975).

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**Table 3-1  
Timeline for Establishment of Advisories in Wisconsin**

<b>Year</b>	<b>Action</b>	<b>Reference</b>
1971	Wisconsin State Division of Health recommended restricted consumption of Lake Michigan fish because of excess DDT and PCBs.	Wisconsin DNR, 1971
1975	Consumers advised to limit consumption of fish from Lake Michigan, Green Bay, and other locations because of PCBs. Press release issuing advice refers only to PCBs.	Wisconsin DNR, 1975
1976	First formal fish consumption advisory issued for fish that may exceed FDA standards for PCBs. Advisory included Green Bay, Fox River, Lake Michigan, and other locations.	Wisconsin DNR, 1976
1976-1994	Yearly consumption advisories issued.	Wisconsin DNR, 1976; Wisconsin DNR, 1977-1986; Wisconsin DNR, 1987-1994
1976-1977	Consumers advised to refrain from eating more than one meal per week of fish listed in the advisory.	Wisconsin DNR, 1976; Wisconsin DNR, 1977-1986
1978	Children and women of child-bearing age advised to avoid eating fish listed in the advisory.	Wisconsin DNR, 1978
1979-1983	Consumers advised to avoid eating all fish from specified locations.	Wisconsin DNR, 1977-1986
1984	Consumption advisory issued in four categories for fish with low, moderate, high, and extremely high contaminant concentrations.	Wisconsin DNR, 1977-1986
1985	Joint health advisory issued by Wisconsin, Illinois, Indiana, and Michigan for Lake Michigan fish. PCB tolerance of 2.0 ppm in fish tissue was used as the basis for the health advisory.	Wisconsin DNR, 1985
1987	Announcement that advisories will be issued twice a year (April 1 and October 1) instead of once a year.	Wisconsin DNR, 1987
1995-1996	Booklets with fish consumption advisory information were not issued.	J. Amrhein, personal communication
1997	Format and content of fish consumption advisory changed to follow the uniform protocol developed by the Great Lakes Fish Advisory Task Force.	Wisconsin Division of Health and Wisconsin DNR, 1997

Also in 1975, recommendations on PCBs were released by the “Ad Hoc Lake Michigan Fisheries Task Force,” which was appointed by the Wisconsin DNR. The task force noted that PCBs in Lake Michigan fish exceeded the FDA tolerance. The task force recommended that the Wisconsin DNR intensify its program to identify and control PCB sources. The task force also recommended that the State of Wisconsin work with the U.S. EPA and other states in developing standards and recommending actions to reduce PCBs in the environment (Ad Hoc Lake Michigan Fisheries Task Force, 1975).

In 1976, the Wisconsin DNR published its first formal “Fish Consumption Advisory,” (J. Amrhein, Wisconsin DNR, personal communication). This consumption advisory included trout and salmon from Lake Michigan and Green Bay and carp from Green Bay. The advisory said that consumers should refrain from eating more than one meal per week of these fish and that children and pregnant women should limit themselves to one average size serving per week of these fish.

From 1976 to 1978, the consumption advisory stated that all consumers should refrain from eating more than one meal per week of any of the fish listed in the advisory. In 1978, the Wisconsin Division of Health changed the advisory to indicate that women of child-bearing age and children should not eat the listed species, and other consumers should limit consumption. In 1979, the advisory was changed to include a “no consumption” recommendation for some species of fish for all consumers. Certain fish species from Green Bay and Lake Michigan were not placed into the “no consumption” category. Consumers were advised to avoid eating more than ½ pound per week of the listed species for Green Bay and Lake Michigan.

In 1984, the format and content of the advisory changed substantially and the advisory was issued as a pamphlet. Fish were grouped into one of four contaminant concentration categories: low, moderate, high, and extremely high. In 1985, separate advisories were issued for mercury contamination and for PCB and pesticide contamination. In addition, the health standard for PCBs was lowered to 2 ppm in the 1985 advisory, reflecting the FDA’s reduction of the PCB tolerance for fish from 5 ppm to 2 ppm in August 1984 (see Chapter 2).

The advisories issued in 1985 and 1986 by Wisconsin included minor adjustments to the 1984 advisory. For Lake Michigan fish only, the 1985 Wisconsin advisory was part of a joint advisory also issued by Illinois, Indiana, and Michigan. Fish were grouped into three categories (Group 1, Group 2, Group 3), based on contaminant concentrations (Table 3-2). This initial three-group approach was used in 1985 and 1986. Group 1 fish were defined as posing the lowest health risk. This group contained fish for which contaminant levels in 10% or fewer of those tested were higher than the FDA tolerance. Consumers were advised to trim all fat and skin from these fish before cooking and eating. Group 2 contained fish for which contaminant levels in 50% or more of those tested exceeded the FDA tolerance. Pregnant women, nursing mothers, women who expect to bear children, and infants and children were warned against eating Group 2 fish. Other consumers were advised to limit consumption of these fish and to trim all fat and skin before

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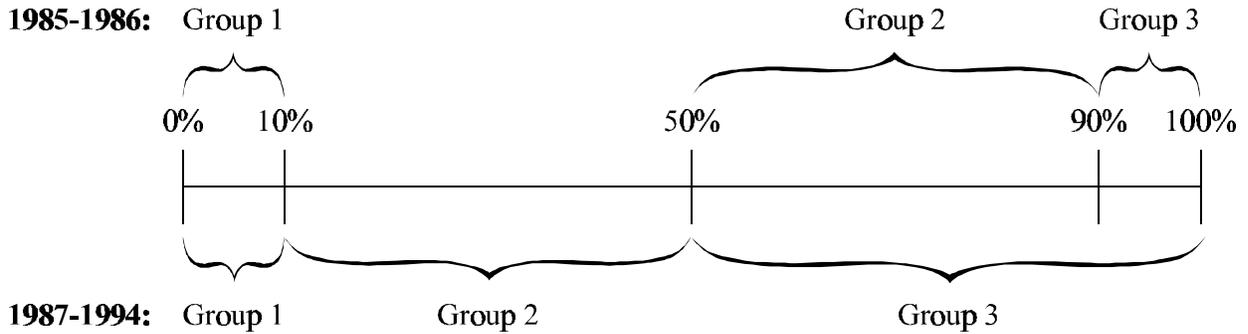
<b>Table 3-2 Criteria for Triggering Group 1, Group 2, and Group 3 Fish Consumption Advisories</b>			
<b>Year</b>	<b>Group 1 Advisory (trim fat and skin before cooking fish)</b>	<b>Group 2 Advisory (women and children should not eat these fish; others should limit consumption)</b>	<b>Group 3 Advisory (no one should eat these fish)</b>
1985- 1986	Contaminant levels in 10% or fewer of tested fish exceed the FDA tolerance.	Contaminant levels in 50% or more of tested fish exceed the FDA tolerance.	Contaminant levels in 90% or more of tested fish exceed the FDA tolerance.
1987- 1996*	Contaminant levels in 10% or fewer of tested fish are higher than one or more health standards.	Contaminant levels in more than 10% but fewer than 50% of tested fish are higher than one or more health standards.	Contaminant levels in 50% or more of tested fish are higher than one or more health standards.
* Advisories were not reprinted in 1995 or 1996. We assumed that the 1994 advisories remained in force during those years.			
Sources: Wisconsin DNR, 1977-1986; Wisconsin DNR, 1987-1994.			

cooking and eating. Group 3 contained fish for which contaminant levels in 90% or more of those tested exceeded the FDA tolerance. All consumers were advised against eating Group 3 fish. In the 1985 and 1986 advisories, no advisory group was assigned to species where 10% to 50% of tested fish exceeded FDA standards (Figure 3-1).

In 1987, the advisories were changed substantially to include additional species and size classes. The criteria for triggering Group 2 and Group 3 advisories were changed to eliminate the apparent omission in 1985 and 1986 of species in the 10% to 50% exceedence category, and to make the advisories more restrictive (Table 3-2, Figure 3-1). Also in 1987, the Wisconsin DNR announced that they would begin issuing advisories every six months. (Previously, advisories had been issued annually.) In a press release, the DNR commented that they had been urged by environmental groups and sport fish consumers to provide more frequent information. The DNR also commented that other parties had criticized the announcements of consumption advisories because of their potential impact on tourism (Wisconsin DNR, 1987).

The advisories changed very little from 1987 to 1994. In 1995 and 1996, the State of Wisconsin did not issue an updated “Health Guide” containing the fish consumption advisory. The advisory issued in 1994 was considered to be in effect during 1995 and 1996. During this time, discussions were under way concerning the adoption of the uniform protocol developed by the Great Lakes Sport Fish Advisory Task Force (J. Amrhein, Wisconsin DNR, personal communication). This advisory contains advice for five fish consumption levels: unlimited

**Figure 3-1**  
**Percentage of Tested Fish Exceeding Standards and the Advisory that Would Be Triggered**



consumption, one meal per week, one meal per month, one meal every two months, and no consumption. The advisory was developed so that consumers do not consume more than 0.05 µg PCBs in sport fish per kilogram of body weight per day (Great Lakes Sport Fish Advisory Task Force, 1993; see Chapter 5).

In 1997, the Wisconsin DNR changed the format of the fish consumption advisory to match the uniform protocol developed by the Great Lakes Sport Fish Advisory Task Force (Table 3-3) (Wisconsin Division of Health and Wisconsin DNR, 1997).

<b>Table 3-3</b> <b>PCB Trigger Levels for the 1997 Wisconsin Fish Consumption</b> <b>Advisory (based on the uniform protocol developed</b> <b>by the Great Lakes Sport Fish Advisory Task Force)</b>	
<b>PCB Concentration in Fish</b> <b>(skin-on fillets)</b>	<b>Advice to Consumers</b>
<0.05 ppm	Consumers may eat an unlimited number of meals
0.05-0.2 ppm	Restrict consumption to one meal per week or 52 meals per year
0.2-1.0 ppm	Restrict consumption to one meal per month or 12 meals per year
1.0-1.9 ppm	Restrict consumption to one meal every two months or six meals per year
>1.9 ppm	Do not eat these fish
Source: Wisconsin Division of Health and Wisconsin DNR, 1997.	

### 3.3 TRIGGER LEVELS FOR ADVISORIES

Beginning in 1985, the Wisconsin DNR included in the printed advisories the trigger levels for contaminant concentrations in fish tissue used to establish advisories (Table 3-4). The trigger levels for DDT (5.0 ppm), chlordane (0.3 ppm), and dieldrin (0.3 ppm) are equivalent to FDA action levels (U.S. FDA, 1994). The FDA action level for mercury is 1.0 ppm. The FDA raised the action level from 0.5 ppm to 1.0 ppm in 1979 as a result of a court order (Humphrey and Hesse, 1986). Wisconsin chose to use 0.5 ppm as the trigger level for mercury after 1986. There are no FDA action levels for dioxin or toxaphene<sup>1</sup>; Wisconsin has adopted trigger levels of 50 ppt (1987-1989) and 10 ppt (1990-today) for dioxin and 5.0 ppm for toxaphene. Before 1997, PCB trigger levels in Wisconsin corresponded to the FDA tolerance. In 1997, the PCB trigger level was changed to a range of levels (0.05 ppm to 2 ppm) that trigger different advisories (Table 3-3). No information on trigger levels for other contaminants was included in the 1997 advisory.

<b>Table 3-4</b>	
<b>Contaminants and Trigger Levels Used to Establish Fish Consumption Advisories in Wisconsin</b>	
<b>Contaminant</b>	<b>Trigger Level<sup>1</sup></b>
Chlordane	0.3 ppm
DDT and DDT metabolites (DDE, DDD)	5.0 ppm
Dieldrin (aldrin)	0.3 ppm
Dioxin (2,3,7,8 TCDD)	50 ppt (1987-1989); 10 ppt (1990-today)
Mercury	1.0 ppm (1986); 0.5 ppm (1987-today)
PCBs	5.0 ppm (1976-1984); 2.0 ppm (1985-1996); 0.05 ppm-2.0 ppm (1997)
Toxaphene	5.0 ppm (1987-today)
1. Trigger levels were first published in advisories in 1985, except where noted.	
Sources: Wisconsin DNR, 1987-1994; Wisconsin Division of Health and Wisconsin DNR, 1997.	

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1. In the Great Lakes states, a compound that appears in analytical tests to be the pesticide toxaphene has been detected downstream of pulp and paper mills even though the pesticide was used only on crops in the South. Although this compound may more correctly be termed “apparent toxaphene,” we are following the practice of the Wisconsin and Michigan DNRs by just using the name toxaphene. The FDA cancelled its action level for toxaphene in 1993 because toxaphene was no longer occurring as an unavoidable contaminant in the food and feed commodities subject to action levels (G. Cramer, U.S. FDA, Center for Food Safety and Applied Nutrition, personal communication).

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### 3.4 CONTAMINANTS RESPONSIBLE FOR ADVISORIES

The printed fish consumption advisories issued by the State of Wisconsin did not always mention the specific contaminant responsible for an advisory. The press release issued by the Wisconsin DNR in 1971 stated that the State Division of Health suggested limited consumption of Lake Michigan lake trout and salmon “because these fish contain excess amounts of DDT and PCB’s” (Wisconsin DNR, 1971). The press release issued in 1975 only mentioned PCBs in Lake Michigan trout and salmon as contributing to the advisory (Wisconsin DNR, 1975).

From 1976 to 1983, the consumption advisories for the Lower Fox River, Green Bay, and Lake Michigan only mentioned PCBs as contributing to the advisories (Wisconsin DNR, 1976; Wisconsin DNR, 1977-1986). The 1984 advisory did not specify which contaminants were responsible for the advisories. From 1985 to 1994, the advisories for the Lower Fox River, Green Bay, and Lake Michigan were listed under the heading “PCB and Pesticide Contamination in Fish.” This section was separated from the advisories necessitated by mercury contamination. Since 1990, the text in the “Health Guide” has focused on PCBs and mercury and states that “other known fish contaminants, such as toxaphene, dieldrin and DDT, are not as commonly found in Wisconsin sport fish as PCBs and mercury” (Wisconsin DNR, 1987-1994). In 1997, the section in the printed advisory previously labeled “PCB and Pesticide Contamination in Fish” was relabeled the “PCB advisory” (Wisconsin Division of Health and Wisconsin DNR, 1997).

Data collected by the Wisconsin DNR and the Michigan DNR from 1977 to 1994 confirm that PCBs and not pesticides are responsible for the fish consumption advisories in the Lower Fox River, Green Bay, and Lake Michigan. The combined fish contaminant monitoring database from these agencies reveals that while PCBs have repeatedly exceeded the FDA tolerance (see Section 3.6), other chemicals, including chlordane, dieldrin, toxaphene, DDT, and mercury, have infrequently exceeded trigger levels used by Wisconsin for issuing advisories (Appendix C, Tables C-1 to C-40). All exceedences of trigger levels for chemicals other than PCBs are summarized in Table 3-5. Species not listed in Table 3-5 did not exceed a trigger level for a contaminant, other than PCBs (see Appendix C).

In the Lower Fox River upstream of the DePere Dam, the mercury trigger level was exceeded in 22% of the walleye samples collected between 1985 and 1989 and in 50% of the smallmouth bass samples collected between 1990 and 1994. The median mercury concentration was below the trigger level. There were no exceedences of the trigger levels for other contaminants, except for PCBs.

In the Lower Fox River downstream of the DePere Dam, the mercury trigger level was exceeded in 33% of the walleye samples collected between 1985 and 1989 and in 7.7% of the walleye samples collected between 1990 and 1994. For both sets of years, the median mercury concentration was below the trigger level. There were no exceedences of the trigger levels for other contaminants, except for PCBs.

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**Table 3-5**  
**Samples Exceeding Wisconsin or Michigan Trigger Levels**  
**for Contaminants Other than PCBs**

Species	Contaminant	Time Period	Trigger Level	Total Number of Samples	Percent of Samples Exceeding Trigger Level	Median Concentration
<b>Lower Fox River upstream of the DePere Dam</b>						
Walleye	Mercury	1985-1989	0.5 ppm	9	22%	0.24 ppm
Smallmouth Bass	Mercury	1990-1994	0.5 ppm	2	50%	0.44 ppm
<b>Lower Fox River downstream of the DePere Dam</b>						
Walleye	Mercury	1985-1989	0.5 ppm	12	33%	0.42 ppm
Walleye	Mercury	1990-1994	0.5 ppm	26	7.7%	0.08 ppm
<b>Green Bay</b>						
Smallmouth Bass	Mercury	1990-1994	0.5 ppm	7	14%	0.31 ppm
Walleye	Mercury	1985-1989	0.5 ppm	20	25%	0.24 ppm
Walleye	Mercury	1990-1994	0.5 ppm	24	25%	0.34 ppm
<b>Northern Lake Michigan</b>						
Lake Trout	Chlordane (measured as alpha-chlordane)	1980-1984	0.3 ppm	15	6.7%	0.20 ppm
Lake Trout	Dieldrin	1980-1984	0.3 ppm	14	71%	0.33 ppm
Lake Whitefish	Dieldrin	1985-1989	0.3 ppm	11	18%	0.16 ppm
Lake Trout	DDT (measured as 4,4-DDE)	1980-1984	5.0 ppm	9	56%	5.20 ppm
Bloater Chub	Dieldrin	1980-1984	0.3 ppm	19	16%	0.27 ppm
Sources: Wisconsin DNR, 1971-1995; Michigan DNR, 1983-1995.						

In Green Bay, the mercury trigger level was exceeded in 14% of smallmouth bass samples collected between 1990 and 1994 and in 25% of walleye samples collected between 1985 and 1994. For both species the median mercury concentration was below the trigger level. There were no exceedences of the trigger levels for other contaminants, except for PCBs.

In northern Lake Michigan, the chlordane trigger level was exceeded in 6.7% of lake trout samples analyzed for alpha-chlordane. The dieldrin trigger level was exceeded in 71% of lake trout samples. These samples were collected between 1980 and 1984. More recent data were not available in the database. The dieldrin trigger level was also exceeded in 18% of lake whitefish samples collected between 1985 and 1989, and in 16% of bloater chub samples collected between 1980 and 1984. The DDT trigger level was exceeded in 56% of lake trout samples collected between 1980 and 1984. More recent data were not available. There were no exceedences of the trigger levels for other contaminants, except for PCBs.

### **3.5 WISCONSIN ADVISORIES**

Over time, Wisconsin's fish consumption advisories have become more specific with regard to the fish species and size classes included in the advisories and the consumption advice given. Advisories for the Lower Fox River are presented in Table 3-6. Separate advisories for the Lower Fox River between Green Bay and the DePere Dam were first issued in 1987. These advisories are presented in Table 3-7. Advisories for the Wisconsin waters of Green Bay are presented in Table 3-8. Advisories for the Wisconsin waters of Lake Michigan are presented in Table 3-9. Advisories issued in press releases before 1976 are not included in Tables 3-6 to 3-9. Also, based on discussions with the Wisconsin DNR, the assumption was made that the 1994 advisories continued for 1995 and 1996, when new advisory booklets were not issued (J. Amrhein, Wisconsin DNR, personal communication).

Overall, fish consumption advisories have been issued by Wisconsin for a wide variety of species. In the Lower Fox River, there have been advisories for carp, walleye, and bullhead for at least 10 years. In Green Bay, there have been continuous advisories for carp, brown trout, and rainbow trout, from 1976 through 1997. Several other species have been under advisories for more than 10 years, including walleye, chinook salmon, and splake. In the Wisconsin waters of Lake Michigan, there have been continuous advisories for carp, lake trout, and brown trout from 1976 through 1997. Chinook and coho salmon have been under advisories for more than 10 years.

### **3.6 COMPARISON OF PCB CONCENTRATIONS TO ADVISORY THRESHOLDS**

PCB concentrations in fish from the Fox River, Green Bay, and Lake Michigan were compared to thresholds used by Wisconsin for triggering fish consumption advisories. This analysis was

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**Table 3-6  
Fish Consumption Advisories for the Lower Fox River<sup>1</sup>**

Species	Size	'76	'77	'78	'79	'80	'81	'82	'83	'84	'84+	'85	'85+	'86	'87	'88	'89	'90	'91	'92	'93	'94	'95	'96	'97#	
Carp	All	⊖	⊖								⊕	●													●	
	>16"												●	●												
	>17"														●	●	●	●	●	●	●	●	●	●	●	
All species in the Fox River except perch and northern pike in LLBDM <sup>2</sup>	All			⊗	⊗ <sup>3</sup>																					
											⊕	⊕	⊗	⊗	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	1 per mn
Northern Pike	All										⊕	⊕	⊗	⊗												1 per mn
Walleye	All										⊕	⊕	⊗	⊗												1 per mn
	>15"														⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	
	≤15"														⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	
White Bass	All										⊕	●		⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	1 per mn
Rock Bass	All										⊖	⊖														
White Sucker	All										⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	1 per 2 mn
Yellow Perch	All										⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	1 per wk
White Perch	All																									1 per mn
Smallmouth Bass	All																									1 per mn
Bullhead	All											⊖	⊖	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	

● = No consumption.  
 ⊗ = Limit consumption for general population, no consumption by children age 6 or under, or by women who are pregnant, nursing, or expect to bear children.  
 ⊕ = No consumption by infants, children, or by women who are pregnant, nursing, or expect to bear children.  
 ⊖ = Limit consumption to 1 meal per week for general population, limit consumption to 1 average size serving per week for pregnant women and children.  
 ⊙ = Remove all fat and skin before cooking, follow cooking and cleaning tips for reducing PCB levels.  
 + = This advisory was published in a health guide separate from the fishing regulations pamphlet (Wisconsin DNR, 1984-1985).  
 \* = Advisories were not reprinted in 1995 or 1996. The 1994 advisory remained in force during these years.  
 # = Advisories for 1997 are as follows: 1 per wk = 1 meal per week or 52 meals per year; 1 per mn = 1 meal per month or 12 meals per year; 1 per 2 mn = 1 meal every 2 months or 6 meals per year.

1. From 1976 to 1983, this advisory applied to the Lower Fox River from Lake Winnebago to Green Bay. In 1984, this advisory applied to the Lower Fox River from Lake Winnebago to the DePere Dam. From 1985 to 1996, this advisory applied to the Lower Fox River from the Neenah-Menasha Dam to the DePere Dam. In 1997, this advisory applied to the Lower Fox River from Little Lake Butte des Morts to the DePere Dam.  
 2. Little Lake Butte des Morts.  
 3. Consumption limit for general population is 1 meal (1/2 pound) per week.

Sources: 1976-1986 advisories were printed in the Wisconsin Fishing Regulations (Wisconsin DNR, 1976; Wisconsin DNR, 1977-1986); 1987-1997 advisories were printed as health guides (Wisconsin DNR, 1987-1994; Wisconsin Division of Health and Wisconsin DNR, 1997).

**Table 3-7  
Fish Consumption Advisories for the Lower Fox River  
between the Dam at DePere and Green Bay<sup>1</sup>**

Species	Size	'87	'88	'89	'90	'91	'92	'93	'94	'95*	'96*	'97#
White Bass	All	●	●	●	●	●	●	●	●	●	●	●
Carp	All	●	●	●	●	●	●	●	●	●	●	●
White Sucker	All	●	●	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	1 per 2 mn
Northern Pike	All		⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	
	>25"											1 per 2 mn
	<25"											1 per mn
Walleye	All	●	●	●								
	>18"				●	●	●	●	●	●	●	
	15-18"				⊗	⊗	⊗	⊗	⊗	⊗	⊗	
	<15"				⊖	⊖	⊖	⊖	⊖	⊖	⊖	
	>22"											●
	16-22"											1 per 2 mn
	<16"											1 per mn
Channel Catfish	All		●	●	●	●	●	●	●	●	●	●
Drum	All		●	●	●	●	●	●	●	●	●	
Yellow Perch	All											1 per mn
Smallmouth Bass	All											1 per 2 mn
Bluegill	All											1 per mn
Rock Bass	All											1 per mn
Black Crappie	>9"											1 per 2 mn
	<9"											1 per mn
Sheepshead	>13"											●
	10-13"											1 per 2 mn
	<10"											1 per mn

● = No consumption.  
 ⊗ = Limit consumption for general population, no consumption by children age 6 or under or by women who are pregnant, nursing, or expect to bear children.  
 ⊕ = No consumption by infants, children, or by women who are pregnant, nursing, or expect to bear children.  
 ⊖ = Limit consumption to 1 meal per week for general population, limit consumption to 1 average size serving per week for pregnant women and children  
 ⊙ = Remove all fat and skin before cooking, follow cooking and cleaning tips for reducing PCB levels.  
 \* = Advisories were not reprinted in 1995 or 1996. The 1994 advisory remained in force during these years.  
 # = Advisories for 1997 are as follows: 1 per wk = 1 meal per week or 52 meals per year; 1 per mn = 1 meal per month or 12 meals per year; 1 per 2 mn = 1 meal every 2 months or 6 meals per year.

1. From 1976 to 1983, advisories for the Lower Fox River from the DePere Dam to Green Bay were included in the general advisory for the Lower Fox River (Table 3-6). In 1984, advisories for the Lower Fox River from the DePere Dam to Green Bay were not specified. In 1985 and 1986, advisories for the Lower Fox River from the DePere Dam to Green Bay were included in the Green Bay advisory (Table 3-8). Starting in 1987, advisories were issued specific to the Lower Fox River between Green Bay and the dam at DePere.

Sources: 1987-1997 advisories were printed as health guides (Wisconsin DNR, 1987-1994; Wisconsin Division of Health and Wisconsin DNR, 1997).

**Table 3-8**  
**Fish Consumption Advisories for the Wisconsin Waters of Green Bay**  
**(from 1987-1997, the Green Bay advisory was restricted to Green Bay south of Marinette;**  
**from 1985-1986, the Green Bay advisory included the Fox River downstream of the DePere Dam)**

Species	Size	'76	'77	'78	'79	'80	'81	'82	'83	'84	'84+	'85	'85+	'86	'87	'88	'89	'90	'91	'92	'93	'94	'95*	'96*	'97#	
Carp	All	⊖	⊖	⊗	⊗ <sup>1</sup>	●	●	●	●	●	● <sup>1</sup>	●	●	●	●	●	●	●	●	●						
Trout	>20"	⊖	⊖	⊗	⊗ <sup>1</sup>	See advisories for lake, brown, brook, <sup>1</sup> and rainbow trout.																				
Salmon	>20"	⊖	⊖	⊗	⊗ <sup>1</sup>	⊗ <sup>1</sup>	⊗ <sup>1</sup>	⊗ <sup>1</sup>		⊗ <sup>1</sup>	See advisories for coho and chinook salmon.															
Whitefish	All				⊗	⊗ <sup>1,3</sup>															1 per 2 mn					
Lake Whitefish	All										⊕	⊕													1 per 2 mn	
Bullheads	All			⊗	⊗ <sup>1,3</sup>	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	1 per 2 mn					
Catfish	All			⊗	⊗ <sup>1,3</sup>	⊗ <sup>1,3</sup>		1,2					●	●												1 per 2 mn
Rainbow Smelt	All										⊖	⊖	⊖	⊖												
Yellow Perch	All										⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	1 per wk
Chinook Salmon	All										⊕															
	>25"											●	⊗	⊗	●	●	●	●	●	●	●	●	●	●	●	
	≤25"											⊕			⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	
	>29"																									1 per mn
<29"																									1 per wk	
Coho Salmon	All										⊕		⊖	⊖												
	≥28"											●														
	<28"											⊕														
Lake Trout	All											●		●	●											
	≥25"													●	●											
	20-25"													⊗	⊗											
	<25"											⊕														
	<20"													⊖	⊖											
Walleye	All										⊕	⊕														
	>20"													●	●	●	●	●	●	●	●	●	●	●	●	●
	≤20"													⊗	⊗	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	
	>26"																									●
	17-26"																									1 per 2 mn
<17"																									1 per mn	



**Table 3-8 (cont.)  
Fish Consumption Advisories for the Wisconsin Waters of Green Bay  
(from 1987-1997, the Green Bay advisory was restricted to Green Bay south of Marinette;  
from 1985-1986 the Green Bay advisory included the Fox River downstream of the DePere Dam)**

Species	Size	'76	'77	'78	'79	'80	'81	'82	'83	'84	'84+	'85	'85+	'86	'87	'88	'89	'90	'91	'92	'93	'94	'95*	'96*	'97*
Splake	>16"														●	●	●	●	●	●	●	●	●	●	
	≤16"														⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	1 per mn
	>20																								●
	16-20"																								1 per 2 mn
Sturgeon	All																				●	●	●	●	●
White Perch	All																								●

● = No consumption.  
 ⊗ = Limit consumption for general population, no consumption by children age 6 or under, or by women who are pregnant, nursing, or expect to bear children.  
 ⊕ = No consumption by infants, children, or by women who are pregnant, nursing, or expect to bear children.  
 ⊖ = Limit consumption to 1 meal per week for general population, limit consumption to 1 average size serving per week for pregnant women and children.  
 ⊙ = Remove all fat and skin before cooking, follow cooking and cleaning tips for reducing PCB levels.  
 + = This advisory was published in a health guide separate from the fishing regulations pamphlet (Wisconsin DNR, 1984-1985).  
 \* = Advisories were not reprinted in 1995 or 1996. The 1994 advisory remained in force during these years.  
 # = Advisories for 1997 are as follows: 1 per wk = 1 meal per week or 52 meals per year; 1 per mn = 1 meal per month or 12 meals per year; 1 per 2 mn = 1 meal every 2 months or 6 meals per year.

1. Consumption limit for general population is 1 meal (1/2 pound) per week.
2. Advisory limited to southern Green Bay.
3. Advisory limited to southern Green Bay south of a line from Pensaukee to Little Sturgeon Bay.
4. Advisory limited to Little Sturgeon Bay; other sites not sampled.

Sources: 1976-1986 advisories were printed in the Wisconsin Fishing Regulations (Wisconsin DNR, 1976; Wisconsin DNR, 1977-1986); 1987-1997 advisories were printed as health guides (Wisconsin DNR, 1987-1994; Wisconsin Division of Health and Wisconsin DNR, 1997).

**Table 3-9  
Fish Consumption Advisories for the Wisconsin Waters of Lake Michigan Caused by PCBs and Pesticides**

Species	Size	'76	'77	'78	'79	'80	'81	'82	'83	'84	'84+	'85	'85+	'86	'87	'88	'89	'90	'91	'92	'93	'94	'95*	'96*	'97#	
Carp	All	⊖	⊖	⊗	⊗ <sup>1</sup>	●	●	●	●	● <sup>1</sup>	●	●	●	●	●	●	●	●	●							
Trout	>20"	⊖	⊖	⊗	⊗ <sup>1</sup>	See advisories for lake, brown, brook, and rainbow trout.																				
Salmon	>20"	⊖	⊖	⊗	⊗ <sup>1</sup>	⊗ <sup>1</sup>	⊗ <sup>1</sup>	⊗ <sup>1</sup>		⊗ <sup>1</sup>	See advisories for chinook, coho, and pink salmon.															
Lake Whitefish	All										⊕	⊕														
Whitefish	>25"																								1 per 2 mn	
	19-25"																								1 per mn	
	<19"																								1 per wk	
Bullheads	All									⊙	⊙	⊙	⊙													
Rainbow Smelt	All										⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙		
Smelt	All																								1 per wk	
Yellow Perch	All										⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	1 per wk	
Chinook Salmon	All										⊕															
	≥25"											●	⊗	⊗												
	<25"											⊕														
	>32"														●	●	●	●	●	●	●	●	●	●	●	
	21-32"														⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	
	<21"														⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	
	>30"																									1 per 2 mn
<30"																									1 per mn	
Coho Salmon	All										⊕		⊙	⊙												1 per mn
	>26"														⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	
	≤26"														⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	
	≥28"																									
	<28"																									

**Table 3-9 (cont.)  
Fish Consumption Advisories for the Wisconsin Waters of Lake Michigan Caused by PCBs and Pesticides**

Species	Size	'76	'77	'78	'79	'80	'81	'82	'83	'84	'84+	'85	'85+	'86	'87	'88	'89	'90	'91	'92	'93	'94	'95*	'96*	'97#	
Lake Trout	All											●														
	≥25"										●		●	●												
	20-25"												⊗	⊗												
	<25"										⊕															
	>27"																									●
	23-27"																									1 per 2 mn
	>23"														●	●	●	●	●	●	●	●	●	●	●	
	<23"																									1 per mn
	20-23"														⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	
<20"												○	○	○	○	○	○	○	○	○	○	○	○	○		
Walleye	All										⊕	⊕														
	>20"											●	●													
	<20"												⊗	⊗												
Brook Trout	All										⊕	⊕			○	○	○	○	○	○	○	○	○	○		
Northern Pike	All										⊕	⊕	⊗	⊗												
Brown Trout	All										⊕	●	●	●												
	>23"														●	●	●	●	●	●	●	●	●	●	●	
	<23"														⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗		
	>22"																									1 per 2 mn
<22"																									1 per mn	
White Sucker	All										⊕	⊕	●	●												
Rainbow Trout	All										⊕	⊕	○	○	○	○	○	○	○	○	○	○	○	○	○	
	>17"																									1 per mn
	<17"																									1 per wk
Catfish	All											●	●	●	●	●	●	●	●	●	●	●	●	●		
White Bass	All											●	●													
Smallmouth Bass	All										⊕	●	⊗	⊗												

**Table 3-9 (cont.)  
Fish Consumption Advisories for the Wisconsin Waters of Lake Michigan Caused by PCBs and Pesticides**

Species	Size	'76	'77	'78	'79	'80	'81	'82	'83	'84	'84+	'85	'85+	'86	'87	'88	'89	'90	'91	'92	'93	'94	'95*	'96*	'97#
Burbot	All													⊙											
Pink Salmon	All														⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	
Chubs	All																								1 per mn

● = No consumption.  
 ⊗ = Limit consumption for general population, no consumption by children age 6 or under, or by women who are pregnant, nursing, or expect to bear children.  
 ⊕ = No consumption by infants, children, or by women who are pregnant, nursing, or expect to bear children.  
 ⊖ = Limit consumption to 1 meal per week for general population, limit consumption to 1 average size serving per week for pregnant women and children.  
 ⊙ = Remove all fat and skin before cooking, follow cooking and cleaning tips for reducing PCB levels.  
 + = This advisory was published in a health guide separate from the fishing regulations pamphlet (Wisconsin DNR, 1984-1985).  
 \* = Advisories were not reprinted in 1995 or 1996. The 1994 advisory remained in force during these years.  
 # = Advisories for 1997 are as follows: 1 per wk = 1 meal per week or 52 meals per year; 1 per mn = 1 meal per month or 12 meals per year; 1 per 2 mn = 1 meal every 2 months or 6 meals per year.

1. Consumption limit for the general population is 1 meal (1/2 pound) per week.

Sources: 1976-1986 advisories were printed in the Wisconsin Fishing Regulations (Wisconsin DNR, 1976; Wisconsin DNR, 1977-1986); 1987-1997 advisories were printed as health guides (Wisconsin DNR, 1987-1994; Wisconsin Division of Health and Wisconsin DNR, 1997).

limited to the following species, which are important to the recreational fishery and have adequate data for the analysis:

- ▶ chinook salmon
- ▶ rainbow trout
- ▶ brown trout
- ▶ lake trout
- ▶ northern pike
- ▶ white perch
- ▶ smallmouth bass
- ▶ yellow perch
- ▶ walleye.

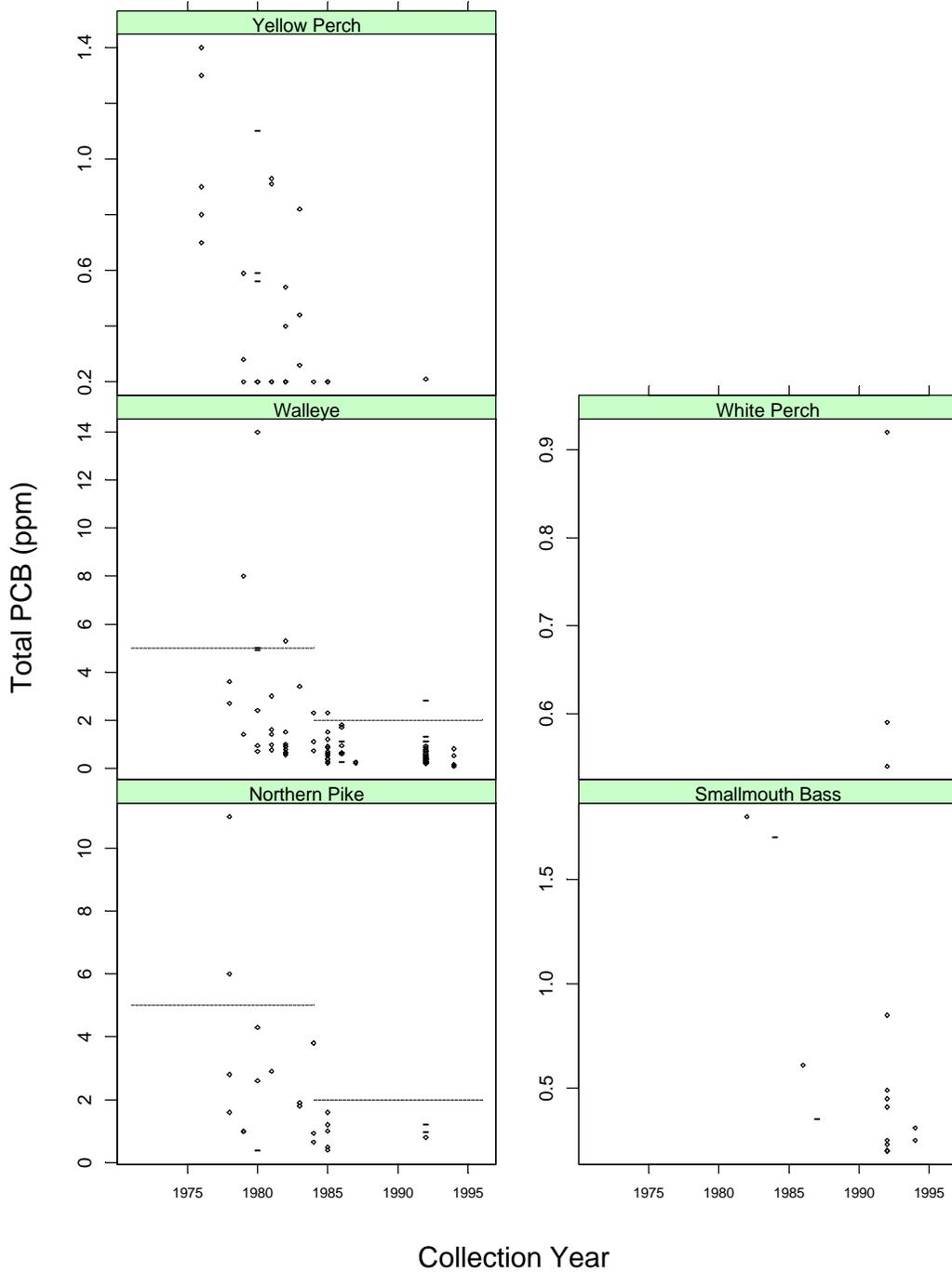
For these species, total PCB concentrations were compared to the appropriate FDA tolerance used by Wisconsin to trigger an advisory (5 ppm until 1984; 2 ppm after 1984) (Figures 3-2 to 3-5). Data from both the Wisconsin and Michigan databases (Wisconsin DNR, 1971-1995; Michigan DNR, 1983-1995) were used in the analysis because Wisconsin and Michigan have shared fish contaminant data from boundary waters (J. Amrhein, Wisconsin DNR, personal communication). Separate comparisons were made for the Lower Fox River upstream of the DePere Dam, the Lower Fox River downstream of the DePere Dam, Green Bay, and northern Lake Michigan. For each location, only those species (out of the nine species listed above) with PCB data in the databases were included in the figure. The purpose of this evaluation was to examine the consistency of the state advisories with reported fish tissue data. It should be noted that the state fish consumption advisories take into account various factors, including fish size, sampling frequency, contamination of closely related species, uncertainties, and other risk management considerations related to protection of public health (J. Amrhein, Wisconsin DNR, personal communication). The incorporation of these factors is not reflected in a simple comparison of fish tissue PCB concentrations with trigger levels.

Overall, comparison of the monitoring data with the state fish consumption advisory program indicates that Wisconsin's advisories have a reasonable analytical basis. In the Lower Fox River upstream of the DePere Dam, northern pike and walleye have had specific advisories since 1984 and have exceeded the FDA tolerance for PCBs since before that time (Figure 3-2). In 1997, new advisories to limit consumption of white perch, smallmouth bass, and yellow perch corresponded with exceedences of new trigger levels that are below the FDA tolerance. These trigger levels (beginning at 0.05 ppm PCBs) were established when Wisconsin adopted the uniform Great Lakes consumption advisory (Table 3-3).

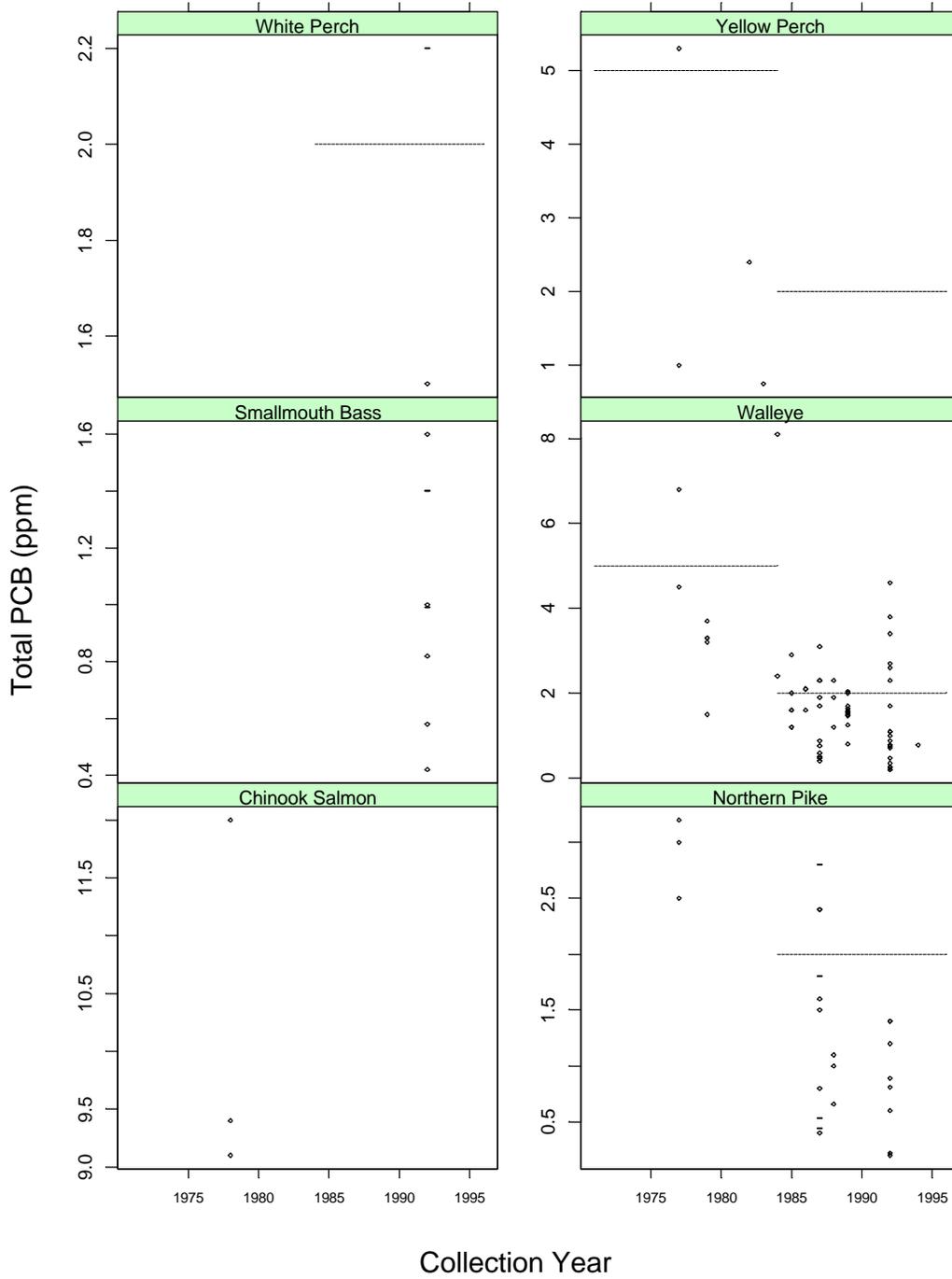
In the Lower Fox River downstream of the DePere Dam, advisories have been issued for four of the species considered in this analysis (northern pike, smallmouth bass, yellow perch, walleye). Multiple samples of northern pike and walleye have exceeded the FDA tolerance for PCBs (Figure 3-3). Advisories for smallmouth bass and yellow perch were first issued in 1997,

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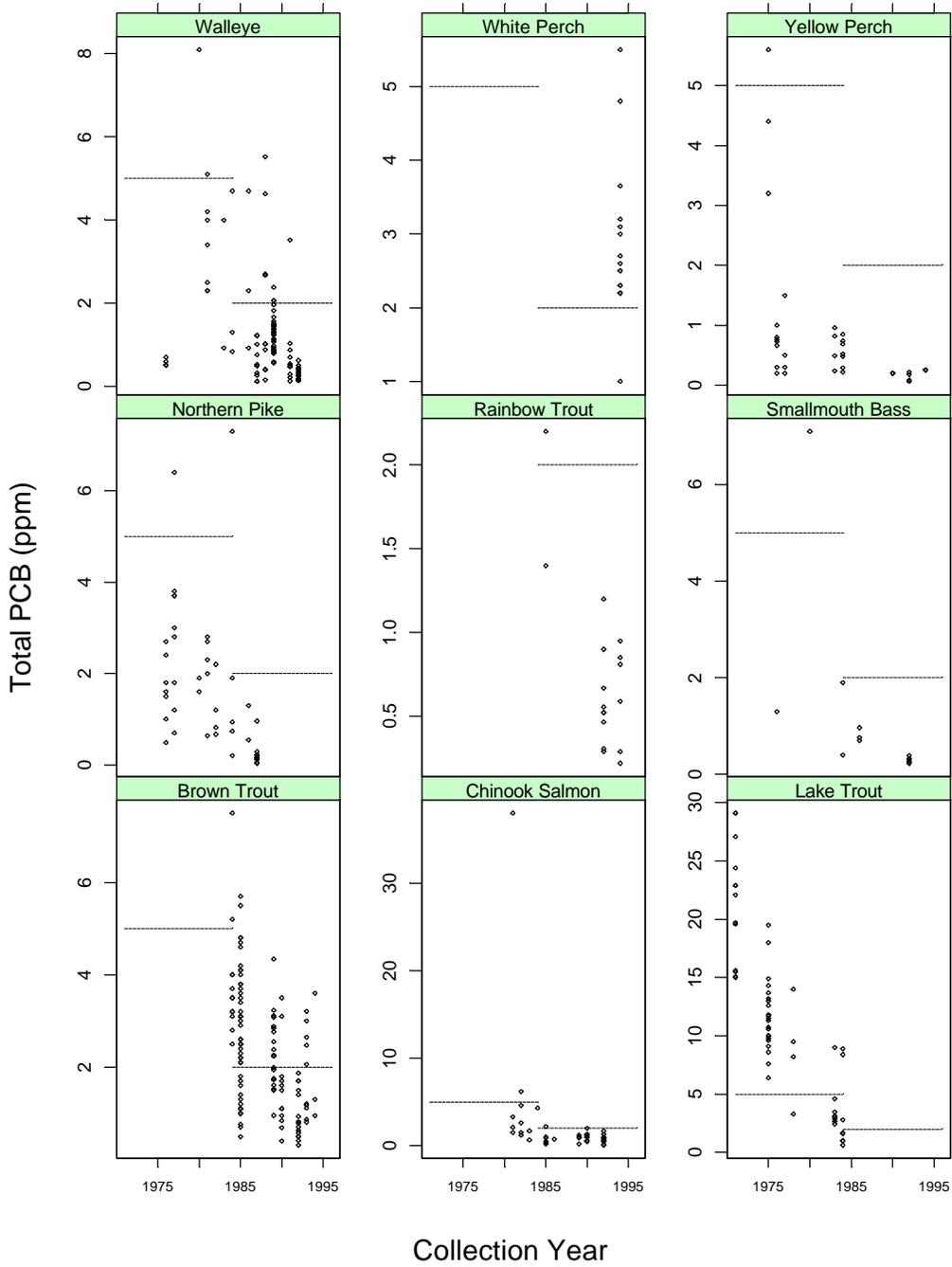
**Figure 3-2**  
**PCB Concentrations in Selected Fish Species from the Lower Fox River**  
**upstream of the DePere Dam (dashed lines indicate the FDA tolerance)**



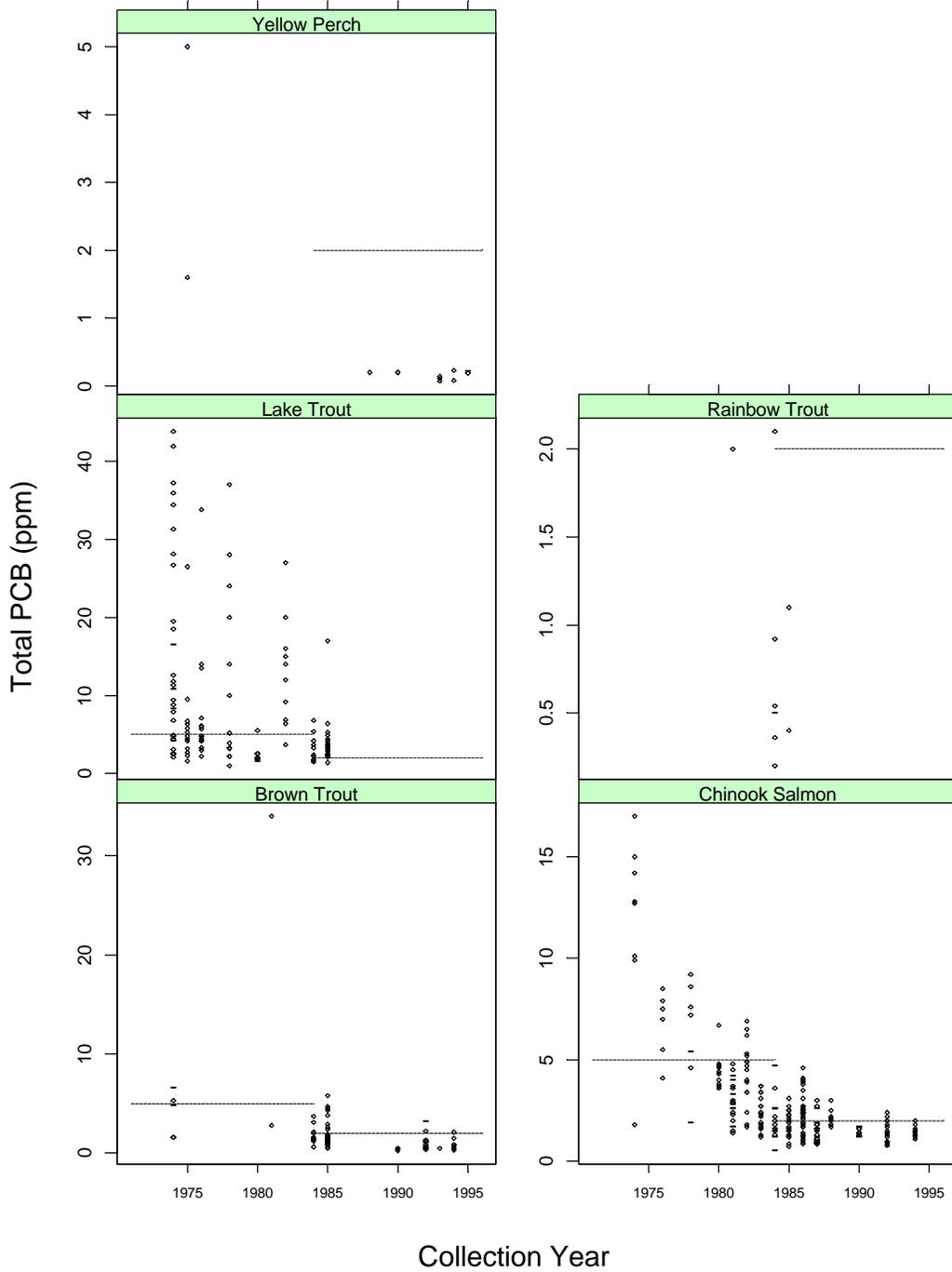
**Figure 3-3**  
**PCB Concentrations in Selected Fish Species from the Lower Fox River**  
**downstream of the DePere Dam (dashed lines indicate the FDA tolerance)**



**Figure 3-4**  
**PCB Concentrations in Selected Fish Species from Green Bay**  
**(dashed lines indicate FDA tolerance)**



**Figure 3-5**  
**PCB Concentrations in Selected Fish Species from Northern Lake Michigan**  
(dashed lines indicate the FDA tolerance)



corresponding to exceedences of the newly adopted trigger levels that are below the FDA tolerance (and one exceedence of the FDA tolerance by yellow perch).

In Green Bay, advisories have been issued for all nine species considered in this analysis. All of these species have exceeded the FDA tolerance on at least one occasion (Figure 3-4). In northern Lake Michigan, advisories have been issued for all species considered in this analysis except for white perch. Five of these species have exceeded the FDA tolerance in samples caught in Lake Michigan (yellow perch, lake trout, rainbow trout, brown trout, chinook salmon) (Figure 3-5). For the other three species, advisories most likely were based on exceedences in samples caught in river mouths or harbors of Lake Michigan (J. Amrhein, Wisconsin DNR, personal communication).

The PCB data from the Lower Fox River, Green Bay, and northern Lake Michigan, together with the above-noted risk management factors, provide support for Wisconsin's fish consumption advisories. Increased restrictions in the 1997 advisories compared to previous years reflect adoption of revised trigger levels that are below the FDA tolerance (Table 3-3).

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## **CHAPTER 4**

### **MICHIGAN FISH CONSUMPTION ADVISORIES**

#### **4.1 INTRODUCTION**

Injuries to fishery resources were also determined by examining fish consumption advisories issued by the State of Michigan for Green Bay and northern Lake Michigan. This chapter presents an overview of the Michigan advisory program (Section 4.2), describes the process used by Michigan to set advisories (Section 4.3), discusses the contaminants responsible for the advisories (Section 4.4), presents a list of the advisories issued by Michigan (Section 4.5), and presents a comparison of PCB concentrations to thresholds used to trigger advisories (Section 4.6). A more detailed description of the procedures used by Michigan to set advisories is found in Appendix B.

#### **4.2 OVERVIEW OF MICHIGAN'S ADVISORY PROGRAM**

Since 1970, the Michigan Department of Public Health (DPH) has advised that people restrict their consumption of contaminated sport-caught fish. Between 1970 and today, fish consumption advisories have changed to reflect current data on fish contaminant levels, current data on contaminant toxicity, and new methodologies for establishing and issuing advisories (Table 4-1). This section presents an overview of fish consumption advisories in Michigan.

The first fish consumption advisory issued by the Michigan DPH in 1970 applied to walleye and other species in the Lake St. Clair area containing excessive levels of mercury (Humphrey and Hesse, 1986). In 1977, the Michigan DPH began issuing advisories for Lake Michigan and other locations, including Lake Huron, Lake Superior, Lake Erie, Lake St. Clair, Saginaw Bay, the Detroit River, the St. Clair River, and tributaries to Lake Michigan and Lake Huron. These advisories were published in the annual fishing guide issued by the Michigan DNR. In the advisory, the Michigan DPH recommended that people “eat no more than one meal (½ lb) per week” of listed species, and that females of childbearing age “not eat fish containing elevated levels of PCB” (Michigan DNR, 1977-1997). The 1977 advisory for salmon in Lake Michigan was issued for contamination by PCBs and mercury, and the 1977 advisory for lake trout in Lake Michigan was issued for contamination by PCBs and DDT (Michigan DNR, 1977-1997).

In 1980, Michigan's contaminant monitoring program was placed under the direction of the Michigan Fish Contaminants Advisory Committee (FCAC), guided by a memorandum of

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**Table 4-1  
Timeline for Establishment of Advisories in Michigan**

<b>Year</b>	<b>Action</b>	<b>Reference</b>
1970	Michigan DPH first issued fish consumption advice for walleye and other species in the Lake St. Clair area with excessive levels of mercury.	Humphrey and Hesse, 1986
1977	Consumption advisories distributed as part of the annual fishing guide.	Humphrey and Hesse, 1986
1980	Great Lakes Environmental Contaminants Survey program was reorganized under the direction of the Michigan FCAC.	Humphrey and Hesse, 1986
1981	Michigan began using 2 ppm as the PCB standard for fish consumption advisories.	Humphrey and Hesse, 1986
1984	Uniform health advisory for consumption of Lake Michigan fish agreed to by Wisconsin, Illinois, Indiana, and Michigan.	Humphrey and Hesse, 1986
1989	Separate advisory issued for Green Bay.	Michigan DNR, 1977-1997
1991	Separate advisory issued for Little Bay de Noc.	Michigan DNR, 1977-1997
1997	Michigan removed salmon from their Lake Michigan advisory.	Michigan DNR, 1977-1997

understanding between the directors of the Departments of Agriculture, Public Health, and Natural Resources. Representatives from the FDA, the USFWS, and the Toxic Substance Control Commission also sat on the committee. The FCAC coordinates monitoring of commercial and recreational fisheries, and preparation and dissemination of fish consumption advisories.

From 1977 to 1985, the consumption advisory for Lake Michigan stated that consumers should refrain from eating more than one meal (½ lb) per week of any of the fish listed in the advisory. The advisory also specified that some groups of women and children should not consume listed fish. The specific groups mentioned in the advisory varied from year to year. In 1977, the advisory applied to women of childbearing age. In 1978, 1981, 1982, and 1983, the advisory applied to children and to women who were pregnant, nursing, or expected to bear children. In 1979 and 1980, the advisory applied to children and to nursing mothers. In 1984 to 1986, the advisory applied to children age 6 and under as well as to women who were pregnant, nursing, or expected to bear children. From 1987 to 1997, the advisory applied to children age 15 and under as well as to women who were pregnant, nursing, or expected to bear children.

In 1981, Michigan began using 2 ppm as the PCB trigger level for fish consumption advisories. This standard was adopted based on calculations of risk reductions associated with the change from a 5 ppm PCB standard to a 2 ppm PCB standard. The FDA did not adopt 2 ppm as the tolerance for PCBs until 1984 (Humphrey and Hesse, 1986).

In 1984, Wisconsin, Illinois, Indiana, and Michigan agreed on a uniform health advisory for consumption of fish from Lake Michigan. These states also agreed to make their sampling, sample handling, and analytical approaches more consistent.

Beginning in 1989, a separate advisory was issued by Michigan for Green Bay south of Cedar River. Beginning in 1991, a separate advisory was issued for Little Bay de Noc. Before these dates, Green Bay and Little Bay de Noc were covered by the general Lake Michigan advisory.

In 1996 and 1997, Michigan was the only state bordering Lake Michigan to remove salmon from their Lake Michigan advisory (Michigan DNR, 1977-1997; Michigan DNR, 1997). In response, the U.S. EPA issued a “supplementary” fish consumption advisory in 1997 for the State of Michigan, which included an advisory for salmon.

### **4.3 TRIGGER LEVELS FOR ADVISORIES**

Michigan has used the contaminants and trigger levels in Table 4-2 to establish fish consumption advisories (Humphrey and Hesse, 1986). The guidance document by Humphrey and Hesse (1986) comments that “trigger levels” for establishment of fish consumption advisories were historically based on FDA guidelines. However, the document also notes that some of the FDA action levels may be outdated or may have been influenced by analytical detection limits or economic considerations (Humphrey and Hesse, 1986).

In 1981, Michigan began to apply risk assessment methodologies to determine trigger levels for certain contaminants. The Michigan DPH adopted a trigger level of 2 ppm for PCBs in 1981, three years before this level was adopted by the FDA. This decision was based on the analysis that a reduction to 2 ppm for PCBs would reduce the estimated excess cancer risk below 1 in 100,000 for people consuming 6.5 g/day of fish for 70 years (approximately 5.2 pounds of fish per year). In 1983, the DPH evaluated the FDA standard for chlordane and determined that the FDA standard provided adequate protection. In 1986, the DPH evaluated the dioxin trigger level of 25 ppt and adopted a lower trigger value of 10 ppt. Michigan continues to apply a trigger value of 0.5 ppm for mercury, although the FDA raised their guideline to 1.0 ppm as a result of a court order (Humphrey and Hesse, 1986).

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**Table 4-2**  
**Contaminants and Trigger Levels Used to**  
**Establish Fish Consumption Advisories in Michigan**

Contaminant	Trigger Level*
Chlordane	0.3 ppm
DDT and DDT Metabolites (DDE, DDD)	5.0 ppm
Dieldrin (aldrin)	0.3 ppm
Dioxin (2,3,7,8 TCDD)	25 ppt (before 1986); 10 ppt (1986-today) (no current FDA action level)
Endrin	0.3 ppm (no current FDA action level)
Heptachlor	0.3 ppm
Mercury	0.5 ppm (FDA action level = 1.0 ppm)
Mirex	0.1 ppm
PCB	5.0 ppm (before 1981); 2.0 ppm (1981-today)
Toxaphene	5.0 ppm (no current FDA action level)
* = Trigger level differs from current FDA tolerance or action level only where noted.	
Source: Humphrey and Hesse, 1986.	

### Application of Trigger Levels

The guidance document comments that the Michigan DPH proposed adoption of a slightly modified version of criteria developed in 1985 by a multistate group for a uniform advisory in Lake Michigan. These criteria specify the type of advisory to be used for different degrees of exceedence of a trigger level (Table 4-3). These criteria are similar to those used by Wisconsin from 1987 to 1996 (Chapter 3).

The guidance document specifies that “prudent public health professional judgment” must be part of the decision making process (Humphrey and Hesse, 1986). For example, a precautionary position may be advocated before data are available to fully characterize the degree of contamination.

The advisories for children and for certain classes of women are more stringent than the advisories for the general population because of the concern that certain chemicals may have adverse reproductive effects. The guidance document specifies that the more stringent advisories should apply to all children under the age of 15, and to women who are pregnant, nursing, or

**Table 4-3**  
**Criteria for Application of Trigger Levels by the Michigan DPH**

<b>Risk Category</b>	<b>Degree of Exceedence</b>	<b>Consumption Advice</b>
Low Risk	<ul style="list-style-type: none"> <li>▶ 0-10% of fish tested exceed trigger level</li> <li><b>And</b></li> <li>▶ Mean concentration less than trigger</li> </ul>	No restriction on consumption
Moderate Risk	<ul style="list-style-type: none"> <li>▶ 11-49% of fish tested exceed trigger level</li> <li><b>And</b></li> <li>▶ Mean concentration less than trigger level</li> </ul>	Limit consumption to 1 meal (½ pound) per week No consumption of listed fish by male children age 15 and under, by female children, or by women who are pregnant, nursing, or expect to bear children
Medium Risk	<ul style="list-style-type: none"> <li>▶ 50-89% of fish tested exceed trigger level</li> <li><b>Or</b></li> <li>▶ Mean concentration greater than trigger level but not more than 2 times the trigger level</li> </ul>	Limit consumption to 1 meal (½ pound) per month No consumption of listed fish by male children age 15 and under, by female children, or by women who are pregnant, nursing, or expect to bear children.
High Risk	<ul style="list-style-type: none"> <li>▶ 90-100% of fish tested exceed trigger level</li> <li><b>Or</b></li> <li>▶ Mean concentration equal to or greater than 2 times the trigger level</li> </ul>	No consumption

expect to bear children (Humphrey and Hesse, 1986). From 1984 to 1986, the printed advisories referred to children age 6 and under (Michigan DNR, 1977-1997).

#### **4.4 CONTAMINANTS RESPONSIBLE FOR ADVISORIES**

From 1977 to 1981, and again from 1989 to 1997, the printed fish consumption advisories for Lake Michigan issued by the State of Michigan indicated which contaminant was responsible for the advisories (Table 4-4). From 1982 to 1988, this information was not provided in the printed advisories. From 1977 to 1981, the advisory for salmon was attributed to PCBs and mercury, the

**Table 4-4**  
**Contaminants Responsible for Michigan Advisories in Green Bay, Lake Michigan, and Little Bay de Noc**  
**(excluding advisories given for the southern half of Lake Michigan only)**

<b>Location</b>	<b>Species Included in Advisory</b>	<b>Year</b>	<b>Contaminant Responsible</b>
Lake Michigan	Salmon	1977-1981	PCBs, Mercury
Lake Michigan	Lake trout	1977-1981	PCBs, DDT
Lake Michigan	Steelhead	1977-1981	PCBs
Lake Michigan	All species in advisory (carp, catfish, salmon, trout, whitefish)	1982-1985	Not given in advisory
Lake Michigan	All species in advisory (catfish, chinook salmon, lake trout)	1986	Not given in advisory
Lake Michigan	All species in advisory (lake trout, coho salmon, chinook salmon, brown trout, carp, catfish)	1987-1988	Not given
Lake Michigan	All species in advisory (lake trout, coho salmon, chinook salmon, brown trout, carp, catfish)	1989-1991	PCBs
Green Bay	All species in advisory (splake, rainbow trout, chinook salmon, brown trout, brook trout, northern pike, walleye, white bass, carp)	1989-1996	PCBs
Little Bay de Noc	All species in advisory (walleye, longnose suckers)	1991-1992	PCBs, Mercury
Lake Michigan	All species in advisory (lake trout, coho salmon, chinook salmon, brown trout, walleye, carp, catfish)	1992	PCBs, Mercury, Chlordane
Lake Michigan	Lake trout, coho salmon, chinook salmon, brown trout, carp, catfish	1993-1994	PCBs
Green Bay	Splake, rainbow trout, chinook salmon, brown trout, brook trout, northern pike, walleye, white bass, sturgeon, carp	1993-1996	PCBs
Lake Michigan, Little Bay de Noc	Walleye	1993-1995	Mercury
Little Bay de Noc	Longnose suckers	1993	PCBs, Chlordane
Little Bay de Noc	Longnose suckers	1994	PCBs
Lake Michigan	Lake trout, chinook salmon, brown trout, carp, catfish	1995	PCBs
Lake Michigan	Lake trout, brown trout, carp, catfish	1996	PCBs
Lake Michigan	Walleye	1996	Mercury
Little Bay de Noc	Longnose suckers	1996-1997	PCBs
Lake Michigan	Lake trout, brown trout, carp, catfish, sturgeon	1997	PCBs
Lake Michigan	Walleye	1997	Mercury
Green Bay	Walleye	1997	PCBs, Mercury

advisory for lake trout was attributed to PCBs and DDT, and the advisory for steelhead was attributed to PCBs. From 1989 to 1990, all of the advisories in Lake Michigan were attributed to PCBs. However, from 1991 to 1992, the advisories were attributed to PCBs, mercury, and chlordane. Beginning in 1993, the printed advisory indicated which contaminant was responsible for each species listing.

From 1993 to 1996, all of the advisories for all of the species listed for Lake Michigan were attributed to PCBs except the advisory for walleye, which was attributed to mercury, and the advisory for whitefish in the southern part of the lake, which was attributed to chlordane. It is likely that this same pattern held in 1991 and 1992, although the printed advisory did not specify which contaminants were responsible for each species listing. In 1997, the listing of all species in Lake Michigan was attributed to PCBs, except for that of walleye, which was attributed to mercury.

The Green Bay advisories were attributed entirely to PCBs from 1989 to 1996. In 1997, the advisory for walleye in Green Bay was attributed to both PCBs and mercury. The advisory in Little Bay de Noc for walleye and longnose suckers was attributed to both PCBs and mercury in 1991 and 1992. From 1993 to 1995, the listing of longnose suckers in the advisory was attributed to PCBs and the walleye listing was attributed to mercury. It is likely that this same pattern held in 1991 and 1992, although the advisory did not specify which contaminants were responsible for each species listing. In 1996 and 1997, only longnose suckers were specifically listed in the Little Bay de Noc advisory. This listing was attributed to PCBs.

Data collected by the Michigan DNR and the Wisconsin DNR from 1977 to 1994 confirm that PCBs and not pesticides are responsible for the fish consumption advisories in Green Bay. The combined fish contaminant monitoring database from these agencies reveals that PCBs have repeatedly exceeded the FDA tolerance (see Section 4.6), whereas other chemicals, including chlordane, dieldrin, toxaphene, DDT, and mercury, have infrequently exceeded trigger levels used by Michigan for issuing advisories (Appendix C, Tables C-1 to C-40). All exceedences of trigger levels for chemicals other than PCBs are summarized in Table 3-5 and discussed in Section 3.4. There were no exceedences of chemicals for which Michigan has established trigger levels but Wisconsin has not (i.e., endrin, heptachlor, mirex).

## **4.5 MICHIGAN ADVISORIES**

Fish consumption advisories issued by the State of Michigan were first distributed as part of the annual fishing guide in 1977. Over time, advisories have become more specific with regard to the fish species and size classes included in the advisories and the consumption advice given. Advisories issued by Michigan for Green Bay, northern Lake Michigan, and Little Bay de Noc are presented in Tables 4-5 to 4-7. Advisories issued in press releases before 1977 are not included in Tables 4-5 to 4-7.

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**Table 4-5  
State of Michigan Fish Consumption Advisories for Green Bay South of Cedar River  
(advisory applies to Michigan and Wisconsin waters,  
including the Menominee River from mouth to first dam)**

Species	Size	'88	'89	'90	'91	'92	'93	'94	'95	'96	'97
Rainbow trout	>22"	●	●	●	●	●	●	●	●	●	●
Chinook salmon	>25"	●	●	●	●	●	●	●	●		
Brown trout	>12"	●	●	●	●	●	●	●	●		
	>21"									●	
	≤21"									○ <sup>1</sup>	
	>18"										●
	≤18"										○ <sup>1</sup>
Brook trout	>15"	●	●	●	●	●	●	●	●	●	
	14-30"										●
Splake	>16"	●	●	●	●	●	●	●	●		
	≤16"	○ <sup>1</sup>									
	>20"									●	
	≤20"									○ <sup>1</sup>	
	>18"										●
	≤18"										○ <sup>1</sup>
Northern pike	>28"	●	●	●	●	●	●	●	●	●	
	≥26"										●
Walleye	>20"	●	●	●	●	●	●	●	●	●	
Walleye (advisory issued for PCBs and mercury)	≥18"										●
White bass	All	●	●	●	●	●	●	●	●	●	
	≤22"										●
Carp	All	●	●	●	●	●	●	●	●	●	●
White sucker	All	●									
Sturgeon	All						●	●	●	●	
	≥30"										●
Lake trout	≥22"										○ <sup>1</sup>
Catfish	All										●

● = No consumption.

○ = Limit consumption to 1 meal (½ pound) per week.

1. No consumption of listed fish by children age 15 and under or by women who are pregnant, nursing, or expect to bear children.

Source: Michigan DNR, 1977-1997.

**Table 4-6**  
**State of Michigan Fish Consumption Advisories for Lake Michigan**  
 [table excludes advisories given for southern half of lake (south of Frankfort, MI) only]

Species	Size	'77	'78	'79	'80	'81	'82	'83	'84	'85	'86	'87	'88	'89	'90	'91	'92	'93	'94	'95	'96	'97
Salmon	All	○	○ <sup>2</sup>	○ <sup>3</sup>	○ <sup>3</sup>	○ <sup>2</sup>	○ <sup>2</sup> <sup>1</sup>	○ <sup>2</sup>	○ <sup>4</sup>	○ <sup>4</sup>	See advisories for chinook and coho salmon.											
Steelhead (rainbow trout) (PCBs)	All	○	○ <sup>2</sup>	○ <sup>3</sup>	○ <sup>3</sup>	○ <sup>2</sup>		1														
Trout	All						○	○ <sup>2</sup>	○ <sup>4</sup>	○ <sup>4</sup>		2										
Lake trout	All	○	○ <sup>2</sup>	○ <sup>3</sup>	○ <sup>3</sup>	○ <sup>2</sup>		1														
	>25"										●											
	<25"										○	4										
	>23"											●	●	●	●	●	●	●	●	○	○ <sup>5</sup>	
	≥22"																					○
20-23"											○	○ <sup>5</sup>										
Carp	All						○	○ <sup>2</sup>	○ <sup>4</sup>	○ <sup>4</sup>	●	3	●	●	●	●	●	●	●	●	●	●
Catfish	All						○	○ <sup>2</sup>	○ <sup>4</sup>	○ <sup>4</sup>	○ <sup>4</sup>	● <sup>2</sup>	●	●	●	●	●	●	●	●	●	●
Chinook salmon	>25"										○							4				
	>32"											●	●	●	●	●	●	●	●	○		
	21-32"										○	○ <sup>5</sup>										
Coho salmon	>26"										○	○ <sup>5</sup>										
Brown trout	All										●											
	>23"											●	●	●	●	●	●	●	●	●	●	●
	≤23"										○	○ <sup>5</sup>										
	>22"																					●
Walleye (mercury)	>22"																○	○ <sup>6</sup>				
Sturgeon	≥30"																					●

● = No consumption.  
 ○ = Limit consumption to 1 meal (½ pound) per week.

1. No consumption of fish containing elevated levels of PCBs by women of child bearing age.
2. No consumption of listed fish by children or by women who are pregnant, nursing, or expect to bear children.
3. No consumption of listed fish by children or by nursing mothers.
4. No consumption of listed fish by children age 6 and under or by women who are pregnant, nursing, or expect to bear children.
5. No consumption of listed fish by children age 15 and under or by women who are pregnant, nursing, or expect to bear children.
6. No more than one meal a month of listed fish by children age 15 and under or by women who are pregnant, nursing, or expect to bear children.

Source: Michigan DNR, 1977-1997.

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**Table 4-7**  
**State of Michigan Fish Consumption Advisories for Little Bay de Noc (Lake Michigan)**

Species	Size	'89	'90	'91	'92	'93	'94	'95	'96	'97
Longnose suckers	>16"		○ <sup>1</sup>	○ <sup>1</sup>	○ <sup>1</sup>	○ <sup>1</sup>	○ <sup>1</sup>	○ <sup>1</sup>	○ <sup>1</sup>	
	≥14"									○ <sup>1</sup>
Walleye	>22"	○ <sup>2,3</sup>	○ <sup>2,3</sup>	○ <sup>2</sup>	○ <sup>2</sup>	○ <sup>2,3</sup>	○ <sup>2,3</sup>	○ <sup>2,3</sup>		

○ = Limit consumption to 1 meal (½ pound) per week.

1. No consumption of listed fish by children age 15 and under or by women who are pregnant, nursing, or expect to bear children.
2. No more than one meal a month of listed fish by children age 15 and under or by women who are pregnant, nursing, or expect to bear children.
3. Advisory listed for mercury only.

Source: Michigan DNR, 1977-1997.

Advisories for Green Bay were issued separately from the Lake Michigan advisories beginning in 1988 (Table 4-5). These advisories remained the same from 1989 to 1995 with the exception that an advisory for sturgeon was added in 1993. Size classes of species included in the advisories were changed in 1996 and again in 1997. Advisories for catfish and lake trout were added in 1997.

For Lake Michigan, similar advisories were issued from 1977 to 1981 (Table 4-6). During this time, the species included in the advisory did not change. However, there were minor adjustments to the text concerning which categories of women and children were included in the advisories. The Lake Michigan advisories changed slightly in 1982 to include two more species, carp and catfish. Similar advisories were issued from 1982 to 1985, with minor adjustments again to the text concerning advice for women and children. The advisories changed in 1986 and then again in 1987 with respect to the species and size classes listed. In 1986, the consumption advisory for Lake Michigan first included a “no consumption” recommendation for three species (lake trout larger than 25 inches, brown trout, carp). From 1987 to 1994, the advisories remained the same, with the exception that an advisory for walleye because of mercury contamination was added in 1992. In 1995, the advisory for lake trout and chinook salmon was changed from “no consumption” to “limit consumption to 1 meal per week.” Coho salmon and chinook salmon were removed from the advisories in 1995 and 1996, respectively. In 1997, the size classes of species included in the advisories were adjusted to make them fit into uniform categories.

Advisories for Little Bay de Noc were issued separately from the Green Bay advisories beginning in 1989 (Table 4-7). In 1989, the only advisory issued specifically for Little Bay de Noc was for walleye as a result of mercury contamination. In 1990, an advisory was added for longnose suckers in response to PCB contamination. The advisory remained the same from 1990 to 1996. In 1997, the size class for longnose suckers was changed.

#### **4.6 COMPARISON OF PCB CONCENTRATIONS TO ADVISORY THRESHOLDS**

PCB concentrations in fish from Green Bay and Lake Michigan were compared to the trigger level (5 ppm until 1981; 2 ppm after 1981) used by Michigan for triggering fish consumption advisories. Data from both the Wisconsin and Michigan databases (Wisconsin DNR, 1971-1995; Michigan DNR, 1983-1995) were used in the analysis because Wisconsin and Michigan have shared fish contaminant data from boundary waters (J. Amrhein, Wisconsin DNR, personal communication). This analysis was limited to the following species, which are important to the recreational fishery (Figures 3-4 to 3-5) and for which adequate data exist for the analysis:

- ▶ chinook salmon
- ▶ rainbow trout
- ▶ brown trout
- ▶ lake trout
- ▶ northern pike
- ▶ white perch
- ▶ smallmouth bass
- ▶ yellow perch
- ▶ walleye.

The purpose of this evaluation was to examine the consistency of the Michigan advisories with reported fish tissue data. It should be noted that the state fish consumption advisories may take into account various factors, including fish size, uncertainties, and other risk management considerations related to protection of public health.

Overall, a comparison of the monitoring data with Michigan's fish consumption advisory program indicates that Michigan's advisories have a reasonable analytical basis. In Green Bay, advisories have been issued for all species considered in this analysis, except for white perch, yellow perch, and smallmouth bass, which had no exceedences. All of the species with advisories have exceeded the Michigan trigger level on at least one occasion (Figure 3-4). In Lake Michigan (excluding the southern half of the lake), advisories resulting from PCBs have been issued for chinook salmon, brown trout, lake trout, and rainbow trout (called steelhead in the advisory). All of these species have exceeded the Michigan trigger level for PCBs (Figure 3-5).

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## **CHAPTER 5**

### **COMPARISON OF APPROACHES USED FOR ESTABLISHING FISH CONSUMPTION ADVISORIES**

#### **5.1 INTRODUCTION**

Wisconsin and Michigan have issued similar, although not identical, fish consumption advisories for Green Bay and Lake Michigan. The advisories issued by Wisconsin until 1997 and by Michigan through 1997 are less restrictive than the “Uniform Great Lakes Consumption Advisory” developed by the Great Lakes Sport Fish Advisory Task Force (1993). The Wisconsin and Michigan advisories are also less restrictive than advisories suggested by the National Wildlife Federation (NWF) (no date) and by the U.S. EPA (1993, 1994).

This chapter compares Michigan’s and Wisconsin’s advisories for Green Bay (Section 5.2) and for Lake Michigan (Section 5.3), describes the uniform protocol for Great Lakes consumption advisories (Section 5.4), describes the NWF’s advisory project (Section 5.5) and U.S. EPA’s guidance documents for advisories (Section 5.6), and summarizes the comparison of approaches (Section 5.7).

#### **5.2 COMPARISON OF MICHIGAN AND WISCONSIN ADVISORIES FOR GREEN BAY**

Wisconsin issued advisories that were specific to Green Bay beginning in 1978, whereas Michigan did not issue fish consumption advisories for Green Bay separately from its Lake Michigan advisories until 1988. From 1978 to 1987, Wisconsin’s advisories for Green Bay were more restrictive than Michigan’s advisories for Lake Michigan; Wisconsin also included more species in its advisories and included more “no consumption” advisories (see Tables 3-8 and 4-6).

From 1988 to 1995, Michigan and Wisconsin both issued “no consumption” advisories and “limit consumption” advisories for identical species and size classes in Green Bay. During this time, Wisconsin issued additional advisories to “trim skin and fat” before cooking for selected species. Michigan did not issue these fish preparation advisories.

In 1996, Michigan’s Green Bay advisory became less restrictive than Wisconsin’s Green Bay advisory. In 1996, Michigan removed its advisory for chinook salmon and increased the size of the fish that would trigger an advisory for several species. For example, Michigan’s 1995 advisory for brown trout applied to fish 12 in. and larger, while the 1996 advisory for brown trout applied only to fish 21 in. and larger.

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In 1997, Wisconsin changed its Green Bay advisory to conform to the uniform Great Lakes Consumption Advisory protocol. Consequently, in 1997 Wisconsin's advisory included more species than Michigan's advisory. However, for several species, Michigan issued a more stringent advisory or issued its advisory for smaller fish. Table 5-1 summarizes the differences between Wisconsin and Michigan's advisories for Green Bay in 1996 and 1997.

### **5.3 COMPARISON OF MICHIGAN AND WISCONSIN ADVISORIES FOR LAKE MICHIGAN**

From 1977 to 1983, Wisconsin and Michigan both issued advisories to restrict consumption for trout and salmon in Lake Michigan. Wisconsin also issued an advisory to restrict consumption of Lake Michigan carp from 1977 to 1983, while Michigan issued an advisory for carp beginning in 1982.

Between 1984 and 1986, Wisconsin's Lake Michigan advisory became more restrictive than Michigan's Lake Michigan advisory. Wisconsin added 18 additional species to its advisory, and Michigan added only 4 additional species to its advisory. Both states changed some advisories from "limit consumption" to "no consumption" (see Tables 3-9 and 4-6).

From 1987 to 1994, Michigan and Wisconsin issued "no consumption" advisories and "limit consumption" advisories for identical species and size classes in Lake Michigan, with two exceptions. While Michigan and Wisconsin both suggested that consumers trim skin and fat and cook fish in such a way as to reduce fat as a means of reducing PCB levels in cooked fish, Wisconsin issued additional advisories to "trim skin and fat" before cooking for selected species. Michigan did not issue these specific fish preparation advisories. In addition, from 1992 to 1994 Michigan issued advisories for walleye because of mercury contamination, and Wisconsin did not issue such advisories.

In 1995 and 1996, Michigan's advisory for Lake Michigan became less restrictive than Wisconsin's Lake Michigan advisory. In 1995, Michigan changed its advisory for lake trout and chinook salmon from "no consumption" to "limit consumption." Michigan also removed its advisory for coho salmon in 1995 and its advisory for chinook salmon in 1996.

In 1997, Wisconsin changed its Lake Michigan advisory to conform to the uniform Great Lakes Consumption Advisory protocol. Consequently, in 1997 Wisconsin's advisory included three more species than Michigan's advisory. However, for several species, Michigan issued a more stringent advisory. Table 5-1 summarizes the differences between Wisconsin and Michigan's advisories for Lake Michigan in 1996 and 1997.

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**Table 5-1  
Comparison of Michigan and Wisconsin Fish Consumption Advisories  
for Green Bay and Lake Michigan in 1996 and 1997**

Species	Size	1996 Advisories Green Bay		1997 Advisories Green Bay		1996 Advisories Lake Michigan		1997 Advisories Lake Michigan	
		WI	MI	WI	MI	WI	MI	WI	MI
Brook trout	All					⊙			
	>15"	●	●						
	≤15"	⊙							
	14-30"				●				
Brown trout	>23"					●	●		
	≤23"					⊗	<sup>1</sup>		
	>22"							1 per 2 mn	●
	<22"							1 per mn	
	>21"		●	●					
	≤21"		⊗	<sup>1</sup>					
	>18"				●				
	≤18"				⊗	<sup>1</sup>			
	14-21"			1 per 2 mn					
	<14"			1 per mn					
	>12"	●							
	≤12"	⊙							
Bullheads	All	⊙							
Carp	All	●	●	●	●	●	●		●
Catfish	All			1 per 2 mn	●	●	●		●
Chinook salmon	>30"							1 per 2 mn	
	<30"							1 per mn	
	>29"			1 per mn					
	<29"			1 per wk					
	>25"	●							
	≤25"	⊙							
	>32"					●			
	21-32"					⊗	<sup>1</sup>		
<21"					⊙				
Chubs								1 per mn	

**Table 5-1 (cont.)  
Comparison of Michigan and Wisconsin Fish Consumption Advisories  
for Green Bay and Lake Michigan in 1996 and 1997**

Species	Size	1996 Advisories		1997 Advisories		1996 Advisories Lake Michigan		1997 Advisories Lake Michigan	
		WI	MI	WI	MI	WI	MI	WI	MI
Coho salmon	All							1 per mn	
	>26"					⊗	<sup>1</sup>		
	≤26"					⊙			
Lake trout	>27"							●	
	23-27"							1 per 2 mn	
	<23"							1 per mn	
	>23"					●	⊗		
	20-23"					⊗	<sup>1</sup>		
	<20"					⊙			
	≥22"				⊗	<sup>1</sup>			⊗ <sup>1</sup>
Northern pike	>28"	●	●						
	<28"	⊙							
	≥26"				●				
	>22"			1 per mn					
	<22"			1 per wk					
Pink salmon					⊙				
Rainbow trout	All			1 per mn		⊙			
	>22"	●	●		●				
	>17"							1 per mn	
	<17"							1 per wk	
Smallmouth bass	All	⊙		1 per mn					
Smelt							1 per wk		
Splake	>20"		●	●					
	16-20"			1 per 2 mn					
	≤20"		⊗	<sup>1</sup>					
	>18"				●				
	≤18"				⊗	<sup>1</sup>			
	>16"	●							
≤16"	⊗	<sup>2</sup>	1 per mn						

**Table 5-1 (cont.)  
Comparison of Michigan and Wisconsin Fish Consumption Advisories  
for Green Bay and Lake Michigan in 1996 and 1997**

Species	Size	1996 Advisories		1997 Advisories		1996 Advisories Lake Michigan		1997 Advisories Lake Michigan	
		WI	MI	WI	MI	WI	MI	WI	MI
Sturgeon	All	●	●	●					
	≥30"				●				●
Walleye	>22"							⊗	⊗ <sup>1</sup>
Walleye	>20"	●	●						
	≤20"	⊙							
	>26"			●					
	≥18"				●				
	17-26"			1 per 2 mn					
	<17"			1 per mn					
White bass	All	●	●	●					
	≤22"				●				
White perch	All			●					
White sucker	All	⊙		1 per mn					
Whitefish	All			1 per 2 mn					
	>25"							1 per 2 mn	
	19-25"							1 per mn	
	<19"							1 per wk	
Lake whitefish	All			1 per 2 mn					
Yellow perch	All	⊙		1 per wk				1 per wk	

● = No consumption.

⊗ = Limit consumption.

⊙ = Remove all skin and fat before cooking, follow cooking and cleaning tips for reducing PCB levels.

1. No consumption of listed fish by children age 15 and under or by women who are pregnant, nursing, or expect to bear children.
2. No consumption by children age 6 and under, or by women who are pregnant, nursing, or expect to bear children.
3. No more than one meal a month of listed fish by children age 15 and under or by women who are pregnant, nursing, or expect to bear children.

Sources: Michigan DNR, 1977-1997; Wisconsin DNR, 1987-1994; Wisconsin Division of Health and Wisconsin DNR, 1997.

## **5.4 UNIFORM PROTOCOL FOR GREAT LAKES CONSUMPTION ADVISORIES**

Because of discrepancies between the fish consumption advisories issued by different Great Lakes states, a task force was set up by the Council of Great Lakes Governors in 1986 to develop a uniform protocol for sport fish consumption advisories across the Great Lakes. In 1993, the task force published a uniform protocol that included procedures for the development and communication of fish consumption advisories (Great Lakes Sport Fish Advisory Task Force, 1993). The uniform protocol was based on PCB concentrations in fish and included advisories in five categories: do not eat, restrict consumption to 6 meals per year (1 meal per 2 months), restrict consumption to 1 meal per month, restrict consumption to 1 meal per week, and no restriction (Great Lakes Sport Fish Advisory Task Force, 1993).

Wisconsin adopted the protocol in 1997 (Wisconsin Division of Health and Wisconsin DNR, 1997); as of 1997, Michigan had not yet adopted the protocol. The comparisons in Sections 5.2 and 5.3 of Wisconsin's 1997 advisory (which was based on the uniform protocol) to Wisconsin's 1996 advisory and to Michigan's 1997 advisory indicate that the uniform protocol is more restrictive than previous advisories issued by Wisconsin or Michigan. A detailed description of the development of the uniform protocol is presented in Appendix B.

## **5.5 NATIONAL WILDLIFE FEDERATION ADVISORY PROJECT**

One of the first external critiques of Lake Michigan fish consumption advisories came from the NWF. The NWF believed that the advisories issued by state governments were inadequate because they were based on the FDA's tolerance and action levels instead of the results of a risk assessment. Consequently, the NWF established its Lake Michigan Sport Fish Consumption Advisory Project to evaluate the health effects of consuming Lake Michigan sport fish. The NWF claimed that FDA levels are "outdated and do not adequately protect the health of people who eat sport fish" (NWF, no date).

The NWF compared fish contaminant data to cancer risk thresholds to develop a fish consumption advisory for Lake Michigan. The NWF used 1985-1986 data from the state fish contaminant monitoring databases to evaluate contamination levels in Lake Michigan fish. Based on a literature review, the NWF developed cancer risk thresholds for combined exposure to PCBs, DDT, dieldrin, and chlordane. The NWF developed their advisory for three different cancer risk levels, based on lifetime consumption of sport fish. The NWF also advised that children under 15 and women who are pregnant, nursing, or intend to have children should not eat Lake Michigan fish (NWF, no date).

A technical document describing the risk assessment approach used by the NWF was distributed to relevant agencies. The NWF also published an informational booklet for the public in 1987,

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describing the risk assessment process and presenting their fish consumption advisory (NWF, no date).

The advisory issued by the NWF was more restrictive than state advisories at that time, and also more restrictive than the subsequent 1997 Wisconsin advisory based on the uniform protocol. For example, the 1989 Wisconsin advisory for coho salmon in Lake Michigan stated that the general population should limit consumption of fish larger than 26 in., but there was no specific advisory regarding how consumption should be limited (e.g., number of meals). In contrast, the NWF advisory stated that for an incremental cancer risk of 1 in 100,000, consumers should eat no more than 15 meals of coho salmon over their lifetime.

## **5.6 U.S. EPA GUIDANCE DOCUMENTS FOR FISH CONSUMPTION ADVISORIES**

During the time that the Great Lakes Sport Fish Advisory Task Force was developing the uniform protocol, the U.S. EPA established a fish contaminant workgroup to formulate guidance on fish consumption advisories. The goal of the guidance was to provide a summary of critical information necessary for states to make informed decisions regarding the development of fish consumption advisories (U.S. EPA, 1994). The guidance included methods for sample collection, chemical and statistical analysis, risk assessment, risk management, and risk communication.

The U.S. EPA guidance presents a risk-based approach for developing fish consumption advisories. This approach is different from the approach used by Michigan and from the approach used by Wisconsin before Wisconsin adopted the uniform protocol. Use of the U.S. EPA methodology would result in more restrictive advisories than those issued by Michigan, Wisconsin, or the uniform protocol (Table 5-2). For example, according to the risk-based U.S. EPA methodology, a no consumption advisory would be issued for a species with a mean PCB concentration of either 0.4 ppm (based on health endpoints other than cancer) or 0.04 ppm (based on a 1 in 100,000 cancer risk). In contrast, Michigan and Wisconsin (before 1997) used the FDA tolerance (2 ppm) to trigger advisories. The uniform protocol uses a concentration of 1.9 ppm to trigger a no consumption advisory, and concentrations of 0.06 to 1.9 ppm to trigger restrict consumption advisories rather than a no consumption advisory.

The methodology described by U.S. EPA for determining consumption limits also differs from the approach adopted in the uniform protocol. The U.S. EPA provided risk-based consumption limits for 23 contaminants, whereas the uniform protocol focused on developing consumption limits only for PCBs (U.S. EPA, 1994).

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<p align="center"><b>Table 5-2</b>  <b>Concentrations that Would Trigger Each Advisory Level Based on U.S. EPA Guidance</b></p>		
<p align="center"><b>Advisory Level and Consumption Frequency</b></p>	<p align="center"><b>Concentration to Trigger Advisory Level Based on Health Endpoints Other than Cancer (ppm PCBs in raw fish fillet)</b></p>	<p align="center"><b>Concentration to Trigger Advisory Level Based on a 1 in 100,000 Cancer Risk Level (ppm PCBs in raw fish fillet)</b></p>
Group 1 — unrestricted consumption	≤0.01	0.0006
Group 2 — 1 meal per week	0.04	0.003
Group 3 — 1 meal per month	0.1	0.008
Group 4 — 6 meals per year	0.2	0.02
Group 5 — no consumption	0.4	0.04
Source: U.S. EPA, 1994.		

**5.7 SUMMARY OF COMPARISON OF APPROACHES USED FOR ESTABLISHING ADVISORIES**

In general, Wisconsin and Michigan issued similar advisories for Green Bay and Lake Michigan until 1994. However, Wisconsin’s advisories were more restrictive than Michigan’s advisories before 1987. From 1987 to 1994, Wisconsin and Michigan issued identical advisories, with minor exceptions. In 1995 and 1996, Michigan removed advisories for some species. In 1997, after adopting the uniform protocol, Wisconsin’s advisories once again became more restrictive than Michigan’s advisories (see Tables 3-8, 3-9, 4-5, 4-6, and 5-1).

Alternative approaches to fish consumption advisories developed by the NWF and the U.S. EPA would generally have resulted in more restrictive advisories than those issued by Wisconsin and Michigan (NWF, no date; U.S. EPA, 1994). The uniform protocol adopted by Wisconsin in 1997 was also more restrictive than Wisconsin’s advisories before 1997 and more restrictive than Michigan’s advisories through 1997.

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## **CHAPTER 6**

### **SUMMARY OF INJURY DETERMINATION AND QUANTIFICATION**

Data presented in this report demonstrate that multiple fish species in the Lower Fox River, Green Bay, and Lake Michigan have been injured because of exceedences of: (1) tolerances for PCBs established by the FDA under the Food, Drug and Cosmetic Act [43 CFR 11.62(f)(1)(ii)]; and (2) PCB levels for which Wisconsin and Michigan have issued directives to limit or ban consumption [43 CFR 11.62(f)(1)(iii)].

Tables 6-1 to 6-3 summarize the results of the injury determination and quantification pursuant to exceedences of the FDA tolerance for PCBs. Thirteen fish species in the Lower Fox River have exceeded the FDA tolerance for PCBs (Table 6-1); 23 species in Green Bay have exceeded the FDA tolerance for PCBs (Table 6-2); and 6 species in northern Lake Michigan have exceeded the FDA tolerance for PCBs (Table 6-3). Exceedences have occurred since the first sample collections in the 1970s, and have continued through 1995 (the most recent year for which fish contaminant monitoring program data were available).

Tables 6-4 to 6-6 summarize the results of the injury determination and quantification pursuant to the establishment of Michigan and Wisconsin state PCB fish advisories. Advisories were divided into six time periods that reflect when major changes in advisories took place. Fish consumption advisories have been issued by Wisconsin for 15 species in the Lower Fox River (Table 6-4), and fish consumption advisories have been issued by Wisconsin or Michigan for more than 20 species in Green Bay and Lake Michigan (Tables 6-5 and 6-6). Formal advisories have been issued from 1976 to 1997, demonstrating that injury has occurred to multiple species throughout this time period.

This report documents that multiple fish species in the Lower Fox River, Green Bay, and northern Lake Michigan have been injured as a result of PCB releases, with injuries occurring since at least 1971 and continuing through 1995 (the most recent year for which data are available).

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**Table 6-1**  
**Summary of Fish Species in the Lower Fox River**  
**that Have Exceeded the FDA Tolerance<sup>1</sup> for PCBs, 1971-1995**

	1971-1974	1975-1979	1980-1984	1985-1989	1990-1995
Brown bullhead		●	○	●	
Carp		●	●	●	●
Channel catfish				○	●
Chinook salmon		●			
Flathead catfish				●	
Gizzard shad			●		
Northern pike		●	○	●	○
Sheepshead/drum			●	●	
Walleye		●	●	●	●
White bass			○	●	●
White perch					●
White sucker		●	○	●	
Yellow perch		●	○		

1. Samples collected through 1984 were compared to the FDA tolerance of 5 ppm in edible tissue; fish collected after 1984 were compared to the revised FDA tolerance of 2 ppm in edible tissue.

● = At least one sample exceeded FDA tolerance for PCBs.

○ = No samples exceeded FDA tolerance for PCBs.

A blank means that the species was not analyzed for PCBs during that time period.

Sources: Wisconsin DNR (1971-1995).

**Table 6-2**  
**Summary of Fish Species in Green Bay**  
**that Have Exceeded the FDA Tolerance<sup>1</sup> for PCBs, 1971-1995**

	1971-1974	1975-1979	1980-1984	1985-1989	1990-1995
Alewife		○	●		
Brook trout			○	●	○
Brown bullhead		●	○		
Brown trout			●	●	●
Carp		●	●	●	●
Channel catfish					●
Chinook salmon			●	●	○
Cisco/lake herring		●		○	
Coho salmon		●			
Gizzard shad		●			
Lake sturgeon				●	
Lake trout	●	●	●		
Lake whitefish		●	○	○	○
Longnose sucker				●	●
Northern pike		●	●	○	
Rainbow trout				●	○
Smallmouth bass		○	●	○	○
Splake				●	●
Walleye		○	●	●	●
White bass		●	○		
White perch					●
White sucker		●	○	○	
Yellow perch		●	○		○

1. Samples collected through 1984 were compared to the FDA tolerance of 5 ppm in edible tissue; fish collected after 1984 were compared to the revised FDA tolerance of 2 ppm in edible tissue.

● = At least one sample exceeded FDA tolerance for PCBs.

○ = No samples exceeded FDA tolerance for PCBs.

A blank means that the species was not analyzed for PCBs during that time period.

Sources: Wisconsin DNR (1971-1995); Michigan DNR (1983-1995).

**Table 6-3**  
**Summary of Fish Species in Northern Lake Michigan**  
**that Have Exceeded the FDA Tolerance<sup>1</sup> for PCBs, 1971-1995**

	1971-1974	1975-1979	1980-1984	1985-1989	1990-1995
Brook trout			○	●	
Brown trout	●		●	●	●
Chinook salmon	●	●	●	●	●
Coho salmon	●		○		
Lake trout	●	●	●	●	
Lake whitefish		●	○	●	○

1. Samples collected through 1984 were compared to the FDA tolerance of 5 ppm in edible tissue; fish collected after 1984 were compared to the revised FDA tolerance of 2 ppm in edible tissue.

● = At least one sample exceeded FDA tolerance for PCBs.

○ = No samples exceeded FDA tolerance for PCBs.

A blank means that the species was not analyzed for PCBs during that time period.

Sources: Wisconsin DNR (1971-1995); Michigan DNR (1983-1995).

**Table 6-4**  
**Summary of Fish Species in the Lower Fox River for which PCB Consumption**  
**Advisories Have Been Issued by Wisconsin, 1976-1997**

	1976-1977	1978-1983 <sup>†</sup>	1984*-1986	1987-1994	1995-1996	1997
Black crappie	○	●	○	○	○	●
Bluegill	○	●	○	○	○	●
Bullhead	○	●	○	●	●	○
Carp	●	●	●	●	●	●
Channel catfish	○	●	○	●	●	●
Drum	○	●	○	●	●	○
Northern pike	○	●	●	●	●	●
Rock bass	○	●	○	○	○	●
Sheepshead	○	●	○	○	○	●
Smallmouth bass	○	●	○	○	○	●
Walleye	○	●	●	●	●	●
White bass	○	●	●	●	●	●
White perch	○	●	○	○	○	●
White sucker	○	●	○	●	●	●
Yellow perch	○	●	○	○	○	●

○ = No advisory issued.

● = Consumption advisory (either “no consumption” or “limit consumption”) issued.

\* For 1984, the advisories are taken from the Health Guide (Wisconsin DNR, 1984-1985).

† From 1978 to 1983, a “limit consumption” advisory was issued for all species in the Lower Fox River.

Source: Wisconsin DNR (1971-1995).

**Table 6-5**  
**Summary of Fish Species in Green Bay for which PCB Consumption Advisories Have**  
**Been Issued by Wisconsin or Michigan, 1976-1997**

	1976-1977	1978-1983	1984*-1986	1987-1994	1995-1996	1997
Brook trout	See advisory for trout.		●	●	●	●
Brown trout	See advisory for trout.		●	●	●	●
Bullheads	○	●	○	○	○	○
Carp	●	●	●	●	●	●
Catfish	○	●	●	○	○	●
Chinook salmon	See advisory for salmon.		●	●	●	●
Coho salmon	See advisory for salmon.		●	○	○	○
Lake trout	See advisory for trout.		●	○	○	●
Lake whitefish	○	○	●	○	○	●
Northern pike	○	○	●	●	●	●
Rainbow trout	See advisory for trout.		●	●	●	●
Salmon	●	●	See advisories for coho and chinook salmon.			
Smallmouth bass	○	○	●	○	○	●
Splake	○	○	○	●	●	●
Sturgeon	○	○	○	●	●	●
Trout	●	●	See advisories for lake, brown, brook, and rainbow trout.			
Walleye	○	○	●	●	●	●
White bass	○	○	●	●	●	●
White perch	○	○	○	○	○	●
White sucker	○	○	●	●	○	●
Whitefish	○	●	○	○	○	●
Yellow perch	○	○	○	○	○	●

○ = No advisory issued.

● = Consumption advisory (either “no consumption” or “limit consumption”) issued.

\* For 1984, the Wisconsin advisories are taken from the Health Guide (Wisconsin DNR, 1984-1985).

The table excludes advisories issued by Michigan for mercury only.

Sources: Wisconsin DNR (1971-1995); Michigan DNR (1983-1995).

**Table 6-6**  
**Summary of Fish Species in Lake Michigan (Wisconsin Waters and Northern Lake Michigan north of Frankfort, MI) for which PCB Consumption Advisories Have Been Issued by Wisconsin or Michigan, 1976-1997**

	1976-1977	1978-1983	1984*-1986	1987-1994	1995-1996	1997
Brook trout	See advisory for trout.		●	○	○	○
Brown trout	See advisory for trout.		●	●	●	●
Carp	●	●	●	●	●	●
Catfish	○	●	●	●	●	●
Chinook salmon	See advisory for salmon.		●	●	●	●
Chubs	○	○	○	○	○	●
Coho salmon	See advisory for salmon.		●	●	●	○
Lake trout	●	●	●	●	●	●
Lake whitefish	○	○	●	○	○	○
Longnose suckers <sup>†</sup>	○	○	○	●	●	●
Northern pike	○	○	●	○	○	○
Rainbow trout or steelhead	●	●	●	○	○	●
Salmon	●	●	See advisories for chinook and coho salmon.			
Smallmouth bass	○	○	●	○	○	○
Smelt	○	○	○	○	○	●
Sturgeon	○	○	○	○	○	●
Trout	●	●	See advisories for lake, brown, brook, and rainbow trout.			
Walleye	○	○	●	○	○	○
White bass	○	○	●	○	○	○
White sucker	○	○	●	○	○	○
Whitefish	○	○	○	○	○	●
Yellow perch	○	○	○	○	○	●

○ = No advisory issued.

● = Consumption advisory (either “no consumption” or “limit consumption”) issued.

\* For 1984, the advisories are taken from the Health Guide (Wisconsin DNR, 1984-1985).

<sup>†</sup> Advisory for longnose suckers issued for Little Bay de Noc only.

The table excludes advisories issued by Michigan for mercury only.

Sources: Wisconsin DNR (1971-1995); Michigan DNR (1983-1995).



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## CHAPTER 7

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**APPENDIX A**  
**PCB CONCENTRATIONS IN FISH AND FREQUENCY**  
**OF EXCEEDENCES OF THE FDA TOLERANCE LEVEL**

A-1 Summary of PCB Tissue Concentrations (ppm) and Frequency of Exceedences of  
FDA Tolerance for Fish in the Fox River upstream of the DePere Dam, 1976-1994 . . . A-2

A-2 Summary of PCB Tissue Concentrations (ppm) and Frequency of Exceedences of  
FDA Tolerance for Fish in the Fox River downstream of the DePere Dam,  
1977-1994 . . . . . A-6

A-3 Summary of PCB Tissue Concentrations (ppm) and Frequency of Exceedences of  
FDA Tolerance for Fish in Green Bay, 1971-1994 . . . . . A-10

A-4 Summary of PCB Tissue Concentrations (ppm) and Frequency of Exceedences of  
FDA Tolerance for Fish in Northern Lake Michigan, 1974-1995 . . . . . A-15

**Table A-1**  
**Summary of PCB Tissue Concentrations (ppm) and Frequency of Exceedences of FDA Tolerance**  
**for Fish in the Fox River upstream of the DePere Dam, 1976-1994**

Species	Param. <sup>1</sup>	1976	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1992	1994
Black Bullhead	n	-	-	-	-	-	-	-	-	-	1	-	-	-
	max	-	-	-	-	-	-	-	-	-	0.3	-	-	-
	mean	-	-	-	-	-	-	-	-	-	0.3	-	-	-
	med	-	-	-	-	-	-	-	-	-	0.3	-	-	-
	%>FDA <sup>2</sup>	-	-	-	-	-	-	-	-	-	0.0	-	-	-
Black Crappie	n	-	-	-	-	-	1	-	2	-	-	-	-	-
	max	-	-	-	-	-	2.3	-	0.6	-	-	-	-	-
	mean	-	-	-	-	-	2.3	-	0.4	-	-	-	-	-
	med	-	-	-	-	-	2.3	-	0.4	-	-	-	-	-
	%>FDA <sup>2</sup>	-	-	-	-	-	0.0	-	0.0	-	-	-	-	-
Bluegill	n	-	-	-	-	-	-	-	-	-	-	-	1	-
	max	-	-	-	-	-	-	-	-	-	-	-	0.2	-
	mean	-	-	-	-	-	-	-	-	-	-	-	0.2	-
	med	-	-	-	-	-	-	-	-	-	-	-	0.2	-
	%>FDA <sup>2</sup>	-	-	-	-	-	-	-	-	-	-	-	0.0	-
Brown Bullhead	n	2	-	2	6	-	-	2	-	3	-	-	-	-
	max	13.6	-	2.7	4.2	-	-	1.5	-	3.4	-	-	-	-
	mean	9.4	-	2.0	2.6	-	-	0.8	-	2.1	-	-	-	-
	med	9.4	-	2.0	2.2	-	-	0.8	-	1.8	-	-	-	-
	%>FDA <sup>2</sup>	100.0	-	0.0	0.0	-	-	0.0	-	33.3	-	-	-	-
Carp	n	4	10	1	7	4	10	1	2	6	6	7	8	-
	max	39.0	57.0	11.0	30.0	6.2	14.0	3.2	19.0	6.3	9.8	31.0	7.9	-
	mean	25.2	19.3	11.0	12.9	4.8	5.3	3.2	10.2	2.7	3.7	11.2	3.5	-
	med	25.0	16.5	11.0	8.1	5.4	5.0	3.2	10.2	1.3	3.2	8.8	3.8	-
	%>FDA <sup>2</sup>	100.0	70.0	100.0	100.0	75.0	50.0	0.0	50.0	33.3	66.7	85.7	62.5	-

**Table A-1 (cont.)**  
**Summary of PCB Tissue Concentrations (ppm) and Frequency of Exceedences of FDA Tolerance**  
**for Fish in the Fox River upstream of the DePere Dam, 1976-1994**

Species	Param. <sup>1</sup>	1976	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1992	1994
Channel Catfish	n	-	-	-	-	-	-	-	-	-	1	-	-	5
	max	-	-	-	-	-	-	-	-	-	1.6	-	-	4.0
	mean	-	-	-	-	-	-	-	-	-	1.6	-	-	1.7
	med	-	-	-	-	-	-	-	-	-	1.6	-	-	1.1
	%>FDA <sup>2</sup>	-	-	-	-	-	-	-	-	-	0.0	-	-	20.0
Flathead Catfish	n	-	-	-	-	-	-	-	-	-	2	-	4	-
	max	-	-	-	-	-	-	-	-	-	0.7	-	1.2	-
	mean	-	-	-	-	-	-	-	-	-	0.5	-	0.5	-
	med	-	-	-	-	-	-	-	-	-	0.5	-	0.4	-
	%>FDA <sup>2</sup>	-	-	-	-	-	-	-	-	-	0.0	-	0.0	-
Green Sunfish	n	1	-	-	-	-	-	-	-	-	-	-	-	-
	max	3.1	-	-	-	-	-	-	-	-	-	-	-	-
	mean	3.1	-	-	-	-	-	-	-	-	-	-	-	-
	med	3.1	-	-	-	-	-	-	-	-	-	-	-	-
	%>FDA <sup>2</sup>	0.0	-	-	-	-	-	-	-	-	-	-	-	-
Northern Pike	n	-	4	2	3	1	-	2	3	5	-	-	3	-
	max	-	11.0	1.0	4.3	2.9	-	1.9	3.8	1.6	-	-	1.2	-
	mean	-	5.4	1.0	2.4	2.9	-	1.8	1.8	0.9	-	-	1.0	-
	med	-	4.4	1.0	2.6	2.9	-	1.8	0.9	1.0	-	-	1.0	-
	%>FDA <sup>2</sup>	-	50.0	0.0	0.0-	0.0	-	0.0	0.0	0.0	0.0	-	0.0	-
Rock Bass	n	-	-	-	-	-	2	1	-	-	-	-	1	-
	max	-	-	-	-	-	0.7	0.4	-	-	-	-	0.2	-
	mean	-	-	-	-	-	0.5	0.4	-	-	-	-	0.2	-
	med	-	-	-	-	-	0.5	0.4	-	-	-	-	0.2	-
	%>FDA <sup>2</sup>	-	-	-	-	-	0.0	0.0	-	-	-	-	0.0	-

**Table A-1 (cont.)**  
**Summary of PCB Tissue Concentrations (ppm) and Frequency of Exceedences of FDA Tolerance**  
**for Fish in the Fox River upstream of the DePere Dam, 1976-1994**

Species	Param. <sup>1</sup>	1976	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1992	1994
Sauger	n	-	-	-	-	-	1	-	1	-	-	-	-	-
	max	-	-	-	-	-	1.6	-	1.7	-	-	-	-	-
	mean	-	-	-	-	-	1.6	-	1.7	-	-	-	-	-
	med	-	-	-	-	-	1.6	-	1.7	-	-	-	-	-
	%>FDA <sup>2</sup>	-	-	-	-	-	0.0	-	0.0	-	-	-	-	-
Sheepshead/Drum	n	-	-	-	2	-	-	-	-	-	-	-	-	-
	max	-	-	-	6.1	-	-	-	-	-	-	-	-	-
	mean	-	-	-	5.2	-	-	-	-	-	-	-	-	-
	med	-	-	-	5.2	-	-	-	-	-	-	-	-	-
	%>FDA <sup>2</sup>	-	-	-	50.0	-	-	-	-	-	-	-	-	-
Smallmouth Bass	n	-	-	-	-	-	1	-	1	-	1	1	9	2
	max	-	-	-	-	-	1.8	-	1.7	-	0.6	0.4	0.8	0.3
	mean	-	-	-	-	-	1.8	-	1.7	-	0.6	0.4	0.4	0.3
	med	-	-	-	-	-	1.8	-	1.7	-	0.6	0.4	0.2	0.3
	%>FDA <sup>2</sup>	-	-	-	-	-	0.0	-	0.0	-	0.0	0.0	0.0	0.0
Walleye	n	-	2	2	6	5	9	1	3	13	8	2	29	5
	max	-	3.6	8.0	14.0	3.0	5.3	3.4	2.3	2.3	1.8	0.2	2.8	0.8
	mean	-	3.2	4.7	4.7	1.5	1.4	3.4	1.4	0.8	1.0	0.2	0.6	0.3
	med	-	3.2	4.7	3.6	1.4	0.9	3.4	1.1	0.6	0.8	0.2	0.4	0.1
	%>FDA <sup>2</sup>	-	0.0	50.0	16.7	0.0	11.1	0.0	0.0	7.7	0.0	0.0	3.4	0.0
White Bass	n	-	-	-	1	-	-	-	-	3	3	-	5	5
	max	-	-	-	3.8	-	-	-	-	0.3	2.2	-	3.6	2.3
	mean	-	-	-	3.8	-	-	-	-	0.3	0.9	-	1.3	1.1
	med	-	-	-	3.8	-	-	-	-	0.3	0.3	-	0.7	0.8
	%>FDA <sup>2</sup>	-	-	-	0.0	-	-	-	-	0.0	33.3	-	20.0	20

**Table A-1 (cont.)**  
**Summary of PCB Tissue Concentrations (ppm) and Frequency of Exceedences of FDA Tolerance**  
**for Fish in the Fox River upstream of the DePere Dam, 1976-1994**

Species	Param. <sup>1</sup>	1976	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1992	1994
White Perch	n	-	-	-	-	-	-	-	-	-	-	-	3	-
	max	-	-	-	-	-	-	-	-	-	-	-	0.9	-
	mean	-	-	-	-	-	-	-	-	-	-	-	0.7	-
	med	-	-	-	-	-	-	-	-	-	-	-	0.6	-
	%>FDA <sup>2</sup>	-	-	-	-	-	-	-	-	-	-	-	0.0	-
White Sucker	n	-	5	1	9	5	9	2	1	-	-	-	-	-
	max	-	9.2	1.4	4.1	3.1	1.3	1.2	0.2	-	-	-	-	-
	mean	-	4.8	1.4	2.4	1.7	0.8	1.1	0.2	-	-	-	-	-
	med	-	3.6	1.4	2.5	1.3	0.6	1.1	0.2	-	-	-	-	-
	%>FDA <sup>2</sup>	-	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-	-
Yellow Perch	n	5	-	3	5	4	5	3	1	3	-	-	1	-
	max	1.4	-	0.6	1.1	0.9	0.5	0.8	0.2	0.2	-	-	0.2	-
	mean	1.0	-	0.4	0.5	0.6	0.3	0.5	0.2	0.2	-	-	0.2	-
	med	0.9	-	0.3	0.6	0.6	0.2	0.4	0.2	0.2	-	-	0.2	-
	%>FDA <sup>2</sup>	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-	0.0	-

1. Parameters are as follows:

- n = number of samples
- max = maximum PCB concentration
- mean = mean PCB concentration
- med = median PCB concentration
- %>FDA = percentage of samples exceeding FDA tolerance.

2. Fish collected through 1984 were compared to the FDA tolerance of 5 ppm; fish collected after 1984 were compared to the revised FDA tolerance of 2 ppm.

**Table A-2**  
**Summary of PCB Tissue Concentrations (ppm) and Frequency of Exceedences of FDA Tolerance**  
**for Fish in the Fox River downstream of the DePere Dam, 1977-1994**

Species	Param <sup>1</sup>	1977	1978	1979	1982	1983	1984	1985	1986	1987	1988	1989	1992	1994
Black Bullhead	n	-	-	-	1	-	-	-	-	3	-	-	-	-
	max	-	-	-	1.2	-	-	-	-	1.8	-	-	-	-
	mean	-	-	-	1.2	-	-	-	-	0.8	-	-	-	-
	med	-	-	-	1.2	-	-	-	-	0.5	-	-	-	-
	%>FDA <sup>2</sup>	-	-	-	0.0	-	-	-	-	0.0	-	-	-	-
Black Crappie	n	-	-	-	-	-	-	-	-	5	-	-	2	-
	max	-	-	-	-	-	-	-	-	1.3	-	-	1.7	-
	mean	-	-	-	-	-	-	-	-	0.7	-	-	1.3	-
	med	-	-	-	-	-	-	-	-	0.6	-	-	1.3	-
	%>FDA <sup>2</sup>	-	-	-	-	-	-	-	-	0.0	-	-	0.0	-
Bluegill	n	-	-	-	-	-	-	-	-	3	-	-	2	-
	max	-	-	-	-	-	-	-	-	0.2	-	-	0.6	-
	mean	-	-	-	-	-	-	-	-	0.2	-	-	0.5	-
	med	-	-	-	-	-	-	-	-	0.2	-	-	0.5	-
	%>FDA <sup>2</sup>	-	-	-	-	-	-	-	-	0.0	-	-	0.0	-
Bowfin	n	1	-	-	-	-	-	-	-	-	-	-	-	-
	max	0.5	-	-	-	-	-	-	-	-	-	-	-	-
	mean	0.5	-	-	-	-	-	-	-	-	-	-	-	-
	med	0.5	-	-	-	-	-	-	-	-	-	-	-	-
	%>FDA <sup>2</sup>	0.0	-	-	-	-	-	-	-	-	-	-	-	-
Carp	n	1	-	-	1	-	1	3	2	-	-	-	-	-
	max	2.5	-	-	11.0	-	6.8	12.0	50.0	-	-	-	-	-
	mean	2.5	-	-	11.0	-	6.8	6.3	28.8	-	-	-	-	-
	med	2.5	-	-	11.0	-	6.8	3.7	28.8	-	-	-	-	-
	%>FDA <sup>2</sup>	0.0	-	-	100.0	-	100.0	100.0	100.0	-	-	-	-	-

**Table A-2 (cont.)**  
**Summary of PCB Tissue Concentrations (ppm) and Frequency of Exceedences of FDA Tolerance**  
**for Fish in the Fox River downstream of the DePere Dam, 1977-1994**

Species	Param <sup>1</sup>	1977	1978	1979	1982	1983	1984	1985	1986	1987	1988	1989	1992	1994
Channel Catfish	n	-	-	-	-	-	-	-	-	10	5	-	-	-
	max	-	-	-	-	-	-	-	-	14.0	3.9	-	-	-
	mean	-	-	-	-	-	-	-	-	6.9	1.9	-	-	-
	med	-	-	-	-	-	-	-	-	6.1	1.7	-	-	-
	%>FDA <sup>2</sup>	-	-	-	-	-	-	-	-	100.0	20.0	-	-	-
Chinook Salmon	n	-	3	-	-	-	-	-	-	-	-	-	-	-
	max	-	12.0	-	-	-	-	-	-	-	-	-	-	-
	mean	-	10.2	-	-	-	-	-	-	-	-	-	-	-
	med	-	9.4	-	-	-	-	-	-	-	-	-	-	-
	%>FDA <sup>2</sup>	-	100.0	-	-	-	-	-	-	-	-	-	-	-
Flathead Catfish	n	-	-	-	-	-	-	-	-	-	2	-	-	-
	max	-	-	-	-	-	-	-	-	-	2.4	-	-	-
	mean	-	-	-	-	-	-	-	-	-	1.8	-	-	-
	med	-	-	-	-	-	-	-	-	-	1.8	-	-	-
	%>FDA <sup>2</sup>	-	-	-	-	-	-	-	-	-	50.0	-	-	-
Gizzard Shad	n	-	-	-	2	-	-	-	-	-	-	-	-	-
	max	-	-	-	6.6	-	-	-	-	-	-	-	-	-
	mean	-	-	-	6.2	-	-	-	-	-	-	-	-	-
	med	-	-	-	6.2	-	-	-	-	-	-	-	-	-
	%>FDA <sup>2</sup>	-	-	-	100.0	-	-	-	-	-	-	-	-	-
Northern Pike	n	3	-	-	-	-	-	-	-	10	3	-	8	-
	max	3.2	-	-	-	-	-	-	-	2.8	1.1	-	1.4	-
	mean	2.9	-	-	-	-	-	-	-	1.5	0.9	-	0.8	-
	med	3.0	-	-	-	-	-	-	-	1.6	1.0	-	0.8	-
	%>FDA <sup>2</sup>	0.0	-	-	-	-	-	-	-	30.0	0.0	-	0.0	-

**Table A-2 (cont.)**  
**Summary of PCB Tissue Concentrations (ppm) and Frequency of Exceedences of FDA Tolerance**  
**for Fish in the Fox River downstream of the DePere Dam, 1977-1994**

Species	Param <sup>1</sup>	1977	1978	1979	1982	1983	1984	1985	1986	1987	1988	1989	1992	1994
Rock Bass	n	-	-	-	-	-	-	-	-	4	-	-	2	-
	max	-	-	-	-	-	-	-	-	0.6	-	-	0.5	-
	mean	-	-	-	-	-	-	-	-	0.5	-	-	0.5	-
	med	-	-	-	-	-	-	-	-	0.4	-	-	0.5	-
	%>FDA <sup>2</sup>	-	-	-	-	-	-	-	-	0.0	-	-	0.0	-
Sheepshead/Drum	n	-	-	-	-	-	-	-	-	10	-	-	-	-
	max	-	-	-	-	-	-	-	-	4.6	-	-	-	-
	mean	-	-	-	-	-	-	-	-	2.6	-	-	-	-
	med	-	-	-	-	-	-	-	-	3.1	-	-	-	-
	%>FDA <sup>2</sup>	-	-	-	-	-	-	-	-	60.0	-	-	-	-
Smallmouth Bass	n	-	-	-	-	-	-	-	-	-	-	-	8	-
	max	-	-	-	-	-	-	-	-	-	-	-	1.6	-
	mean	-	-	-	-	-	-	-	-	-	-	-	1.0	-
	med	-	-	-	-	-	-	-	-	-	-	-	1.0	-
	%>FDA <sup>2</sup>	-	-	-	-	-	-	-	-	-	-	-	0.0	-
Walleye	n	2	-	5	-	-	2	6	3	11	3	11	20	1
	max	6.8	-	3.7	-	-	8.1	2.9	2.1	3.1	2.3	2.0	4.6	0.8
	mean	5.6	-	3.0	-	-	5.2	1.7	1.9	1.4	1.8	1.6	1.5	0.8
	med	5.6	-	3.3	-	-	5.2	1.6	2.1	0.9	1.9	1.6	0.9	0.8
	%>FDA <sup>2</sup>	50.0	-	0.0	-	-	50.0	16.7	66.7	27.3	33.3	9.1	30.0	0.0
White Bass	n	-	-	-	-	1	1	3	-	10	-	-	6	-
	max	-	-	-	-	4.8	4.7	6.5	-	8.4	-	-	4.8	-
	mean	-	-	-	-	4.8	4.7	5.0	-	3.8	-	-	2.5	-
	med	-	-	-	-	4.8	4.7	6.5	-	3.4	-	-	2.2	-
	%>FDA <sup>2</sup>	-	-	-	-	0.0	0.0	66.7	-	80.0	-	-	66.7	-

**Table A-2 (cont.)  
Summary of PCB Tissue Concentrations (ppm) and Frequency of Exceedences of FDA Tolerance  
for Fish in the Fox River downstream of the DePere Dam, 1977-1994**

Species	Param <sup>1</sup>	1977	1978	1979	1982	1983	1984	1985	1986	1987	1988	1989	1992	1994
White Perch	n	-	-	-	-	-	-	-	-	-	-	-	2	-
	max	-	-	-	-	-	-	-	-	-	-	-	2.2	-
	mean	-	-	-	-	-	-	-	-	-	-	-	1.8	-
	med	-	-	-	-	-	-	-	-	-	-	-	1.8	-
	%>FDA <sup>2</sup>	-	-	-	-	-	-	-	-	-	-	-	50.0	-
White Sucker	n	5	-	-	1	1	2	3	-	5	-	5	-	-
	max	4.4	-	-	1.9	2.3	2.9	3.7	-	1.6	-	1.9	-	-
	mean	3.1	-	-	1.9	2.3	2.4	2.0	-	1.2	-	0.9	-	-
	med	3.2	-	-	1.9	2.3	2.4	1.5	-	1.3	-	0.5	-	-
	%>FDA <sup>2</sup>	0.0	-	-	0.0	0.0	0.0	33.3	-	0.0	-	0.0	-	-
Yellow Perch	n	2	-	-	1	1	-	-	-	-	-	-	-	-
	max	5.3	-	-	2.4	0.8	-	-	-	-	-	-	-	-
	mean	3.2	-	-	2.4	0.8	-	-	-	-	-	-	-	-
	med	3.2	-	-	2.4	0.8	-	-	-	-	-	-	-	-
	%>FDA <sup>2</sup>	50.0	-	-	0.0	0.0	-	-	-	-	-	-	-	-

1. Parameters are as follows:

- n = number of samples
- max = maximum PCB concentration
- mean = mean PCB concentration
- med = median PCB concentration
- %>FDA = percentage of samples exceeding FDA tolerance.

2. Fish collected through 1984 were compared to the FDA tolerance of 5 ppm; fish collected after 1984 were compared to the revised FDA tolerance of 2 ppm.

**Table A-3  
Summary of PCB Tissue Concentrations (ppm) and Frequency of Exceedences of FDA Tolerance  
for Fish in Green Bay, 1971-1994**

Species	Param <sup>1</sup>	1971	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Alewife	n	-	-	1	-	1	-	-	-	-	2	2	-	-	-	-	-	-	-	-	-	-
	max	-	-	4.2	-	4.6	-	-	-	-	5.4	5.0	-	-	-	-	-	-	-	-	-	-
	mean	-	-	4.2	-	4.6	-	-	-	-	4.1	3.8	-	-	-	-	-	-	-	-	-	-
	med	-	-	4.2	-	4.6	-	-	-	-	4.1	3.8	-	-	-	-	-	-	-	-	-	-
	%>FDA <sup>2</sup>	-	-	0.0	-	0.0	-	-	-	-	50.0	0.0	-	-	-	-	-	-	-	-	-	-
Black Bullhead	n	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-
	max	-	-	-	-	-	-	-	-	-	1.9	-	-	-	-	-	-	-	-	-	-	-
	mean	-	-	-	-	-	-	-	-	-	1.6	-	-	-	-	-	-	-	-	-	-	-
	med	-	-	-	-	-	-	-	-	-	1.7	-	-	-	-	-	-	-	-	-	-	-
	%>FDA <sup>2</sup>	-	-	-	-	-	-	-	-	-	0.0	-	-	-	-	-	-	-	-	-	-	-
Black Crappie	n	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	max	-	-	1.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	mean	-	-	0.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	med	-	-	0.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	%>FDA <sup>2</sup>	-	-	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Brook Trout	n	-	-	-	-	-	-	-	-	-	-	1	7	-	-	-	-	-	-	2	-	-
	max	-	-	-	-	-	-	-	-	-	-	0.2	3.4	-	-	-	-	-	-	0.2	-	-
	mean	-	-	-	-	-	-	-	-	-	-	0.2	1.4	-	-	-	-	-	-	0.2	-	-
	med	-	-	-	-	-	-	-	-	-	-	0.2	0.9	-	-	-	-	-	-	0.2	-	-
	%>FDA <sup>2</sup>	-	-	-	-	-	-	-	-	-	-	0.0	14.3	-	-	-	-	-	-	0.0	-	-
Brown Bullhead	n	-	-	5	4	2	-	-	-	-	3	4	-	-	-	-	-	-	-	-	-	-
	max	-	-	9.4	1.3	3.1	-	-	-	-	0.5	1.8	-	-	-	-	-	-	-	-	-	-
	mean	-	-	4.1	1.2	2.8	-	-	-	-	0.3	1.1	-	-	-	-	-	-	-	-	-	-
	med	-	-	1.9	1.2	2.8	-	-	-	-	0.3	1.1	-	-	-	-	-	-	-	-	-	-
	%>FDA <sup>2</sup>	-	-	40.0	0.0	0.0	-	-	-	-	0.0	0.0	-	-	-	-	-	-	-	-	-	-
Brown Trout	n	-	-	-	-	-	-	-	-	-	-	12	48	-	-	-	20	12	-	15	10	3
	max	-	-	-	-	-	-	-	-	-	-	7.5	5.7	-	-	-	4.3	3.5	-	1.9	3.2	3.6
	mean	-	-	-	-	-	-	-	-	-	-	3.8	2.7	-	-	-	2.3	1.5	-	1.0	1.9	2
	med	-	-	-	-	-	-	-	-	-	-	3.5	2.6	-	-	-	2.3	1.3	-	0.8	1.6	1.3
	%>FDA <sup>2</sup>	-	-	-	-	-	-	-	-	-	-	16.7	68.8	-	-	-	60.0	16.7	-	0.0	50.0	33.3

**Table A-3 (cont.)  
Summary of PCB Tissue Concentrations (ppm) and Frequency of Exceedences of FDA Tolerance  
for Fish in Green Bay, 1971-1994**

Species	Param <sup>1</sup>	1971	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Burbot	n	-	-	3	12	-	-	-	-	-	2	-	-	-	-	-	-	9	-	-	-	-
	max	-	-	1.5	4.6	-	-	-	-	-	0.2	-	-	-	-	-	-	0.6	-	-	-	-
	mean	-	-	1.0	1.7	-	-	-	-	-	0.2	-	-	-	-	-	-	0.2	-	-	-	-
	med	-	-	1.0	1.6	-	-	-	-	-	0.2	-	-	-	-	-	-	0.2	-	-	-	-
	%>FDA <sup>2</sup>	-	-	0.0	0.0	-	-	-	-	-	0.0	-	-	-	-	-	-	0.0	-	-	-	-
Carp	n	-	6	9	-	4	-	3	-	5	4	3	-	5	-	10	31	-	-	-	8	-
	max	-	51.6	13.3	-	24.0	-	13.0	-	9.3	12.3	16.0	-	34.0	-	5.9	16.9	-	-	-	2.8	-
	mean	-	22.7	6.2	-	12.2	-	10.1	-	5.7	8.8	13.7	-	11.2	-	3.1	5.8	-	-	-	1.8	-
	med	-	17.3	5.4	-	11.1	-	9.7	-	4.7	8.8	13.0	-	5.6	-	3.2	4.1	-	-	-	2.8	-
	%>FDA <sup>2</sup>	-	100.0	66.7	-	50.0	-	100.0	-	40.0	100.0	100.0	-	80.0	-	80.0	74.2	-	-	-	62.5	-
Channel Catfish	n	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-
	max	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.5	-	-	-
	mean	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.2	-	-	-
	med	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.2	-	-	-
	%>FDA <sup>2</sup>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20.0	-	-	-
Chinook Salmon	n	-	-	-	-	-	-	-	4	5	2	1	7	1	-	-	4	10	-	13	-	-
	max	-	-	-	-	-	-	-	38.0	6.2	1.7	4.3	2.2	0.8	-	-	1.2	2.0	-	1.7	-	-
	mean	-	-	-	-	-	-	-	11.2	3.2	1.2	4.3	0.8	0.8	-	-	0.8	1.0	-	0.7	-	-
	med	-	-	-	-	-	-	-	2.7	2.6	1.2	4.3	0.5	0.8	-	-	0.9	1.0	-	0.6	-	-
	%>FDA <sup>2</sup>	-	-	-	-	-	-	-	25.0	20.0	0.0	0.0	14.3	0.0	-	-	0.0	0.0	-	0.0	-	-
Cisco/Lake Herring	n	-	-	-	-	4	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
	max	-	-	-	-	13.0	-	-	-	-	-	-	0.2	-	-	-	-	-	-	-	-	-
	mean	-	-	-	-	6.5	-	-	-	-	-	-	0.2	-	-	-	-	-	-	-	-	-
	med	-	-	-	-	5.6	-	-	-	-	-	-	0.2	-	-	-	-	-	-	-	-	-
	%>FDA <sup>2</sup>	-	-	-	-	50.0	-	-	-	-	-	-	0.0	-	-	-	-	-	-	-	-	-
Coho Salmon	n	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	max	-	6.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	mean	-	6.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	med	-	6.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	%>FDA <sup>2</sup>	-	100.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

**Table A-3 (cont.)  
Summary of PCB Tissue Concentrations (ppm) and Frequency of Exceedences of FDA Tolerance  
for Fish in Green Bay, 1971-1994**

Species	Param <sup>1</sup>	1971	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Gizzard Shad	n	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	max	-	-	12.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	mean	-	-	12.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	med	-	-	12.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	%>FDA <sup>2</sup>	-	-	100.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lake Sturgeon	n	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
	max	-	-	-	-	-	-	-	-	-	-	-	3.9	-	-	-	-	-	-	-	-	-
	mean	-	-	-	-	-	-	-	-	-	-	-	3.9	-	-	-	-	-	-	-	-	-
	med	-	-	-	-	-	-	-	-	-	-	-	3.9	-	-	-	-	-	-	-	-	-
	%>FDA <sup>2</sup>	-	-	-	-	-	-	-	-	-	-	-	100.0	-	-	-	-	-	-	-	-	-
Lake Trout	n	13	23	-	-	4	-	-	-	-	8	8	-	-	-	-	-	-	-	-	-	-
	max	29.1	19.5	-	-	14.0	-	-	-	-	9.0	8.9	-	-	-	-	-	-	-	-	-	-
	mean	21.4	11.7	-	-	8.8	-	-	-	-	3.9	3.3	-	-	-	-	-	-	-	-	-	-
	med	22.1	11.5	-	-	8.8	-	-	-	-	3.1	1.6	-	-	-	-	-	-	-	-	-	-
	%>FDA <sup>2</sup>	100.0	100.0	-	-	75.0	-	-	-	-	12.5	25.0	-	-	-	-	-	-	-	-	-	-
Lake Whitefish	n	-	15	-	8	9	8	-	-	-	11	5	2	-	-	1	3	10	-	-	-	-
	max	-	15.2	-	17.3	5.5	3.7	-	-	-	2.5	2.5	0.9	-	-	0.4	1.5	0.7	-	-	-	-
	mean	-	4.9	-	8.4	3.4	2.1	-	-	-	1.2	1.6	0.8	-	-	0.4	1.2	0.4	-	-	-	-
	med	-	3.4	-	8.2	3.1	2.0	-	-	-	1.1	1.4	0.8	-	-	0.4	1.3	0.4	-	-	-	-
	%>FDA <sup>2</sup>	-	33.3	-	75.0	11.1	0.0	-	-	-	0.0	0.0	0.0	-	-	0.0	0.0	0.0	-	-	-	-
Largemouth Bass	n	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	max	-	-	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	mean	-	-	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	med	-	-	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	%>FDA <sup>2</sup>	-	-	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Longnose Sucker	n	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-	-	11	-	-	-
	max	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.2	-	-	3.9	-	-	-
	mean	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.4	-	-	1.9	-	-	-
	med	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.8	-	-	1.9	-	-	-
	%>FDA <sup>2</sup>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30.0	-	-	45.5	-	-	-

**Table A-3 (cont.)**  
**Summary of PCB Tissue Concentrations (ppm) and Frequency of Exceedences of FDA Tolerance**  
**for Fish in Green Bay, 1971-1994**

Species	Param. <sup>1</sup>	1971	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Northern Pike	n	-	-	7	9	-	-	2	5	4	-	5	-	2	10	-	-	-	-	-	-	-
	max	-	-	2.7	6.4	-	-	1.9	2.8	2.2	-	7.3	-	1.3	1.0	-	-	-	-	-	-	-
	mean	-	-	1.6	3.0	-	-	1.8	2.1	1.2	-	2.2	-	0.9	0.2	-	-	-	-	-	-	-
	med	-	-	1.6	3.0	-	-	1.8	2.3	1.0	-	0.9	-	0.9	0.2	-	-	-	-	-	-	-
	%>FDA <sup>2</sup>	-	-	0.0	11.1	-	-	0.0	0.0	0.0	-	20.0	-	0.0	0.0	-	-	-	-	-	-	-
Pumpkinseed	n	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	max	-	-	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	mean	-	-	0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	med	-	-	0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	%>FDA <sup>2</sup>	-	-	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rainbow Smelt	n	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-
	max	-	-	-	-	-	-	-	-	-	-	0.4	-	-	-	-	-	-	-	-	-	-
	mean	-	-	-	-	-	-	-	-	-	-	0.3	-	-	-	-	-	-	-	-	-	-
	med	-	-	-	-	-	-	-	-	-	-	0.4	-	-	-	-	-	-	-	-	-	-
	%>FDA <sup>2</sup>	-	-	-	-	-	-	-	-	-	-	0.0	-	-	-	-	-	-	-	-	-	-
Rainbow Trout	n	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	9	-	6
	max	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	1.2	-	1
	mean	-	-	-	-	-	-	-	-	-	-	-	1.8	-	-	-	-	-	-	0.6	-	0.6
	med	-	-	-	-	-	-	-	-	-	-	-	1.8	-	-	-	-	-	-	0.5	-	0.7
	%>FDA <sup>2</sup>	-	-	-	-	-	-	-	-	-	-	-	50.0	-	-	-	-	-	-	0.0	-	0
Smallmouth Bass	n	-	-	1	-	-	-	1	-	-	-	2	-	3	-	-	-	-	-	6	-	-
	max	-	-	1.3	-	-	-	7.1	-	-	-	1.9	-	1.0	-	-	-	-	-	0.4	-	-
	mean	-	-	1.3	-	-	-	7.1	-	-	-	1.2	-	0.8	-	-	-	-	-	0.3	-	-
	med	-	-	1.3	-	-	-	7.1	-	-	-	1.2	-	0.8	-	-	-	-	-	0.3	-	-
	%>FDA <sup>2</sup>	-	-	0.0	-	-	-	100.0	-	-	-	0.0	-	0.0	-	-	-	-	-	0.0	-	-
Splake	n	-	-	-	-	-	-	-	-	-	-	-	60	2	-	-	6	-	-	4	6	6
	max	-	-	-	-	-	-	-	-	-	-	-	3.7	3.5	-	-	3.4	-	-	1.7	2.9	3.3
	mean	-	-	-	-	-	-	-	-	-	-	-	1.9	3.2	-	-	2.0	-	-	0.6	2.0	2.1
	med	-	-	-	-	-	-	-	-	-	-	-	1.9	3.2	-	-	1.8	-	-	0.3	2.1	2.2
	%>FDA <sup>2</sup>	-	-	-	-	-	-	-	-	-	-	-	46.7	100.0	-	-	50.0	-	-	0.0	50.0	50

**Table A-3 (cont.)  
Summary of PCB Tissue Concentrations (ppm) and Frequency of Exceedences of FDA Tolerance  
for Fish in Green Bay, 1971-1994**

Species	Param. <sup>1</sup>	1971	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Walleye	n	-	-	4	-	-	-	1	7	-	2	3	-	3	10	10	37	-	10	14	-	-
	max	-	-	0.7	-	-	-	8.1	5.1	-	4.0	4.7	-	4.7	1.2	5.5	2.4	-	3.5	0.6	-	-
	mean	-	-	0.6	-	-	-	8.1	3.4	-	2.5	2.3	-	2.6	0.6	1.9	1.3	-	0.8	0.3	-	-
	med	-	-	0.6	-	-	-	8.1	3.4	-	2.5	1.3	-	2.3	0.5	1.0	1.3	-	0.5	0.3	-	-
	%>FDA <sup>2</sup>	-	-	0.0	-	-	-	100.0	14.3	-	0.0	0.0	-	66.7	0.0	40.0	8.1	-	10.0	0.0	-	-
White Bass	n	-	-	1	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-
	max	-	-	8.0	-	-	-	-	-	-	-	2.4	-	-	-	-	-	-	-	-	-	-
	mean	-	-	8.0	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-
	med	-	-	8.0	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-
	%>FDA <sup>2</sup>	-	-	100.0	-	-	-	-	-	-	-	0.0	-	-	-	-	-	-	-	-	-	-
White Perch	n	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16
	max	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.5
	mean	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.9
	med	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.6
	%>FDA <sup>2</sup>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	93.8
White Sucker	n	-	-	5	6	-	-	-	-	-	-	1	-	-	-	9	-	-	-	-	-	-
	max	-	-	3.2	5.1	-	-	-	-	-	-	1.5	-	-	-	1.1	-	-	-	-	-	-
	mean	-	-	1.8	3.6	-	-	-	-	-	-	1.5	-	-	-	0.4	-	-	-	-	-	-
	med	-	-	1.4	3.9	-	-	-	-	-	-	1.5	-	-	-	0.1	-	-	-	-	-	-
	%>FDA <sup>2</sup>	-	-	0.0	16.7	-	-	-	-	-	-	0.0	-	-	-	0.0	-	-	-	-	-	-
Yellow Perch	n	-	3	7	4	-	-	-	-	-	4	7	-	-	-	-	-	3	-	4	-	2
	max	-	5.6	1.0	1.5	-	-	-	-	-	1.0	0.8	-	-	-	-	-	0.2	-	0.2	-	0.3
	mean	-	4.4	0.6	0.6	-	-	-	-	-	0.6	0.5	-	-	-	-	-	0.2	-	0.1	-	0.3
	med	-	4.4	0.7	0.4	-	-	-	-	-	0.7	0.5	-	-	-	-	-	0.2	-	0.1	-	0.3
	%>FDA <sup>2</sup>	-	33.3	0.0	0.0	-	-	-	-	-	0.0	0.0	-	-	-	-	-	0.0	-	0.0	-	0

1. Parameters are as follows:

- n = number of samples
- max = maximum PCB concentration
- mean = mean PCB concentration
- med = median PCB concentration
- %>FDA = percentage of samples exceeding FDA tolerance.

2. Fish collected through 1984 were compared to the FDA tolerance of 5 ppm; fish collected after 1984 were compared to the revised FDA tolerance of 2 ppm.

**Table A-4**  
**Summary of PCB Tissue Concentrations (ppm) and Frequency of Exceedences of FDA Tolerance**  
**for Fish in Northern Lake Michigan, 1974-1995**

Species	Param. <sup>1</sup>	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Bloater Chub	n	-	-	-	5	-	-	-	-	-	-	7	-	2	-	-	-	-	1	-	-	-	-
	max	-	-	-	1.9	-	-	-	-	-	-	1.1	-	0.8	-	-	-	-	0.5	-	-	-	-
	mean	-	-	-	1.5	-	-	-	-	-	-	0.9	-	0.8	-	-	-	-	0.5	-	-	-	-
	med	-	-	-	1.7	-	-	-	-	-	-	1.0	-	0.8	-	-	-	-	0.5	-	-	-	-
	%>FDA <sup>2</sup>	-	-	-	0.0	-	-	-	-	-	-	0.0	-	0.0	-	-	-	-	0.0	-	-	-	-
Brook Trout	n	-	-	-	-	-	-	-	1	-	-	1	17	-	-	-	-	-	-	-	-	-	-
	max	-	-	-	-	-	-	-	0.9	-	-	0.6	2.1	-	-	-	-	-	-	-	-	-	-
	mean	-	-	-	-	-	-	-	0.9	-	-	0.6	0.8	-	-	-	-	-	-	-	-	-	-
	med	-	-	-	-	-	-	-	0.9	-	-	0.6	0.8	-	-	-	-	-	-	-	-	-	-
	%>FDA <sup>2</sup>	-	-	-	-	-	-	-	0.0	-	-	0.0	5.9	-	-	-	-	-	-	-	-	-	-
Brown Trout	n	5	-	-	-	-	-	-	2	-	-	11	30	-	-	-	-	4	-	12	1	8	-
	max	6.6	-	-	-	-	-	-	34.0	-	-	3.7	5.8	-	-	-	-	0.5	-	3.2	0.5	2.1	-
	mean	4.0	-	-	-	-	-	-	18.4	-	-	1.8	1.9	-	-	-	-	0.4	-	1.1	0.5	0.9	-
	med	4.8	-	-	-	-	-	-	18.4	-	-	1.4	1.4	-	-	-	-	0.5	-	1.0	0.5	0.8	-
	%>FDA <sup>2</sup>	40.0	-	-	-	-	-	-	50.0	-	-	0.0	26.7	-	-	-	-	0.0	-	16.7	0.0	12.5	-
Burbot	n	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	max	-	-	-	-	-	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	mean	-	-	-	-	-	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	med	-	-	-	-	-	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	%>FDA <sup>2</sup>	-	-	-	-	-	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chinook Salmon	n	8	-	6	-	7	-	12	20	17	18	16	21	39	22	8	-	10	-	16	-	10	-
	max	17.0	-	8.5	-	9.2	-	6.7	4.8	6.9	3.7	4.7	3.1	4.6	3.0	3.0	-	1.7	-	2.4	-	2.0	-
	mean	11.7	-	6.8	-	6.4	-	4.4	2.9	4.4	2.4	2.1	1.8	2.3	1.5	2.2	-	1.5	-	1.5	-	1.5	-
	med	12.8	-	7.2	-	7.2	-	4.4	2.8	4.7	2.3	1.9	1.7	2.4	1.4	2.1	-	1.5	-	1.4	-	1.4	-
	%>FDA <sup>2</sup>	87.5	-	83.3	-	71.4	-	8.3	0.0	29.4	0.0	0.0	38.1	64.1	13.6	62.5	-	0.0	-	12.5	-	0.0	-



**Table A-4 (cont.)**  
**Summary of PCB Tissue Concentrations (ppm) and Frequency of Exceedences of FDA Tolerance**  
**for Fish in Northern Lake Michigan, 1974-1995**

Species	Param. <sup>1</sup>	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Yellow Perch	n	-	2	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	-	-	3	2	2
	max	-	5.0	-	-	-	-	-	-	-	-	-	-	-	-	0.2	-	0.2	-	-	0.1	0.2	0.2
	mean	-	3.3	-	-	-	-	-	-	-	-	-	-	-	-	0.2	-	0.2	-	-	0.1	0.2	0.2
	med	-	3.3	-	-	-	-	-	-	-	-	-	-	-	-	0.2	-	0.2	-	-	0.1	0.2	0.2
	%>FDA <sup>2</sup>	-	0.0	-	-	-	-	-	-	-	-	-	-	-	-	0.0	-	0.0	-	-	0.0	0.0	0.0

1. Parameters are as follows:

- n = number of samples
- max = maximum PCB concentration
- mean = mean PCB concentration
- med = median PCB concentration
- %>FDA = percentage of samples exceeding FDA tolerance.

2. Fish collected through 1984 were compared to the FDA tolerance of 5 ppm; fish collected after 1984 were compared to the revised FDA tolerance of 2 ppm.



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## **APPENDIX B**

### **PROCEDURES FOR ESTABLISHING AND PROMULGATING FISH CONSUMPTION ADVISORIES**

This appendix describes the procedures used by the States of Wisconsin and Michigan for establishing and promulgating fish consumption advisories. These procedures are set forth in internal documents of the Wisconsin DNR (Wisconsin DNR, 1985a; Bochert, 1987; Amrhein and Liebenstein, 1991) and the Michigan DNR (Humphrey and Hesse, 1986; Great Lakes Environmental Assessment Section (GLEAS), 1993, 1995). This appendix also describes the development of a protocol for a uniform Great Lakes consumption advisory (Great Lakes Sport Fish Advisory Task Force, 1993), and a critical review of that protocol by the Michigan Environmental Science Board (Fischer et al., 1995).

#### **B.1 PROCESS FOR SETTING ADVISORIES IN WISCONSIN**

The process used by the state of Wisconsin in setting fish consumption advisories has included establishing trigger levels for issuing advisories, analyzing contaminants in fish, evaluating fish contaminant data, and issuing advisories. The following sections outline the procedures used by Wisconsin to accomplish these tasks, as set forth in internal DNR documents (Wisconsin DNR, 1985a; Bochert, 1987; Amrhein and Liebenstein, 1991) and as inferred from the text of the advisories.

##### **B.1.1 Procedures for Setting Advisories before 1985**

Explicit documentation of the procedures used to set advisories prior to 1985 does not exist. However, some information about the process can be inferred from the text of the advisories. For example, beginning in 1976, the advisory text stated that consumption of fish that exceeded the FDA tolerance for PCBs should be limited. Therefore, it can be inferred that advisories were set based on a comparison of PCB tissue concentrations in fish to the FDA tolerance. However, before 1985, there is no printed information on the percentage of samples that needed to exceed the FDA tolerance for an advisory to be issued.

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### **B.1.2 Procedures for Setting Advisories from 1985 to 1987**

The following procedures are summarized from Wisconsin DNR (1985), which is a copy of the Fish Contaminant Testing Protocol from the Wisconsin DNR Manual Code. (It is likely that some of these procedures were in place before 1985. However, documentation of protocols before 1985 was not available from the Wisconsin DNR.)

Starting in 1985, Wisconsin's state fish contaminant testing protocol was designed to provide for annual review of contaminant data. According to this testing protocol, a sampling collection schedule is prepared between January and May of each year. Sampling recommendations are developed based on the previous year's schedule, program guidance, and other relevant information. The collection schedule is coordinated between the Wisconsin Bureau of Fish Management, which is responsible for fish consumption advisories and other fisheries actions, and the Wisconsin Bureau of Water Resources, which is responsible for effluent limits and other water quality actions (Wisconsin DNR, 1985).

According to the 1985 protocol, district fish staff specialists coordinate the collection and preparation of fish samples and transport the samples to Madison. A designee from the Bureau of Water Resources receives samples from the field, processes the samples, and transmits them to the laboratory for analysis. Following laboratory analysis, designees from the Bureau of Water Resources and the Bureau of Fish Management review laboratory data and report unusual results to Bureau directors, who may initiate emergency action, if appropriate, for unusually high or unexpected contaminant levels. Otherwise, results are sent to the Bureau directors and to the Bureau of Information Management at regular intervals (Wisconsin DNR, 1985).

### **B.1.3 Recommended Changes in the Fish Consumption Advisory Procedures in 1987**

In April 1986, the Wisconsin DNR established a committee to reevaluate their fish consumption advisory procedures. The committee was charged with responding to the following questions:

- ▶ What tools should be used to communicate fish consumption advisories to the public?
- ▶ How often should advisories be updated and communicated to the public?
- ▶ When is fish contaminant data considered public information under the Open Records Law?

The committee evaluated these questions and also considered other questions and problems with the then current procedure. In 1987, the committee produced a document recommending the following changes (Bochert, 1987):

- ▶ Advisories should be issued twice a year, in April and October. The April update would include data received through the previous January, and the October update would contain
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available analyses and data through July 1. [This recommendation was adopted and announced in a 1987 press release (Wisconsin DNR, 1987).]

- ▶ Advisories should be released in the form of a news release that would include the entire advisory as an attachment. [This recommendation was adopted (e.g., Wisconsin DNR, 1987, 1988, 1989).]
- ▶ Background information describing contaminants, sources, and health information should be prepared and released as fact sheets. [This recommendation was adopted for PCBs in Lake Michigan fish through the preparation of a fact sheet (University of Wisconsin Sea Grant Institute, 1988).]
- ▶ Historical sampling data should be made available on a request basis, but not otherwise distributed. [This recommendation was adopted (J. Amrhein, WDNR, personal communication).]
- ▶ The fishing regulations pamphlet should announce that the advisory is available from Wisconsin DNR offices. (This recommendation was adopted.)

The committee also made the following recommendations regarding data collection, data verification, data interpretation, data release, the issuing of advisories under emergency conditions, and public notification (Bochert, 1987):

1. **Data collection.** The Central Office of the DNR and the Districts should decide where and how many fish to sample. The Districts collect fish; the Central Office sends fish to the laboratory for analysis and interprets sample results. On March 1 and September 1, the Central Office sends a draft advisory and unverified data to each District for review.
  2. **Data verification.** The District designee holds a meeting with all District and Area staff to review and verify data sent by the Central Office. The District designee sends verified data back to the Central Office by March 15 and September 15.
  3. **Data interpretation.** The Central Office reviews all verified data and draft advisories to determine the final advisories.
  4. **Data release.** The Central Office releases the new advisories and indicates availability of verified data by April 1 and October 1 each year. The Central Office also sends a data summary to agencies such as the FDA and to commercial fishing businesses, including Indian tribes that fish commercially. District staffs may make localized news releases in conjunction with Central Office release. [Press releases are issued in April and October of each year, although not always by April 1 and October 1 (e.g., Wisconsin DNR, 1987, 1988).]
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5. ***Emergency circumstances.*** An emergency circumstance exists if an advisory is needed other than at the scheduled times of April and October because the concentration of a contaminant was found to be at an “extremely high level” (Bochert, 1987). The committee did not give numerical definitions for “extremely high” but instructed that the following factors should be considered in determining whether an emergency condition exists: the nature of the compound; the amount of fishing in a water body; success levels for catching the contaminated species; the species, size, and number of contaminated fish; and the length of time until the next scheduled advisory (Bochert, 1987).
  
6. ***Public notification.*** The committee made recommendations concerning ways to notify the public. Posting signs by a given water body was considered to be a technique reserved for extraordinary or imminent health threats. Recommended information techniques included:
  - ▶ issuing news releases [this was adopted (e.g., Wisconsin DNR, 1987, 1995b)]
  - ▶ preparing informational packets for community leaders and interest groups
  - ▶ including information in newsletters and newspaper columns
  - ▶ providing guest speakers to organizations and groups
  - ▶ providing a list of contact names to reporters who wish to cover the issue
  - ▶ inserting appropriate messages into the fishing regulations pamphlet [this was adopted (e.g., Wisconsin DNR, 1987, 1995b)]
  - ▶ distributing information to health care professionals, clinics, and publications
  - ▶ providing teachers with materials on toxic pollutants
  - ▶ distributing information at sport shows and at the State Fair (Bochert, 1987).

#### **B.1.4 1991 Summary of Wisconsin’s Fish Contaminant Program**

A summary of Wisconsin’s Fish Contaminant Program was prepared in 1991 by the Wisconsin DNR as an internal document (Amrhein and Liebenstein, 1991). The summary describes uses of the fish contaminant data, types of sampling conducted, frequency of sampling, and the development of a monitoring strategy for Wisconsin waters of the Great Lakes as of 1991.

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1. ***Uses of fish contaminant data.*** The summary document stated that fish contaminant data are used to accomplish a number of specific program goals and objectives. These objectives include:
    - ▶ evaluating contaminant levels in commercial fish and issuing reports to relevant state and federal agencies
    - ▶ evaluating impacts of contaminants on wildlife by analyzing forage fish
    - ▶ issuing fish consumption advisories
    - ▶ evaluating stocking programs to promote species less likely to accumulate contaminants
    - ▶ establishing baseline levels and trends for contaminants in the water column
    - ▶ evaluating effectiveness of pollution control programs
    - ▶ evaluating impact of air emissions on surface water
    - ▶ determining if compounds leaching into groundwater are reaching surface water
    - ▶ evaluating the effects of land use practices, including pesticide use
    - ▶ evaluating areas of contaminated sediment and tracking effectiveness of remedial action programs.
  2. ***Types of sampling conducted.*** The summary document outlined the following types of sampling conducted by Wisconsin's Fish Contaminant Program:
    - ▶ Surveillance sampling at new or trend monitoring sites, which includes collection of bottom feeding species and predator species. If surveillance indicates an area of potential health concern, follow-up sampling of popular sport species is conducted.
    - ▶ Mercury sampling in inland lakes, which consists of two to three predator species of varying sizes and a sample of panfish.
  3. ***Frequency of sampling.*** Table B-1 gives a general indication of sampling frequency, as presented in the summary document.
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**Table B-1  
Fish Contaminant Monitoring Strategy  
for Lake Superior, Lake Michigan, and Tributaries**

<b>Sampling Location or Type</b>	<b>Sampling Frequency</b>
Major industrial rivers listed under a fish consumption advisory	Annually
Waters monitored as part of basin plans	Every 5 years
Inland lakes identified as high harvest waters	As soon as possible to determine mercury concentrations
Young-of-the-year yellow perch mercury monitoring program in subset of lakes water quality program	Every other fall
Fish sampling from the following National Ambient Monitoring network sites: Fox River below DePere Dam, Wisconsin River above Biron Dam, Milwaukee River at Kern Park, Root River at 6th Street in Racine, Mississippi River at Redwing	Annually
Salmonid species, alewife, and bloater chubs in Lake Michigan and Green Bay	Biennially
Lake trout, wiscowett, sculpins, and herring in Lake Superior	Frequency not specified
Walleye in tributaries to Lake Superior	Frequency not specified
Nearshore monitoring of coho salmon at the Sheboygan and Root rivers on Lake Michigan and Pine Creek or the Brule River on Lake Superior	Every other year beginning fall 1988
Nearshore monitoring of chinook salmon at the Sheboygan River and Strawberry Creek	Every other year beginning fall 1987
Open-lake monitoring program for lake trout (collected by the USFWS)	Frequency not specified
Intensive monitoring in Areas of Concern where the Remedial Action Plan is in the implementation phase	Frequency not specified
Source: Amrhein and Liebenstein, 1991.	

### **B.1.5 Fish Contaminant Advisory Protocols Used in 1997**

For the 1997 advisory, the State of Wisconsin began to follow the protocols for a uniform Great Lakes consumption advisory developed by the Great Lakes Sport Fish Advisory Task Force (1993). This advisory gives specific recommendations on how many meals of fish are safe to eat in one year, based on five categories of PCB concentrations. A detailed description of these protocols is presented in Section B.3.

## **B.2 PROCESS FOR SETTING ADVISORIES IN MICHIGAN**

The Michigan Department of Community Health (formerly called the Department of Public Health) has the responsibility for issuing fish consumption advisories, according to the Michigan Public Health Code (Humphrey and Hesse, 1986). The process used by the State of Michigan in setting fish consumption advisories has included collecting fish for contaminant analysis, analyzing fish contaminant data, and promulgating advisories. The following sections outline the procedures used by Michigan to accomplish these tasks, as set forth in a draft procedural statement by Humphrey and Hesse (1986) and in procedures developed by the Great Lakes Environmental Assessment Section (GLEAS) (1993, 1995).

### **B.2.1 Annual Schedule**

The following annual schedule for developing fish consumption advisories is taken from Humphrey and Hesse (1986).

In January, the Michigan DNR submits a draft fish monitoring plan and schedule to Michigan's Fish Contaminant Advisory Committee (FCAC) for review. The plan includes sampling locations, species, and size classes. After agreement is reached on the recommendations, the DNR develops and implements a monitoring plan.

From March to October, fish are collected by the DNR according to the monitoring plan, using established procedures for labeling, storage, and transport of samples. Samples are analyzed for specified contaminants according to acceptable and documented laboratory practices and quality assurance procedures. The DNR collates laboratory reports on a monthly basis as data become available. Reports include data received from other Great Lakes states and the Province of Ontario. Reports are forwarded to the FCAC at regularly scheduled monthly meetings.

October 15 is the cutoff date for receipt of fish contaminant data for use in developing the following year's fish consumption advisory. At this time, all remaining data are submitted to the FCAC. The FCAC transmits all data reports to the Center for Environmental Health Sciences within the DNR.

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From October 15 to November 1, the Center for Environmental Health Sciences reviews laboratory data reports for acceptable quality assurance. Unacceptable data sets are removed from the fish monitoring computer database by the DNR.

From November 1 to November 15, staff at the Center for Environmental Health Sciences reviews new and historical contaminant monitoring data, site trends, toxicological and biochemical considerations, population sensitivity and fishing trends, suitability of FDA action levels, and risk assessment estimates. A draft advisory for each site and species is developed, and text for the statewide fish consumption advisory is prepared.

From November 15 to December 1, the draft advisory text is shared with other state agencies, the FCAC, and the Governor's Executive Office for information and comment. The advisory is made available for public review and comment.

From December 1 to December 31, a public meeting is held to discuss the draft advisory, and comments and suggestions on the draft advisory are solicited. December 31 is the cutoff date for receipt of written comments.

From January 1 to January 15, replies to written comments are prepared. The final form of the advisory is prepared and approved by the Michigan Director of Public Health.

On January 15, the advisory is officially released for incorporation into the Michigan Fishing Guide booklet. Other mechanisms for public dissemination are pursued as well.

### **B.2.2 Specimen Selection**

The FCAC defined which portion of different species is considered edible and should be tested for contaminants (Humphrey and Hesse, 1986). Trout, salmon, perch, walleye, bass, crappies, sunfish, suckers, and similar species are analyzed as skin-on fillets. Bullheads, catfish, pike, herring, chubs, and carp are analyzed as skin-off fillets. Rainbow smelt are analyzed as headless, gutted whole fish. Sturgeon have been analyzed as both skin-off fillets and skin-off steaks (Humphrey and Hesse, 1986; GLEAS, 1995). The use of skin-off fillets and whole fish for contaminant analysis differs from FDA specifications. The FDA specifies that its PCB tolerance applies to the edible portion of the fish, where edible portion excludes head, scales, viscera, and edible bones (44 Fed. Reg. 38340).

Michigan DNR guidelines specify that fish tested for advisory purposes should be at least legal size and preferably as large as possible. Also, fish should be tested as individual fish instead of composites (Humphrey and Hesse, 1986). Updated procedures for fish specimen collection and processing were standardized in 1995 (GLEAS, 1995).

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### **B.2.3 Site Selection**

Factors used to select sampling sites include “amount of fishing activity, past documentation of contamination, suspicion of contamination, and the need to update existing advisories” (Humphrey and Hesse, 1986). Based on these criteria, higher trophic level and bottom feeding species in the Great Lakes and sites known or suspected to receive contamination receive the highest priority for monitoring (Humphrey and Hesse, 1986).

The guidance document recommends that specimens be collected at multiple sites along a section of river or stream being evaluated as well as at multiple sites within the Great Lakes. The document also recommends that reliable data from other jurisdictions bordering the lake be used to supplement the Michigan database (Humphrey and Hesse, 1986).

### **B.2.4 Sample Size**

The guidance document describes factors that should be considered in determining sample size, as well as general recommendations made by the FCAC. Factors to be considered in determining sample size for a species include migratory patterns, presence or absence of barriers to migration, average size range, bioaccumulation potential, and whether the contaminant source is localized or not. Larger sample sizes are needed when there is a large variation in contaminant levels in a fish species at a particular location (Humphrey and Hesse, 1986).

The FCAC has made the following general recommendations regarding determining sample sizes. Initial monitoring of a water body should be done on the largest specimens collected. The sample should include at least 10 large individuals of an omnivorous bottom feeding species (preferably carp or catfish) and 10 individuals of a predatory game species (walleye, northern pike, bass). If only one species is tested, then a bottom feeder should be selected if the suspected contaminant is not mercury or a predatory species should be selected if the suspected contaminant is mercury. For the Great Lakes, the FCAC has recommended testing 10 large individuals of each species of concern for each major region of the analyzed lake. If the data show that 10 samples are not adequate to define the level of contamination, the DNR will be requested to collect additional samples.

### **B.2.5 Laboratory Requirements**

The guidance document sets out general standards to which analytical laboratories should adhere (Humphrey and Hesse, 1986). These standards include the existence of a well defined and documented quality assurance program, use of an accepted analytical methodology, and implementation of a satisfactory methodology for extracting and measuring the lipid content of fish. As a minimum standard, the laboratory should demonstrate  $\pm 20\%$  recovery of a standard

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reference sample. The guidance document also recommends that 10% of fish specimens to be analyzed be split between approved laboratories for the purpose of comparison. A detailed laboratory quality assurance manual was produced in 1997 for the laboratory that analyzes the fish monitoring samples (Michigan Department of Community Health, 1997).

### **B.2.6 Modification or Removal of an Advisory**

Advisories may be modified or removed based on follow-up data on the same species and size classes that served as the basis of the advisory. If these data are not available, data from an omnivorous bottom feeding species (e.g., carp or catfish) and data from a large predator species (e.g., walleye, northern pike, bass trout) may be substituted. In this case, the chemical must be absent from both classes of fish for the advisory to be removed (Humphrey and Hesse, 1986).

### **B.2.7 Public Information and Education**

According to the guidance document, the objective of the public information and education campaign is to allow fish consumers to select fish species and sizes that will minimize their contaminant exposure, not to convince consumers to reduce their fish intake. Before 1986, publicity was primarily limited to publication of the advisories in the Michigan Fishing Guide, and press releases and occasional feature stories in magazines and newspapers. In 1986, the Michigan Department of Public Health published a “Fish Preparation and Cooking Guide,” which summarized the advisories and provided specific information regarding trimming and cooking fish to reduce contaminant levels (Humphrey and Hesse, 1986).

New educational initiatives were proposed for 1987, including:

1. distribution of an updated version of the 1986 “Fish Preparation and Cooking Guide”
  2. posting of advisories in displays, where available, at public fishing sites
  3. distribution of a map showing locations where advisories are in effect
  4. distribution of advisories to physicians, obstetricians, pediatricians, gynecologists, hospitals, and clinics to be used in prenatal and postnatal counseling
  5. communication through food and nutrition organizations
  6. publication through Cooperative Extension Bulletins
  7. provision of pamphlets to sporting goods stores
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8. contacting editors of appropriate magazine and journals (Humphrey and Hesse, 1986).

The U.S. EPA (1994) guidance document is also used as an information resource for risk communication (J. Bedford, Michigan Department of Community Health, personal communication to M. Holey, USFWS, June 25, 1997).

### **B.3 DEVELOPMENT OF THE UNIFORM GREAT LAKES CONSUMPTION ADVISORY**

In 1986, a task force was empowered by the Council of Great Lakes Governors to develop a uniform protocol for sport fish consumption advisories (“uniform protocol”) across the Great Lakes. The task force included representatives from each public health and environmental or natural resources agency of the eight states bordering the Great Lakes. In 1993, the task force published a uniform protocol that included procedures for the development and communication of fish consumption advisories. The stated goals of the uniform protocol “are to: (1) maintain the health benefit of fish consumption, (2) minimize the potential for angler toxic chemical exposure, (3) use credible and understandable science and, (4) present the information in a manner conducive to maximal voluntary compliance” (Great Lakes Sport Fish Advisory Task Force, 1993).

The task force was established formally by the “Toxic Substances Control Agreement” signed by the Great Lakes governors in 1986 (Council of Great Lakes Governors, 1986). In 1987 and 1989, the task force surveyed the methodologies used by jurisdictions (eight states and one province) to establish and issue consumption advisories. From 1990 to 1993, the task force worked on achieving a uniform protocol. The protocol was issued in 1993. This protocol was substantially different from the protocols used by Lake Michigan states at that time to develop their advisories. Indiana implemented the uniform protocol in 1996 (Indiana DNR, 1996). Wisconsin adopted the protocol in 1997 (Wisconsin Division of Health and Wisconsin DNR, 1997). Michigan has not yet adopted the protocol.

#### **B.3.1 Outline of Development of the Uniform Advisory**

In 1990, a general framework for a uniform protocol was presented at a task force meeting. The task force agreed that the uniform protocol would include specifications for the number of consumption categories, the criteria for placing fish into categories, the advice given for each category, and the description of risk for each category. Tasks assigned to each state included completing a description of current advisory programs, developing a strawman advisory based on reproductive risks, and comparing the “percent” approach used by Michigan and Wisconsin to assign fish to categories to an approach using mean concentrations (Liebenstein, 1990).

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In 1992, the states submitted comments on a strawman advisory proposal. The list of comments included the following:

- ▶ Quantity of monitoring data may not be sufficient to support placing fish into five different consumption categories.
- ▶ The strawman protocol did not address whether consumers can eat fish from different categories without incurring additional risk.
- ▶ Several issues regarding plotting a regression of length versus concentration need to be addressed, including what type of regression to use, how to treat values below the detection limit, and how many years of data to use.
- ▶ The revised protocol should clarify how to treat local areas with high concentrations (“hot spots”) within a lake.
- ▶ Different cooking reduction factors should be used for species analyzed as skin-off versus skin-on fillets.
- ▶ Potential adverse reproductive effects from chemicals other than PCBs should be evaluated to determine if an advisory based on PCB concentrations will be adequately protective for other chemicals.
- ▶ A mechanism for periodically reevaluating the health protection value should be developed.
- ▶ Use of a five year running regression may not be appropriate on inland lakes that are sampled infrequently (Liebenstein and Anderson, 1992).

Specific comments on risk communication in the uniform protocol were provided by Knuth (1992), based on her research in this area. Her comments included the following:

- ▶ Fewer than 80% of New York licensed anglers followed the recommended techniques for trimming and cooking fish to reduce contaminant levels.
  - ▶ Anglers preferred a “cajoling” message in the advisory (e.g., How much fish should you eat?) to a “commanding” message (e.g., limit your fish consumption).
  - ▶ Combinations of quantitative and qualitative risk information, and combinations of a cleaning diagram and description, would be most effective for communicating the advisory information.
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- ▶ Inclusion of advisory information in the newspaper, as well as in fishing regulations pamphlets, will increase knowledge of the advisory.

Specific issues related to the uniform protocol were discussed and agreed to at a task force meeting in October 1992. The points that were agreed to included:

- ▶ keeping the task force intact as a standing committee to review data, revise the advisory, and update the protocol if necessary
- ▶ using a 50% contaminant reduction factor for cooking and cleaning fish
- ▶ using a uniform meal size of ½ lb of raw fish for an average body size of 70 kg
- ▶ using five consumption categories in the advisory
- ▶ using a standard skin-on fillet for analysis with the exception of certain scaleless species that would be analyzed as skin-off fillets
- ▶ using a best fit regression for placing fish into consumption groups
- ▶ excluding contaminant “hot spots” from the data used to establish a lake-wide advisory
- ▶ using a minimum of one year of data to list a site or species in advisory
- ▶ using at least two separate years of data over five years to reduce a lake-wide advisory for a species or size class (Amrhein, 1992).

### **B.3.2 Specific Components of the Uniform Protocol**

The following information is derived from the Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory (Great Lakes Sport Fish Advisory Task Force, 1993). All direct quotations are taken from this document.

The uniform protocol incorporates a range of decisions regarding risk management and risk communication. The task force reviewed toxicity studies, evaluated the effect of cleaning and cooking on fish contaminant residues, decided on methods for analyzing and compositing tissue samples, estimated rates of fish consumption, decided on categories of consumption frequency to include in the advisory, and drafted model text for consumption advisories. The decisions made by the task force in each of these areas were explained in the uniform protocol and are reviewed briefly below (Great Lakes Sport Fish Advisory Task Force, 1993).

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The toxicology subgroup within the task force chose to focus its toxicity review on PCBs. PCBs were chosen because of their ubiquity in the Great Lakes and because extensive exposure and toxicity data for PCBs are available. The task force decided that the FDA tolerance for PCBs (2 ppm in the edible portion of fish) was “no longer appropriate” for advising anglers on fish consumption. The task force then chose to use a “weight-of-evidence approach” to develop an individual health protection value that would give a safe daily intake level for PCBs. Based on a review of toxicology and epidemiology studies, the task force adopted a health protection value of 0.05 µg PCBs/kg body weight/day for sport fish consumption. Although the task force did not use a quantitative method to assign weights to specific studies, the task force did give more consideration to adverse reproductive and developmental endpoints than to cancer risk. The task force agreed that the health protection value developed for PCBs would account for most of the health risk from other chemicals present. Where contaminants other than PCBs predominate, the uniform protocol states that consumption advisories would be based on new health protection values for those contaminants. However, new health protection values for contaminants other than PCBs were not included in the 1993 draft of the uniform protocol (Great Lakes Sport Fish Advisory Task Force, 1993).

The task force decided that a standard raw, skin-on fillet should be used as the sample for analysis, with the exception of a few species that would be analyzed as skin-off fillets (burbot, catfish, bullheads, sturgeon). Because PCBs and other organic contaminants concentrate preferentially in fat, trimming and cooking fish can reduce contaminant levels. Based on a literature review, the task force estimated that trimming and cooking would reduce PCBs and organic contaminants by 50% for species analyzed as skin-on fillets and by 30% for species analyzed as skin-off fillets. These reduction values for trimming and cooking were used in the calculations of exposure (Great Lakes Sport Fish Advisory Task Force, 1993).

The task force recommended uniform methods for analyzing and compositing fish tissue samples. As described above, skin-on or skin-off fillets, depending on the species, would be used for tissue analysis. Whole fish would never be used for the purpose of issuing consumption advisories. The task force decided that individual samples are preferred for analysis. If composite samples are analyzed, the smallest fish should be at least 75% of the length of the largest fish (Great Lakes Sport Fish Advisory Task Force, 1993).

The task force chose to issue advisories for five different fish consumption frequencies: unrestricted consumption, one meal per week, one meal per month, six meals per year, and no consumption. A standard meal was considered to be a ½ pound raw fillet (227 g), which is then trimmed and cooked. For an estimate of consumption in the unrestricted consumption category, the task force used 140 g/day, which is the 90th percentile of consumption for recreational anglers according to EPA’s Exposure Factors Handbook (1989 as cited in Great Lakes Sport Fish Advisory Task Force, 1993).

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The task force calculated the maximum contaminant concentrations that would not exceed the health protection value for the consumption frequency (meals per year) at each advisory level. The calculation method is the same for each advisory level, with only the number of meals per year changing (Table B-2). For purposes of issuing an advisory, the calculated concentrations were rounded and converted into concentration ranges (Great Lakes Sport Fish Advisory Task Force, 1993).

<p align="center"><b>Table B-2</b>  <b>Mean PCB Tissue Concentrations that Trigger Each Advisory Level</b></p>		
<p align="center"><b>Advisory Level and Consumption Frequency</b></p>	<p align="center"><b>Calculated Concentration that Equals the Health Protection Value of 0.05 µg PCB/kg Body Weight/Day (µg/g PCBs in raw fish skin-on fillet)</b></p>	<p align="center"><b>Concentration Ranges Used in Advisory (µg/g PCBs in raw fish skin-on fillet)</b></p>
Group 1 — unrestricted consumption = 225 meals per year	0.05	0-0.05
Group 2 — 1 meal per week	0.22	0.06-0.2
Group 3 — 1 meal per month	0.95	0.2-1.0
Group 4 — 6 meals per year	1.89	1.1-1.9
Group 5 — no consumption	>1.89	>1.9
<p>Source: Great Lakes Sport Fish Advisory Task Force, 1993.</p>		

The task force drafted model text to be included in an advisory. The uniform protocol specifies that each state can tailor the advisory text for its own needs, but that a consistent message is important. The task force based its model text on a study that identified preferred reading level and presentation style for advisories (Connelly and Knuth, 1993). The model text includes (1) a general statement about the benefits of eating fish and the potential harm from contaminant exposure, (2) a statement about cancer risk, (3) a statement about the benefits of fish consumption, (4) advice about proper fish preparation and cooking to reduce contaminant levels, and (5) an explanation of how to use the advisory.

### **B.3.3 Critical Review of the Uniform Protocol by the Michigan Environmental Science Board**

As chair of the Council of Great Lakes Governors, Governor John Engler of Michigan charged the Michigan Environmental Science Board with reviewing the uniform protocol after it was presented to the Council of Great Lakes Governors in 1993 (Engler, 1994). The Michigan Environmental Science Board convened a special Fish Advisory Panel to facilitate the review, which was completed in 1995 (Fischer et al., 1995).

The review of the uniform protocol included the following findings and recommendations (Fischer et al., 1995):

- ▶ The health protection value developed for the uniform protocol does not have adequate scientific justification, because the task force did not use a quantitative or qualitative weight-of-evidence process. However, the studies reviewed for the uniform protocol supported the use of the health protection value for women of child-bearing age.
- ▶ The process used to develop the health protection value may not be capable of accommodating changes in contamination or advances in scientific knowledge.
- ▶ A second health protection value should be developed for portions of the population less susceptible to harm than developing fetuses and young children.
- ▶ A uniform monitoring program with sampling schedules and analytical methods should be developed in conjunction with the uniform advisory protocol.
- ▶ Specific data analysis methods used in the protocol should be made more statistically rigorous and objective. In particular, the nonweighted method of regression analysis and the assumptions used to handle data below detection limits should be revised.
- ▶ Communication materials should be pretested with members of the target audience to improve risk communication.
- ▶ Discussion of the following topics in the uniform protocol should be improved:
  - (1) potential risks associated with chemical contaminants in fish,
  - (2) comparisons between sport- and commercially caught fish,
  - (3) risks of consuming fish versus other foods, and
  - (4) health benefits of eating fish.

In 1996, Governor John Engler requested that the Michigan Environmental Science Board review new information on PCB toxicity to determine if the conclusions of the critical review should be revised (Fischer et al., 1997). The Fish Advisory Panel concluded that the new material did not alter the previous conclusions. The panel members felt that the health protection value of 0.05 µg PCB/kg body weight/day was adequately protective for pregnant women, but that a less restrictive value could be developed for less sensitive segments of the population (Fischer et al., 1997). Through the end of 1997, Michigan had still chosen not to implement the uniform protocol. The critical review of the uniform protocol by the Michigan Environmental Science Board did not lead to a revision of the uniform protocol.

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**APPENDIX C**  
**CONCENTRATIONS OF CONTAMINANTS OTHER THAN PCBs IN FISH**  
**AND FREQUENCY OF EXCEEDENCES OF WISCONSIN**  
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**Table C-1**  
**Summary of Toxaphene Tissue Concentrations (ppm) and Frequency of Exceedences of Trigger Level for Fish in Lower Fox River upstream of the DePere Dam**

<b>Species</b>	<b>Parameter</b>	<b>1985-1989</b>
Carp	No. of Samples	4
	Maximum Toxaphene Conc.	1.00
	Mean Toxaphene Conc.	1.00
	Median Toxaphene Conc.	1.00
	% Exceeding Trigger Level	0.00
Walleye	No. of Samples	1
	Maximum Toxaphene Conc.	1.00
	Mean Toxaphene Conc.	1.00
	Median Toxaphene Conc.	1.00
	% Exceeding Trigger Level	0.00

**Table C-2**  
**Summary of Mercury Tissue Concentrations (ppm) and Frequency of Exceedences**  
**of Trigger Level for Fish in Lower Fox River upstream of the DePere Dam**

<b>Species</b>	<b>Parameter</b>	<b>1985-1989</b>	<b>1990-1994</b>
Flathead Catfish	No. of Samples	-	3
	Maximum Mercury Conc.	-	0.32
	Mean Mercury Conc.	-	0.22
	Median Mercury Conc.	-	0.19
	% Exceeding Trigger Level	-	0.00
Northern Pike	No. of Samples	-	2
	Maximum Mercury Conc.	-	0.14
	Mean Mercury Conc.	-	0.12
	Median Mercury Conc.	-	0.12
	% Exceeding Trigger Level	-	0.00
Smallmouth Bass	No. of Samples	1	2
	Maximum Mercury Conc.	0.22	0.63
	Mean Mercury Conc.	0.22	0.44
	Median Mercury Conc.	0.22	0.44
	% Exceeding Trigger Level	0.00	50.00
Walleye	No. of Samples	9	23
	Maximum Mercury Conc.	0.60	0.44
	Mean Mercury Conc.	0.30	0.20
	Median Mercury Conc.	0.24	0.15
	% Exceeding Trigger Level	22.22	0.00
Yellow Perch	No. of Samples	-	1
	Maximum Mercury Conc.	-	0.05
	Mean Mercury Conc.	-	0.05
	Median Mercury Conc.	-	0.05
	% Exceeding Trigger Level	-	0.00

**Table C-3**  
**Summary of 2,3,7,8-TCDD Tissue Concentrations (ppt) and Frequency of Exceedences of Trigger Level for Fish in Lower Fox River upstream of the DePere Dam**

Species	Parameter	1985-1989
Smallmouth Bass	No. of Samples	1
	Maximum 2,3,7,8-TCDD Conc.	1.10
	Mean 2,3,7,8-TCDD Conc.	1.10
	Median 2,3,7,8-TCDD Conc.	1.10
	% Exceeding Trigger Level	0.00

<b>Table C-4</b> <b>Summary of alpha-Chlordane Tissue Concentrations (ppm) and Frequency of Exceedences of 0.3 ppm Advisory Trigger Level for Fish in Lower Fox River downstream of the DePere Dam</b>				
Species	Parameter	1980-1984	1985-1989	1990-1994
Carp	No. of Samples	1	-	-
	Maximum alpha-Chlordane Conc.	0.06	-	-
	Mean alpha-Chlordane Conc.	0.06	-	-
	Median alpha-Chlordane Conc.	0.06	-	-
	% Exceeding Trigger Level	0.00	-	-
Channel Catfish	No. of Samples	-	1	-
	Maximum alpha-Chlordane Conc.	-	0.05	-
	Mean alpha-Chlordane Conc.	-	0.05	-
	Median alpha-Chlordane Conc.	-	0.05	-
	% Exceeding Trigger Level	-	0.00	-
Northern Pike	No. of Samples	-	1	-
	Maximum alpha-Chlordane Conc.	-	0.05	-
	Mean alpha-Chlordane Conc.	-	0.05	-
	Median alpha-Chlordane Conc.	-	0.05	-
	% Exceeding Trigger Level	-	0.00	-
Walleye	No. of Samples	2	-	-
	Maximum alpha-Chlordane Conc.	0.05	-	-
	Mean alpha-Chlordane Conc.	0.05	-	-
	Median alpha-Chlordane Conc.	0.05	-	-
	% Exceeding Trigger Level	0.00	-	-
White Perch	No. of Samples	-	-	2
	Maximum alpha-Chlordane Conc.	-	-	0.05
	Mean alpha-Chlordane Conc.	-	-	0.05
	Median alpha-Chlordane Conc.	-	-	0.05
	% Exceeding Trigger Level	-	-	0.00

**Table C-5**  
**Summary of gamma-Chlordane Tissue Concentrations (ppm) and Frequency of Exceedences of 0.3 ppm Advisory Trigger Level for Fish in Lower Fox River downstream of the DePere Dam**

<b>Species</b>	<b>Parameter</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Carp	No. of Samples	1	-	-
	Maximum gamma-Chlordane Conc.	0.05	-	-
	Mean gamma-Chlordane Conc.	0.05	-	-
	Median gamma-Chlordane Conc.	0.05	-	-
	% Exceeding Trigger Level	0.00	-	-
Channel Catfish	No. of Samples	-	1	-
	Maximum gamma-Chlordane Conc.	-	0.05	-
	Mean gamma-Chlordane Conc.	-	0.05	-
	Median gamma-Chlordane Conc.	-	0.05	-
	% Exceeding Trigger Level	-	0.00	-
Northern Pike	No. of Samples	-	1	-
	Maximum gamma-Chlordane Conc.	-	0.05	-
	Mean gamma-Chlordane Conc.	-	0.05	-
	Median gamma-Chlordane Conc.	-	0.05	-
	% Exceeding Trigger Level	-	0.00	-
Walleye	No. of Samples	2	-	-
	Maximum gamma-Chlordane Conc.	0.05	-	-
	Mean gamma-Chlordane Conc.	0.05	-	-
	Median gamma-Chlordane Conc.	0.05	-	-
	% Exceeding Trigger Level	0.00	-	-
White Perch	No. of Samples	-	-	2
	Maximum gamma-Chlordane Conc.	-	-	0.05
	Mean gamma-Chlordane Conc.	-	-	0.05
	Median gamma-Chlordane Conc.	-	-	0.05
	% Exceeding Trigger Level	-	-	0.00

**Table C-6**  
**Summary of Dieldrin Tissue Concentrations (ppm) and Frequency of Exceedences**  
**of 0.3 ppm Advisory Trigger Level for Fish in Lower Fox River**  
**downstream of the DePere Dam**

<b>Species</b>	<b>Parameter</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Channel Catfish	No. of Samples	-	1	-
	Maximum Dieldrin Conc.	-	0.20	-
	Mean Dieldrin Conc.	-	0.20	-
	Median Dieldrin Conc.	-	0.20	-
	% Exceeding Trigger Level	-	0.00	-
Northern Pike	No. of Samples	-	1	-
	Maximum Dieldrin Conc.	-	0.02	-
	Mean Dieldrin Conc.	-	0.02	-
	Median Dieldrin Conc.	-	0.02	-
	% Exceeding Trigger Level	-	0.00	-
Walleye	No. of Samples	1	-	-
	Maximum Dieldrin Conc.	0.20	-	-
	Mean Dieldrin Conc.	0.20	-	-
	Median Dieldrin Conc.	0.20	-	-
	% Exceeding Trigger Level	0.00	-	-
White Perch	No. of Samples	-	-	2
	Maximum Dieldrin Conc.	-	-	0.0
	Mean Dieldrin Conc.	-	-	0.0
	Median Dieldrin Conc.	-	-	0.0
	% Exceeding Trigger Level	-	-	0.0

**Table C-7**  
**Summary of 2,4-DDT Tissue Concentrations (ppm) and Frequency of Exceedences**  
**of 5.0 ppm Advisory Trigger Level for Fish in Lower Fox River**  
**downstream of the DePere Dam**

<b>Species</b>	<b>Parameter</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Carp	No. of Samples	1	-	-
	Maximum 2,4-DDT Conc.	0.05	-	-
	Mean 2,4-DDT Conc.	0.05	-	-
	Median 2,4-DDT Conc.	0.05	-	-
	% Exceeding Trigger Level	0.00	-	-
Channel Catfish	No. of Samples	-	1	-
	Maximum 2,4-DDT Conc.	-	0.05	-
	Mean 2,4-DDT Conc.	-	0.05	-
	Median 2,4-DDT Conc.	-	0.05	-
	% Exceeding Trigger Level	-	0.00	-
Northern Pike	No. of Samples	-	1	-
	Maximum 2,4-DDT Conc.	-	0.05	-
	Mean 2,4-DDT Conc.	-	0.05	-
	Median 2,4-DDT Conc.	-	0.05	-
	% Exceeding Trigger Level	-	0.00	-
Walleye	No. of Samples	2	-	-
	Maximum 2,4-DDT Conc.	0.05	-	-
	Mean 2,4-DDT Conc.	0.05	-	-
	Median 2,4-DDT Conc.	0.05	-	-
	% Exceeding Trigger Level	0.00	-	-
White Perch	No. of Samples	-	-	2
	Maximum 2,4-DDT Conc.	-	-	0.05
	Mean 2,4-DDT Conc.	-	-	0.05
	Median 2,4-DDT Conc.	-	-	0.05
	% Exceeding Trigger Level	-	-	0.00

**Table C-8**  
**Summary of 4,4-DDT Tissue Concentrations (ppm) and Frequency of Exceedences**  
**of 5.0 ppm Advisory Trigger Level for Fish in Lower Fox River**  
**downstream of the DePere Dam**

<b>Species</b>	<b>Parameter</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Carp	No. of Samples	1	-	-
	Maximum 4,4-DDT Conc.	0.05	-	-
	Mean 4,4-DDT Conc.	0.05	-	-
	Median 4,4-DDT Conc.	0.05	-	-
	% Exceeding Trigger Level	0.00	-	-
Channel Catfish	No. of Samples	-	1	-
	Maximum 4,4-DDT Conc.	-	0.05	-
	Mean 4,4-DDT Conc.	-	0.05	-
	Median 4,4-DDT Conc.	-	0.05	-
	% Exceeding Trigger Level	-	0.00	-
Northern Pike	No. of Samples	-	1	-
	Maximum 4,4-DDT Conc.	-	0.05	-
	Mean 4,4-DDT Conc.	-	0.05	-
	Median 4,4-DDT Conc.	-	0.05	-
	% Exceeding Trigger Level	-	0.00	-
Walleye	No. of Samples	2	-	-
	Maximum 4,4-DDT Conc.	0.05	-	-
	Mean 4,4-DDT Conc.	0.05	-	-
	Median 4,4-DDT Conc.	0.05	-	-
	% Exceeding Trigger Level	0.00	-	-
White Perch	No. of Samples	-	-	2
	Maximum 4,4-DDT Conc.	-	-	0.05
	Mean 4,4-DDT Conc.	-	-	0.05
	Median 4,4-DDT Conc.	-	-	0.05
	% Exceeding Trigger Level	-	-	0.00

**Table C-9  
Summary of Mercury Tissue Concentrations (ppm) and Frequency of Exceedences  
of 0.5 ppm Advisory Trigger Level for Fish in Lower Fox River  
downstream of the DePere Dam**

<b>Species</b>	<b>Parameter</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Carp	No. of Samples	1	-	-
	Maximum Mercury Conc.	0.03	-	-
	Mean Mercury Conc.	0.03	-	-
	Median Mercury Conc.	0.03	-	-
	% Exceeding Trigger Level	0.00	-	-
Channel Catfish	No. of Samples	-	1	-
	Maximum Mercury Conc.	-	0.28	-
	Mean Mercury Conc.	-	0.28	-
	Median Mercury Conc.	-	0.28	-
	% Exceeding Trigger Level	-	0.00	-
Northern Pike	No. of Samples	-	4	4
	Maximum Mercury Conc.	-	0.38	0.15
	Mean Mercury Conc.	-	0.25	0.11
	Median Mercury Conc.	-	0.27	0.10
	% Exceeding Trigger Level	-	0.00	0.00
Smallmouth Bass	No. of Samples	-	-	3
	Maximum Mercury Conc.	-	-	0.28
	Mean Mercury Conc.	-	-	0.21
	Median Mercury Conc.	-	-	0.18
	% Exceeding Trigger Level	-	-	0.00
Walleye	No. of Samples	2	12	26
	Maximum Mercury Conc.	0.16	0.78	1.10
	Mean Mercury Conc.	0.16	0.42	0.21
	Median Mercury Conc.	0.16	0.42	0.08
	% Exceeding Trigger Level	0.00	33.33	7.69
White Bass	No. of Samples	-	1	-
	Maximum Mercury Conc.	-	0.19	-
	Mean Mercury Conc.	-	0.19	-
	Median Mercury Conc.	-	0.19	-
	% Exceeding Trigger Level	-	0.00	-
White Perch	No. of Samples	-	-	2
	Maximum Mercury Conc.	-	-	0.12
	Mean Mercury Conc.	-	-	0.12
	Median Mercury Conc.	-	-	0.12
	% Exceeding Trigger Level	-	-	0.00

**Table C-10**  
**Summary of Toxaphene Tissue Concentrations (ppm) and Frequency of Exceedences**  
**of 5.0 ppm Advisory Trigger Level for Fish in Lower Fox River**  
**downstream of the DePere Dam**

Species	Parameter	1990-1994
White Perch	No. of Samples	2
	Maximum Toxaphene Conc.	1.00
	Mean Toxaphene Conc.	1.00
	Median Toxaphene Conc.	1.00
	% Exceeding Trigger Level	0.00

**Table C-11**  
**Summary of 2,3,7,8-TCDD Tissue Concentrations (ppt) and Frequency of Exceedences**  
**of 10 ppt Advisory Trigger Level for Fish in Lower Fox River**  
**downstream of the DePere Dam**

Species	Parameter	1980-1984
Carp	No. of Samples	4
	Maximum 2,3,7,8-TCDD Conc.	10.00
	Mean 2,3,7,8-TCDD Conc.	4.45
	Median 2,3,7,8-TCDD Conc.	3.30
	% Exceeding Trigger Level	0.00
Walleye	No. of Samples	3
	Maximum 2,3,7,8-TCDD Conc.	5.00
	Mean 2,3,7,8-TCDD Conc.	2.47
	Median 2,3,7,8-TCDD Conc.	1.20
	% Exceeding Trigger Level	0.00

**Table C-12**  
**Summary of Endrin Tissue Concentrations (ppm) and Frequency of Exceedences of Trigger Level for Fish in Lower Fox River downstream of the DePere Dam**

Species	Parameter	1980-1984
Walleye	No. of Samples	1
	Maximum Endrin Conc.	0.02
	Mean Endrin Conc.	0.02
	Median Endrin Conc.	0.02
	% Exceeding Trigger Level	0.00

**Table C-13**  
**Summary of 4,4-DDE Tissue Concentrations (ppm) and Frequency of Exceedences of Trigger Level for Fish in Lower Fox River downstream of the DePere Dam**

<b>Species</b>	<b>Parameter</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Channel Catfish	No. of Samples	-	1	-
	Maximum 4,4-DDE Conc.	-	0.29	-
	Mean 4,4-DDE Conc.	-	0.29	-
	Median 4,4-DDE Conc.	-	0.29	-
	% Exceeding Trigger Level	-	0.00	-
Northern Pike	No. of Samples	-	1	-
	Maximum 4,4-DDE Conc.	-	0.07	-
	Mean 4,4-DDE Conc.	-	0.07	-
	Median 4,4-DDE Conc.	-	0.07	-
	% Exceeding Trigger Level	-	0.00	-
Walleye	No. of Samples	1	-	-
	Maximum 4,4-DDE Conc.	0.31	-	-
	Mean 4,4-DDE Conc.	0.31	-	-
	Median 4,4-DDE Conc.	0.31	-	-
	% Exceeding Trigger Level	0.00	-	-
White Perch	No. of Samples	-	-	2
	Maximum 4,4-DDE Conc.	-	-	0.05
	Mean 4,4-DDE Conc.	-	-	0.02
	Median 4,4-DDE Conc.	-	-	0.02
	% Exceeding Trigger Level	-	-	0.00

**Table C-14**  
**Summary of 2,4-DDD Tissue Concentrations (ppm) and Frequency of Exceedences**  
**of Trigger Level for Fish in Lower Fox River downstream of the DePere Dam**

<b>Species</b>	<b>Parameter</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Carp	No. of Samples	2	-	-
	Maximum 2,4-DDD Conc.	0.05	-	-
	Mean 2,4-DDD Conc.	0.05	-	-
	Median 2,4-DDD Conc.	0.05	-	-
	% Exceeding Trigger Level	0.00	-	-
Channel Catfish	No. of Samples	-	2	-
	Maximum 2,4-DDD Conc.	-	0.05	-
	Mean 2,4-DDD Conc.	-	0.05	-
	Median 2,4-DDD Conc.	-	0.05	-
	% Exceeding Trigger Level	-	0.00	-
Northern Pike	No. of Samples	-	2	-
	Maximum 2,4-DDD Conc.	-	0.05	-
	Mean 2,4-DDD Conc.	-	0.05	-
	Median 2,4-DDD Conc.	-	0.05	-
	% Exceeding Trigger Level	-	0.00	-
Walleye	No. of Samples	4	-	-
	Maximum 2,4-DDD Conc.	0.05	-	-
	Mean 2,4-DDD Conc.	0.05	-	-
	Median 2,4-DDD Conc.	0.05	-	-
	% Exceeding Trigger Level	0.00	-	-
White Perch	No. of Samples	-	-	4
	Maximum 2,4-DDD Conc.	-	-	0.05
	Mean 2,4-DDD Conc.	-	-	0.05
	Median 2,4-DDD Conc.	-	-	0.05
	% Exceeding Trigger Level	-	-	0.00

**Table C-15**  
**Summary of 2,4-DDE Tissue Concentrations (ppm) and Frequency of Exceedences**  
**of Trigger Level for Fish in Lower Fox River downstream of the DePere Dam**

<b>Species</b>	<b>Parameter</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Channel Catfish	No. of Samples	-	1	-
	Maximum 2,4-DDE Conc.	-	0.05	-
	Mean 2,4-DDE Conc.	-	0.05	-
	Median 2,4-DDE Conc.	-	0.05	-
	% Exceeding Trigger Level	-	0.00	-
Northern Pike	No. of Samples	-	1	-
	Maximum 2,4-DDE Conc.	-	0.05	-
	Mean 2,4-DDE Conc.	-	0.05	-
	Median 2,4-DDE Conc.	-	0.05	-
	% Exceeding Trigger Level	-	0.00	-
Walleye	No. of Samples	1	-	-
	Maximum 2,4-DDE Conc.	0.05	-	-
	Mean 2,4-DDE Conc.	0.05	-	-
	Median 2,4-DDE Conc.	0.05	-	-
	% Exceeding Trigger Level	0.00	-	-
White Perch	No. of Samples	-	-	2
	Maximum 2,4-DDE Conc.	-	-	0.05
	Mean 2,4-DDE Conc.	-	-	0.05
	Median 2,4-DDE Conc.	-	-	0.05
	% Exceeding Trigger Level	-	-	0.00

**Table C-16**  
**Summary of alpha-Chlordane Tissue Concentrations (ppm) and Frequency**  
**of Exceedences of 0.3 ppm Advisory Trigger Level for Fish in Green Bay**

<b>Species</b>	<b>Parameter</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Alewife	No. of Samples	2	-	-
	Maximum alpha-Chlordane Conc.	0.05	-	-
	Mean alpha-Chlordane Conc.	0.05	-	-
	Median alpha-Chlordane Conc.	0.05	-	-
	% Exceeding Trigger Level	0.00	-	-
Brook Trout	No. of Samples	1	-	2
	Maximum alpha-Chlordane Conc.	0.05	-	0.05
	Mean alpha-Chlordane Conc.	0.05	-	0.05
	Median alpha-Chlordane Conc.	0.05	-	0.05
	% Exceeding Trigger Level	0.00	-	0.00
Brown Bullhead	No. of Samples	4	-	-
	Maximum alpha-Chlordane Conc.	0.05	-	-
	Mean alpha-Chlordane Conc.	0.05	-	-
	Median alpha-Chlordane Conc.	0.05	-	-
	% Exceeding Trigger Level	0.00	-	-
Brown Trout	No. of Samples	12	7	25
	Maximum alpha-Chlordane Conc.	0.05	0.05	0.05
	Mean alpha-Chlordane Conc.	0.05	0.05	0.03
	Median alpha-Chlordane Conc.	0.05	0.05	0.05
	% Exceeding Trigger Level	0.00	0.00	0.00
Burbot	No. of Samples	-	-	9
	Maximum alpha-Chlordane Conc.	-	-	0.00
	Mean alpha-Chlordane Conc.	-	-	0.00
	Median alpha-Chlordane Conc.	-	-	0.00
	% Exceeding Trigger Level	-	-	0.00
Carp	No. of Samples	-	19	8
	Maximum alpha-Chlordane Conc.	-	0.07	0.01
	Mean alpha-Chlordane Conc.	-	0.02	0.00
	Median alpha-Chlordane Conc.	-	0.02	0.01
	% Exceeding Trigger Level	-	0.00	0.00

**Table C-16 (cont.)  
Summary of alpha-Chlordane Tissue Concentrations (ppm) and Frequency  
of Exceedences of 0.3 ppm Advisory Trigger Level for Fish in Green Bay**

<b>Species</b>	<b>Parameter</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Chinook Salmon	No. of Samples	3	3	9
	Maximum alpha-Chlordane Conc.	0.05	0.05	0.05
	Mean alpha-Chlordane Conc.	0.05	0.05	0.04
	Median alpha-Chlordane Conc.	0.05	0.05	0.05
	% Exceeding Trigger Level	0.00	0.00	0.00
Lake Sturgeon	No. of Samples	-	1	-
	Maximum alpha-Chlordane Conc.	-	0.08	-
	Mean alpha-Chlordane Conc.	-	0.08	-
	Median alpha-Chlordane Conc.	-	0.08	-
	% Exceeding Trigger Level	-	0.00	-
Lake Trout	No. of Samples	8	-	-
	Maximum alpha-Chlordane Conc.	0.10	-	-
	Mean alpha-Chlordane Conc.	0.06	-	-
	Median alpha-Chlordane Conc.	0.05	-	-
	% Exceeding Trigger Level	0.00	-	-
Lake Whitefish	No. of Samples	5	1	10
	Maximum alpha-Chlordane Conc.	0.05	0.05	0.03
	Mean alpha-Chlordane Conc.	0.05	0.05	0.02
	Median alpha-Chlordane Conc.	0.05	0.05	0.02
	% Exceeding Trigger Level	0.00	0.00	0.00
Longnose Sucker	No. of Samples	-	10	12
	Maximum alpha-Chlordane Conc.	-	0.06	0.09
	Mean alpha-Chlordane Conc.	-	0.04	0.05
	Median alpha-Chlordane Conc.	-	0.04	0.05
	% Exceeding Trigger Level	-	0.00	0.00
Northern Pike	No. of Samples	2	10	-
	Maximum alpha-Chlordane Conc.	0.05	0.01	-
	Mean alpha-Chlordane Conc.	0.05	0.00	-
	Median alpha-Chlordane Conc.	0.05	0.00	-
	% Exceeding Trigger Level	0.00	0.00	-

<p align="center"><b>Table C-16 (cont.)</b>  <b>Summary of alpha-Chlordane Tissue Concentrations (ppm) and Frequency of Exceedences of 0.3 ppm Advisory Trigger Level for Fish in Green Bay</b></p>				
<b>Species</b>	<b>Parameter</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Rainbow Smelt	No. of Samples	3	-	-
	Maximum alpha-Chlordane Conc.	0.05	-	-
	Mean alpha-Chlordane Conc.	0.05	-	-
	Median alpha-Chlordane Conc.	0.05	-	-
	% Exceeding Trigger Level	0.00	-	-
Rainbow Trout	No. of Samples	-	2	11
	Maximum alpha-Chlordane Conc.	-	0.05	0.05
	Mean alpha-Chlordane Conc.	-	0.05	0.03
	Median alpha-Chlordane Conc.	-	0.05	0.02
	% Exceeding Trigger Level	-	0.00	0.00
Smallmouth Bass	No. of Samples	-	-	7
	Maximum alpha-Chlordane Conc.	-	-	0.00
	Mean alpha-Chlordane Conc.	-	-	0.00
	Median alpha-Chlordane Conc.	-	-	0.00
	% Exceeding Trigger Level	-	-	0.00
Splake	No. of Samples	-	15	12
	Maximum alpha-Chlordane Conc.	-	0.05	0.05
	Mean alpha-Chlordane Conc.	-	0.05	0.04
	Median alpha-Chlordane Conc.	-	0.05	0.04
	% Exceeding Trigger Level	-	0.00	0.00
Walleye	No. of Samples	-	20	24
	Maximum alpha-Chlordane Conc.	-	0.09	0.05
	Mean alpha-Chlordane Conc.	-	0.02	0.01
	Median alpha-Chlordane Conc.	-	0.01	0.01
	% Exceeding Trigger Level	-	0.00	0.00
White Sucker	No. of Samples	-	10	-
	Maximum alpha-Chlordane Conc.	-	0.02	-
	Mean alpha-Chlordane Conc.	-	0.01	-
	Median alpha-Chlordane Conc.	-	0.00	-
	% Exceeding Trigger Level	-	0.00	-

**Table C-16 (cont.)**  
**Summary of alpha-Chlordane Tissue Concentrations (ppm) and Frequency of Exceedences of 0.3 ppm Advisory Trigger Level for Fish in Green Bay**

<b>Species</b>	<b>Parameter</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Yellow Perch	No. of Samples	5	-	9
	Maximum alpha-Chlordane Conc.	0.05	-	0.05
	Mean alpha-Chlordane Conc.	0.05	-	0.05
	Median alpha-Chlordane Conc.	0.05	-	0.05
	% Exceeding Trigger Level	0.00	-	0.00

**Table C-17**  
**Summary of gamma-Chlordane Tissue Concentrations (ppm) and Frequency of Exceedences of 0.3 ppm Advisory Trigger Level for Fish in Green Bay**

Species	Parameter	1980-1984	1985-1989	1990-1994
Alewife	No. of Samples	2	-	-
	Maximum gamma-Chlordane Conc.	0.05	-	-
	Mean gamma-Chlordane Conc.	0.05	-	-
	Median gamma-Chlordane Conc.	0.05	-	-
	% Exceeding Trigger Level	0.00	-	-
Brook Trout	No. of Samples	1	-	2
	Maximum gamma-Chlordane Conc.	0.05	-	0.05
	Mean gamma-Chlordane Conc.	0.05	-	0.05
	Median gamma-Chlordane Conc.	0.05	-	0.05
	% Exceeding Trigger Level	0.00	-	0.00
Brown Bullhead	No. of Samples	4	-	-
	Maximum gamma-Chlordane Conc.	0.05	-	-
	Mean gamma-Chlordane Conc.	0.05	-	-
	Median gamma-Chlordane Conc.	0.05	-	-
	% Exceeding Trigger Level	0.00	-	-
Brown Trout	No. of Samples	12	7	25
	Maximum gamma-Chlordane Conc.	0.05	0.05	0.05
	Mean gamma-Chlordane Conc.	0.05	0.05	0.03
	Median gamma-Chlordane Conc.	0.05	0.05	0.05
	% Exceeding Trigger Level	0.00	0.00	0.00
Burbot	No. of Samples	-	-	9
	Maximum gamma-Chlordane Conc.	-	-	0.00
	Mean gamma-Chlordane Conc.	-	-	0.00
	Median gamma-Chlordane Conc.	-	-	0.00
	% Exceeding Trigger Level	-	-	0.00
Carp	No. of Samples	-	19	8
	Maximum gamma-Chlordane Conc.	-	0.03	0.00
	Mean gamma-Chlordane Conc.	-	0.01	0.00
	Median gamma-Chlordane Conc.	-	0.01	0.00
	% Exceeding Trigger Level	-	0.00	0.00

<p align="center"><b>Table C-17 (cont.)</b>  <b>Summary of gamma-Chlordane Tissue Concentrations (ppm) and Frequency of Exceedences of 0.3 ppm Advisory Trigger Level for Fish in Green Bay</b></p>				
<b>Species</b>	<b>Parameter</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Chinook Salmon	No. of Samples	3	3	9
	Maximum gamma-Chlordane Conc.	0.05	0.05	0.05
	Mean gamma-Chlordane Conc.	0.05	0.05	0.04
	Median gamma-Chlordane Conc.	0.05	0.05	0.05
	% Exceeding Trigger Level	0.00	0.00	0.00
Lake Sturgeon	No. of Samples	-	1	-
	Maximum gamma-Chlordane Conc.	-	0.05	-
	Mean gamma-Chlordane Conc.	-	0.05	-
	Median gamma-Chlordane Conc.	-	0.05	-
	% Exceeding Trigger Level	-	0.00	-
Lake Trout	No. of Samples	8	-	-
	Maximum gamma-Chlordane Conc.	0.05	-	-
	Mean gamma-Chlordane Conc.	0.05	-	-
	Median gamma-Chlordane Conc.	0.05	-	-
	% Exceeding Trigger Level	0.00	-	-
Lake Whitefish	No. of Samples	5	1	10
	Maximum gamma-Chlordane Conc.	0.05	0.05	0.02
	Mean gamma-Chlordane Conc.	0.05	0.05	0.01
	Median gamma-Chlordane Conc.	0.05	0.05	0.01
	% Exceeding Trigger Level	0.00	0.00	0.00
Longnose Sucker	No. of Samples	-	10	12
	Maximum gamma-Chlordane Conc.	-	0.03	0.04
	Mean gamma-Chlordane Conc.	-	0.02	0.02
	Median gamma-Chlordane Conc.	-	0.02	0.02
	% Exceeding Trigger Level	-	0.00	0.00
Northern Pike	No. of Samples	2	10	-
	Maximum gamma-Chlordane Conc.	0.05	0.00	-
	Mean gamma-Chlordane Conc.	0.05	0.00	-
	Median gamma-Chlordane Conc.	0.05	0.00	-
	% Exceeding Trigger Level	0.00	0.00	-

<p align="center"><b>Table C-17 (cont.)</b>  <b>Summary of gamma-Chlordane Tissue Concentrations (ppm) and Frequency of Exceedences of 0.3 ppm Advisory Trigger Level for Fish in Green Bay</b></p>				
<b>Species</b>	<b>Parameter</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Rainbow Smelt	No. of Samples	3	-	-
	Maximum gamma-Chlordane Conc.	0.05	-	-
	Mean gamma-Chlordane Conc.	0.05	-	-
	Median gamma-Chlordane Conc.	0.05	-	-
	% Exceeding Trigger Level	0.00	-	-
Rainbow Trout	No. of Samples	-	2	11
	Maximum gamma-Chlordane Conc.	-	0.05	0.05
	Mean gamma-Chlordane Conc.	-	0.05	0.02
	Median gamma-Chlordane Conc.	-	0.05	0.01
	% Exceeding Trigger Level	-	0.00	0.00
Smallmouth Bass	No. of Samples	-	-	7
	Maximum gamma-Chlordane Conc.	-	-	0.00
	Mean gamma-Chlordane Conc.	-	-	0.00
	Median gamma-Chlordane Conc.	-	-	0.00
	% Exceeding Trigger Level	-	-	0.00
Splake	No. of Samples	-	15	12
	Maximum gamma-Chlordane Conc.	-	0.05	0.05
	Mean gamma-Chlordane Conc.	-	0.05	0.03
	Median gamma-Chlordane Conc.	-	0.05	0.01
	% Exceeding Trigger Level	-	0.00	0.00
Walleye	No. of Samples	-	20	24
	Maximum gamma-Chlordane Conc.	-	0.03	0.01
	Mean gamma-Chlordane Conc.	-	0.01	0.00
	Median gamma-Chlordane Conc.	-	0.00	0.00
	% Exceeding Trigger Level	-	0.00	0.00
White Sucker	No. of Samples	-	10	-
	Maximum gamma-Chlordane Conc.	-	0.01	-
	Mean gamma-Chlordane Conc.	-	0.00	-
	Median gamma-Chlordane Conc.	-	0.00	-
	% Exceeding Trigger Level	-	0.00	-

**Table C-17 (cont.)**  
**Summary of gamma-Chlordane Tissue Concentrations (ppm) and Frequency**  
**of Exceedences of 0.3 ppm Advisory Trigger Level for Fish in Green Bay**

<b>Species</b>	<b>Parameter</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Yellow Perch	No. of Samples	5	-	9
	Maximum gamma-Chlordane Conc.	0.05	-	0.05
	Mean gamma-Chlordane Conc.	0.05	-	0.05
	Median gamma-Chlordane Conc.	0.05	-	0.05
	% Exceeding Trigger Level	0.00	-	0.00

**Table C-18**  
**Summary of Dieldrin Tissue Concentrations (ppm) and Frequency of Exceedences**  
**of 0.3 ppm Advisory Trigger Level for Fish in Green Bay**

<b>Species</b>	<b>Parameter</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Alewife	No. of Samples	2	-	-
	Maximum Dieldrin Conc.	0.02	-	-
	Mean Dieldrin Conc.	0.02	-	-
	Median Dieldrin Conc.	0.02	-	-
	% Exceeding Trigger Level	0.00	-	-
Brook Trout	No. of Samples	1	-	2
	Maximum Dieldrin Conc.	0.02	-	0.02
	Mean Dieldrin Conc.	0.02	-	0.02
	Median Dieldrin Conc.	0.02	-	0.02
	% Exceeding Trigger Level	0.00	-	0.00
Brown Bullhead	No. of Samples	3	-	-
	Maximum Dieldrin Conc.	0.02	-	-
	Mean Dieldrin Conc.	0.02	-	-
	Median Dieldrin Conc.	0.02	-	-
	% Exceeding Trigger Level	0.00	-	-
Brown Trout	No. of Samples	12	7	25
	Maximum Dieldrin Conc.	0.11	0.11	0.18
	Mean Dieldrin Conc.	0.06	0.08	0.05
	Median Dieldrin Conc.	0.06	0.08	0.04
	% Exceeding Trigger Level	0.00	0.00	0.00
Burbot	No. of Samples	-	-	9
	Maximum Dieldrin Conc.	-	-	0.01
	Mean Dieldrin Conc.	-	-	0.01
	Median Dieldrin Conc.	-	-	0.01
	% Exceeding Trigger Level	-	-	0.00
Carp	No. of Samples	-	19	8
	Maximum Dieldrin Conc.	-	0.12	0.01
	Mean Dieldrin Conc.	-	0.03	0.01
	Median Dieldrin Conc.	-	0.01	0.01
	% Exceeding Trigger Level	-	0.00	0.00
Chinook Salmon	No. of Samples	3	3	9
	Maximum Dieldrin Conc.	0.06	0.05	0.11
	Mean Dieldrin Conc.	0.06	0.03	0.04
	Median Dieldrin Conc.	0.06	0.02	0.02
	% Exceeding Trigger Level	0.00	0.00	0.00

**Table C-18 (cont.)  
Summary of Dieldrin Tissue Concentrations (ppm) and Frequency of Exceedences  
of 0.3 ppm Advisory Trigger Level for Fish in Green Bay**

<b>Species</b>	<b>Parameter</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Lake Sturgeon	No. of Samples	-	1	-
	Maximum Dieldrin Conc.	-	0.20	-
	Mean Dieldrin Conc.	-	0.20	-
	Median Dieldrin Conc.	-	0.20	-
	% Exceeding Trigger Level	-	0.00	-
Lake Trout	No. of Samples	14	-	-
	Maximum Dieldrin Conc.	0.24	-	-
	Mean Dieldrin Conc.	0.08	-	-
	Median Dieldrin Conc.	0.04	-	-
	% Exceeding Trigger Level	0.00	-	-
Lake Whitefish	No. of Samples	11	1	10
	Maximum Dieldrin Conc.	0.28	0.15	0.22
	Mean Dieldrin Conc.	0.08	0.15	0.16
	Median Dieldrin Conc.	0.05	0.15	0.16
	% Exceeding Trigger Level	0.00	0.00	0.00
Longnose Sucker	No. of Samples	-	10	12
	Maximum Dieldrin Conc.	-	0.16	0.17
	Mean Dieldrin Conc.	-	0.10	0.09
	Median Dieldrin Conc.	-	0.10	0.08
	% Exceeding Trigger Level	-	0.00	0.00
Northern Pike	No. of Samples	2	10	-
	Maximum Dieldrin Conc.	0.03	0.01	-
	Mean Dieldrin Conc.	0.02	0.01	-
	Median Dieldrin Conc.	0.02	0.00	-
	% Exceeding Trigger Level	0.00	0.00	-
Rainbow Smelt	No. of Samples	3	-	-
	Maximum Dieldrin Conc.	0.03	-	-
	Mean Dieldrin Conc.	0.02	-	-
	Median Dieldrin Conc.	0.02	-	-
	% Exceeding Trigger Level	0.00	-	-

**Table C-18 (cont.)  
Summary of Dieldrin Tissue Concentrations (ppm) and Frequency of Exceedences  
of 0.3 ppm Advisory Trigger Level for Fish in Green Bay**

<b>Species</b>	<b>Parameter</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Rainbow Trout	No. of Samples	-	2	11
	Maximum Dieldrin Conc.	-	0.04	0.06
	Mean Dieldrin Conc.	-	0.03	0.03
	Median Dieldrin Conc.	-	0.03	0.03
	% Exceeding Trigger Level	-	0.00	0.00
Smallmouth Bass	No. of Samples	-	-	7
	Maximum Dieldrin Conc.	-	-	0.01
	Mean Dieldrin Conc.	-	-	0.01
	Median Dieldrin Conc.	-	-	0.01
	% Exceeding Trigger Level	-	-	0.00
Splake	No. of Samples	-	15	12
	Maximum Dieldrin Conc.	-	0.08	0.10
	Mean Dieldrin Conc.	-	0.04	0.06
	Median Dieldrin Conc.	-	0.05	0.06
	% Exceeding Trigger Level	-	0.00	0.00
Walleye	No. of Samples	-	20	24
	Maximum Dieldrin Conc.	-	0.05	0.03
	Mean Dieldrin Conc.	-	0.02	0.01
	Median Dieldrin Conc.	-	0.01	0.01
	% Exceeding Trigger Level	-	0.00	0.00
White Sucker	No. of Samples	-	10	-
	Maximum Dieldrin Conc.	-	0.05	-
	Mean Dieldrin Conc.	-	0.01	-
	Median Dieldrin Conc.	-	0.01	-
	% Exceeding Trigger Level	-	0.00	-
Yellow Perch	No. of Samples	5	-	9
	Maximum Dieldrin Conc.	0.02	-	0.02
	Mean Dieldrin Conc.	0.02	-	0.02
	Median Dieldrin Conc.	0.02	-	0.02
	% Exceeding Trigger Level	0.00	-	0.00

**Table C-19**  
**Summary of 2,4-DDT Tissue Concentrations (ppm) and Frequency of Exceedences**  
**of 5.0 ppm Advisory Trigger Level for Fish in Green Bay**

<b>Species</b>	<b>Parameter</b>	<b>1985-1989</b>	<b>1990-1994</b>
Brook Trout	No. of Samples	-	2
	Maximum 2,4-DDT Conc.	-	0.05
	Mean 2,4-DDT Conc.	-	0.05
	Median 2,4-DDT Conc.	-	0.05
	% Exceeding Trigger Level	-	0.00
Brown Trout	No. of Samples	-	13
	Maximum 2,4-DDT Conc.	-	0.05
	Mean 2,4-DDT Conc.	-	0.05
	Median 2,4-DDT Conc.	-	0.05
	% Exceeding Trigger Level	-	0.00
Chinook Salmon	No. of Samples	2	8
	Maximum 2,4-DDT Conc.	0.05	0.05
	Mean 2,4-DDT Conc.	0.05	0.05
	Median 2,4-DDT Conc.	0.05	0.05
	% Exceeding Trigger Level	0.00	0.00
Lake Sturgeon	No. of Samples	1	-
	Maximum 2,4-DDT Conc.	0.05	-
	Mean 2,4-DDT Conc.	0.05	-
	Median 2,4-DDT Conc.	0.05	-
	% Exceeding Trigger Level	0.00	-
Rainbow Trout	No. of Samples	-	4
	Maximum 2,4-DDT Conc.	-	0.05
	Mean 2,4-DDT Conc.	-	0.05
	Median 2,4-DDT Conc.	-	0.05
	% Exceeding Trigger Level	-	0.00
Splake	No. of Samples	2	5
	Maximum 2,4-DDT Conc.	0.05	0.05
	Mean 2,4-DDT Conc.	0.05	0.05
	Median 2,4-DDT Conc.	0.05	0.05
	% Exceeding Trigger Level	0.00	0.00

**Table C-19 (cont.)**  
**Summary of 2,4-DDT Tissue Concentrations (ppm) and Frequency of Exceedences**  
**of 5.0 ppm Advisory Trigger Level for Fish in Green Bay**

<b>Species</b>	<b>Parameter</b>	<b>1985-1989</b>	<b>1990-1994</b>
Yellow Perch	No. of Samples	-	9
	Maximum 2,4-DDT Conc.	-	0.05
	Mean 2,4-DDT Conc.	-	0.05
	Median 2,4-DDT Conc.	-	0.05
	% Exceeding Trigger Level	-	0.00

**Table C-20**  
**Summary of 4,4-DDT Tissue Concentrations (ppm) and Frequency of Exceedences**  
**of 5.0 ppm Advisory Trigger Level for Fish in Green Bay**

<b>Species</b>	<b>Parameter</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Brook Trout	No. of Samples	-	-	2
	Maximum 4,4-DDT Conc.	-	-	0.05
	Mean 4,4-DDT Conc.	-	-	0.05
	Median 4,4-DDT Conc.	-	-	0.05
	% Exceeding Trigger Level	-	-	0.00
Brown Trout	No. of Samples	-	-	25
	Maximum 4,4-DDT Conc.	-	-	0.08
	Mean 4,4-DDT Conc.	-	-	0.04
	Median 4,4-DDT Conc.	-	-	0.05
	% Exceeding Trigger Level	-	-	0.00
Burbot	No. of Samples	-	-	9
	Maximum 4,4-DDT Conc.	-	-	0.02
	Mean 4,4-DDT Conc.	-	-	0.01
	Median 4,4-DDT Conc.	-	-	0.00
	% Exceeding Trigger Level	-	-	0.00
Carp	No. of Samples	-	19	8
	Maximum 4,4-DDT Conc.	-	0.02	0.00
	Mean 4,4-DDT Conc.	-	0.01	0.00
	Median 4,4-DDT Conc.	-	0.00	0.00
	% Exceeding Trigger Level	-	0.00	0.00
Chinook Salmon	No. of Samples	-	2	9
	Maximum 4,4-DDT Conc.	-	0.05	0.07
	Mean 4,4-DDT Conc.	-	0.05	0.05
	Median 4,4-DDT Conc.	-	0.05	0.05
	% Exceeding Trigger Level	-	0.00	0.00
Lake Sturgeon	No. of Samples	-	1	-
	Maximum 4,4-DDT Conc.	-	0.07	-
	Mean 4,4-DDT Conc.	-	0.07	-
	Median 4,4-DDT Conc.	-	0.07	-
	% Exceeding Trigger Level	-	0.00	-

**Table C-20 (cont.)  
Summary of 4,4-DDT Tissue Concentrations (ppm) and Frequency of Exceedences  
of 5.0 ppm Advisory Trigger Level for Fish in Green Bay**

<b>Species</b>	<b>Parameter</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Lake Trout	No. of Samples	6	-	-
	Maximum 4,4-DDT Conc.	1.51	-	-
	Mean 4,4-DDT Conc.	1.34	-	-
	Median 4,4-DDT Conc.	1.40	-	-
	% Exceeding Trigger Level	0.00	-	-
Lake Whitefish	No. of Samples	6	-	10
	Maximum 4,4-DDT Conc.	0.42	-	0.03
	Mean 4,4-DDT Conc.	0.20	-	0.02
	Median 4,4-DDT Conc.	0.20	-	0.02
	% Exceeding Trigger Level	0.00	-	0.00
Longnose Sucker	No. of Samples	-	10	12
	Maximum 4,4-DDT Conc.	-	0.18	0.19
	Mean 4,4-DDT Conc.	-	0.06	0.06
	Median 4,4-DDT Conc.	-	0.02	0.03
	% Exceeding Trigger Level	-	0.00	0.00
Northern Pike	No. of Samples	-	10	-
	Maximum 4,4-DDT Conc.	-	0.01	-
	Mean 4,4-DDT Conc.	-	0.01	-
	Median 4,4-DDT Conc.	-	0.00	-
	% Exceeding Trigger Level	-	0.00	-
Rainbow Trout	No. of Samples	-	-	11
	Maximum 4,4-DDT Conc.	-	-	0.05
	Mean 4,4-DDT Conc.	-	-	0.03
	Median 4,4-DDT Conc.	-	-	0.02
	% Exceeding Trigger Level	-	-	0.00
Smallmouth Bass	No. of Samples	-	-	7
	Maximum 4,4-DDT Conc.	-	-	0.01
	Mean 4,4-DDT Conc.	-	-	0.01
	Median 4,4-DDT Conc.	-	-	0.01
	% Exceeding Trigger Level	-	-	0.00

**Table C-20 (cont.)  
Summary of 4,4-DDT Tissue Concentrations (ppm) and Frequency of Exceedences  
of 5.0 ppm Advisory Trigger Level for Fish in Green Bay**

<b>Species</b>	<b>Parameter</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Splake	No. of Samples	-	2	12
	Maximum 4,4-DDT Conc.	-	0.05	0.05
	Mean 4,4-DDT Conc.	-	0.05	0.04
	Median 4,4-DDT Conc.	-	0.05	0.05
	% Exceeding Trigger Level	-	0.00	0.00
Walleye	No. of Samples	-	20	24
	Maximum 4,4-DDT Conc.	-	0.12	0.09
	Mean 4,4-DDT Conc.	-	0.02	0.01
	Median 4,4-DDT Conc.	-	0.01	0.01
	% Exceeding Trigger Level	-	0.00	0.00
White Sucker	No. of Samples	-	10	-
	Maximum 4,4-DDT Conc.	-	0.01	-
	Mean 4,4-DDT Conc.	-	0.01	-
	Median 4,4-DDT Conc.	-	0.00	-
	% Exceeding Trigger Level	-	0.00	-
Yellow Perch	No. of Samples	-	-	9
	Maximum 4,4-DDT Conc.	-	-	0.05
	Mean 4,4-DDT Conc.	-	-	0.05
	Median 4,4-DDT Conc.	-	-	0.05
	% Exceeding Trigger Level	-	-	0.00

**Table C-21**  
**Summary of Mercury Tissue Concentrations (ppm) and Frequency of Exceedences**  
**of 0.5 ppm Advisory Trigger Level for Fish in Green Bay**

<b>Species</b>	<b>Parameter</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Brown Trout	No. of Samples	-	-	12
	Maximum Mercury Conc.	-	-	0.23
	Mean Mercury Conc.	-	-	0.12
	Median Mercury Conc.	-	-	0.10
	% Exceeding Trigger Level	-	-	0.00
Burbot	No. of Samples	-	-	9
	Maximum Mercury Conc.	-	-	0.38
	Mean Mercury Conc.	-	-	0.31
	Median Mercury Conc.	-	-	0.31
	% Exceeding Trigger Level	-	-	0.00
Carp	No. of Samples	-	19	8
	Maximum Mercury Conc.	-	0.44	0.29
	Mean Mercury Conc.	-	0.21	0.28
	Median Mercury Conc.	-	0.21	0.29
	% Exceeding Trigger Level	-	0.00	0.00
Chinook Salmon	No. of Samples	-	-	1
	Maximum Mercury Conc.	-	-	0.05
	Mean Mercury Conc.	-	-	0.05
	Median Mercury Conc.	-	-	0.05
	% Exceeding Trigger Level	-	-	0.00
Lake Sturgeon	No. of Samples	-	1	-
	Maximum Mercury Conc.	-	0.21	-
	Mean Mercury Conc.	-	0.21	-
	Median Mercury Conc.	-	0.21	-
	% Exceeding Trigger Level	-	0.00	-
Lake Trout	No. of Samples	1	-	-
	Maximum Mercury Conc.	0.31	-	-
	Mean Mercury Conc.	0.31	-	-
	Median Mercury Conc.	0.31	-	-
	% Exceeding Trigger Level	0.00	-	-

**Table C-21 (cont.)  
Summary of Mercury Tissue Concentrations (ppm) and Frequency of Exceedences  
of 0.5 ppm Advisory Trigger Level for Fish in Green Bay**

<b>Species</b>	<b>Parameter</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Lake Whitefish	No. of Samples	-	1	10
	Maximum Mercury Conc.	-	0.03	0.04
	Mean Mercury Conc.	-	0.03	0.03
	Median Mercury Conc.	-	0.03	0.03
	% Exceeding Trigger Level	-	0.00	0.00
Longnose Sucker	No. of Samples	-	10	12
	Maximum Mercury Conc.	-	0.21	0.31
	Mean Mercury Conc.	-	0.13	0.16
	Median Mercury Conc.	-	0.10	0.14
	% Exceeding Trigger Level	-	0.00	0.00
Northern Pike	No. of Samples	-	10	-
	Maximum Mercury Conc.	-	0.39	-
	Mean Mercury Conc.	-	0.26	-
	Median Mercury Conc.	-	0.24	-
	% Exceeding Trigger Level	-	0.00	-
Rainbow Trout	No. of Samples	-	-	7
	Maximum Mercury Conc.	-	-	0.11
	Mean Mercury Conc.	-	-	0.08
	Median Mercury Conc.	-	-	0.09
	% Exceeding Trigger Level	-	-	0.00
Smallmouth Bass	No. of Samples	-	-	7
	Maximum Mercury Conc.	-	-	0.60
	Mean Mercury Conc.	-	-	0.36
	Median Mercury Conc.	-	-	0.31
	% Exceeding Trigger Level	-	-	14.29
Splake	No. of Samples	-	-	7
	Maximum Mercury Conc.	-	-	0.23
	Mean Mercury Conc.	-	-	0.14
	Median Mercury Conc.	-	-	0.14
	% Exceeding Trigger Level	-	-	0.00

**Table C-21 (cont.)  
Summary of Mercury Tissue Concentrations (ppm) and Frequency of Exceedences  
of 0.5 ppm Advisory Trigger Level for Fish in Green Bay**

<b>Species</b>	<b>Parameter</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Walleye	No. of Samples	-	20	24
	Maximum Mercury Conc.	-	0.96	1.15
	Mean Mercury Conc.	-	0.36	0.45
	Median Mercury Conc.	-	0.24	0.34
	% Exceeding Trigger Level	-	25.00	25.00
White Sucker	No. of Samples	-	10	-
	Maximum Mercury Conc.	-	0.30	-
	Mean Mercury Conc.	-	0.17	-
	Median Mercury Conc.	-	0.18	-
	% Exceeding Trigger Level	-	0.00	-

**Table C-22**  
**Summary of Toxaphene Tissue Concentrations (ppm) and Frequency of Exceedences**  
**of 5.0 ppm Advisory Trigger Level for Fish in Green Bay**

<b>Species</b>	<b>Parameter</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Alewife	No. of Samples	1	-	-
	Maximum Toxaphene Conc.	1.00	-	-
	Mean Toxaphene Conc.	1.00	-	-
	Median Toxaphene Conc.	1.00	-	-
	% Exceeding Trigger Level	0.00	-	-
Brown Trout	No. of Samples	-	-	12
	Maximum Toxaphene Conc.	-	-	0.60
	Mean Toxaphene Conc.	-	-	0.22
	Median Toxaphene Conc.	-	-	0.18
	% Exceeding Trigger Level	-	-	0.00
Burbot	No. of Samples	-	-	9
	Maximum Toxaphene Conc.	-	-	0.05
	Mean Toxaphene Conc.	-	-	0.05
	Median Toxaphene Conc.	-	-	0.05
	% Exceeding Trigger Level	-	-	0.00
Carp	No. of Samples	1	19	8
	Maximum Toxaphene Conc.	1.00	0.05	0.05
	Mean Toxaphene Conc.	1.00	0.05	0.05
	Median Toxaphene Conc.	1.00	0.05	0.05
	% Exceeding Trigger Level	0.00	0.00	0.00
Chinook Salmon	No. of Samples	-	-	1
	Maximum Toxaphene Conc.	-	-	0.05
	Mean Toxaphene Conc.	-	-	0.05
	Median Toxaphene Conc.	-	-	0.05
	% Exceeding Trigger Level	-	-	0.00
Lake Sturgeon	No. of Samples	-	1	-
	Maximum Toxaphene Conc.	-	2.00	-
	Mean Toxaphene Conc.	-	2.00	-
	Median Toxaphene Conc.	-	2.00	-
	% Exceeding Trigger Level	-	0.00	-

**Table C-22 (cont.)  
Summary of Toxaphene Tissue Concentrations (ppm) and Frequency of Exceedences  
of 5.0 ppm Advisory Trigger Level for Fish in Green Bay**

<b>Species</b>	<b>Parameter</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Lake Whitefish	No. of Samples	2	-	10
	Maximum Toxaphene Conc.	1.00	-	0.28
	Mean Toxaphene Conc.	1.00	-	0.20
	Median Toxaphene Conc.	1.00	-	0.20
	% Exceeding Trigger Level	0.00	-	0.00
Longnose Sucker	No. of Samples	-	10	12
	Maximum Toxaphene Conc.	-	0.35	0.50
	Mean Toxaphene Conc.	-	0.22	0.23
	Median Toxaphene Conc.	-	0.21	0.22
	% Exceeding Trigger Level	-	0.00	0.00
Northern Pike	No. of Samples	-	10	-
	Maximum Toxaphene Conc.	-	0.08	-
	Mean Toxaphene Conc.	-	0.05	-
	Median Toxaphene Conc.	-	0.05	-
	% Exceeding Trigger Level	-	0.00	-
Rainbow Trout	No. of Samples	-	-	7
	Maximum Toxaphene Conc.	-	-	0.35
	Mean Toxaphene Conc.	-	-	0.15
	Median Toxaphene Conc.	-	-	0.05
	% Exceeding Trigger Level	-	-	0.00
Smallmouth Bass	No. of Samples	-	-	7
	Maximum Toxaphene Conc.	-	-	0.08
	Mean Toxaphene Conc.	-	-	0.05
	Median Toxaphene Conc.	-	-	0.05
	% Exceeding Trigger Level	-	-	0.00
Splake	No. of Samples	-	-	7
	Maximum Toxaphene Conc.	-	-	0.25
	Mean Toxaphene Conc.	-	-	0.15
	Median Toxaphene Conc.	-	-	0.12
	% Exceeding Trigger Level	-	-	0.00

**Table C-22 (cont.)  
Summary of Toxaphene Tissue Concentrations (ppm) and Frequency of Exceedences  
of 5.0 ppm Advisory Trigger Level for Fish in Green Bay**

<b>Species</b>	<b>Parameter</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Walleye	No. of Samples	1	20	24
	Maximum Toxaphene Conc.	1.00	1.20	0.57
	Mean Toxaphene Conc.	1.00	0.24	0.10
	Median Toxaphene Conc.	1.00	0.11	0.05
	% Exceeding Trigger Level	0.00	0.00	0.00
White Sucker	No. of Samples	-	10	-
	Maximum Toxaphene Conc.	-	0.10	-
	Mean Toxaphene Conc.	-	0.06	-
	Median Toxaphene Conc.	-	0.05	-
	% Exceeding Trigger Level	-	0.00	-

**Table C-23**  
**Summary of Dioxin (2,3,7,8-TCDD) Tissue Concentrations (ppt) and Frequency of Exceedences of 10 ppt Advisory Trigger Level for Fish in Green Bay**

<b>Species</b>	<b>Parameter</b>	<b>1980-1984</b>	<b>1985-1989</b>
Brown Trout	No. of Samples	-	2
	Maximum 2,3,7,8-TCDD Conc.	-	2.90
	Mean 2,3,7,8-TCDD Conc.	-	2.90
	Median 2,3,7,8-TCDD Conc.	-	2.90
	% Exceeding Trigger Level	-	0.00
Carp	No. of Samples	2	1
	Maximum 2,3,7,8-TCDD Conc.	13.00	3.80
	Mean 2,3,7,8-TCDD Conc.	9.00	3.80
	Median 2,3,7,8-TCDD Conc.	9.00	3.80
	% Exceeding Trigger Level	0.00	0.00
Walleye	No. of Samples	2	-
	Maximum 2,3,7,8-TCDD Conc.	5.00	-
	Mean 2,3,7,8-TCDD Conc.	5.00	-
	Median 2,3,7,8-TCDD Conc.	5.00	-
	% Exceeding Trigger Level	0.00	-

**Table C-24**  
**Summary of Mirex Tissue Concentrations (ppm) and Frequency of Exceedences**  
**of Trigger Level for Fish in Green Bay**

<b>Species</b>	<b>Parameter</b>	<b>1985-1989</b>	<b>1990-1994</b>
Brown Trout	No. of Samples	-	12
	Maximum Mirex Conc.	-	0.00
	Mean Mirex Conc.	-	0.00
	Median Mirex Conc.	-	0.00
	% Exceeding Trigger Level	-	0.00
Burbot	No. of Samples	-	9
	Maximum Mirex Conc.	-	0.00
	Mean Mirex Conc.	-	0.00
	Median Mirex Conc.	-	0.00
	% Exceeding Trigger Level	-	0.00
Carp	No. of Samples	19	8
	Maximum Mirex Conc.	0.00	0.00
	Mean Mirex Conc.	0.00	0.00
	Median Mirex Conc.	0.00	0.00
	% Exceeding Trigger Level	0.00	0.00
Chinook Salmon	No. of Samples	-	1
	Maximum Mirex Conc.	-	0.00
	Mean Mirex Conc.	-	0.00
	Median Mirex Conc.	-	0.00
	% Exceeding Trigger Level	-	0.00
Lake Whitefish	No. of Samples	-	10
	Maximum Mirex Conc.	-	0.00
	Mean Mirex Conc.	-	0.00
	Median Mirex Conc.	-	0.00
	% Exceeding Trigger Level	-	0.00
Longnose Sucker	No. of Samples	10	12
	Maximum Mirex Conc.	0.00	0.00
	Mean Mirex Conc.	0.00	0.00
	Median Mirex Conc.	0.00	0.00
	% Exceeding Trigger Level	0.00	0.00

**Table C-24 (cont.)  
Summary of Mirex Tissue Concentrations (ppm) and Frequency of Exceedences  
of Trigger Level for Fish in Green Bay**

<b>Species</b>	<b>Parameter</b>	<b>1985-1989</b>	<b>1990-1994</b>
Northern Pike	No. of Samples	10	-
	Maximum Mirex Conc.	0.00	-
	Mean Mirex Conc.	0.00	-
	Median Mirex Conc.	0.00	-
	% Exceeding Trigger Level	0.00	-
Rainbow Trout	No. of Samples	-	7
	Maximum Mirex Conc.	-	0.00
	Mean Mirex Conc.	-	0.00
	Median Mirex Conc.	-	0.00
	% Exceeding Trigger Level	-	0.00
Smallmouth Bass	No. of Samples	-	7
	Maximum Mirex Conc.	-	0.00
	Mean Mirex Conc.	-	0.00
	Median Mirex Conc.	-	0.00
	% Exceeding Trigger Level	-	0.00
Splake	No. of Samples	-	7
	Maximum Mirex Conc.	-	0.00
	Mean Mirex Conc.	-	0.00
	Median Mirex Conc.	-	0.00
	% Exceeding Trigger Level	-	0.00
Walleye	No. of Samples	20	24
	Maximum Mirex Conc.	0.00	0.00
	Mean Mirex Conc.	0.00	0.01
	Median Mirex Conc.	0.00	0.00
	% Exceeding Trigger Level	0.00	0.00
White Sucker	No. of Samples	10	-
	Maximum Mirex Conc.	0.00	-
	Mean Mirex Conc.	0.00	-
	Median Mirex Conc.	0.00	-
	% Exceeding Trigger Level	0.00	-

**Table C-25**  
**Summary of Heptachlor Tissue Concentrations (ppm) and Frequency of Exceedences**  
**of Trigger Level for Fish in Green Bay**

<b>Species</b>	<b>Parameter</b>	<b>1985-1989</b>	<b>1990-1994</b>
Brown Trout	No. of Samples	-	12
	Maximum Heptachlor Conc.	-	0.00
	Mean Heptachlor Conc.	-	0.00
	Median Heptachlor Conc.	-	0.00
	% Exceeding Trigger Level	-	0.00
Burbot	No. of Samples	-	9
	Maximum Heptachlor Conc.	-	0.00
	Mean Heptachlor Conc.	-	0.00
	Median Heptachlor Conc.	-	0.00
	% Exceeding Trigger Level	-	0.00
Carp	No. of Samples	19	8
	Maximum Heptachlor Conc.	0.00	0.00
	Mean Heptachlor Conc.	0.00	0.00
	Median Heptachlor Conc.	0.00	0.00
	% Exceeding Trigger Level	0.00	0.00
Chinook Salmon	No. of Samples	-	1
	Maximum Heptachlor Conc.	-	0.00
	Mean Heptachlor Conc.	-	0.00
	Median Heptachlor Conc.	-	0.00
	% Exceeding Trigger Level	-	0.00
Lake Whitefish	No. of Samples	-	10
	Maximum Heptachlor Conc.	-	0.00
	Mean Heptachlor Conc.	-	0.00
	Median Heptachlor Conc.	-	0.00
	% Exceeding Trigger Level	-	0.00
Longnose Sucker	No. of Samples	10	12
	Maximum Heptachlor Conc.	0.00	0.00
	Mean Heptachlor Conc.	0.00	0.00
	Median Heptachlor Conc.	0.00	0.00
	% Exceeding Trigger Level	0.00	0.00

**Table C-25 (cont.)  
Summary of Heptachlor Tissue Concentrations (ppm) and Frequency of Exceedences  
of Trigger Level for Fish in Green Bay**

<b>Species</b>	<b>Parameter</b>	<b>1985-1989</b>	<b>1990-1994</b>
Northern Pike	No. of Samples	10	-
	Maximum Heptachlor Conc.	0.00	-
	Mean Heptachlor Conc.	0.00	-
	Median Heptachlor Conc.	0.00	-
	% Exceeding Trigger Level	0.00	-
Rainbow Trout	No. of Samples	-	7
	Maximum Heptachlor Conc.	-	0.00
	Mean Heptachlor Conc.	-	0.00
	Median Heptachlor Conc.	-	0.00
	% Exceeding Trigger Level	-	0.00
Smallmouth Bass	No. of Samples	-	7
	Maximum Heptachlor Conc.	-	0.00
	Mean Heptachlor Conc.	-	0.00
	Median Heptachlor Conc.	-	0.00
	% Exceeding Trigger Level	-	0.00
Splake	No. of Samples	-	7
	Maximum Heptachlor Conc.	-	0.00
	Mean Heptachlor Conc.	-	0.00
	Median Heptachlor Conc.	-	0.00
	% Exceeding Trigger Level	-	0.00
Walleye	No. of Samples	20	24
	Maximum Heptachlor Conc.	0.00	0.00
	Mean Heptachlor Conc.	0.00	0.01
	Median Heptachlor Conc.	0.00	0.00
	% Exceeding Trigger Level	0.00	0.00
White Sucker	No. of Samples	10	-
	Maximum Heptachlor Conc.	0.00	-
	Mean Heptachlor Conc.	0.00	-
	Median Heptachlor Conc.	0.00	-
	% Exceeding Trigger Level	0.00	-

**Table C-26**  
**Summary of 4,4-DDE Tissue Concentrations (ppm) and Frequency of Exceedences of Trigger Level for Fish in Green Bay**

Species	Parameter	1985-1989	1990-1994
Brook Trout	No. of Samples	-	2
	Maximum 4,4-DDE Conc.	-	0.06
	Mean 4,4-DDE Conc.	-	0.06
	Median 4,4-DDE Conc.	-	0.06
	% Exceeding Trigger Level	-	0.00
Brown Trout	No. of Samples	-	25
	Maximum 4,4-DDE Conc.	-	0.95
	Mean 4,4-DDE Conc.	-	0.27
	Median 4,4-DDE Conc.	-	0.21
	% Exceeding Trigger Level	-	0.00
Burbot	No. of Samples	-	9
	Maximum 4,4-DDE Conc.	-	0.24
	Mean 4,4-DDE Conc.	-	0.05
	Median 4,4-DDE Conc.	-	0.02
	% Exceeding Trigger Level	-	0.00
Carp	No. of Samples	19	8
	Maximum 4,4-DDE Conc.	2.63	0.36
	Mean 4,4-DDE Conc.	0.76	0.24
	Median 4,4-DDE Conc.	0.50	0.36
	% Exceeding Trigger Level	0.00	0.00
Chinook Salmon	No. of Samples	2	9
	Maximum 4,4-DDE Conc.	0.41	0.54
	Mean 4,4-DDE Conc.	0.29	0.25
	Median 4,4-DDE Conc.	0.29	0.24
	% Exceeding Trigger Level	0.00	0.00
Lake Sturgeon	No. of Samples	1	-
	Maximum 4,4-DDE Conc.	0.59	-
	Mean 4,4-DDE Conc.	0.59	-
	Median 4,4-DDE Conc.	0.59	-
	% Exceeding Trigger Level	0.00	-

**Table C-26 (cont.)**  
**Summary of 4,4-DDE Tissue Concentrations (ppm) and Frequency of Exceedences of Trigger Level for Fish in Green Bay**

<b>Species</b>	<b>Parameter</b>	<b>1985-1989</b>	<b>1990-1994</b>
Lake Whitefish	No. of Samples	-	10
	Maximum 4,4-DDE Conc.	-	0.22
	Mean 4,4-DDE Conc.	-	0.18
	Median 4,4-DDE Conc.	-	0.19
	% Exceeding Trigger Level	-	0.00
Longnose Sucker	No. of Samples	10	12
	Maximum 4,4-DDE Conc.	1.37	1.74
	Mean 4,4-DDE Conc.	0.56	0.70
	Median 4,4-DDE Conc.	0.28	0.52
	% Exceeding Trigger Level	0.00	0.00
Northern Pike	No. of Samples	10	-
	Maximum 4,4-DDE Conc.	0.12	-
	Mean 4,4-DDE Conc.	0.06	-
	Median 4,4-DDE Conc.	0.06	-
	% Exceeding Trigger Level	0.00	-
Rainbow Trout	No. of Samples	-	11
	Maximum 4,4-DDE Conc.	-	0.28
	Mean 4,4-DDE Conc.	-	0.18
	Median 4,4-DDE Conc.	-	0.18
	% Exceeding Trigger Level	-	0.00
Smallmouth Bass	No. of Samples	-	7
	Maximum 4,4-DDE Conc.	-	0.16
	Mean 4,4-DDE Conc.	-	0.10
	Median 4,4-DDE Conc.	-	0.09
	% Exceeding Trigger Level	-	0.00
Splake	No. of Samples	2	12
	Maximum 4,4-DDE Conc.	0.40	0.66
	Mean 4,4-DDE Conc.	0.34	0.29
	Median 4,4-DDE Conc.	0.34	0.28
	% Exceeding Trigger Level	0.00	0.00

**Table C-26 (cont.)  
Summary of 4,4-DDE Tissue Concentrations (ppm) and Frequency of Exceedences  
of Trigger Level for Fish in Green Bay**

<b>Species</b>	<b>Parameter</b>	<b>1985-1989</b>	<b>1990-1994</b>
Walleye	No. of Samples	20	24
	Maximum 4,4-DDE Conc.	1.70	1.20
	Mean 4,4-DDE Conc.	0.30	0.16
	Median 4,4-DDE Conc.	0.15	0.10
	% Exceeding Trigger Level	0.00	0.00
White Sucker	No. of Samples	10	-
	Maximum 4,4-DDE Conc.	0.32	-
	Mean 4,4-DDE Conc.	0.10	-
	Median 4,4-DDE Conc.	0.05	-
	% Exceeding Trigger Level	0.00	-
Yellow Perch	No. of Samples	-	9
	Maximum 4,4-DDE Conc.	-	0.05
	Mean 4,4-DDE Conc.	-	0.05
	Median 4,4-DDE Conc.	-	0.05
	% Exceeding Trigger Level	-	0.00

**Table C-27**  
**Summary of 2,4-DDD Tissue Concentrations (ppm) and Frequency of Exceedences of Trigger Level for Fish in Green Bay**

<b>Species</b>	<b>Parameter</b>	<b>1985-1989</b>	<b>1990-1994</b>
Brook Trout	No. of Samples	-	4
	Maximum 2,4-DDD Conc.	-	0.05
	Mean 2,4-DDD Conc.	-	0.05
	Median 2,4-DDD Conc.	-	0.05
	% Exceeding Trigger Level	-	0.00
Brown Trout	No. of Samples	-	26
	Maximum 2,4-DDD Conc.	-	0.05
	Mean 2,4-DDD Conc.	-	0.05
	Median 2,4-DDD Conc.	-	0.05
	% Exceeding Trigger Level	-	0.00
Chinook Salmon	No. of Samples	4	16
	Maximum 2,4-DDD Conc.	0.05	0.05
	Mean 2,4-DDD Conc.	0.05	0.05
	Median 2,4-DDD Conc.	0.05	0.05
	% Exceeding Trigger Level	0.00	0.00
Lake Sturgeon	No. of Samples	2	-
	Maximum 2,4-DDD Conc.	0.05	-
	Mean 2,4-DDD Conc.	0.05	-
	Median 2,4-DDD Conc.	0.05	-
	% Exceeding Trigger Level	0.00	-
Rainbow Trout	No. of Samples	-	8
	Maximum 2,4-DDD Conc.	-	0.05
	Mean 2,4-DDD Conc.	-	0.05
	Median 2,4-DDD Conc.	-	0.05
	% Exceeding Trigger Level	-	0.00
Splake	No. of Samples	4	10
	Maximum 2,4-DDD Conc.	0.05	0.05
	Mean 2,4-DDD Conc.	0.05	0.05
	Median 2,4-DDD Conc.	0.05	0.05
	% Exceeding Trigger Level	0.00	0.00

**Table C-27 (cont.)  
Summary of 2,4-DDD Tissue Concentrations (ppm) and Frequency of Exceedences  
of Trigger Level for Fish in Green Bay**

<b>Species</b>	<b>Parameter</b>	<b>1985-1989</b>	<b>1990-1994</b>
Yellow Perch	No. of Samples	-	18
	Maximum 2,4-DDD Conc.	-	0.05
	Mean 2,4-DDD Conc.	-	0.05
	Median 2,4-DDD Conc.	-	0.05
	% Exceeding Trigger Level	-	0.00

**Table C-28**  
**Summary of 2,4-DDE Tissue Concentrations (ppm) and Frequency of Exceedences of Trigger Level for Fish in Green Bay**

<b>Species</b>	<b>Parameter</b>	<b>1985-1989</b>	<b>1990-1994</b>
Brook Trout	No. of Samples	-	2
	Maximum 2,4-DDE Conc.	-	0.05
	Mean 2,4-DDE Conc.	-	0.05
	Median 2,4-DDE Conc.	-	0.05
	% Exceeding Trigger Level	-	0.00
Brown Trout	No. of Samples	-	13
	Maximum 2,4-DDE Conc.	-	0.05
	Mean 2,4-DDE Conc.	-	0.04
	Median 2,4-DDE Conc.	-	0.05
	% Exceeding Trigger Level	-	0.00
Chinook Salmon	No. of Samples	2	8
	Maximum 2,4-DDE Conc.	0.05	0.05
	Mean 2,4-DDE Conc.	0.05	0.04
	Median 2,4-DDE Conc.	0.05	0.05
	% Exceeding Trigger Level	0.00	0.00
Lake Sturgeon	No. of Samples	1	-
	Maximum 2,4-DDE Conc.	0.05	-
	Mean 2,4-DDE Conc.	0.05	-
	Median 2,4-DDE Conc.	0.05	-
	% Exceeding Trigger Level	0.00	-
Rainbow Trout	No. of Samples	-	4
	Maximum 2,4-DDE Conc.	-	0.05
	Mean 2,4-DDE Conc.	-	0.05
	Median 2,4-DDE Conc.	-	0.05
	% Exceeding Trigger Level	-	0.00
Splake	No. of Samples	2	5
	Maximum 2,4-DDE Conc.	0.05	0.14
	Mean 2,4-DDE Conc.	0.05	0.09
	Median 2,4-DDE Conc.	0.05	0.05
	% Exceeding Trigger Level	0.00	0.00

**Table C-28 (cont.)**  
**Summary of 2,4-DDE Tissue Concentrations (ppm) and Frequency of Exceedences**  
**of Trigger Level for Fish in Green Bay**

Species	Parameter	1985-1989	1990-1994
Yellow Perch	No. of Samples	-	9
	Maximum 2,4-DDE Conc.	-	0.05
	Mean 2,4-DDE Conc.	-	0.05
	Median 2,4-DDE Conc.	-	0.05
	% Exceeding Trigger Level	-	0.00

**Table C-29**  
**Summary of alpha-Chlordane Tissue Concentrations (ppm) and Frequency of Exceedences of 0.3 ppm Advisory Trigger Level for Fish in Northern Lake Michigan**

<b>Species</b>	<b>Parameter</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Bloater Chub	No. of Samples	7	-	2
	Maximum alpha-Chlordane Conc.	0.08	-	0.05
	Mean alpha-Chlordane Conc.	0.07	-	0.05
	Median alpha-Chlordane Conc.	0.07	-	0.05
	% Exceeding Trigger Level	0.00	-	0.00
Brook Trout	No. of Samples	1	3	-
	Maximum alpha-Chlordane Conc.	0.05	0.05	-
	Mean alpha-Chlordane Conc.	0.05	0.05	-
	Median alpha-Chlordane Conc.	0.05	0.05	-
	% Exceeding Trigger Level	0.00	0.00	-
Brown Trout	No. of Samples	9	3	17
	Maximum alpha-Chlordane Conc.	0.07	0.05	0.05
	Mean alpha-Chlordane Conc.	0.05	0.05	0.05
	Median alpha-Chlordane Conc.	0.05	0.05	0.05
	% Exceeding Trigger Level	0.00	0.00	0.00
Chinook Salmon	No. of Samples	37	38	16
	Maximum alpha-Chlordane Conc.	0.11	0.05	0.05
	Mean alpha-Chlordane Conc.	0.06	0.05	0.05
	Median alpha-Chlordane Conc.	0.05	0.05	0.05
	% Exceeding Trigger Level	0.00	0.00	0.00
Coho Salmon	No. of Samples	6	-	-
	Maximum alpha-Chlordane Conc.	0.05	-	-
	Mean alpha-Chlordane Conc.	0.05	-	-
	Median alpha-Chlordane Conc.	0.05	-	-
	% Exceeding Trigger Level	0.00	-	-
Lake Trout	No. of Samples	15	-	-
	Maximum alpha-Chlordane Conc.	0.33	-	-
	Mean alpha-Chlordane Conc.	0.18	-	-
	Median alpha-Chlordane Conc.	0.20	-	-
	% Exceeding Trigger Level	6.67	-	-

**Table C-29 (cont.)**  
**Summary of alpha-Chlordane Tissue Concentrations (ppm) and Frequency of Exceedences of 0.3 ppm Advisory Trigger Level for Fish in Northern Lake Michigan**

<b>Species</b>	<b>Parameter</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Lake Whitefish	No. of Samples	5	11	16
	Maximum alpha-Chlordane Conc.	0.05	0.11	0.05
	Mean alpha-Chlordane Conc.	0.05	0.06	0.05
	Median alpha-Chlordane Conc.	0.05	0.05	0.05
	% Exceeding Trigger Level	0.00	0.00	0.00
Pink Salmon	No. of Samples	2	-	-
	Maximum alpha-Chlordane Conc.	0.05	-	-
	Mean alpha-Chlordane Conc.	0.05	-	-
	Median alpha-Chlordane Conc.	0.05	-	-
	% Exceeding Trigger Level	0.00	-	-
Rainbow Trout	No. of Samples	5	1	-
	Maximum alpha-Chlordane Conc.	0.05	0.05	-
	Mean alpha-Chlordane Conc.	0.05	0.05	-
	Median alpha-Chlordane Conc.	0.05	0.05	-
	% Exceeding Trigger Level	0.00	0.00	-
Yellow Perch	No. of Samples	-	1	7
	Maximum alpha-Chlordane Conc.	-	0.05	0.05
	Mean alpha-Chlordane Conc.	-	0.05	0.05
	Median alpha-Chlordane Conc.	-	0.05	0.05
	% Exceeding Trigger Level	-	0.00	0.00

**Table C-30**  
**Summary of gamma-Chlordane Tissue Concentrations (ppm) and Frequency of Exceedences of 0.3 ppm Advisory Trigger Level for Fish in Northern Lake Michigan**

<b>Species</b>	<b>Parameter</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Bloater Chub	No. of Samples	7	-	2
	Maximum gamma-Chlordane Conc.	0.05	-	0.05
	Mean gamma-Chlordane Conc.	0.05	-	0.05
	Median gamma-Chlordane Conc.	0.05	-	0.05
	% Exceeding Trigger Level	0.00	-	0.00
Brook Trout	No. of Samples	1	3	-
	Maximum gamma-Chlordane Conc.	0.05	0.05	-
	Mean gamma-Chlordane Conc.	0.05	0.05	-
	Median gamma-Chlordane Conc.	0.05	0.05	-
	% Exceeding Trigger Level	0.00	0.00	-
Brown Trout	No. of Samples	9	3	17
	Maximum gamma-Chlordane Conc.	0.05	0.05	0.05
	Mean gamma-Chlordane Conc.	0.05	0.05	0.05
	Median gamma-Chlordane Conc.	0.05	0.05	0.05
	% Exceeding Trigger Level	0.00	0.00	0.00
Chinook Salmon	No. of Samples	37	38	16
	Maximum gamma-Chlordane Conc.	0.05	0.05	0.05
	Mean gamma-Chlordane Conc.	0.05	0.05	0.05
	Median gamma-Chlordane Conc.	0.05	0.05	0.05
	% Exceeding Trigger Level	0.00	0.00	0.00
Coho Salmon	No. of Samples	6	-	-
	Maximum gamma-Chlordane Conc.	0.05	-	-
	Mean gamma-Chlordane Conc.	0.05	-	-
	Median gamma-Chlordane Conc.	0.05	-	-
	% Exceeding Trigger Level	0.00	-	-
Lake Trout	No. of Samples	15	-	-
	Maximum gamma-Chlordane Conc.	0.14	-	-
	Mean gamma-Chlordane Conc.	0.08	-	-
	Median gamma-Chlordane Conc.	0.07	-	-
	% Exceeding Trigger Level	0.00	-	-

**Table C-30 (cont.)**  
**Summary of gamma-Chlordane Tissue Concentrations (ppm) and Frequency of Exceedences of 0.3 ppm Advisory Trigger Level for Fish in Northern Lake Michigan**

<b>Species</b>	<b>Parameter</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Lake Whitefish	No. of Samples	5	11	16
	Maximum gamma-Chlordane Conc.	0.05	0.09	0.05
	Mean gamma-Chlordane Conc.	0.05	0.05	0.05
	Median gamma-Chlordane Conc.	0.05	0.05	0.05
	% Exceeding Trigger Level	0.00	0.00	0.00
Pink Salmon	No. of Samples	2	-	-
	Maximum gamma-Chlordane Conc.	0.05	-	-
	Mean gamma-Chlordane Conc.	0.05	-	-
	Median gamma-Chlordane Conc.	0.05	-	-
	% Exceeding Trigger Level	0.00	-	-
Rainbow Trout	No. of Samples	5	1	-
	Maximum gamma-Chlordane Conc.	0.05	0.05	-
	Mean gamma-Chlordane Conc.	0.05	0.05	-
	Median gamma-Chlordane Conc.	0.05	0.05	-
	% Exceeding Trigger Level	0.00	0.00	-
Yellow Perch	No. of Samples	-	1	7
	Maximum gamma-Chlordane Conc.	-	0.05	0.05
	Mean gamma-Chlordane Conc.	-	0.05	0.05
	Median gamma-Chlordane Conc.	-	0.05	0.05
	% Exceeding Trigger Level	-	0.00	0.00

**Table C-31**  
**Summary of Dieldrin Tissue Concentrations (ppm) and Frequency of Exceedences**  
**of 0.3 ppm Advisory Trigger Level for Fish in Northern Lake Michigan**

<b>Species</b>	<b>Parameter</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Bloater Chub	No. of Samples	19	8	2
	Maximum Dieldrin Conc.	0.36	0.22	0.15
	Mean Dieldrin Conc.	0.27	0.15	0.15
	Median Dieldrin Conc.	0.27	0.14	0.15
	% Exceeding Trigger Level	15.79	0.00	0.00
Brook Trout	No. of Samples	1	3	-
	Maximum Dieldrin Conc.	0.03	0.06	-
	Mean Dieldrin Conc.	0.03	0.04	-
	Median Dieldrin Conc.	0.03	0.03	-
	% Exceeding Trigger Level	0.00	0.00	-
Brown Trout	No. of Samples	9	3	17
	Maximum Dieldrin Conc.	0.21	0.18	0.07
	Mean Dieldrin Conc.	0.12	0.14	0.04
	Median Dieldrin Conc.	0.12	0.12	0.04
	% Exceeding Trigger Level	0.00	0.00	0.00
Chinook Salmon	No. of Samples	37	38	16
	Maximum Dieldrin Conc.	0.25	0.07	0.08
	Mean Dieldrin Conc.	0.04	0.03	0.04
	Median Dieldrin Conc.	0.03	0.02	0.04
	% Exceeding Trigger Level	0.00	0.00	0.00
Coho Salmon	No. of Samples	6	-	-
	Maximum Dieldrin Conc.	0.07	-	-
	Mean Dieldrin Conc.	0.04	-	-
	Median Dieldrin Conc.	0.02	-	-
	% Exceeding Trigger Level	0.00	-	-
Lake Trout	No. of Samples	14	-	-
	Maximum Dieldrin Conc.	0.60	-	-
	Mean Dieldrin Conc.	0.35	-	-
	Median Dieldrin Conc.	0.33	-	-
	% Exceeding Trigger Level	71.43	-	-

**Table C-31 (cont.)  
Summary of Dieldrin Tissue Concentrations (ppm) and Frequency of Exceedences  
of 0.3 ppm Advisory Trigger Level for Fish in Northern Lake Michigan**

<b>Species</b>	<b>Parameter</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Lake Whitefish	No. of Samples	5	11	16
	Maximum Dieldrin Conc.	0.19	0.50	0.14
	Mean Dieldrin Conc.	0.15	0.19	0.05
	Median Dieldrin Conc.	0.16	0.16	0.04
	% Exceeding Trigger Level	0.00	18.18	0.00
Pink Salmon	No. of Samples	2	-	-
	Maximum Dieldrin Conc.	0.02	-	-
	Mean Dieldrin Conc.	0.02	-	-
	Median Dieldrin Conc.	0.02	-	-
	% Exceeding Trigger Level	0.00	-	-
Rainbow Trout	No. of Samples	5	1	-
	Maximum Dieldrin Conc.	0.07	0.02	-
	Mean Dieldrin Conc.	0.05	0.02	-
	Median Dieldrin Conc.	0.05	0.02	-
	% Exceeding Trigger Level	0.00	0.00	-
Yellow Perch	No. of Samples	-	1	7
	Maximum Dieldrin Conc.	-	0.02	0.02
	Mean Dieldrin Conc.	-	0.02	0.02
	Median Dieldrin Conc.	-	0.02	0.02
	% Exceeding Trigger Level	-	0.00	0.00

**Table C-32**  
**Summary of 2,4-DDT Tissue Concentrations (ppm) and Frequency of Exceedences**  
**of 5.0 ppm Advisory Trigger Level for Fish in Northern Lake Michigan**

<b>Species</b>	<b>Parameter</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Bloater Chub	No. of Samples	-	-	2
	Maximum 2,4-DDT Conc.	-	-	0.05
	Mean 2,4-DDT Conc.	-	-	0.05
	Median 2,4-DDT Conc.	-	-	0.05
	% Exceeding Trigger Level	-	-	0.00
Brown Trout	No. of Samples	-	-	17
	Maximum 2,4-DDT Conc.	-	-	0.05
	Mean 2,4-DDT Conc.	-	-	0.05
	Median 2,4-DDT Conc.	-	-	0.05
	% Exceeding Trigger Level	-	-	0.00
Chinook Salmon	No. of Samples	19	6	16
	Maximum 2,4-DDT Conc.	0.30	0.05	0.05
	Mean 2,4-DDT Conc.	0.14	0.05	0.05
	Median 2,4-DDT Conc.	0.10	0.05	0.05
	% Exceeding Trigger Level	0.00	0.00	0.00
Lake Trout	No. of Samples	10	-	-
	Maximum 2,4-DDT Conc.	1.00	-	-
	Mean 2,4-DDT Conc.	0.52	-	-
	Median 2,4-DDT Conc.	0.30	-	-
	% Exceeding Trigger Level	0.00	-	-
Lake Whitefish	No. of Samples	-	1	16
	Maximum 2,4-DDT Conc.	-	0.06	0.05
	Mean 2,4-DDT Conc.	-	0.06	0.05
	Median 2,4-DDT Conc.	-	0.06	0.05
	% Exceeding Trigger Level	-	0.00	0.00
Yellow Perch	No. of Samples	-	-	7
	Maximum 2,4-DDT Conc.	-	-	0.05
	Mean 2,4-DDT Conc.	-	-	0.05
	Median 2,4-DDT Conc.	-	-	0.05
	% Exceeding Trigger Level	-	-	0.00

**Table C-33**  
**Summary of 4,4-DDT Tissue Concentrations (ppm) and Frequency of Exceedences**  
**of 5.0 ppm Advisory Trigger Level for Fish in Northern Lake Michigan**

<b>Species</b>	<b>Parameter</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Bloater Chub	No. of Samples	-	-	2
	Maximum 4,4-DDT Conc.	-	-	0.05
	Mean 4,4-DDT Conc.	-	-	0.05
	Median 4,4-DDT Conc.	-	-	0.05
	% Exceeding Trigger Level	-	-	0.00
Brown Trout	No. of Samples	-	-	17
	Maximum 4,4-DDT Conc.	-	-	0.05
	Mean 4,4-DDT Conc.	-	-	0.05
	Median 4,4-DDT Conc.	-	-	0.05
	% Exceeding Trigger Level	-	-	0.00
Chinook Salmon	No. of Samples	19	6	16
	Maximum 4,4-DDT Conc.	0.14	0.08	0.09
	Mean 4,4-DDT Conc.	0.08	0.07	0.06
	Median 4,4-DDT Conc.	0.07	0.06	0.05
	% Exceeding Trigger Level	0.00	0.00	0.00
Lake Trout	No. of Samples	10	-	-
	Maximum 4,4-DDT Conc.	0.68	-	-
	Mean 4,4-DDT Conc.	0.33	-	-
	Median 4,4-DDT Conc.	0.30	-	-
	% Exceeding Trigger Level	0.00	-	-
Lake Whitefish	No. of Samples	-	1	16
	Maximum 4,4-DDT Conc.	-	0.31	0.10
	Mean 4,4-DDT Conc.	-	0.31	0.05
	Median 4,4-DDT Conc.	-	0.31	0.05
	% Exceeding Trigger Level	-	0.00	0.00
Yellow Perch	No. of Samples	-	-	7
	Maximum 4,4-DDT Conc.	-	-	0.05
	Mean 4,4-DDT Conc.	-	-	0.05
	Median 4,4-DDT Conc.	-	-	0.05
	% Exceeding Trigger Level	-	-	0.00

**Table C-34**  
**Summary of Mercury Tissue Concentrations (ppm) and Frequency of Exceedences**  
**of 0.5 ppm Advisory Trigger Level for Fish in Northern Lake Michigan**

<b>Species</b>	<b>Parameter</b>	<b>1985-1989</b>
Bloater Chub	No. of Samples	2
	Maximum Mercury Conc.	0.05
	Mean Mercury Conc.	0.04
	Median Mercury Conc.	0.04
	% Exceeding Trigger Level	0.00

**Table C-35**  
**Summary of Toxaphene Tissue Concentrations (ppm) and Frequency of Exceedences of 5.0 ppm Advisory Trigger Level for Fish in Northern Lake Michigan**

Species	Parameter	1980-1984	1985-1989
Chinook Salmon	No. of Samples	11	14
	Maximum Toxaphene Conc.	2.00	2.00
	Mean Toxaphene Conc.	1.09	1.14
	Median Toxaphene Conc.	1.00	1.00
	% Exceeding Trigger Level	0.00	0.00

**Table C-36**  
**Summary of 2,3,7,8-TCDD Tissue Concentrations (ppt) and Frequency of Exceedences**  
**of 10 ppt Advisory Trigger Level for Fish in Northern Lake Michigan**

Species	Parameter	1980-1984
Chinook Salmon	No. of Samples	1
	Maximum 2,3,7,8-TCDD Conc.	10.00
	Mean 2,3,7,8-TCDD Conc.	10.00
	Median 2,3,7,8-TCDD Conc.	10.00
	% Exceeding Trigger Level	0.00

**Table C-37**  
**Summary of Endrin Tissue Concentrations (ppm) and Frequency of Exceedences**  
**of Trigger Level for Fish in Northern Lake Michigan**

<b>Species</b>	<b>Parameter</b>	<b>1980-1984</b>
Chinook Salmon	No. of Samples	18
	Maximum Endrin Conc.	0.05
	Mean Endrin Conc.	0.02
	Median Endrin Conc.	0.02
	% Exceeding Trigger Level	0.00
Lake Trout	No. of Samples	10
	Maximum Endrin Conc.	0.05
	Mean Endrin Conc.	0.03
	Median Endrin Conc.	0.02
	% Exceeding Trigger Level	0.00

**Table C-38**  
**Summary of 4,4-DDE Tissue Concentrations (ppm) and Frequency of Exceedences**  
**of Trigger Level for Fish in Northern Lake Michigan**

<b>Species</b>	<b>Parameter</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Bloater Chub	No. of Samples	-	-	2
	Maximum 4,4-DDE Conc.	-	-	0.31
	Mean 4,4-DDE Conc.	-	-	0.26
	Median 4,4-DDE Conc.	-	-	0.26
	% Exceeding Trigger Level	-	-	0.00
Brown Trout	No. of Samples	-	-	17
	Maximum 4,4-DDE Conc.	-	-	0.48
	Mean 4,4-DDE Conc.	-	-	0.20
	Median 4,4-DDE Conc.	-	-	0.17
	% Exceeding Trigger Level	-	-	0.00
Chinook Salmon	No. of Samples	19	6	16
	Maximum 4,4-DDE Conc.	1.80	0.82	0.81
	Mean 4,4-DDE Conc.	0.96	0.52	0.47
	Median 4,4-DDE Conc.	0.92	0.50	0.41
	% Exceeding Trigger Level	0.00	0.00	0.00
Lake Trout	No. of Samples	9	-	-
	Maximum 4,4-DDE Conc.	17.00	-	-
	Mean 4,4-DDE Conc.	6.44	-	-
	Median 4,4-DDE Conc.	5.20	-	-
	% Exceeding Trigger Level	55.56	-	-
Lake Whitefish	No. of Samples	-	1	16
	Maximum 4,4-DDE Conc.	-	0.87	0.20
	Mean 4,4-DDE Conc.	-	0.87	0.08
	Median 4,4-DDE Conc.	-	0.87	0.06
	% Exceeding Trigger Level	-	0.00	0.00
Yellow Perch	No. of Samples	-	-	7
	Maximum 4,4-DDE Conc.	-	-	0.05
	Mean 4,4-DDE Conc.	-	-	0.05
	Median 4,4-DDE Conc.	-	-	0.05
	% Exceeding Trigger Level	-	-	0.00

**Table C-39**  
**Summary of 2,4-DDD Tissue Concentrations (ppm) and Frequency of Exceedences**  
**of Trigger Level for Fish in Northern Lake Michigan**

<b>Species</b>	<b>Parameter</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Bloater Chub	No. of Samples	-	-	4
	Maximum 2,4-DDD Conc.	-	-	0.05
	Mean 2,4-DDD Conc.	-	-	0.05
	Median 2,4-DDD Conc.	-	-	0.05
	% Exceeding Trigger Level	-	-	0.00
Brown Trout	No. of Samples	-	-	34
	Maximum 2,4-DDD Conc.	-	-	0.05
	Mean 2,4-DDD Conc.	-	-	0.05
	Median 2,4-DDD Conc.	-	-	0.05
	% Exceeding Trigger Level	-	-	0.00
Chinook Salmon	No. of Samples	38	12	32
	Maximum 2,4-DDD Conc.	0.06	0.05	0.05
	Mean 2,4-DDD Conc.	0.05	0.05	0.05
	Median 2,4-DDD Conc.	0.05	0.05	0.05
	% Exceeding Trigger Level	0.00	0.00	0.00
Lake Trout	No. of Samples	20	-	-
	Maximum 2,4-DDD Conc.	0.15	-	-
	Mean 2,4-DDD Conc.	0.07	-	-
	Median 2,4-DDD Conc.	0.05	-	-
	% Exceeding Trigger Level	0.00	-	-
Lake Whitefish	No. of Samples	-	2	32
	Maximum 2,4-DDD Conc.	-	0.05	0.05
	Mean 2,4-DDD Conc.	-	0.05	0.05
	Median 2,4-DDD Conc.	-	0.05	0.05
	% Exceeding Trigger Level	-	0.00	0.00
Yellow Perch	No. of Samples	-	-	14
	Maximum 2,4-DDD Conc.	-	-	0.05
	Mean 2,4-DDD Conc.	-	-	0.05
	Median 2,4-DDD Conc.	-	-	0.05
	% Exceeding Trigger Level	-	-	0.00

**Table C-40**  
**Summary of 2,4-DDE Tissue Concentrations (ppm) and Frequency of Exceedences**  
**of Trigger Level for Fish in Northern Lake Michigan**

<b>Species</b>	<b>Parameter</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>
Bloater Chub	No. of Samples	-	-	2
	Maximum 2,4-DDE Conc.	-	-	0.05
	Mean 2,4-DDE Conc.	-	-	0.05
	Median 2,4-DDE Conc.	-	-	0.05
	% Exceeding Trigger Level	-	-	0.00
Brown Trout	No. of Samples	-	-	17
	Maximum 2,4-DDE Conc.	-	-	0.05
	Mean 2,4-DDE Conc.	-	-	0.05
	Median 2,4-DDE Conc.	-	-	0.05
	% Exceeding Trigger Level	-	-	0.00
Chinook Salmon	No. of Samples	19	6	16
	Maximum 2,4-DDE Conc.	0.10	0.05	0.07
	Mean 2,4-DDE Conc.	0.09	0.05	0.04
	Median 2,4-DDE Conc.	0.10	0.05	0.05
	% Exceeding Trigger Level	0.00	0.00	0.00
Lake Trout	No. of Samples	6	-	-
	Maximum 2,4-DDE Conc.	0.30	-	-
	Mean 2,4-DDE Conc.	0.17	-	-
	Median 2,4-DDE Conc.	0.16	-	-
	% Exceeding Trigger Level	0.00	-	-
Lake Whitefish	No. of Samples	-	1	16
	Maximum 2,4-DDE Conc.	-	0.05	0.05
	Mean 2,4-DDE Conc.	-	0.05	0.05
	Median 2,4-DDE Conc.	-	0.05	0.05
	% Exceeding Trigger Level	-	0.00	0.00
Yellow Perch	No. of Samples	-	-	7
	Maximum 2,4-DDE Conc.	-	-	0.05
	Mean 2,4-DDE Conc.	-	-	0.05
	Median 2,4-DDE Conc.	-	-	0.05
	% Exceeding Trigger Level	-	-	0.00

