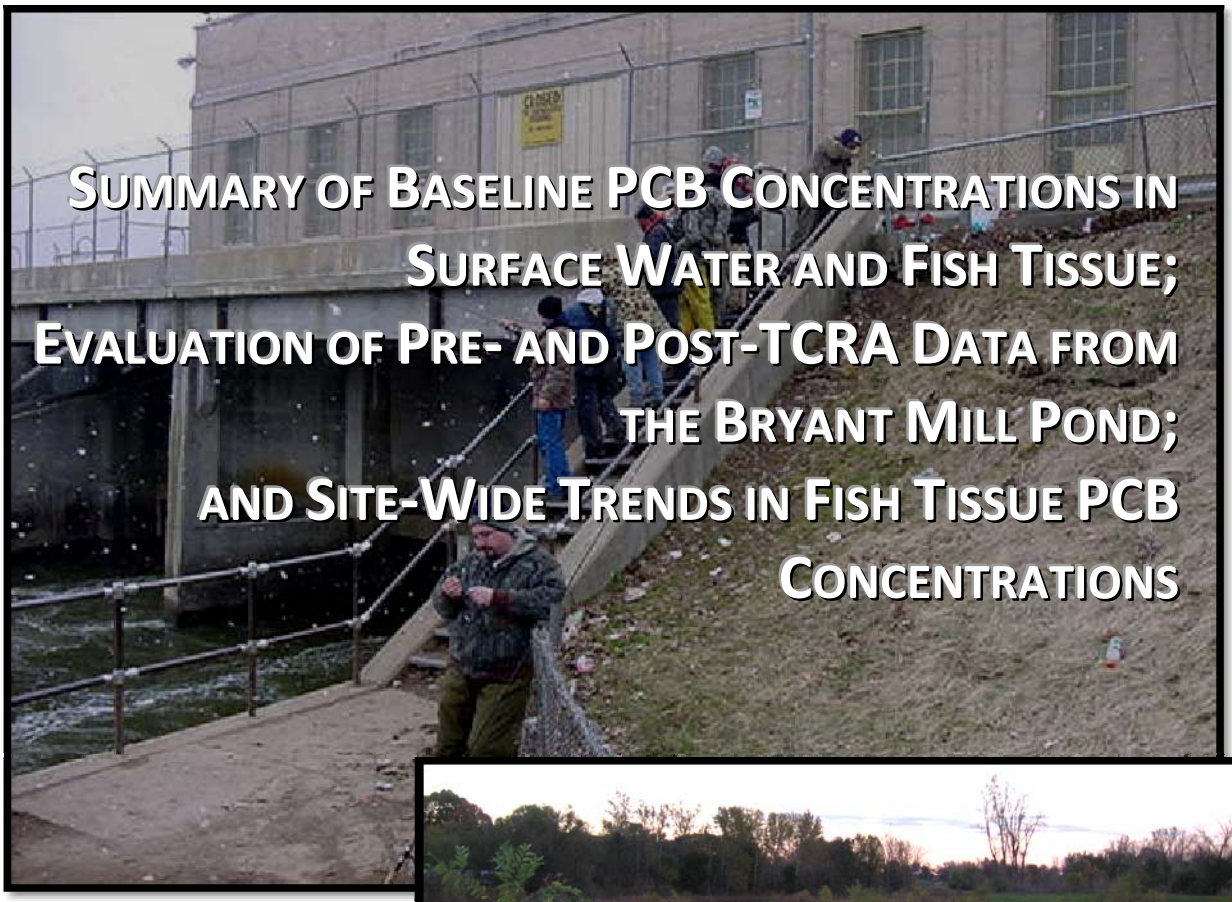
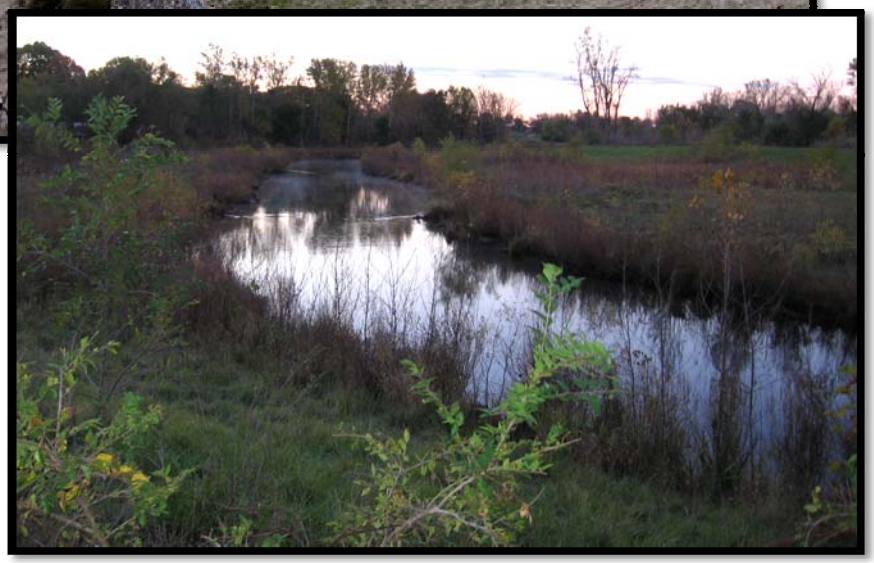
ALLIED PAPER INC./PORTAGE CREEK/
KALAMAZOO RIVER SUPERFUND SITE



SUMMARY OF BASELINE PCB CONCENTRATIONS IN SURFACE WATER AND FISH TISSUE; EVALUATION OF PRE- AND POST-TCRA DATA FROM THE BRYANT MILL POND; AND SITE-WIDE TRENDS IN FISH TISSUE PCB CONCENTRATIONS



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Prepared By:
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Acronyms and Abbreviations

2,3,7,8-TCDD	2,3,7,8-Tetrachlorodibenzo-p-dioxin
ABSA	Aquatic Biota Sampling Area
BBEPC	Blasland & Bouck Engineers, P.C
BBL	Blasland, Bouck, & Lee
BMP	Bryant Mill Pond
CDM	Camp Dresser & McKee
CFS	Cubic feet per Second
CM	Centimeter
FAWCAC	Fish and Wildlife Contaminant Advisory Committee
GLEAS	Great Lakes Environmental Assessment Section
IO	Inlet/Outlet
IRM	Interim remedial measures
L	Liter
L-N	Lipid-Normalized
LOAEL	Lowest Observable Adverse Effect Level
LTM	Long-Term Monitoring
MDCH	Michigan Department of Community Health
MDEQ	Michigan Department of Environmental Quality
MDNR	Michigan Department of Natural Resources
ML	Milliliter
ug/L	Micrograms per liter
mg/kg	Milligrams per kilogram
mg/l	Milligrams per liter
NEA	Northeast Analytical, Inc.
ng/kg	Nanograms per kilogram
ng/l	Nanograms per liter
NOAEL	No Observable Adverse Effect Level
NPL	National Priorities List
NRC	National Research Council
OU	Operable Unit
OU-1	Allied Paper, Inc. Operable Unit
OU-2	Willow Blvd/A-Site Landfills on the Kalamazoo River
OU-3	King Highway Landfill on the Kalamazoo River
OU-4	12th Street Landfill on the Kalamazoo River
PCB	Polychlorinated Biphenyl

PCDD	Polychlorinated dibenzo-p-dioxins
PCDF	Polychlorinated dibenzofurans
PPM	Parts per million
PPT	Parts per trillion
RA	Remedial and/or Removal Action
RI	Remedial Investigation
RP	Responsible Parties
RSD	Relative standard deviation
SITE	Allied Paper, Inc./Portage Creek/ Kalamazoo River Superfund Site
SOP	Standard operating procedure
SPMD	Semi-permeable membrane devices
STL	Severn Trent Laboratory
TCRA	Time Critical Removal Action
TEF	Toxicity Equivalent Factor
TEQ	Toxicity Equivalent Quotient
TSS	Total suspended solids
USACE	United States Army Corps of Engineers
US EPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WHO	World Health Organization
WW	Wet-weight
YOY	Young of year

Section 1
Introduction

In 1998, the Michigan Department of Environmental Quality (MDEQ) and Camp Dresser and McKee (CDM) initiated a Long Term Monitoring (LTM) program for the Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site (site) in southwestern Michigan. The objectives of this program were to:

- Collect data to develop a baseline data set for polychlorinated biphenyl (PCB) concentrations in fish and surface water prior to remediation activities at locations within the site.
- Document and monitor levels of PCB concentrations in fish and surface water after remediation activities have occurred to evaluate the effectiveness of remedial and/or removal action(s) (RA).
- Determine the utility of using caged channel catfish and semi-permeable membrane devices (SPMDs) as short-term, location specific sampling devices for measuring bioavailable PCBs.

The purpose of this report is to summarize the analytical results of surface water and fish sampling activities from 1999 to 2004 that represent a baseline data set for PCBs in these media. The report also includes fish data from 2006 which represent the first trend monitoring dataset. While overall averages and general spatial and temporal trends are presented in this summary report, more detailed discussion of the individual fish and surface water sampling as well as other sampling events (e.g., bedload and bedded sediments) can be found in the annual LTM reports for years 1999, 2000, and 2001 (CDM, 2001a; 2002a; 2002b).

This report also includes data collected before and after the United States Environmental Protection Agency (US EPA) completed a Time-Critical Removal Action (TCRA) in the Bryant Mill Pond (BMP) area of Portage Creek, in late 1999. Surface water and fish tissue data collected during Remedial Investigation (RI) activities at the Allied Paper, Inc. Operable Unit (OU-1) and data from the LTM program represent pre- and post-TCRA datasets, respectively.

The data are compared and an assessment of the effectiveness of the BMP TCRA is discussed further in Section 4. Site-wide trends in fish tissue PCB concentration are presented in Section 5. Section 6 is a general summary of how future LTM objectives will be met.

1.1 Site Description

The main stem of the Kalamazoo River begins in Albion, Michigan at the confluence of the North and South Branches of the Kalamazoo River, and flows northwesterly for 123 miles through Calhoun, Kalamazoo, and Allegan Counties to Lake Michigan at Saugatuck (see Figure 1.1). The Kalamazoo River drainage basin encompasses approximately 2,000 square miles and the Kalamazoo River is fed by more than 400 miles of tributaries, including Portage Creek (Blasland & Bouck Engineers, P.C. [BBEPC], 1992). Portage Creek begins in the city of Portage, Michigan and including its west fork, flows a distance of approximately 18.5 miles to its confluence with the Kalamazoo River in Kalamazoo, Michigan.

The Kalamazoo River is an alternating series of free flowing sections and impoundments formed by dams. The dams are commonly referred to as Plainwell, Otsego City, Otsego, Trowbridge, Allegan City, and Lake Allegan (or Calkins Dam). The Plainwell, Otsego, and Trowbridge dams have been removed to their sill levels, exposing approximately 507 acres of former instream sediments as floodplain sediments (BBEPC, 1992).

The exposed floodplain sediments in the Plainwell and Otsego Impoundments, in particular, contain PCB concentrations ranging from non-detect to 120 milligrams per kilogram (mg/kg), and these floodplain sediments have the potential to continually erode into the Kalamazoo River. Since these impoundments are located downstream of known historic source areas of PCBs, they serve as natural traps for PCB-contaminated sediments and are on-going sources of PCBs to the Kalamazoo River. Michigan Department of Natural Resources (MDNR) owns Plainwell, Otsego, and Trowbridge dams and their long-standing intention is to remove them and begin implementing its fisheries management plan. In 2008, a TCRA in the Plainwell Impoundment was completed which directed the Kalamazoo River flow around the dam, through the former powerhouse discharge channel. This action restored the river to free-flowing conditions. The Otsego City, Allegan City, and Lake Allegan dams are still intact, and Consumers Energy uses the Lake Allegan Dam to produce hydroelectric power.

Remedial evaluations and studies within the site have been broadly segmented into two phases. The Phase I study area encompasses the Kalamazoo River from Morrow Lake Dam to the Lake Allegan Dam, including Portage Creek from the confluence with the Kalamazoo River upstream to Cork Street. The Phase II study area extends from the Lake Allegan Dam down to the mouth of the Kalamazoo River at Lake Michigan.

There are four land-based operable units (OUs), 1 through 4, within the site. Each OU is or contains a PCB landfill(s) located adjacent to the Kalamazoo River or Portage Creek. Interim remedial measures (IRMs) have been implemented at OU-1, OU-2, and OU-3, while a RA at OU-4 is expected to take place in the near future. The OUs are identified below:

- OU-1: Allied Paper, Inc. on Portage Creek
- OU-2: Willow Blvd/A-Site Landfills on the Kalamazoo River
- OU-3: King Highway Landfill on the Kalamazoo River
- OU-4: 12th Street Landfill on the Kalamazoo River

The LTM program established monitoring locations both upstream and downstream of these land-based OUs and other locations (i.e., bracketing impoundments) along the Kalamazoo River and Portage Creek where future RAs are anticipated to occur.

1.2 Site History

In August 1990, the site was placed on the National Priorities List (NPL) in accordance with the Comprehensive Environmental Response, Compensation and Liability Act, 1980 PL 96-510 as amended by the Superfund Amendments and Reauthorization Act of 1986 also known as Superfund. The site, as designated by the NPL, includes the lower three miles of Portage Creek, from Cork Street to its confluence with the Kalamazoo River, 80 miles of the Kalamazoo River, from Morrow Lake Dam downstream to Lake Michigan, five paper residual disposal areas (landfills) and also five paper mill properties. The NPL identified PCBs as the primary contaminant of concern at the site.

The primary industrial activity associated with PCB releases into the environment was the recycling of PCB-containing carbonless copy paper at several area paper mills. In the process of de-inking and re-pulping recycled paper, the paper mills produced substantial quantities of waste residuals. During the period from 1957 to 1971, carbonless copy paper contained PCB as an ink solvent. Kalamazoo-area paper mills that de-inked or re-pulped the PCB-containing carbonless copy paper thereby incorporated PCB into their waste streams. These paper mills disposed of their

wastes in several ways that resulted in releases of PCB to the environment, including direct discharge to Portage Creek and the Kalamazoo River, and placement of waste in low-lying wet areas along the river, which are now referred to as the landfills. The paper waste contained kaolinite clay, which PCBs readily adsorb to. The clay commonly appears light gray in color in site sediments. PCBs are persistent in the environment and degradation via chemical oxidation, hydrolysis, and photolysis in soil or aquatic systems is generally insignificant (BBEPC, 1992).

The Michigan Department of Community Health (MDCH) has issued a species specific no-consumption fish advisory since 1977 for the Kalamazoo River and Portage Creek portions of this site. The Kalamazoo River and Portage Creek have been designated a site of environmental contamination under Part 201, Environmental Remediation, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA). The Kalamazoo River and Portage Creek also have been identified as an Area of Concern by the International Joint Commission on the Great Lakes due to the detrimental impact that PCB releases have on Lake Michigan.

Section 2
Methodology and Rationale

From 1999 to 2006, sampled media included fish (caged channel catfish, resident adult, yearling and young-of-year [YOY]), SPMDs, and surface water samples collected in the Kalamazoo River and Portage Creek. Appendix A-1 through A-7 summarizes these sampling events for each station on a yearly basis.

Sampling locations and protocols used for years 1999 and 2000 were in accordance to the 1999 LTM Sampling Plan (CDM, 1999). The sampling plan was modified in 2001 and a new sampling plan was produced. Locations and protocols used for years 2001 through 2006 were in accordance with the 2001 LTM Sampling Plan (CDM, 2001b).

2.1 Sampling Location Selection

Sampling stations (i.e., for surface water and fish) were selected to bracket known PCB source areas such as the impoundments formed by the dams, landfills, or exposed floodplain sediments. Analytical results from this sampling strategy are used to establish the baseline dataset for PCBs and can be used to evaluate the effectiveness of a RA at or from a particular segment of the river.

In addition, but to a lesser extent, some sampling stations were selected because they were historically sampled. Data collected as part of the LTM program can be used to evaluate seasonal and spatial distribution patterns and/or trends in PCBs. Figures 3.1, 3.17, 3.22, and 3.38 depict each sampling station for dry weather surface water sampling, wet weather surface water sampling, resident fish collection, and the caged channel catfish and SPMD study, respectively.

2.2 Sample Collection Methods

The sample collection methods used are described in the standard operating procedure (SOP) documents in Appendices A through F in the LTM Sampling Plan for 1999 and 2000 (CDM, 1999) and A through H in the LTM Sampling Plan (CDM, 2001b) for 2001 through 2004.

2.2.1 Surface Water

Surface water was collected for three different studies: Dry weather (base flow), wet weather ("rising" and "falling" limb, collected in 2000 and 2001) and during the caged channel catfish and SPMD studies. These surface water samples were collected to determine the distribution of PCBs during dry and wet weather conditions, as well as at one-week intervals during the 28-day caged channel catfish and SPMD study. Since sediments (instream and floodplain) are continuously entrained in and deposited from the water column, causing redistribution of PCB in the riverine system, surface water samples were also analyzed for total suspended solids (TSS). Surface water samples were not analyzed for TSS during sampling events in 1999.

Surface water samples were collected directly in 1-liter (L) amber glass bottles for PCB analysis and in 500 milliliter (mL) plastic bottles for TSS analysis. Both bottle types were lowered into the surface water simultaneously using a metal harness attached to a rope. The bottles were raised up and down through the water column to collect a depth-integrated sample. Samples were stored on ice in the field and during shipment until extraction by the MDEQ project laboratory, Northeast Analytical, Inc. (NEA).

In 1999, dry weather surface water samples were collected during baseflow conditions. In 2000 and 2001, discharge hydrographs as well as previous daily precipitation were monitored to determine base flow conditions. Discharge hydrographs were downloaded from the United States Geological

Survey (USGS) website at http://waterdata.usgs.gov/mi/nwis/current/ from gages: Battle Creek (USGS 04105000, Kalamazoo River near Battle Creek, MI), Comstock (USGS 04106000, Kalamazoo River at Comstock, MI), Plainwell (USGS 04106906, Kalamazoo River at Plainwell, MI), and Allegan (USGS 04107850, Kalamazoo River Near Allegan, MI). The final two gages (Plainwell and Allegan) were monitored from when they were installed in late 2000. On the mainstem of the Kalamazoo River, dry weather samples were collected at seventeen locations in 1999, nineteen locations in 2000 and fifteen locations in 2001. (Note that station 039 [Rock-Tenn outfall in Otsego] was sampled once in both 1999 and 2000, but was not included in the total sample counts for dry weather events.) Portage Creek was sampled at two locations in 1999 and 2001, and six locations in 2000. Figure 3.1 depicts the location of each sampling station and Appendix A-2 presents the dry weather stations that were sampled by date and location.

Wet weather surface water samples were collected during or just after a significant precipitation event (typically greater than 0.5 inches) that resulted in a discharge increase for the Kalamazoo River (referred to as the rising limb) based on the hydrographs from the USGS stream gages mentioned above. Once the hydrographs indicated discharge had peaked and was decreasing, a second set of samples were collected (referred to as the falling limb) from the same stations. Wet weather surface water samples were collected at ten locations in 2000 and fourteen locations in 2001. Figure 3.17 shows the location of each sampling station and Appendix A-3 presents the wet weather stations that were sampled by date and location.

On August 23, 2001, a rain event greater than 0.5 inches was occurring and the Kalamazoo River hydrographs were rising, which provided appropriate conditions for a "rising limb" wet weather surface water sampling event. However, upon reviewing the hydrograph data after the event, samples were actually collected at the "peak" of a wet weather event and not the "rising limb". The data collected during that "peak" flow of the wet weather event were reviewed and determined to be useful in establishing a baseline dataset for the Kalamazoo River and consequently, they also are presented in this report.

2.2.2 Resident Fish

Fish anglers, both recreational and subsistence, may be exposed to significant levels of PCB, via ingestion of fish, taken from contaminated reaches of the Kalamazoo River and Portage Creek. In many assessments of PCB contamination in river systems, consumption of contaminated fish has resulted in the highest estimates of exposure and health risk.

Fish were collected by electrofishing techniques (and procedures outlined in the LTM Sampling Plan [CDM, 2001b]) under the MDNR Fisheries Division collector's permit number BO247. Fish were collected from locations representing each reach of the river. Electrofishing was conducted in the Kalamazoo River using a boat mounted Coffelt Electroshocker. Electrofishing was done with a 3-feet diameter conductive ring attached to a boom or using a hand-held electrode probe. Shoreline areas of the Kalamazoo River and Portage Creek were the primary areas targeted for sample collection. Resident fish in Portage Creek were harvested using a Coffelt backpack electroshocker and the entire stream width was sampled. Sampling continued until a statistically significant dataset of eleven fish was obtained from each location. Ten locations were sampled in 1999, five in 2000, thirteen in 2001, one location each in 2002, 2003 and 2004, and thirteen in 2006. Figure 3.22 depicts the location of each sampling station and Appendix A-4 presents the fish stations that were sampled by date and location.

Adult carp (*Cyprinus carpio*) were targeted since they are bottom dwelling fish that may be exposed

to PCBs in sediment, and adult smallmouth bass (*Micropterus dolomieui*) were collected as they represent sport fish. In addition to collecting adult smallmouth bass, YOY smallmouth bass were collected to represent first year exposure to PCBs.

In 2000, 2001, 2002, and 2006, yearling white suckers (*Catastomus commersoni*) were collected from Portage Creek because YOY smallmouth bass were not available in adequate numbers. White suckers are bottom dwelling fish so they may be exposed to PCBs in sediment, similar to carp. One adult white sucker was also collected from Portage Creek, as it was determined during processing to be outside the length range for yearlings. In 2001 and 2002, YOY carp were also collected from Portage Creek and analyzed as composite samples.

During the baseline data collection, it became apparent that catfish were considered a sport fish and pursued by many anglers in places such as Morrow Lake, Lake Allegan, and downstream of the Lake Allegan dam to Lake Michigan. As a result, in 1999 and 2001, flathead (*Pylodictis olivaris*) and channel catfish (*Ictalurus punctatus*) were collected if encountered. In 2006, channel catfish were targeted in Lake Allegan. Other game fish (e.g., walleye[*Stizostedion vitreum*] northern pike [*Esox lucius*], brown trout [*Salmo trutta*], largemouth bass [*Micropterus salmoides*], rock bass [*Ambloplites rupestris*], and black crappie [*Pomoxis nigromaculatus*]) were collected as available in 2000.

Adult fish were analyzed for PCB Aroclors and tissue lipid content. YOY smallmouth, carp and yearling white suckers were analyzed for PCB congeners and tissue lipid content, with the exception of the white suckers in 2001 and 2002 which were analyzed for PCB Aroclors.

Length (see Figure 2.1) and weight of each fish were recorded in the field. Adult fish were individually processed, while YOY were combined into composite samples of 40 to 60 grams each (usually five fish). The only exception to the rule was for yearling white suckers collected in the BMP (station 61) in 2001, 2002, and 2006, when the yearlings were processed individually. All whole fish samples were stored on ice in the field and were frozen until processing by MDEQ personnel. Details on procedures and locations were the same as those outlined in Appendix B of the 1999 and 2001 LTM Sampling Plans (CDM, 1999; 2001b).

YOY smallmouth bass, carp, and yearling white sucker composite samples (in 2000) and individual whole body (in 2001, 2002, and 2006) were shipped directly to NEA for processing (i.e., grinding and homogenization) and analysis.

Figure 2.1. Adult Smallmouth Bass Being Measured

MDEQ staff filleted the adult fish (adult and yearling suckers were sent whole body to NEA) in accordance with MDEQ-Surface Water Quality Division Great Lakes Environmental Assessment Section (GLEAS) Procedure #31, and stored the fillets until processing and analysis by NEA. In 1999, PCB analysis was conducted by the MDCH. NEA conducted the analysis from 2000 through 2006. In all years, fish were submitted on ice and under a chain-of-custody to the respective laboratories.

While filleting adult fish, MDEQ staff identified the sex of each fish and removed certain parts for aging. In 2000 and 2001, dorsal spines and/or scales and opercles were removed. Adult smallmouth bass and carp were aged to establish a mechanism (e. g. length versus age) by which fish

age could be estimated in the field without going through time consuming aging techniques. Aging data were used to evaluate potential relationships between PCB concentrations and fish age, length, and weight. Results from the aging did not show reliable positive correlations, and therefore will not be addressed in this report. A detailed discussion of the results and conclusions of fish aging can be found in the 2000 and 2001 Final LTM reports (CDM, 2002a; 2002b).

2.2.3 Caged Channel Catfish and SPMD Study

Both caged channel catfish and SPMDs were deployed in the Kalamazoo River and Portage Creek to evaluate these as cost effective and natural resource conscience methods of monitoring PCB bioavailability.

MDEQ routinely uses caged channel catfish as indicators of bioavailable contaminant concentrations. Caged channel catfish are superior to mobile resident fish as indicators of site-specific contaminant concentrations as their movement is restricted within a stainless steel cage. Channel catfish are used rather than other species, such as fathead minnows (*Pimephales promelas*), due to their tolerance of poor water quality conditions.

SPMDs are polyethylene membrane packets containing a small amount of triglyceride lipid, triolein (see Figure 2.2). SPMDs accumulate hydrophobic contaminants (such as PCBs) by passive diffusion, similar to many aquatic organisms, and have been used as surrogates for fish. SPMDs are useful for determining site-specific concentrations of bioavailable contaminants in locations where aquatic organisms may not survive, or where populations could be depleted.

The caged channel catfish study was conducted consistent with MDEQ GLEAS Procedure #62. One cage with approximately 20 to 25 YOY channel catfish (usually equates to four composite samples of approximately 50 grams each) was placed at a station for an exposure period of 28 days. At the beginning of the study each year, a group of four whole-fish composite samples were used as a control group, and therefore were not deployed at any of the locations. Caged channel catfish were analyzed for PCB congeners and tissue lipid content. Details of procedures are the same as those outlined in Appendix D of the 1999 Final LTM Sampling Plan (CDM, 1999) and Appendix C of the Final LTM Sampling Plan (CDM, 2001b).

Figure 2.2. SPMD and Biofouling

A stainless steel tubular cage containing three SPMDs was attached to the channel catfish cage for the 28-day exposure period to maximize the comparability of these two sample types. Each SPMD was dialyzed into hexane and analyzed individually for PCB congeners. Details of procedures are the same as those outlined in Appendix E of the 1999 LTM Sampling Plan (CDM, 1999) and Appendix C of the 2001 LTM Sampling Plan (CDM, 2001b).

Caged channel catfish were placed at ten stations in 1999, five stations in 2000 and fourteen stations in 2001. Figure 3.38 depicts the location of each sampling station and Appendix A-5 presents the caged channel catfish stations that were sampled by date and location. Surface water samples were collected at the beginning of the study and each

week for four weeks (see Section 2.2.1). SPMDs were placed at the same locations as the caged channel catfish at ten stations in 1999, five in 2000, and a subset of five locations in 2001. Appendix A-6 presents the SPMD sampling stations by date and location. The results from these two sampling methods are compared in Section 3.3.4.

2.3 Sample Analysis Methods

PCB analyses for YOY smallmouth bass, YOY carp, yearling white sucker composites in 2000, individual yearling white suckers in 2002 and 2006, SPMDs, and surface water samples were congener-specific using high-resolution capillary gas chromatography. This procedure provides lower detection limits than Aroclor analyses conducted in similar matrices from earlier studies on the Kalamazoo River. Laboratory data sheets for PCB congener results are contained in appendices from the 1999, 2000 and 2001 Final LTM Reports (CDM 2001a; 2002a; 2002b). Recent data (i.e., data collected from 2002 to 2006) are included in this report in Appendix B. Adult carp, smallmouth bass, individual adult and yearling white suckers from 2001, and channel and flathead catfish samples were analyzed for PCB Aroclors. All fish tissue samples were analyzed for tissue lipid content as shown in Table 2-1.

Polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) are similar to PCBs, in that, they are persistent bioaccumulative contaminants found in many environmental matrices. Toxic effects of these compounds (i.e., reproductive, endocrine functions, mortality, et cetera) have been documented in birds, fish, and mammals. The most well-studied and toxic of these compounds is 2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD). Not all congeners of the PCDDs, PCDFs, and PCBs exhibit toxic or dioxin-like characteristics similar to 2,3,7,8-TCDD. Each has its own degree of toxicity, and as a result, seven of 75 PCDD congeners, 10 of 135 PCDF congeners, and 12 of 209 PCB congeners are normalized to the reference congener, 2,3,7,8-TCDD. Normalizing the data to 2,3,7,8-TCDD weighs the toxicity of each congener as a fraction of this reference compound.

PCDDs, PCDFs, and PCBs congeners are normalized to 2,3,7,8-TCDD by multiplying the analytical result in nanograms per kilogram (ng/kg) or parts per trillion (ppt) by the 2005 Toxicity Equivalent Factor (TEF), developed from the World Health Organization (WHO). Each congener has a specific TEF value that is a fraction of 2,3,7,8-TCDD, which has a value of 1. These TEFs were updated in 2005 and supersede the 1998 values (Van den Berg et al. 2006). The sum of this product is called the Toxicity Equivalent Quotient (TEQ). TEQ is the sum of all 17 congeners of PCDD and PCDF, and the sum of all 12 congeners of PCB. TEQs are used to determine the potential risk a given result poses to human health and the environment. For example, TEQs calculated from fish tissue results are compared to the MDCH's trigger level of 10 ppt for fish consumption advisories. Application of the 2005 WHO TEF values will result in slightly lower TEQs when compared with using the 1998 WHO TEF values.

Two adult carp with the highest PCB concentrations from five locations sampled in 2001 were analyzed for dioxin/furan congeners to determine if these constituents were at concentrations that pose a threat to human health and the environment. A total of ten adult carp were analyzed, two from each station: Lake Allegan, Trowbridge Impoundment, Allegan City Impoundment, Otsego Impoundment, and Plainwell Impoundment. Subsequently, eleven adult smallmouth bass from the Trowbridge Impoundment collected in 2001 were also analyzed for dioxin/furan congeners and the results for these analyses are summarized in Section 3.4. In 2003 and 2004, eleven adult carp from each year were collected and analyzed for dioxin/furans, in addition to, co-planar PCBs (at the request of US EPA). The dioxin/furan and co-planar PCB

analyses were performed by Severn Trent Laboratory (STL) in Sacramento, California.

Table 2-1 lists the analytical methods used for the LTM program.

Table 2-1 Analytical Methods

Matrix	Analyte	Method
Surface Water	PCB congeners	SW 846 – Method 8082 and NEA SOP - NE133-01
	Total suspended solids	U.S. EPA Method 160.2
Fish tissue: YOY smallmouth bass; YOY carp; yearling white suckers (2000, 2002, 2006); SPMDs; and caged channel catfish	PCB congeners	SW 846 – Method 8082 and NEA SOP - NE133-01.
	Tissue lipids	SW 846 – Method 3540
Fish tissue, 1999: Adult smallmouth bass, largemouth bass, carp, catfish, and brown trout	PCB Aroclors	Michigan Department of Public Health methods from Price, et al, 1986
	Tissue lipids	SW 846 – Method 3540
Fish tissue, 2000 through 2006 adult smallmouth bass, carp, catfish, white suckers (yearling and adult in 2001), and other game fish	PCB Aroclors	SW 846 – Method 8082
	Tissue lipids	SW 846 – Method 3540
	Dioxin/Furan	EPA Methods 1613 and 8290
	Co-Planar PCBs	EPA Method 1668

2.4 Sample Heterogeneity

Multiple samples were collected from all sampling events and media to evaluate the difference between samples collected at the same location, also known as sample heterogeneity. Three samples were collected along a transect at each surface water sampling station, as data evaluation of initial sampling events indicated a statistically significant variance between water samples collected from near bank and mid-channel locations (CDM, 1999). These variances in water samples can be attributed to many factors that may include substrate composition, meandering of the river, variations in flow, suspended solids, and PCB source deposits. With these factors in mind, the decision was made to collect three samples along each transect to provide a more accurate representation of water column conditions at the time of sample collection (CDM, 1999).

Eleven of each adult fish target species, five composites of YOY fish, four composites of caged channel catfish, and three SPMDs were collected from each sampling location. This was determined to be the minimum number by matrix to provide statistical significance to the results.

Sample heterogeneity was assessed by calculating a relative standard deviation (RSD) value, as follows:

$$RSD = (Standard\ Deviation/Mean) * 100$$

RSD is a statistical tool used to evaluate how well measurements collected at the same sampling location agreed with one another, after the data have been averaged. If the RSD is low, less than 30, then samples collected at the location are considered to be homogeneous and close to the average of the measurement being taken.

If the RSD is greater than 30, the samples were not as homogeneous as those with RSDs less than 30. Typically, an RSD in excess of 30 indicates that there is an outlier in the data set being averaged, which can skew the average higher or lower. Some contributing factors may include a localized "hot spot" of contamination, as in the case of some water samples, or environmental factors which led to a resident fish having high lipid content. An RSD in excess of 30 is not uncommon when collecting a relatively small number of living organisms in their natural habitat.

Regardless of RSD, all of the data presented in this document are considered usable. Data sets with corresponding RSDs have been presented in each

of the data tables in order to provide additional information on each sampling event.

Section 3
Baseline Data

This section of the report describes general spatial and temporal distribution patterns and general statistics (mean and standard deviation) of baseline data collected by MDEQ beginning in 1999. Section 4 discusses the pre- and post-TCRA surface water and resident fish datasets for the BMP; and, Section 5 evaluates site-wide trends in resident fish PCB concentrations.

3.1 Surface Water

Surface water samples were collected during dry weather events (base flow), wet weather events, and during the caged channel catfish and SPMD study. Samples were analyzed for PCB congeners and TSS. One exception is TSS was not analyzed for sampling events in 1999. Mean total PCB concentrations are calculated by averaging results from the three samples (right bank, mid-channel and left bank) collected along a transect at each sampling station. Seasonal PCB concentrations for each sampling station were calculated by averaging all the data collected over each season and station. Results for individual samples from 2002 and 2003 are included in Appendix B, while those data from 1999 through 2001 are included in the appendices of the annual LTM reports summarizing the 1999 (CDM, 2001a), 2000 (CDM, 2002a) and 2001 (CDM, 2002b) field seasons.

The MDEQ has established several criteria for evaluating surface water quality. The applicable criteria for PCBs are:

- Water Quality Based Effluent Limit (Act 451, Part 31, Rule 57(2) of 0.02 nanograms per liter (ng/L).
- Part 201 Groundwater Surface Water Interface Generic Cleanup Criteria of 200 ng/L.
- Part 201 Drinking Water Generic Cleanup Criteria of 500 ng/L.
- Ecological Risk Assessment (based on mink) of 1.6 to 1.97 ng/L (CDM, 2003b), which are the No Observable Adverse Effect Level (NOAEL) and Lowest Observable Adverse Effect Level (LOAEL), respectively.

3.1.1 Dry Weather Surface Water PCB Analytical Results

There were eight dry weather surface water sampling events conducted between 1999 and 2001 at stations depicted in Figure 3.1 and Appendix A-2. Samples were collected during different times of year in order to evaluate seasonal fluctuations in PCB concentrations. Surface water samples were collected for one spring event, four summer events, two fall events, and one winter event during base flow conditions. The sampling event dates are shown below and are also presented in Figures 3.2 through 3.8 along with the USGS mean daily discharge for the Kalamazoo River at Comstock and Portage Creek at West Fork and Near Kalamazoo gages.

- Spring: April 18 and 19, 2001.
- Summer: September 9 and 10, 1999; September 20 and 21, 1999; July 25 and 26, 2000; July 31, 2001.
- Fall: October 20 and 21, 1999; and October 17 through 21, 2000.
- Winter: January 11, 2000.

Spring Sampling Event

There appears to be minimal spatial variation in PCB concentrations in the Kalamazoo River and Portage Creek as shown in Figure 3.9. Mean total PCB concentrations in the Kalamazoo River ranged from non-detect at station 28 (Bluestar Highway bridge, in Douglas) to 1.57 ng/L at station 53 (Mosel Avenue) and 0.15 ng/L at station 60 (Portage Creek, at Romence Street) to 0.66 ng/L at station 58 (Bryant Street, downstream of Bryant Mill Pond) along Portage Creek as in Table 3-1. However, the spring dataset only contains one round of sampling and one sampling location upstream of Sprinkle road, therefore spatial and temporal patterns are not well defined.

Summer Sampling Events

There appears to be spatial patterns in the four summer surface water sampling events as shown in Figure 3.10. The lowest summer mean total PCB concentration in the Kalamazoo River was 0.34 ng/L recorded at station 16 (State Route 96, King Highway bridge) and the highest was 37.41 ng/L at station 21 (~200' downstream of Otsego Dam) as shown in Table 3-1. In general, mean total PCB concentrations are lowest in samples collected from upstream of the land-based operable units, then increase at Kalamazoo Avenue, and peak within the Otsego and Trowbridge Impoundments. Mean total PCB concentrations decrease below the Trowbridge Impoundment downstream to the Lake Allegan Dam, with an exception of the September 1999 events, where the mean PCB concentration at M-89 bridge and the inlet to Lake Allegan were higher. PCB concentrations downstream of the Lake Allegan Dam are lower than those observed in the impoundments and near land-based operable units, but are two to three times higher than stations upstream of the land-based operable units. Table 3-3 and Figure 3.10 summarize the data.

Portage Creek mean total PCB concentrations ranged from 0.36 to 25.09 ng/L, both recorded at station 14 (Kilgore Road bridge) as shown in Table 3-1. Figure 3.10 does not show a clear pattern in PCBs over the four sampling events on Portage Creek; however, mean total PCB concentrations nearly double between stations upstream and downstream of the BMP (also discussed in Section 4). One anomaly was station 14 (Kilgore Road bridge) on Sept. 9, 1999 when the mid-channel sample at this station was 71.4 ng/L and the two bank samples were 2.3 and 1.6 ng/L, respectively. This observation is discussed in the 1999 annual LTM Report (CDM, 2001a).

Fall Sampling Events

Mean total PCB concentrations for the two fall events (Figure 3.11) follow a similar pattern as observed in the summer events. The lowest fall mean total PCB concentration in the Kalamazoo River was 0.56 ng/L recorded at station 13 (River Road bridge, near Comstock) and the highest was 25.85 ng/L at station 22 (26th Street bridge downstream of Trowbridge Dam) as shown in Table 3-1. Consistent with summer results, fall analytical data indicate mean total PCB concentrations are the lowest in samples collected from upstream of the land-based operable units, and then increase near land-based operable units and in the impoundments to the inlet of Lake Allegan. While summer events showed a slight dip between the Otsego and Trowbridge Impoundment stations to the inlet of Lake Allegan, the fall events depicted a continual rise in PCB concentrations. Also consistent with summer patterns, mean total PCB concentrations decreased downstream of Lake Allegan but still remained higher than stations upstream of the land-based operable units as shown in Table 3-3.

Portage Creek fall surface water data were similar to observed patterns in the summer months. Mean total PCB concentrations nearly double between stations upstream and downstream of the BMP (also discussed in Section 4). Also,

station 14 (Kilgore Road bridge) which had both the highest and lowest observed concentration at 21.19 ng/L and 1.53 ng/L respectively, again was higher than along known source areas (i.e., land-based operable units). These results, however, also correspond to the highest RSD values which may indicate outliers in the dataset as shown in Table 3-1.

Winter Sampling Event
Mean total PCB concentrations recorded during the January 2000 event were similar to the spring event (i.e., there does not appear to be spatial variations in the winter dataset). With the exception of station 53 (Mosel Avenue) reported at 24.18 ng/L, all other stations along the Kalamazoo River and Portage Creek had mean total PCB concentrations ranging from non-detect to 2.6 ng/L, as depicted in Figure 3.12. Again, the winter data are from one sampling event and from only five stations, of which, the furthest downstream station was Mosel Avenue in Kalamazoo. Therefore, spatial and temporal patterns in surface water PCB concentrations may not be well defined.

3.1.2 Dry Weather Surface Water TSS Analytical Results

Spring Sampling Event
Mean TSS concentrations from the spring sampling event appear to be increasing from upstream to downstream in the Kalamazoo River as shown in Figure 3.13. Mean TSS concentrations ranged from 4.5 milligrams per liter (mg/L) at station 16 (State Route 96, King Highway bridge) to 14.3 mg/L at station 28 (Bluestar Highway bridge, Douglas), with a spike of 10.8 mg/L at station 19 (~100' downstream of Plainwell Dam) as presented in Table 3-2. Table 3-4 indicates that the highest TSS concentrations are below Lake Allegan Dam. At two stations sampled in Portage Creek, mean TSS concentrations increased from Cork Street to Alcott Street, which are the upstream and downstream stations for the BMP, respectively.

Summer Sampling Events
Mean TSS concentrations in the summer events appear to decrease from Ceresco Reservoir to the inlet of Morrow Lake. Mean TSS concentrations are relatively constant from downstream of Morrow Lake to Mosel Avenue, and then appear to decrease at D Avenue. Within the impoundments, mean TSS concentrations are relatively constant and then increase near the inlet of Lake Allegan. Mean TSS concentrations do start increasing again downstream of the Lake Allegan Dam, and consistent with the spring event, are some of the highest concentrations observed over the entire site as shown in Figure 3.14. Mean TSS concentrations ranged from 4.6 mg/L at station 12 (35th Street bridge, at Morrow Lake) to 51.2 mg/L at station 16 (State Route 96, King Highway bridge).

Portage Creek mean TSS concentrations, similar to the spring event, appear to be increasing between stations upstream and downstream of the BMP. Mean TSS concentrations for Portage Creek ranged from 1.3 mg/L at station 14 (Kilgore Road bridge) and 17.1 mg/L at station 58 (Bryant Street, downstream of Bryant Mill Pond).

Fall Sampling Event
There does not appear to be a defined spatial pattern in mean TSS concentration for the fall sampling event as depicted in Figure 3.15. All mean TSS concentrations are below 10 mg/L with the exception of station 22 (26th Street bridge downstream of Trowbridge Dam) at 41.5 mg/L and station 26 (58th Street bridge, downstream of New Richmond) at 13.1 mg/L. Mean TSS concentrations ranged from 3.5 mg/L at station 21 (~200' downstream of Otsego Dam) to 41.5 mg/L at station 22 (26th Street bridge downstream of Trowbridge Dam).

Winter Sampling Event
For the winter sampling event, mean TSS concentrations ranged from non-detect at station 13 (River Road bridge, near Comstock) to 7.53

mg/L at station 52 (Gull Street). Based on the limited stations sampled, mean TSS concentrations on the Kalamazoo River did not show any spatial variations between the five sampling stations for the winter sampling event as seen in Figure 3.16.

3.1.3 Dry Weather Surface Water Sampling Data Discussion

PCB concentrations in surface water were higher in summer and fall months compared to spring and winter months. This observation may be partly due to lower water temperatures in the spring and winter, which lower the PCB solubility, biological activity, et cetera. Both summer and fall PCB concentrations in the Kalamazoo River appear to follow a similar pattern, that is, PCBs start increasing at Kalamazoo Avenue and peak near the inlet to Lake Allegan. More specifically, the reaches adjacent to land-based operable units and the impoundments exhibited the highest PCB concentrations as depicted in Figures 3.10 and 3.11. This is also the reach of the Kalamazoo River which has the highest PCB concentrations found in exposed and instream sediments. Surface water PCB concentrations tend to decrease downstream of Lake Allegan Dam, but those are still higher than what is observed upstream of the land-based operable units. TSS concentrations, on average, were the highest downstream of Lake Allegan. TSS concentrations were also highest in the spring and summer months compared to winter and fall months as shown in Figures 3.13 to 3.16. In addition, both PCB and TSS data presented show a decrease in concentrations between the inlet and outlet of Lake Allegan Dam, indicating the lake may act as a PCB sink; however, the lake is also a PCB source for downstream areas (CDM, 1999).

3.1.4 Wet Weather Surface Water PCB Analytical Results

There were a total of three wet weather surface water sampling events conducted between 1999 and 2001 at stations depicted in Figure 3.17. Samples were collected on April 21 and 26, 2000 and April 24 and 26, 2001 when water in the Kalamazoo River and Portage Creek was rising in response to a precipitation event (rising limb of the hydrograph) and when the water was receding (falling limb of the hydrograph). On August 23, 2001 surface water samples were collected during a peak flow event. Ten stations were sampled in 2000, and fourteen in 2001. Wet weather events are noted on hydrographs from 2000 and 2001 (Figures 3.3 and 3.4).

Rising and Falling Limbs

Mean total PCB concentrations collected during the April 2000 rising limb ranged from non-detect at Station 26 (58th Street bridge, downstream of New Richmond) to 3.87 ng/L at station 57 (Michigan Avenue, upstream of Morrow Lake inlet, near Galesburg). During the falling limb, mean total PCB concentrations ranged from non-detect at all sample locations upstream of station 20 (Farmer Street bridge, in Otsego) to 1.12 ng/L at Station 23 (M-89 bridge, in Allegan). There appears to be little spatial variation in surface water PCB concentrations. Figure 3.18 does show that mean total PCB concentrations in the rising limb are generally higher than the falling limb for the April 2000 event. In addition, wet weather concentrations are generally similar to dry weather concentrations for the spring event.

Mean total PCB concentrations collected during the April 2001 rising limb ranged from non-detect at four stations to 2.78 ng/L at station 59 (Grand Street bridge in Allegan, downstream of the Allegan City Dam). During the falling limb, mean PCB ranged from non-detect at station 57 (Michigan Avenue, upstream of Morrow Lake inlet, near Galesburg) to 9.60 ng/L at station 60 (Portage Creek, at Romence Street). There appears to be little spatial variation in surface water PCB concentrations from upstream to downstream. Figure 3.18 shows that mean total PCB concentrations in the rising limb are

generally lower than the falling limb for the April 2001 event, which was opposite to what was observed in the April 2000 event. Again, concentrations for spring wet and dry weather sampling events appear to be similar, with wet weather events being slightly higher in magnitude.

The analytical results are summarized in Tables 3-5 and 3-7 for the rising limb and falling limb, respectively.

Peak Flow

Mean total PCB concentrations during the peak flow event in August 2001 ranged from 0.87 ng/L at station 60 (Portage Creek, at Romence Street) to 30.32 ng/L at station 59 (Grand Street bridge in Allegan, downstream of the Allegan City Dam). Figure 3.20 depicts mean total PCB concentrations are relatively constant from Michigan Avenue. (upstream of Morrow Lake) to D Avenue, and then appear to be increasing from the Plainwell Impoundment to near the inlet of Lake Allegan. Below Lake Allegan Dam, mean total PCB concentrations tend to decrease going downstream to a concentration slightly higher than stations upstream of the land-based operable units. This pattern was also observed in both the summer and fall dry weather events.

The analytical results are summarized in Tables 3-9 and 3-10 for the peak flow event.

3.1.5 Wet Weather Surface Water TSS Analytical Results

Mean TSS concentrations collected in the Kalamazoo River during the April 2000 rising and falling limbs appear to have spatial patterns as shown in Figure 3.19. Mean TSS concentrations tend to start increasing around the D Avenue station to near the inlet of Lake Allegan, and then decrease below Lake Allegan Dam to concentrations slightly above those observed along the land-based operable units. The rising limb, in general, has higher TSS concentrations than the falling limb. The reach downstream of Lake Allegan has higher concentrations than those observed upstream of the land-based operable units, however, Morrow Lake inlet that has the highest TSS concentrations in this segment.

Mean TSS concentrations collected in the Kalamazoo River during the April 2001 rising and falling limbs also appear to have similar spatial patterns as the April 2000 events, but to a lower magnitude. Mean TSS concentrations were higher at all rising limb locations in April 2001, with the exception of stations 18 (U. S. 131 highway bridge, near Plainwell), 20 (Farmer Street bridge, in Otsego) and 26 (58th Street bridge, downstream of New Richmond). Again, the reach downstream of Lake Allegan has higher concentrations than those observed upstream of the land-based operable units. Spring wet weather TSS concentrations were generally double those observed in the dry weather spring events.

Mean TSS concentrations for the peak flow event, as depicted in Figure 3.21, exhibited a similar spatial pattern as the April 2000 rising limb event in Figure 3.19. Mean TSS concentrations stay relatively constant from stations upstream of the land-based operable units to D Avenue, and then begin to increase through the impoundment reach and peak near the inlet of Lake Allegan. Concentrations appear to decrease below Lake Allegan Dam and then stay fairly constant to Kalamazoo Lake. The reach below Lake Allegan exhibit slightly higher concentrations than those observed upstream of the land-based operable units.

The analytical results are summarized in Tables 3-6 and 3-8 for the rising limb and falling limb, respectively.

3.1.6 Wet Weather Surface Water Sampling Data Discussion

The peak event in August had similar to higher PCB and TSS concentrations when compared to

the spring rising and falling limb wet weather events. This pattern (i.e., higher PCBs in the summer compared to spring), were also observed in the dry weather sampling events. However, spring wet weather mean total PCB concentrations shown in Figure 3.18 are generally higher than those in the spring dry weather events (see Figure 3.9). In addition, spring wet weather mean TSS concentrations are almost double those in the spring dry weather events.

3.1.7 Surface Water Data Summary

Surface water PCB concentrations tend to increase and be highest near land-based operable units and within the impoundments. Surface water PCB concentrations downstream of Lake Allegan are usually lower than those observed near the land-based operable units and within the impoundments, but are still higher than those observed upstream of the site (see Table 3-3). Also, summer and fall surface water PCB concentrations are generally higher than those observed in the spring and winter as shown in Table 3-1.

The results of samples collected during dry or wet weather conditions were not observed to be significantly different.

3.2 Resident Fish Collections

Resident fish were collected from ten different reaches of the Kalamazoo River in 1999, four reaches in 2000, eleven reaches in 2001, and thirteen reaches in 2006 (see Figure 3.22). For Portage Creek, one reach was sampled in 2000, two reaches in 2001, and two reaches in 2006. A summary of the total number of fish collected from each reach of the Kalamazoo River and Portage Creek during the baseline data collection period is included in Table 3-11 and Appendix A-4.

The target species for fish sampling included the following:

- 11 adult carp (greater than or equal to 18 inches total length)
- 11 adult smallmouth bass (greater than or equal to 10 inches total length)
- Enough YOY smallmouth bass (5 to 12 centimeters standard length) to create five composite samples weighing approximately 40 to 60 grams each (typically 5 YOY per composite).

In addition, three channel catfish (*Ictalurus punctatus)* were collected in 1999. Subsequent to the 1999 resident fish collection efforts, it became apparent that many anglers fishing the Kalamazoo River pursue catfish. Therefore, any catfish encountered was collected for potential use in evaluating human health risk. In 2006, to be consistent with the statistically significant datasets of resident fish, eleven channel catfish were targeted and successfully collected from Lake Allegan.

A very limited number of game fish, including two brown trout, three largemouth bass, one rock bass, two walleye, one northern pike, and one black crappie were collected.

Length criteria for the adult carp and smallmouth bass were established in consultation with MDEQ personnel. Length criteria for the YOY smallmouth bass, YOY carp, and yearling/adult white suckers were derived from literature values of juvenile growth rates (Carlander, 1977; Wiegmann et al., 1997; Trautman, 1981), respectively.

The number of fish collected from each reach was consistent with the above stated objectives, with the exceptions listed below due to an apparent lack of readily available fish at that time:

- In 1999, only ten adult carp, eight adult smallmouth bass, and two of five composites

of YOY smallmouth bass were collected from New Richmond.

- In 2000, six carp were collected at Kalamazoo Avenue and five carp at D Avenue. Ten adult smallmouth bass were collected from Lake Allegan, no YOY smallmouth bass composites from D Avenue, and one of five composites from Kalamazoo Avenue.

- In 2001, only one adult smallmouth bass was collected from Kalamazoo Avenue, and ten adult smallmouth bass were collected from New Richmond. Two of five YOY smallmouth bass composites were collected from the Otsego City Impoundment. YOY carp composites were collected at the BMP since there were no YOY smallmouth bass (and again in 2002).

- In 2006, to limit the number of YOY smallmouth bass harvested and to maintain consistency in the number of samples per composite, four YOY were composited for each sample. The weight of each composite was between 27 and 82 grams.

MDCH conducted laboratory analyses of the 1999 fish tissue samples. NEA also analyzed a subset of the 1999 fish to evaluate the PCB results from each laboratory. Because these results were comparable (Mulcrone, 2001), NEA analyzed fish tissue samples from 2000 through 2006.

The State of Michigan fish consumption advisories are based on wet weight (ww) total PCB concentrations. Lipid-normalized (L-N) PCB concentrations, calculated by dividing the amount of PCB by the percentage of lipid in the fish tissue, helps reduce the variability in analyzing PCB fish data and are better for evaluating spatial and temporal trends and distribution patterns. Therefore, both ww and L-N results are discussed in this report.

The MDCH has established several "trigger levels" that provide fish consumption advisories for many contaminants. The current "trigger levels" for PCBs are:

WOMEN OF CHILD BEARING AGE AND CHILDREN UNDER 15 YEARS:

- 1 Meal Per Week, 0.05 parts per million (ppm)
- 1 Meal Per Month, 0.2 ppm
- 6 Meals Per Year, 1.0 ppm
- No Consumption, 1.9 ppm

GENERAL POPULATION:

- No Consumption, 2.0 ppm

While there are "trigger levels" for human consumption of PCB contaminated fish, there are no regulated criteria to compare fish tissue PCB concentrations against for ecological consumption (e.g., fish consumed by mink). The Ecological Risk Assessment for the site recommends the NOAEL and LOAEL for instream and floodplain sediment, which are associated with aquatic or semi-aquatic ecosystems, to be 0.5 mg/kg and 0.6 mg/kg, respectively (CDM, 2003b).

3.2.1 Adult Carp

Wet-weight PCB Results (Aroclors)

Adult carp mean total ww PCB concentrations ranged from 0.09 mg/kg ww at station 31 (Ceresco Reservoir) to 10.30 mg/kg ww at station 32 (Plainwell Impoundment) as shown in Table 3-12. Mean total ww PCB concentrations in the Kalamazoo River are lowest (below 1 mg/kg shown in Figure 3.23) at Ceresco and Morrow Lake, which are both upstream of the site and land-based operable units. In Portage Creek, mean total ww PCB concentrations ranged from 0.09 mg/kg ww at station 68 (Monarch Mill Pond) to 0.72 mg/kg ww at station 61 (BMP).

Mean total ww PCB concentrations start increasing at Kalamazoo Avenue (which is downstream of the Portage Creek and Kalamazoo River confluence) and peak within the Plainwell Impoundment. PCB concentrations are still high (above 2 mg/kg) within the impoundments downstream of Plainwell. Concentrations below Lake Allegan Dam are lower than those observed in the impoundments and near land-based operable units, but are still higher than upstream of the site.

Stations with data from multiple years are fairly consistent from year to year. For example, adult carp were collected from the Allegan City Impoundment for three years, and the mean total PCBs are within 10% of each other. The exception is at Otsego Dam, where one sample in 2001 contained approximately 50 mg/kg ww and the next highest PCB concentration was 9 mg/kg ww. This large gap between the two highest PCB concentrations skews the yearly average high.

Adult carp collected from two stations in Portage Creek indicate an overall average increase in mean total ww PCB concentrations between Monarch Mill Pond and the BMP of 0.13 to 0.41 mg/kg ww, respectively. Even though the concentrations within the BMP are three to four times higher, on average, than in the Monarch Mill Pond, the concentrations are much lower now compared to data collected pre-TCRA as discussed in Section 4.

Tissue Lipid Results
Mean tissue lipid content in adult carp (shown in Figure 3.24) for both the Kalamazoo River and Portage Creek follow similar spatial patterns as exhibited by ww PCB concentrations depicted in Figure 3.23; that is, lipid content in reaches upstream of the land-based operable units are generally the lowest and start to increase at Kalamazoo Avenue. Mean tissue lipid content then peaks at D Avenue and the Plainwell Impoundment with a similar decrease observed in the Otsego City Impoundment. The lowest mean tissue lipid result was observed in Lake Allegan. These data are summarized in Table 3-13.

Lipid-Normalized PCB Results (Aroclors)
Similar to the ww PCB concentrations and tissue lipid content, mean total L-N PCB concentrations in adult carp collected upstream of the land-based operable units are lower than those collected within the impoundments and near the land-based operable units. The L-N data depicted in Figure 3.25 shows an increase at Kalamazoo Avenue and then L-N PCB levels remain relatively constant going downstream through the impoundments to Lake Allegan. The two locations below Lake Allegan Dam appear to decrease going downstream toward Lake Michigan. Portage Creek L-N data shows an increase between Monarch Mill Pond and the BMP as shown in Table 3-14.

The L-N PCB data presented in Figure 3.25 shows that when ww PCB concentrations are normalized to lipid content, spatial patterns are more easily observed and provide a more accurate representation of patterns through the reaches.

3.2.2 Adult Smallmouth Bass

Wet-weight PCB Results (Aroclors)
Adult smallmouth bass mean total ww PCB concentrations ranged from 0.03 mg/kg ww at station 31 (Ceresco Reservoir) to 1.15 mg/kg ww at station 37 (Trowbridge Impoundment) as shown in Table 3-15. Mean total ww PCB concentrations in adult smallmouth bass were, on average, less than six times the concentrations observed in adult carp. Adult smallmouth bass collected from upstream of the land-based operable units have lower ww PCB concentrations than those collected within the impoundments and near the land-based operable units or downstream of Lake Allegan. Mean total ww PCB concentrations start to increase at Kalamazoo Avenue and remain relatively constant (i.e., between 0.5 mg/kg ww to 1.0 mg/kg ww)

downstream to Lake Michigan as depicted in Figure 3.26. The highest mean total ww PCB concentrations were observed in the Trowbridge Impoundment. PCB concentrations were also generally consistent from year to year (similar to temporal variability in adult carp).

Tissue Lipid Results
Mean lipid content in adult smallmouth bass for the Kalamazoo River follow similar spatial variations as exhibited by ww PCB concentrations (i.e., peaks and/or dips in lipid content correspond to peaks and/or dips in ww PCB concentrations) as shown in Figure 3.27 and summarized in Table 3-16 with two exceptions at Kalamazoo Lake and Ceresco. Mean tissue lipid content were generally consistent from year to year, with the highest being 1.9% at station 34 (Kalamazoo Lake) and the lowest being 0.3 % at station 29 (Morrow Lake).

Lipid-Normalized PCB Results (Aroclors)
Mean total L-N PCB concentrations are generally consistent with the adult carp data, that is, the lowest mean total L-N PCB concentrations are in adult smallmouth collected from reaches upstream of the land-based operable units. L-N PCB concentrations continue to increase near the land-based operable units and within the impoundments. Concentrations tend to decrease at the Allegan City Impoundment downstream to Lake Michigan (see Figure 3.28 and Table 3-17). The general pattern depicted in Figure 3.28 is also consistent with Figure 3.25, in that, the highest mean total normalized L-N PCB concentrations are found in the Trowbridge Impoundment.

3.2.3 YOY Smallmouth Bass

Wet-weight PCB Results (Congeners)
YOY smallmouth bass mean total ww PCB concentrations ranged from 0.10 mg/kg ww at station 31 (Ceresco Reservoir) to 3.75 mg/kg ww from station 38 (Allegan City Impoundment) as shown in Figure 3.29 and Table 3-18. Stations upstream of the land-based operable units are the lowest throughout the site. Mean total ww PCB concentrations in YOY smallmouth bass start increasing near Kalamazoo Avenue and peak in the Allegan City Impoundment. Downstream of Lake Allegan, mean total ww PCB concentrations are lower than what is observed in the impoundments, but are still two to three times higher than upstream of the land-based operable units. These data reflect a similar pattern observed for adult carp (see Figure 3.23) and adult smallmouth bass (see Figure 3.26), that is, ww PCB concentrations are lowest upstream of the land-based operable units and are highest in the impoundments and near the land-based operable units. YOY smallmouth bass ww mean total PCB concentrations are, in general, two to four times higher than those observed in adult smallmouth bass.

Tissue Lipid Results
There does not appear to be clear spatial variations in mean tissue lipid content in YOY smallmouth bass for the Kalamazoo River as shown in Figure 3.30 and summarized in Table 3-19. Mean tissue lipid content was generally consistent between 3 and 4 percent throughout the entire river, with Morrow Lake being consistently the lowest.

Lipid Normalized PCB Results (Congeners)
Mean total L-N PCB concentrations are generally consistent with those spatial patterns observed adult carp (Figure 3.25) and adult smallmouth bass (Figure 3.28). That is, the lowest PCB concentrations are in YOY smallmouth bass collected from upstream of the land-based operable units, then increasing within the impoundments and near the land-based operable units. Concentrations tend to decrease in Lake Allegan and downstream of the dam to Lake Michigan (see Figure 3.31 and Table 3-20).

3.2.4 Channel and Flathead Catfish

Wet-weight PCB Results (Aroclors)

Adult channel catfish total ww PCB concentrations ranged from 0.29 mg/kg ww at station 30 (Lake Allegan) to 5.09 mg/kg ww at station 37 (Trowbridge Impoundment). Adult flathead catfish total ww PCB concentrations, all collected from station 35 (New Richmond), ranged from 0.14 to 3.32 mg/kg ww. These data are presented in Table 3-21 and Figure 3.32

Adult channel catfish in Lake Allegan had slightly higher mean total ww PCB concentrations compared to adult carp (see Tables 3-12 and 3-22). This observation is in contrast at New Richmond, where mean total ww PCB concentrations for flathead and channel catfish were lower than adult carp. The datasets from Morrow Lake, Trowbridge, Allegan City, and Kalamazoo Lake are too small (i.e., only one or two catfish from each station) to compare to adult carp. Mean total PCB data for catfish are included in Table 3-22.

Eleven out of the 33 channel and flathead catfish were above the general population (2.0 mg/kg ww) advisory, while 21 out of 33 samples are above the 6 meals per year (1.0 mg/kg ww) fish consumption advisory.

Tissue Lipid Results

Channel and flathead catfish had tissue lipid levels ranging from 0.34 percent at station 30 (Lake Allegan) to 5.70 percent at station 37 (Trowbridge Reservoir) as shown in Table 3-21 and Figure 3.33.

Lipid Normalized PCB Results (Congeners)

Mean total L-N PCB concentrations for both the channel and flathead catfish ranged from 8.90 mg/kg ww lipid at station 29 (Morrow Lake) to 459.44 mg/kg ww lipid at station 30 (Lake Allegan) as shown in Table 3-21 and Figure 3.34. L-N PCB concentrations do appear to be increasing going upstream to downstream, however, since the datasets are small it is difficult to evaluate spatial patterns.

3.2.5 Other Fish

Eleven other fish representing seven species were collected from a total of five stations as presented in Table 3-23 and Figures 3.35 through 3.37. Because sample sizes are small per species, evaluating patterns spatially or temporally are difficult. However, when both carp, smallmouth bass, catfish, and the other game fish are considered, bottom dwelling species, in general, had higher PCB concentrations, both ww and L-N. The northern pike, walleye, and largemouth bass, all higher on the predatory trophic level, also had elevated PCB levels.

3.2.6 Resident Fish Data Summary

Spatial patterns in adult carp, smallmouth bass, YOY smallmouth bass, catfish, and other game fish ww or L-N PCB concentrations appear to be similar, in that, stations upstream of the land-based operable units exhibit the lowest PCB concentrations, and stations within the impoundments and near the land-based operable units exhibit the highest PCB concentrations, similar to the surface water datasets. Another pattern observed in the resident fish and surface water datasets is an increase in PCB concentrations near the confluence of the Kalamazoo River and Portage Creek.

Resident fish were always collected around the same time of year (i.e., late summer or early fall), so a discussion regarding seasonal patterns in fish tissue data is not warranted.

The resident fish data presented in this report from 1999 to 2006 provides a comprehensive PCB baseline data set and can be used to make a preliminary assessment regarding trends in resident fish PCB concentrations. Additional resident fish sampling will be conducted by MDEQ for trend monitoring in five year increments, with the next site-wide collection

effort scheduled for 2011. Additionally, to meet the LTM objective of evaluating the effectiveness of RAs, MDEQ will collect YOY fish from any area that is and has been subject to RAs. As discussed in the next section, caged channel catfish and SPMDs may be used in place of YOY fish so that existing populations are not exhausted. An evaluation of the effectiveness of a RA using adult, YOY, caged channel catfish, or SPMDs is possible because of the substantial LTM baseline dataset, and the consistent sampling techniques and laboratory analyses used for the LTM program since 1999.

3.3 Caged Channel Catfish and SPMD Study

Each year from 1999 to 2001, caged YOY channel catfish and SPMDs were co-located at sampling locations along the Kalamazoo River and Portage Creek. The channel catfish and SPMDs were utilized to evaluate one or both as potential short-term, site-specific indicators of bioavailable PCBs. Surface water samples were also collected when the caged channel catfish and SPMDs were deployed and in one-week intervals thereafter for 28 days. Caged channel catfish studies were conducted from August 11 to September 8, 1999; September 4 to October 4, 2000; and July 25 to August 22, 2001.

Caged channel catfish and SPMDs were placed at a total of 16 locations (not including the control) over all three years (Figure 3.38). Cages with YOY channel catfish were deployed at ten locations in 1999, five locations in 2000, and 14 locations in 2001. Three individual SPMDs were deployed with each cage at ten locations in 1999, five locations in 2000, and a subset of five locations in 2001.

In 1999, the cage deployed at station 4 (Plainwell) was lost, however, water samples were taken for all four weeks of the study. In 2001, on day eight of exposure at station 67 (Kalamazoo Avenue) the cage had been vandalized and the fish were missing. A new set of SPMDs were deployed on August 8 and left in place until September 5. Surface water samples were collected when the SPMDs were deployed on August 8 and subsequent one-week intervals until September 5.

3.3.1 Caged Channel Catfish Surface Water Results

Mean total PCB concentration in surface water samples ranged from 0.22 ng/L at station 1 (Ceresco Reservoir, off Dam Site Designs Property) to 57.47 ng/L at station 5 (~25' upstream of Otsego City Dam, along left bank) as shown in Table 3-24.

In all three years of sampling, the spatial distribution of mean total PCB concentrations in surface water samples collected during the cage study was fairly consistent during the 28-day exposure period (CDM, 2000; CDM, 2001a; CDM, 2001b). Figure 3.39 shows that the highest observed PCB concentrations in the Kalamazoo River during the studies were in the Otsego City Impoundment. In addition, 1999 surface water mean total PCB concentrations tended to be higher when compared to 2000 and 2001 data, with the exception of the Otsego City Impoundment. In Portage Creek, PCB concentrations appear to nearly double, on average, from the outlet of the Monarch Mill Pond to the outlet of the BMP.

Mean total PCB concentrations in the Kalamazoo River and Portage Creek were also similar to patterns observed in the summer dry weather sampling events (Section 3.1.1). PCB concentrations in surface water were lowest in stations upstream of the land-based operable units, then increased and were highest in the impoundments and near the land-based operable units. Subsequently, PCB concentrations decreased below Lake Allegan downstream toward Lake Michigan, but were still higher than upstream of the land-based operable units.

TSS concentrations were lowest in stations upstream of the land-based operable units during the 28 day exposure period. TSS data for years 2000 and 2001 are presented in Table 3-25 and Figure 3.40.

3.3.2 Caged Channel Catfish Results

Mean tissue lipid content ranged from 1.84% at station 8 (M-89 bridge in Allegan) to 5.15% at station 3 (Alcott Street, Portage Creek). Overall averages for tissue lipid content were within 1.8% of each other and were within 1% to 1.2% for all sampling years. As shown in Figure 3.42, the tissue lipid content is fairly consistent along the Kalamazoo River and Portage Creek from upstream to downstream. This observation was anticipated since all channel catfish were placed in the river at the same time. Lipid content generally decreases from 1999 to 2001. This may be attributed to the control fish, as the lipid content also decreased each year starting in 1999.

The spatial distribution of total PCB concentrations in caged fish is similar to patterns in surface water, and adult and YOY fish tissue samples. That is, PCB concentrations in caged channel catfish from stations upstream of the land-based operable units are lower than those observed in the impoundments and near the land-based operable units. Below Lake Allegan Dam, PCB concentrations are lower than the impoundments, but are still higher than those observed upstream of the land-based operable units. Both ww and L- N PCB concentrations were lowest in the Ceresco Reservoir. PCB concentrations in tissue levels from Portage Creek tend to increase between Monarch Mill Pond and the BMP. Analytical results are reported in Tables 3-26 through 3-28 and Figures 3.41 through 3.43.

3.3.3 SPMD Results

The mean total PCB concentration in SPMD samples ranged from 0.01 mg/kg lipid at station 1 (Ceresco Reservoir, off Dam Site Designs Property) to 18.40 mg/kg lipid at station 5 (~25' upstream of Otsego City Dam, along left bank) as shown in Table 3-29 and Figure 3.44.

The spatial distribution of total PCB concentrations in the Kalamazoo River and Portage Creek in SPMDs are similar to patterns observed in surface water, and adult, YOY, and caged channel catfish tissue samples, that is, stations upstream of the land-based operable units are lowest, then concentrations increase and are highest in the impoundments and near the land-based operable units. PCB concentrations decrease below Lake Allegan downstream toward Lake Michigan, but are still higher than upstream of the land-based operable units. PCB concentrations in SPMDs from Portage Creek tend to increase between Monarch Mill Pond and the BMP by an order of magnitude; however, the datasets were not collected in the same year. Lipid normalized PCB concentrations were also lowest in the Ceresco Reservoir and Monarch Mill Pond. PCB concentrations also showed an increase near the Kalamazoo Avenue location, which was observed in the surface water and resident fish datasets.

3.3.4 Comparison of Caged Channel Catfish and SPMD PCB Results

Correlations between surface water, caged channel catfish, SPMD, and YOY smallmouth bass PCB concentrations were evaluated using datasets from 1999, 2000 and 2001. The strongest correlation was L-N caged channel catfish tissue data and SPMDs, with a $R^2 = 0.89$ (Figure 3.45) using a linear relationship. R^2 is the coefficient of determination with values ranging from 0 to 1. If R^2 is equal to 1, the variables being compared are considered to be correlated, and the relationship can be used to predict one variable [those on the y-axis] from another [those on the x-axis]. Conversely, if R^2 is equal to 0, the variables are not correlated and the relationship can't be used to predict one variable from the other. The R^2 results suggest that SPMDs can provide comparable data

to using caged channel catfish for future sampling and monitoring events. This option is useful especially in areas where caged channel catfish may not survive for 28 days (e.g., in a specific location where dissolved oxygen levels may be low).

The mean total PCB concentration of surface water to L-N PCB concentration for caged channel catfish had a $R^2 = 0.61$ (Figure 3.46). This relationship suggests surface water may be a major contributor to PCB bioaccumulation in the caged channel catfish.

The comparison of caged channel catfish to YOY smallmouth bass L-N PCB concentrations in Figure 3.47 has a $R^2 = 0.55$. While this relationship may not be a good predictor of YOY smallmouth bass L-N PCB concentrations, it does show that, in general, higher PCBs in caged channel catfish result in higher PCBs in YOY smallmouth bass.

The comparison of YOY smallmouth bass L-N PCB concentrations to SPMD PCB concentrations in Figure 4.48 has $R^2 = 0.78$, which indicates a good relationship between the two variables. The relationship suggests that SPMDs may provide comparable data to YOY smallmouth bass for future sampling and monitoring events.

3.4 Dioxin/Furan and Co-Planar PCB Analyses

Prior to 2001, no fish tissue samples collected under the LTM program had been analyzed for dioxin/furan congeners, which can be associated with PCBs. If present in adult fish, dioxin/furans could present risk to human health and the environment. Therefore, fish tissue samples from adult carp and smallmouth bass collected in 2001 were analyzed for dioxin/furans.

Two adult carp with the highest PCB concentrations from Allegan City, Plainwell, Otsego, Trowbridge, and Lake Allegan Impoundments depicted in Figure 3.22 were submitted for dioxin/furan analyses. This biased set of adult carp was selected to determine if dioxin/furans were present in fish tissue with high PCB concentrations. Soon after, eleven adult smallmouth bass that were collected in 2001 from the Trowbridge Impoundment were selected by MDEQ for additional dioxin/furan analyses to represent an unbiased dataset.

In 2003 and again in 2004, eleven adult carp were collected within the Trowbridge Impoundment to establish a larger unbiased dataset for dioxin/furans. By the request of the US EPA, fish were also analyzed for co-planar PCBs. In 2003, only two adult smallmouth bass were observed in the Trowbridge Impoundment during the entire electroshocking effort, so the decision was made to focus these analyses on adult carp.

3.4.1 Dioxin/Furan and Co-Planar PCB Results

Results of the initial investigation (biased data set) revealed detectable levels of dioxin/furan compounds in all adult carp samples. In the dataset from 2001, adult carp total TEQs ranged from 1.2 ng/kg TEQ at station 30 (Lake Allegan) to 29.6 ng/kg TEQ at station 36 (Otsego Impoundment). Station 32 (Plainwell Impoundment) and station 36 (Otsego Impoundment) had the highest averages of 20.7 and 19.4 ng/kg TEQ, respectively. Four out of the ten adult carp samples analyzed in 2001 were above the MDCH advisory trigger level of 10 ppt TEQ.

Total TEQ from dioxin/furan compounds for adult carp (unbiased data set) collected from station 37 (Trowbridge Impoundment) in 2003 and 2004 ranged from 0.4 to 9.0 ng/kg TEQ. While the results of the 2003 and 2004 analysis revealed detectable levels of dioxin/furan compounds, no samples were above the 10 ppt total TEQ trigger level. However, since these samples were also analyzed for co-planar PCBs, the method to compare against the MDCH's

trigger level of 10 ppt is to sum the total TEQ from both dioxin/furans and co-planar PCBs. Table 3-30 shows that all 22 carp samples from 2003 and 2004 exceeded the 10 ppt trigger level for the total TEQ of dioxin/furans and co-planar PCBs. The range of total TEQs were from 24 to 373 ng/kg TEQ.

Adult smallmouth bass ranged from 0.001 ng/kg TEQ to 2.0 ng/kg TEQ at station 37 (Trowbridge Impoundment). Results from the adult smallmouth bass revealed detectable levels of dioxin/furans, however, the levels were well below the MDCH advisory trigger level.

The results of the adult carp and smallmouth bass dioxin/furan and co-planar PCB analyses are presented in Table 3-30 and on Figure 3.49. The raw lab data sheets and TEQ calculation summary tables are included in Appendix B and Appendix C, respectively.

3.4.2 Dioxin/Furan and Co-Planar PCB Summary

Based on the limited data analyzed, four out of 32 adult carp tissue samples analyzed for just dioxin/furan compounds contained levels that exceeded the MDCH advisory trigger level of 10 ppt TEQ. However, all 22 adult carp samples in 2003 and 2004 that were also analyzed for co-planar PCBs, exceeded the trigger level. No adult smallmouth bass tissue sample (out of a total of eleven) exceeded the MDCH advisory trigger level. Additional sampling and analytical data evaluation by the MDCH may be required in order to determine if the fish consumption advisory that is currently in effect for PCB should be expanded to include dioxin/furan compounds as well, co-planar PCBs.

Section 4
Bryant Mill Pond Post-TCRA Monitoring

As stated in annual LTM reports dating back to 1999, one of the primary objectives of the LTM program is to document and monitor levels of PCBs in surface water and resident fish after remediation activities have occurred. This is done to evaluate the effectiveness of those actions.

The information presented in this section includes surface water and fish tissue PCB concentration data collected prior to the US EPA TCRA in the BMP (located within OU-1) and surface water and fish tissue data collected following the TCRA. The BMP TCRA was the first major RA implemented at the site. Post-TCRA data has been collected by MDEQ to meet the LTM objective of evaluating the effectiveness of RAs.

4.1 Background

The Alcott Street dam, which represents the downstream extent of OU-1, was built in 1895 to provide mechanical power and process water for the paper mill. The dam impounded Portage Creek to form the "Bryant Mill Pond" between Alcott Street and just north of Cork Street (southern extent of OU-1) depicted in Figure 4.1.

The Bryant Mill conducted paper manufacturing and recycling operations on the Allied property for approximately 94 years, including de-inking PCB-containing carbonless copy paper as part of its recycling operations. The de-inking process and pulping of the recyclable copy paper released PCB contamination throughout the recycling and wastewater processes. PCB-contaminated wastewater was discharged to Portage Creek and contaminated residual paper pulp was allowed to settle out and accumulate over the years in the floodplain and creek bed of the BMP area.

Allied Paper Company obtained a permit (NO. 75-12-187) from the MDNR to draw down the reservoir nearly 13 feet in 1976 in an effort to reduce the biological oxygen demand loading to Portage Creek. The reservoir drawdown narrowed the creek channel and exposed sediments that had accumulated over the many years of mill operations. PCB concentrations in bedded and exposed sediments ranged from non-detect to 1,000 mg/kg. (BBEPC, 1992).

US EPA obtained the services of the U.S. Army Corps of Engineers (USACE) to perform a TCRA at OU-1 which was completed between June 1998 (start of clearing and grubbing) through September 1999 (demobilization). The TCRA focused on a portion of the operable unit known as the BMP. Nearly all known PCB containing sediments were removed from the currently and formerly impounded areas rather than attempting to isolate and remove individual hotspots. An action level of 10 mg/kg was used with a target level of 1 mg/kg. In total, approximately 146,000 cubic yards (CDM, 2008) of PCB contaminated material was excavated. All verification of soil remediation samples were below the action level and most were below the target level of 1 mg/kg (CDM, 2008).

After the TCRA was completed in the fall of 1999, Blasland, Bouck, & Lee (BBL) initiated IRMs at OU-1. The first IRM was installation of sheetpile around the historic residual dewatering lagoons to stabilize the berms adjacent to Portage Creek. The dewatering lagoons are the same location where US EPA disposed of the excavated BMP residuals. Other IRMs implemented at the site, include consolidation of PCB containing material between the sheetpile and Portage Creek, including the east bank, into the dewatering lagoons; construction of a disposal area cap; installation of a groundwater recovery system behind the sheetpile; and installation of a

groundwater monitoring well network (CDM, 2008). BBL drafted multiple versions of a RI report for OU-1 documenting site investigations, data collection, and IRM activities that have occurred from the early 1990s to the present. MDEQ disapproved the draft RI reports and completed a final RI report with US EPA approval in March 2008.

The data collected under MDEQ's LTM program are used to evaluate the effectiveness of the TCRA. Specifically, this includes surface water samples collected directly upstream and downstream of OU-1 and fish collected from the BMP between Cork and Alcott Street (see Figure 4.1). The focus is on the impact of the TCRA on the BMP; therefore, samples collected further upstream or downstream are not applicable to this evaluation. The bullets below detail the datasets discussed in this section.

Pre-TCRA Datasets

MDCH

- Carp collected in 1985, 1986, and 1987

RI Data

- Surface water samples collected in 1993, 1994, and 1997.
- Carp collected in 1993.

During-TCRA Datasets

BBL

- Surface water samples collected in 1998.
- White suckers collected in 1998.

Post-TCRA Datasets

BBL

- White suckers collected in 1999.

LTM Program

- Surface water samples collected in 1999, 2000, 2001, 2002, 2003, and 2006.
- Carp and white suckers collected in 2000, 2001, 2002, and 2006.

Among other indices, the National Research Council (NRC) recommends ascertaining PCB concentration in fish tissue as an indicator of remedial performance. Water is nearly always sampled as well, but typically is a less sensitive indicator of recovery. Because much of the assessment of recovery is based on fish tissue samples, estimates of current and future fish tissue concentrations are necessary to provide a baseline against which remedial alternatives can be compared.

4.2 Surface Water Sampling

Pre- and during-TCRA surface water samples were collected during dry and wet weather flow conditions at Cork Street (upstream station) and Alcott Street (downstream station) between 1993 and 1998 (BBL, 2000). The samples were collected from a single sampling point, assumed to be a mid-channel location. Samples were analyzed for PCBs, among several other analytes, using EPA Method 8081 and are reported as total Aroclors. The detection limit for this method ranged from 50 micrograms per liter (ug/L) to 2000 ug/L.

Post-TCRA surface water samples were collected by MDEQ usually during dry weather (base flow) conditions from 1999 to 2006 from Cork Street and Alcott Street and/or Bryant Street (in 2001, the downstream station was moved 500 feet to Bryant Street for easier sampling access; both stations are considered appropriate for a downstream sample station). Sampling was conducted in the same manner as other LTM surface water samples (i.e., a total of three discrete samples were collected along a transect off the left bank, in the mid-channel, and off the right bank). Samples were analyzed for PCB congeners using EPA Method 8082 and NEA SOP - NE133-01. The detection limit for congener analysis is 0.02 ng/L.

While the sample collection and PCB analytical methodologies between pre-/during- and post-TCRA surface water samples (i.e. aroclor vs. congener) are different and result in varying detection limits, the total PCB concentration for

each method is calculated by summing the individual compounds and is appropriate for comparison purposes in most cases.

Pre-, during-, and post-TCRA flow data were obtained by adding the mean daily discharge for USGS stream gage 04106300 Portage Creek Near Kalamazoo, MI with 04106400 West Fork Portage Creek At Kalamazoo, MI to represent flow to the operable unit. These two USGS gages are located on separate branches of Portage Creek, but intersect upstream of the operable unit near the Monarch Mill Pond. Mean daily discharges for all events ranged from 20 cubic feet per second (cfs) to 169 cfs, and these data are presented in Figure 4.2 for each sampling event.

4.2.1 Surface Water Analytical Results

Total PCB

Tables 4-1 through 4-8 and Figures 4.3 and 4.4 present the pre-, during-, and post-TCRA surface water sampling results for total PCB and TSS analyses collected from 1993 to 2006. The 1998 dataset is not discussed in the analysis below because it cannot be determined with certainty if results were or were not affected by the TCRA activities.

The pre-TCRA surface water PCB concentration dataset collected by BBL used detection limits ranging from 0.05 to 2 ug/L. Only three of 43 samples collected at Cork Street had detectable levels of PCBs. In contrast, the post-TCRA dataset used a method detection limit two orders of magnitude lower (0.0002 ug/L), and nearly two-thirds of the samples at Cork Street had PCBs detected. Because the discrepancy in the detection limits is fairly large and lower concentrations of PCBs likely went undetected in the pre-TCRA sampling, the pre- and post-TCRA datasets at Cork Street are not used for comparison of concentrations to determine TCRA effectiveness.

Despite the difference in detection limits, there are a sufficient number of PCB detections in both the pre- and post-TCRA datasets from the downstream station at Alcott Street to allow for the comparison of total PCB values to evaluate the effectiveness of the TCRA. The pre-TCRA dataset showed that 37 out of 43 samples had elevated PCBs, while the post-TCRA dataset has 31 out of 36 showing detectable PCBs.

Based on the pre-TCRA dataset, PCB concentrations in the water column increased from Cork Street downstream to Alcott Street Because of the detection limits used, the increase can't be reliably quantified. Nonetheless, this suggests that PCBs in the BMP sediments were a likely source to the water column. Data collected more recently by MDEQ also indicates that PCB concentrations increase from upstream to downstream (by a factor of 3). Table 4-3 shows the average post-TCRA total PCB concentration at Cork Street is 0.0014 ug/L, compared to the downstream station at Bryant Street which is 0.0048 ug/L (shown in Table 4-7). This suggests that the BMP or other areas of OU-1 may still be contributing PCBs to the surface water.

It should be noted that the average post-TCRA PCB concentration of 0.0014 ug/L at Cork Street is similar to mean total PCB concentrations observed at the site reference area, the inlet to Morrow Lake (CDM, 2007).

As suggested, a comparison of pre- and post-TCRA data from Alcott Street can be used to evaluate the effectiveness of the TCRA on the surface water column. Surface water samples from Alcott Street indicate that PCB concentrations decreased more than an order of magnitude (0.112 ug/L to 0.0048 ug/L) following the TCRA (see Figure 4.3). This is consistent with observed reductions in adult carp fillet and whole body white suckers (presented in Section 4.3).

TSS

Tables 4-2 and 4-6 present average TSS concentrations for pre-TCRA conditions that are similar at Cork Street and Alcott Street with 15.5 mg/L and 16.2 mg/L, respectively. Tables 4-4

and 4-8 show that the post-TCRA concentrations are also similar between Cork Street and Alcott Street with 9.4 mg/L and 11.5 mg/L, respectively. On average, pre-TCRA TSS concentrations exiting the BMP at Alcott Street are slightly higher (1.04 times) than entering at Cork Street, which are similar to post-TCRA TSS concentrations at approximately 1.2 times higher.

At both the upstream and downstream stations, the pre- and post-TCRA datasets indicate a reduction in TSS concentrations. Box and Whisker plots in Figure 4.4 show, while the TSS concentrations have dropped 30 to 40 % at each station between pre- and post-TCRA, the overall pattern is still observed (i.e., increasing slightly from Cork to Alcott). The reduction of TSS is probably not attributable to the TCRA since a similar reduction occurred in the pre-TCRA dataset. The mechanism for this reduction is unknown, but could be attributed to factors such as decreases in creek velocity between the southeast corner of the OU-1 disposal areas and Alcott Street, which also corresponds to a large floodplain area with braided channels. The pattern of increasing TSS concentrations from upstream to downstream remains similar in both the pre- and post-TCRA datasets, and therefore, can be concluded that the TCRA did not impact TSS concentrations at the site significantly over the long term.

4.3 Resident Fish Sampling

The age of an adult carp (those greater than 18 inches) can range anywhere from 6 to 10 years old, as a result, those that were collected from 1999 to 2002 as part of LTM program may pre-date the TCRA, even though they were harvested after the TCRA was completed. That is why MDEQ also collected YOY carp and yearling white suckers which represent post-TCRA exposure only. The adult carp likely bioaccumulated PCBs from exposure prior to remediation, and therefore, may not be the best indicators of remediation effectiveness. However, few datasets exist of pre-TCRA fish tissue concentrations so the data will be used and evaluated knowing that a carp may have been exposed to both pre-, during-, and post- TCRA conditions. Adult carp collected in 2006 as part of the trend monitoring dataset are the most likely to have been exposed only to post-TCRA conditions.

YOY carp, on the other hand, are usually less than one year old and can range up to 11 centimeters (Trautman, 1981). There are no datasets that exist for the site for this age and species from pre-TCRA, but YOY fish are excellent indicators to evaluate the effectiveness of the TCRA over time since the exposure duration is less than one year. YOY carp were collected in 2001 and 2002. They were also targeted in 2006, but no YOY carp were observed during the electroshocking event. The reason for the absence of the species is unknown, but the electroshocking occurred in the same areas, at a similar time of year, and under the same level of effort as previous fish collections in 2001 and 2002.

Yearling white suckers were also targeted since they have been historically harvested (along with adult carp) from the BMP and would be good indicators of remediation effectiveness, since similar to YOY fish, they likely were born after the TCRA and have exposure durations of one to two years.

Pre-, during-, and post-TCRA resident fish samples were collected by BBL in the BMP between Alcott Street (downstream extent) and north of the OU1 disposal areas (upstream extent) in 1993, 1998, and 1999. Adult carp and white suckers were collected in 1993, while only white suckers were collected in 1998 and 1999. Fish tissue samples were analyzed for PCB Aroclors by EPA Method 8081 in 1993 and 8080 in 1999, and percent lipids for both years.

Post-TCRA resident fish were collected by MDEQ in 2000, 2001, 2002, and 2006 within the BMP between Alcott Street and north of the OU1 disposal areas. Adult and yearling white suckers

and adult carp were collected for comparison to the pre-TCRA data. From 2000 to 2006, fish tissue samples were analyzed for PCB Aroclors and congener, and percent lipids as outlined in Section 2.3 of this report. Table 3-11 summarizes the total number of fish and species collected from the BMP by MDEQ under the LTM program.

4.3.1 Resident Fish Analytical Results

Tables 4-9 through 4-11 and Figures 4.5 through 4.9 present the pre-, during-, and post-TCRA resident fish sampling results for samples collected from 1993 to 2006. The 1998 dataset is not discussed in the analysis below since the sample results may have been impacted as a result of the TCRA activities.

The analytical data from pre- and post-TCRA at the BMP shows there has been a significant reduction in both the ww and L-N PCB concentrations in yearling white suckers and adult carp. Tables 4-9 through 4-11 and Figures 4.5 through 4.7 show the reduction in mean total PCB concentrations between the pre- and post-TCRA mean PCB concentrations to be almost 5 times less for yearling white suckers, 6 times less for adult white suckers (although there was only one post-TCRA sample for adults), and more than 8 times less for adult carp. Post-TCRA concentrations are substantially lower than would have been expected under the natural recovery scenario as depicted in Figure 4.8 below.

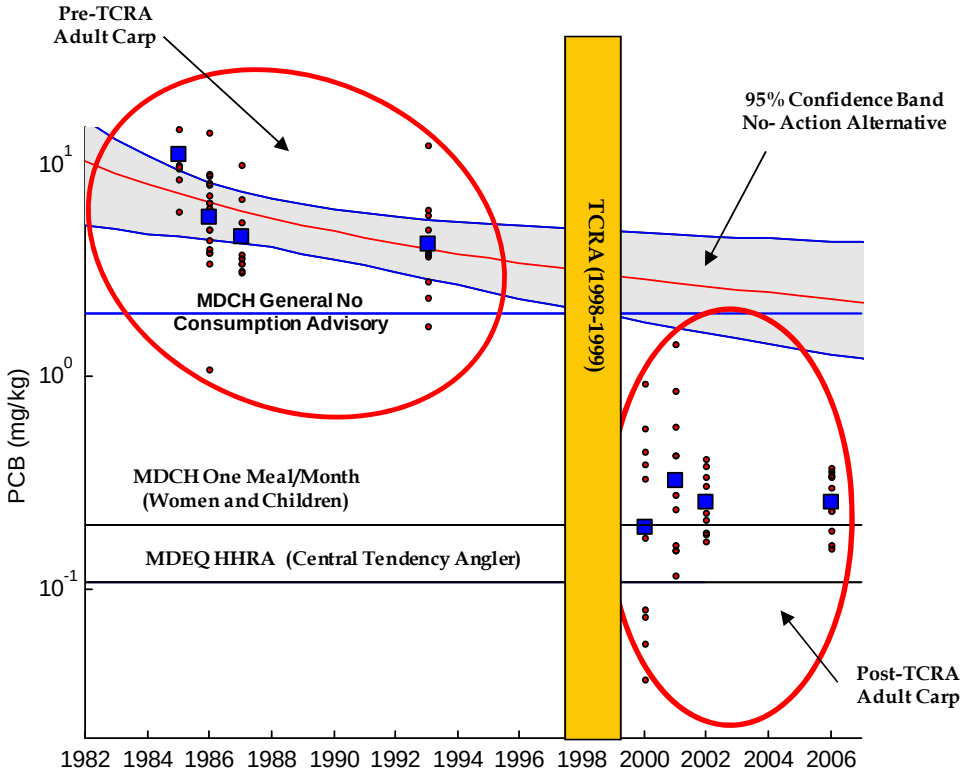

Figure 4.8. Adjusted PCB concentrations in adult carp fillets at the Bryant Mill Pond. The modeled mean represents the expected PCB concentrations in fish with length and lipid content similar to that of average fish in the Kalamazoo River and Portage Creek. Carp captured from 1985 through 2006 averaged 51.7 cm in length and on average had 3.34% lipid. The temporal trend is modeled as a mixed order model that solves the differential equation $dC/dt=-kC^{\theta}$ providing a time dependent decay rate.

Adult carp ww PCB concentrations prior to the TCRA ranged from 4.7 mg/kg to 8.8 mg/kg, averaging 3.4 mg/kg (shown in Table 4-9). Post-TCRA ww PCB concentrations ranged from 0.03 mg/kg to 3.7 mg/kg, averaging 0.41 mg/kg, roughly an order of magnitude decrease from pre-TCRA concentrations.

Under a no action alternative, adjusted concentrations (discussed further in Section 5) at the BMP were predicted to have been around 1.0 mg/kg in 2020 (Kern, 2003). In 2000 and 2001 (post-TCRA), adjusted adult carp fillet concentrations averaged 0.3 mg/kg and 0.4 mg/kg, respectively. In 2006, eleven adult carp were again collected from the BMP, and again, adjusted concentrations were dramatically lower than would have been expected under the natural recovery scenario shown in Figure 4.8. Adjusted concentrations averaged 0.26 mg/kg indicating that concentrations have remained stable and possibly declined slightly since 2000. This strongly suggests that the TCRA accelerated the rate of recovery.

Yearling whole body white sucker ww PCB concentrations prior to the TCRA ranged from 0.44 mg/kg to 4.1 mg/kg, averaging 1.96 mg/kg, a factor of approximately 4 greater than the 0.5 mg/kg NOAEL and a factor of 3 greater than the 0.6 mg/kg LOAEL. Post-TCRA ww PCB concentrations, shown in Table 4-9, averaged 0.24 mg/kg, an order of magnitude decrease from pre-TCRA concentrations.

Length and lipid adjusted concentrations in Figure 4.9 below illustrates the same order of magnitude reduction in post-TCRA whole body concentrations observed in wet weight concentrations. After TCRA, both wet-weight and adjusted whole body concentrations were less than both LOAEL and NOAEL levels for mink dietary items.

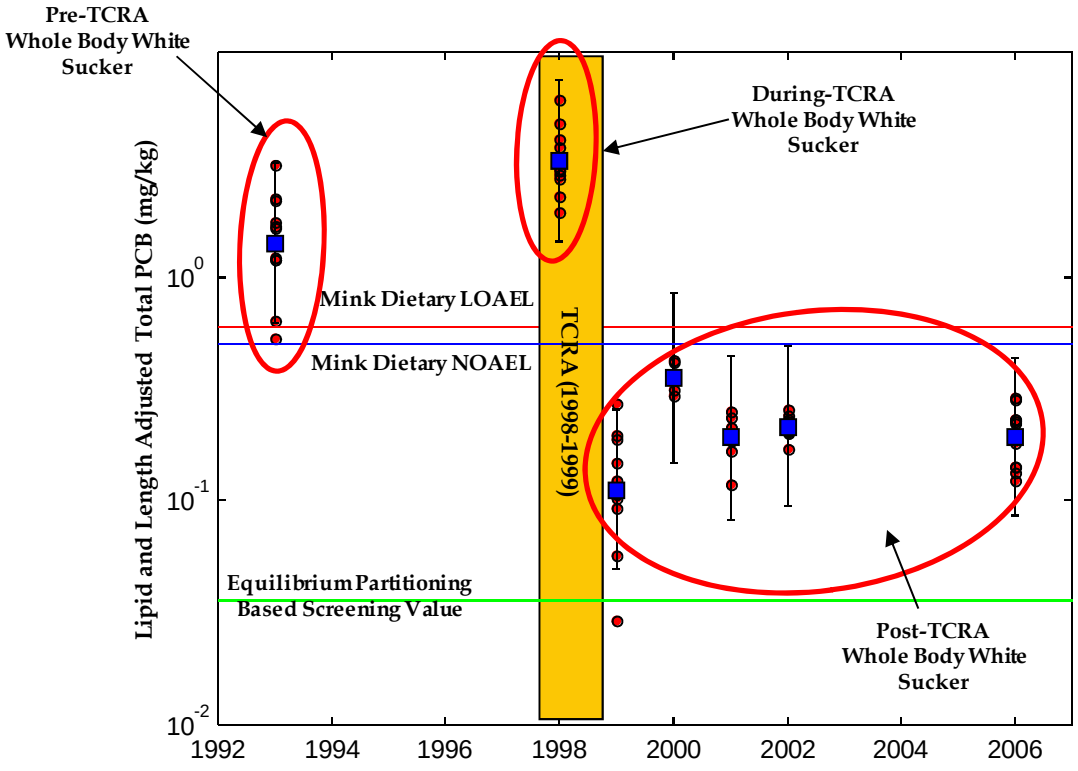

Figure 4.9. Adjusted PCB concentrations in whole body white suckers at the Bryant Mill Pond. All values are adjusted to represent a typical sucker with average length and lipid content of 18 cm and 1.6%, respectively.

Adult and yearling white suckers and adult carp also have higher mean percent lipid contents from 1999 to 2006 compared to 1993. Table 4-10 and Figure 4.6 show that the mean tissue lipid content between pre- and post-TCRA has nearly doubled since the TCRA. The reason for this increase is not fully understood, but may be due to healthier fish as a result of lower PCB concentrations in surface water and sediment.

There is no pre-TCRA dataset to compare YOY carp results against; however, the post-TCRA YOY carp mean total PCB concentrations are similar to that of the yearling white suckers.

4.4 Data Summary

The pre- and post-TCRA analytical data presented in Section 4 clearly shows that the US EPA TCRA had a positive impact on PCB concentrations in surface water and fish tissue, resulting in the reduced PCB concentrations in carp fillets, whole body white suckers and surface water by approximately an order of magnitude.

Prior to the sediment removal at BMP, the percentage of PCB detections in surface water were higher at the downstream site than at the upstream site. Data collected more recently suggest that PCB concentrations increase by a factor of 2 from upstream to downstream of the site. However, comparing pre- and post-TCRA water samples from the downstream station clearly indicate that PCB concentrations have been reduced by approximately an order of magnitude since the TCRA.

Removal of contaminated sediments from the BMP also appears to have accelerated the rate of PCB reduction in carp fillets. Whole body yearling white sucker and water data collected at the BMP also indicate order of magnitude reductions in concentration between pre- and post-TCRA. Carp tissue levels are currently below the general population consumption advisory presented in Section 3.2, but are still above some criteria (e.g., women of child bearing age and children under 15 years).

Fish tissue samples collected in 2006 continue to support the hypothesis that the TCRA reduced PCB concentrations in fish in the BMP. It is important to note that the BMP TCRA involved a comprehensive process of delineation of deposits and targeting all potentially contaminated sediments for removal. Portage Creek was temporarily re-routed during wet excavation and there were no attempts at "surgical" removals.

Since the US EPA TCRA there have been several IRMs initiated and completed at OU-1, however, a final remedy has yet to be selected for the operable unit. After attempts by BBL to complete an approvable RI report were unsuccessful, the MDEQ completed the RI report in 2008 and received US EPA approval of the document. The next steps for the site are the selection and implementation of a final remedy. In the interim, quarterly surface water sampling at Cork and Alcott Streets will continue as part of the Inlet/Outlet (IO) sampling program, in addition to fish collection consistent with the State of Michigan monitoring program and to meet the objectives of the LTM program.

Section 5
Fish Trend Monitoring

As previously described, the NRC recommends ascertaining PCB concentrations in fish tissue as an indicator of remedial performance. Water is nearly always sampled as well, but typically is a less sensitive indicator of recovery. Because much of the assessment of recovery is based on fish tissue samples, estimates of current and future fish-tissue concentrations are necessary to provide a baseline against which remedial alternatives can be compared. Estimates of uncertainty in these predictions are also necessary in order to determine the adequacy of available data to distinguish competing alternatives.

Current PCB concentrations in fish tissue are in general lower than those in the early to mid 1980s. However, mechanisms controlling these declines are not well understood and may include: (1) elimination of point-source discharge of PCBs into the environment; (2) active control of PCB sources to the river, (3) temporal covariation with fish size, condition and lipid content and; (4) natural recovery. Similar temporal trends have been observed at the Hudson, Fox and Saginaw rivers (NRC, 2001; pp. 201-205) and these declines to some degree are also related to temporal variation in lipid content.

Data collected more recently at some sites suggests that current PCB concentrations may be higher than exponential decay rates would have predicted. Stow, et al. (Stow, 1999) showed that decay rates in PCB concentration in salmonids in Lake Michigan were slower in the 1990s than would have been expected under the first order decay assumption. Kern (Kern, 2003) used the same mixed order model to evaluate the potential that decay rates may be changing in fish tissue samples at the Kalamazoo River, but data were in general too variable to distinguish first order decay models from mixed order models. In general, forecasts of future tissue concentrations in 2020 were precise to approximately an order of magnitude (Kern, 2003). To reduce uncertainty in current and future fish tissue concentration estimates and to be consistent with State of Michigan's fish contaminant monitoring program, fish tissue samples will continue to be collected on a five-year rotation.

5.1 Fish Sampling Design

Fish tissue samples have been collected periodically from the Kalamazoo River since the early 1980s. A wide range of species were collected early on, but more recently, resident fish collections have been limited to only those species and sample sizes necessary to meet the objectives of the LTM program. This included adult carp (skin-off fillets), adult smallmouth bass (skin-on fillets), YOY smallmouth bass and YOY carp (whole body), yearling white suckers (whole body), and adult catfish (skin-off fillets). The YOY smallmouth bass and yearling white suckers are thought to represent forage species for piscivorous birds, mammals and fish. Because they are one to less than one year old, they are expected to provide a more sensitive indicator of short term changes in PCB concentrations in sediments and surface water than would adult fish.

Tables 5-1 and 5-2 illustrate the spatial and temporal distribution of sampling effort among the Aquatic Biota Sampling Areas (ABSAs) for the species outlined above.

5.2 Fillet PCB as an Indicator of Site Conditions

Fish tissue samples were adjusted for covariation with length and lipid content and adjusted PCB concentrations were compared among times and locations. Adult carp were standardized to 3% lipid and 55 centimeter (cm) in length, while adult

smallmouth bass were standardized to 0.7% lipid and 32 cm in length. (Refer to Kern's report [Kern, 2003] for detailed information regarding the methods used for the length and lipid standardization process). The effect of this standardization was to provide an analysis framework allowing direct comparisons among locations and sampling events, minimizing the confounding effects of size and lipid content for trend monitoring purposes. Concentrations standardized in this way reflect the extent to which these fish have been exposed to PCBs. In this sense, standardized PCB concentrations allow spatial and temporal comparison of environmental conditions to which fish are exposed. Fish sampled in locations and/or times when mean lipid concentration differs substantially from the overall site average lipid content, adjustments will tend to be larger than when lipid content is similar to the overall average. For example, ww and adjusted PCB concentrations in carp captured at Lake Allegan tended to differ substantially due to large differences in lipid content at Lake Allegan relative to the overall site average. PCB concentration data were similar to a log-normal distribution, so adjusted tissue concentrations were analyzed in log scale. It should be noted that ww PCB concentrations in fish tissue are used by MDCH to determine fish consumption advisories.

Based on LTM samples collected in 2006, after controlling for variations in lipid and length distributions, fish within the site continue to be exposed to and have higher PCB concentrations than those upstream of the site at Battle Creek/Ceresco, and to a lesser degree Morrow Lake, as depicted in Figure 5.1. This is in contrast to the BMP where fish collected from this reach since 1999 (when the TCRA was completed) have similar ww and adjusted PCB concentrations to the upstream reach at Battle Creek. For lipid and length adjusted carp fillets shown in Figure 5.1, PCB concentrations increase with distance downstream from Morrow Lake with a maximum at Lake Allegan. Downstream of Lake Allegan, PCB concentrations in adult carp at New Richmond are similar to concentrations in the impoundments, while Saugatuck is similar to Morrow Lake.

The 2006 adjusted YOY and adult smallmouth bass data exhibit similar trends as adult carp, in that, PCB concentrations increase with distance downstream from Morrow Lake. Maximum concentrations for YOY smallmouth bass are observed at New Richmond, while adult maximum concentrations are observed in fish from the Trowbridge Impoundment.

Mean ww tissue PCB concentrations for all fish collected in 2006 are summarized in Figure 5.2. The figure shows, in general, that ww PCB concentrations increase with distance downstream from Morrow Lake with a maximum at the Plainwell Impoundment. Downstream of Lake Allegan, PCB concentrations are similar to those observed along the land-based operable units and the impoundments.

Spatial and temporal patterns in lipid and length adjusted geometric mean PCB concentrations in carp fillets are summarized in Figure 5.3, while smallmouth bass fillets are presented in Figure 5.5. PCB concentrations are substantially lower at Battle Creek/Ceresco than at any other location within the site. In the past, PCB concentrations in carp at Morrow Lake were similar to those at some locations within the site. However since 1999, PCB concentrations in carp at Morrow Lake have been substantially lower than most sampling locations within the site.

Wet-weight PCB concentrations summarized in Figures 5.4 and 5.6 show that without standardizing to length and lipid, spatial and temporal patterns are less obvious. For example, when comparing Figure 5.3 and Figure 5.4, it can be seen that ww PCB concentrations in carp have recently been highest at Plainwell, Mosel Avenue and Allegan City Dam, which is in contrast to the

length and lipid adjusted concentrations which tend to be highest at Lake Allegan and Allegan City Impoundment, followed by the impoundments, Plainwell, Otsego City, Otsego and Trowbridge which had similar adjusted concentrations. This suggests that consumers of carp could be expected to get higher doses of PCB from Plainwell, Mosel Avenue and Allegan City Impoundment, but that these fish probably have higher concentrations as a result of their lipid content as opposed to being exposed to greater levels of PCBs. From an exposure standpoint, Figure 5.3 suggests PCB exposure to fish is probably greatest in the impoundments (Plainwell, Otsego, Trowbridge), Lake Allegan and Allegan City Impoundment.

5.3 Decay Rates

First order decay rates and corresponding half times were estimated for ABSAs based on data from 1983 through 2006 (herein referred to as long term) at Morrow Lake, Plainwell Impoundment, Lake Allegan and Saugatuck, since these four stations had the most observations over this time period. These decay rates were compared with decay rates on more of a near term dataset from 1997 through 2006 (herein referred to as near term) from the same stations. Half time estimates were compared using an approximate Z statistic to evaluate the statistical significance of observed differences shown in Table 5-3. The Z statistic is a standard, normally distributed random variable with mean 0 and variance 1 calculated from the ratio of the change in decay rates divided by their standard error. Statistical significance of these differences is judged based on the probability of observing a larger Z statistic by chance alone. Significance levels are reported below as p-values which range from zero to one. Small p-values provide support for the alternative hypothesis of a difference in decay rates. Larger p-values close to 1.0 are consistent with similar decay rates.

PCB decay rates for adult carp fillets estimated from near term data were slower than those estimated from long term data at Morrow Lake ($p=0.06$) and Lake Allegan ($p=0.01$) as included in Table 5-3. Exponential decay rates were similar at Plainwell Impoundment ($p=0.97$) and decay rates estimated from near term were faster than those estimated from long term data at Saugatuck ($p=0.05$). At Plainwell Impoundment, carp half times remained essentially the same (i.e., 10 years) when estimated by recent or long term data. At Lake Allegan, estimated carp half times increased from 7.3 years to 143 years, essentially not decreasing.

Smallmouth bass decay rates estimated from near term were slower at Lake Allegan ($p <0.0001$) than estimates based on the long term series. Smallmouth bass half times at Lake Allegan increased from 7.8 years to not decreasing (i.e. the rate coefficient was positive). Adult smallmouth bass PCB half times increased from 10.7 to 30 years or more, based on near term at Morrow Lake, Plainwell and Saugatuck.

Although not all decay rates could be differentiated statistically, it is important to recognize that in seven of the eight species-location combinations in Table 5-3, decay rates were slower when based on the near term than when based on the full long term record. This is consistent with findings by Stow indicating that PCB concentrations in biota in the Great Lakes region may be decaying more slowly in recent years (Stow, 1999). This suggests that forecasts of future PCB concentrations should be based on more near term where adequate data are available. These decay rates appear to be the most reliable estimates in order to approximate the time to reach background conditions discussed in Section 5.4 and presented in Table 5-4 and Figure 5.7.

5.3.1 Carp

From Battle Creek to Lake Allegan, PCB half times (based on near term data) presented in Table 5-4 show carp fillets ranging from 5.7 (Mosel Avenue) to 149.6 years (Lake Allegan). PCB concentrations

in adult carp fillets were not declining at Otsego City, Otsego and Allegan City Impoundments. Downstream of Lake Allegan Dam, half times ranged from 4.3 to 18.4 at Saugatuck and New Richmond, respectively. Three stations, Battle Creek/Ceresco, Monarch Mill Pond, and the BMP are at or below references conditions.

5.3.2 Smallmouth Bass

For adult smallmouth bass located between Morrow Lake Dam and the Lake Allegan Dam, PCB half times (based on near term data) presented in Table 5-4 ranged from 3.5 (Allegan City Impoundment) to 29.4 years (Plainwell Impoundment). PCB concentrations in adult smallmouth bass fillets were not declining at Otsego City Impoundment, Lake Allegan, and Saugatuck. Between Lake Allegan Dam to Lake Michigan, the half time at New Richmond is 9.5 years, which is third highest among all sampling stations for smallmouth bass. Two stations, Battle Creek/Ceresco and Morrow Lake are at or below references conditions.

YOY smallmouth bass half times ranged from 1.1 (Otsego Impoundment) to 14.8 years (Morrow Lake). YOY smallmouth bass at the Trowbridge Impoundment and Saugatuck were not declining Four stations, Battle Creek/Ceresco, Mosel Avenue, Otsego City Impoundment, and Allegan City Impoundment are at or below references conditions.

5.4 Time to Reach Background Conditions

The exponential decay model was used to estimate the time for PCB concentrations in fish tissue to reach those currently observed at Morrow Lake and Battle Creek/Ceresco. Battle Creek/Ceresco and Morrow Lake could be considered to represent background conditions. Fish tissue PCB concentrations at Battle Creek/Ceresco tend to be similar to those at other water bodies in the Great Lakes region that are thought to be at ambient conditions (i.e. not impacted by known PCB sources, other than ambient air deposition). Fish tissue concentrations at Morrow Lake tend to be higher than those at Battle Creek/Ceresco but lower than tissue PCB concentrations from fish collected within the site. Because current decay rates appear to be the most reliable estimates, the time to reach background estimates in Table 5-4 are based on the near term (1997-2006) estimated decay rates.

5.4.1 Carp

Length and lipid adjusted PCB concentrations in carp fillets exceeded those at Morrow Lake by a factor ranging from approximately two to six at Mosel Avenue, Plainwell, Otsego City, Otsego, Trowbridge, Allegan City Impoundments and Lake Allegan (see Table 5-4). Adjusted PCB concentrations in carp at these areas were approximately an order of magnitude higher than at Battle Creek/Ceresco.

Over the past nine years, PCB concentrations in carp have declined very slowly at Lake Allegan resulting in an estimated time to reference condition (Morrow Lake) of over 300 years. PCB concentrations in carp fillets appear not to be declining at Otsego City, Otsego, and Allegan City Impoundments. Also included in Table 5-4 are Portage Creek stations, Monarch Mill Pond and the BMP, where adjusted PCB concentrations are at or below reference conditions (Morrow Lake). Time to reach Morrow Lake estimates are roughly three times less than estimates to reach Battle Creek/Ceresco concentrations.

5.4.2 Smallmouth Bass

Length and lipid adjusted PCB concentrations in smallmouth bass fillets from the site exceed those at Morrow Lake by a factor of approximately two to three at Plainwell, Otsego City, Otsego, Trowbridge Impoundments and Lake Allegan (see Table 5-4). Smallmouth bass fillet PCB concentrations at Morrow Lake were similar to

those at Mosel Avenue, Allegan City Impoundment, New Richmond, and Saugatuck.

Adjusted PCB concentrations in smallmouth bass fillets also appear to be decaying more slowly in the Plainwell and Trowbridge Impoundments when compared to adult carp. Smallmouth bass samples have only been collected in the Otsego Impoundment on three occasions, so estimates of decay rates and time to reference conditions would not be considered reliable. At Plainwell, smallmouth fillets bass will require 29 years to reach PCB concentrations similar to those observed in Morrow Lake, while those at Trowbridge continue to decline at a somewhat faster rate. The data suggest that smallmouth bass fillet PCB concentrations in Trowbridge could reach concentrations similar to those at Morrow Lake within 16 years.

Comparisons between the site and Morrow Lake PCB concentrations in smallmouth bass fillets are mixed. Concentrations appear to be recovered to Morrow Lake conditions at Mosel Avenue, Allegan City Impoundment, New Richmond and Saugatuck, while concentrations at Plainwell, Trowbridge and Lake Allegan remain elevated relative to reference conditions at Morrow Lake and Battle Creek. The data loosely suggest that areas with free flowing conditions may be closer to recovery than currently impounded areas.

It should be noted that these estimates are predicated on the assumption of continuing exponential decay rates similar to those observed over the recent nine years. Based on the mixed order models (Kern, 2003) and the apparent reductions in decay rates documented in this report, it could be expected that these estimated times to reference conditions are likely on the low side. That is not to say that recovery rates couldn't increase again as more RAs take place. Also, changing environmental conditions influencing the size and condition of carp and smallmouth bass could also change future trajectories of PCB concentrations at the site.

Section 6
Summary

The current objectives of the LTM program are generally consistent with the objectives of the LTM program over the past decade. These objectives are listed below as bullet items with planned activities in the paragraph(s) that follow.

- ***Develop baseline datasets for PCBs in fish and surface water at specific reaches targeted for RAs within the site.***

The surface water, resident fish, caged catfish, and SPMD data presented in this report comprise a comprehensive dataset that adequately characterizes baseline conditions for locations in the Kalamazoo River and Portage Creek that were sampled as part of the LTM program since 1999. Future baseline (pre-RA) sampling can target only those areas with planned RA activities. Specifically, it is expected that in 2009 a RA will take place in the Plainwell Dam No. 2 Impoundment. Baseline datasets for surface water and fish have not been established for this specific reach. MDEQ will collect baseline fish and surface water samples in 2009 from locations immediately upstream and downstream of this planned RA area.

- ***Document and monitor levels of PCB concentrations in fish and surface water following a RA to evaluate the effectiveness.***

Baseline (pre-RA) data collected can be used in conjunction with future post-RA sample results to evaluate the effectiveness of RAs. For example, the data sets that were obtained after the BMP TCRA clearly show that PCB concentrations in carp fillets, whole body white suckers, and surface water were reduced by approximately an order of magnitude.

In 2009, the first set of post-TCRA fish will be collected to evaluate the effectiveness of the recently completed Plainwell TCRA. In general, a single set of post-RA data are not sufficient to evaluate the RA effectiveness due to a myriad of environmental conditions that could potentially impact the results in any given year; therefore, a second set of post-TCRA fish will be collected in 2011 during the next scheduled trend monitoring event. The year 2011 was selected for the second set of data collection pursuant to a recommendation from the Responsible Parties (RPs) during the last LTM progress meeting (April 5, 2007).

- ***Evaluate spatial and temporal trends in fish and surface water.***

Fish are now being collected from the Kalamazoo River and Portage Creek in five-year intervals for trend monitoring purposes (next sampling event is scheduled for 2011). These data are shared with the State of Michigan Fish and Wildlife Contaminant Advisory Committee (FAWCAC) and the State's Fish Contaminant Monitoring Program. Resident fish will be collected from locations consistent with and to meet the objectives documented in LTM reports. It should be noted that the RPs also suggested the possibility of collecting fish from both Kalamazoo and D Avenue locations based on potential differences in the PCB results in fish from those locations.

Surface water samples are being collected on a quarterly basis from locations that generally 'bracket' PCB source areas, such as near land-based operable units and at the inlet and outlet impoundments (e.g., Plainwell Impoundment; Lake Allegan). This on-going sampling effort is called the IO component of the LTM program, and was derived based on the results of previous sampling and also, from discussions with, concurrence and recommendations from representatives of US EPA. Technical input was

also received from the United States Fish and Wildlife Service, the USGS, and the RPs.

The IO component of the LTM program is invaluable to understanding the site surface water PCB concentrations under pre-, during-, and post-RA conditions as a result of samples being collected spatially (site-wide from Morrow Lake to Lake Michigan), seasonally (one event per quarter), and temporally (since 2001).

- ***Further evaluate the utility of using caged channel catfish and SPMDs as short-term, location specific sampling devices for measuring bioavailable PCBs.***

As described in Section 3.3.4, a positive correlation exists between surface water, caged channel catfish, SPMDs, and YOY smallmouth bass. YOY fish are scheduled to be collected by MDEQ in 2009 as baseline data for the expected RA at Plainwell Dam No. 2, and as post-TCRA data in the Plainwell TCRA. Therefore, caged channel catfish will be deployed by Water Bureau of the MDEQ to be consistent with previous caged channel catfish studies, and SPMDs will be co-located to provide additional data to further evaluate correlations between these media. The benefits of using caged channel catfish and/or SPMDs as surrogates for YOY fish are they can be deployed at locations where the sport fish resource could be depleted or where they are not present, such as within a "remediation cell" of a large impoundment. Furthermore, they are readily available.

- ***Maintain consistent sample collection methods and laboratory analyses.***

Surface water and fish samples will continue to be collected by MDEQ using established protocols, and will be sent to NEA for analyses.

It should be recognized that due to the dynamic nature of river systems, "baseline" data should be collected at frequent enough intervals using similar collection methods and analyses to monitor changes in PCB concentrations over time. In the event that no RAs occur at the site for an extended period of time, the current IO surface water sampling and fish trend monitoring frequency is believed to be sufficient to evaluate if "baseline" conditions are changing over time.

Sediment samples to establish baseline conditions or to evaluate the effectiveness of a RA are not collected by MDEQ as part the LTM program. In order to maintain consistency regarding sample collection methods and laboratory analyses for this media, it is expected that the RPs will collect any necessary sediment samples per approved work plans.

- ***Prepare a report in 2012 that summarizes the LTM data collected to date.***

Section 7
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Tables

Table 3-1
Mean Total PCB Concentrations for Kalamazoo River and Portage Creek Dry Weather Surface Water Samples

			SPRING			SUMMER															FALL									WINTER		
			April 18-19, 2001			September 9-10, 1999			September 20-21, 1999			July 25-26, 2000			July 31, 2001			SUMMER AVERAGE			October 20-21, 1999			October 17-22, 2000			FALL AVERAGE			January 11, 2000		
	SampleID[1,5] (ordered from Left to Right bank)	Location	Mean Total PCB (ng/L)[2]	Standard Deviation (ng/L)[3]	Relative Standard Deviation (%)[3]	Mean Total PCB (ng/L)[2]	Standard Deviation (ng/L)[3]	Relative Standard Deviation (%)[3]	Mean Total PCB (ng/L)[2]	Standard Deviation (ng/L)[3]	Relative Standard Deviation (%)[3]	Mean Total PCB (ng/L)[2]	Standard Deviation (ng/L)[3]	Relative Standard Deviation (%)[3]	Mean Total PCB (ng/L)[2]	Standard Deviation (ng/L)[3]	Relative Standard Deviation (%)[3]	Mean Total PCB (ng/L)[2]	Standard Deviation (ng/L)[3]	Relative Standard Deviation (%)[3]	Mean Total PCB (ng/L)[2]	Standard Deviation (ng/L)[3]	Relative Standard Deviation (%)[3]	Mean Total PCB (ng/L)[2]	Standard Deviation (ng/L)[3]	Relative Standard Deviation (%)[3]	Mean Total PCB (ng/L)[2]	Standard Deviation (ng/L)[3]	Relative Standard Deviation (%)[3]	Mean Total PCB (ng/L)[2]	Standard Deviation (ng/L)[3]	Relative Standard Deviation (%)[3]
KALAMAZOO RIVER	DW-011-1-01 to DW-011-3-01	Bridge downstream of dam at Ceresco Reservoir				1.88	1.97	105	4.58	2.39	52	0.51	0.59	116				2.38	2.44	102	5.01	0.66	13	0.60	0.52	87	2.81	2.47	88			
	DW-057-1-01 to DW-057-3-01	Michigan Avenue, upstream of Morrow Lake inlet, near Galesburg	1.02	0.80	78										0.63	0.34	54	0.63	0.34	54												
	DW-012-1-01 to DW-012-3-01	35th Street bridge, at Morrow Lake				1.19	0.51	42	5.22	2.30	44	1.69	1.30	77				2.70	2.33	86	4.71	1.33	28	1.71	0.00	0	2.73	2.03	74			
	DW-013-1-01 to DW-013-3-01	River Road bridge, near Comstock				1.12	0.39	35	6.24	1.51	24	1.43	0.79	56				3.16	2.72	86	6.69	3.71	55	0.56	0.27	48	3.63	4.10	113	0.10	-NA-	-NA-
	DW-051-1-01 to DW-051-3-01	Sprinkle Road																						1.63	0.59	36	1.63	0.59	36	0.60	0.86	144
	DW-016-1-01 to DW-016-3-01	State Route 96, King Highway bridge	1.01	0.64	64	2.39	1.03	43	3.03	1.09	36	0.34	0.41	122	0.49	0.50	103	1.49	1.42	95	6.34	4.46	70	1.64	0.00	0	3.95	3.84	97	1.58	2.57	162
	DW-015-1-01 to DW-015-3-01	Kalamazoo Avenue				8.63	6.83	79	18.87	3.92	21	0.36	0.23	63				9.29	8.94	96	10.94	3.97	36	5.01	3.29	66	7.98	4.60	58	2.55	3.88	152
PORTAGE CREEK	DW-056-1-01 to DW-056-3-02	Portage Creek, at Garden Lane																						2.71	0.35	13	2.71	0.35	13	0.76	1.14	150
	DW-060-1-01 to DW-060-3-03	Portage Creek, at Romence Street	0.15	0.09	61							1.47	0.61	42	0.40	0.52	130	0.94	0.78	83												
	DW-014-1-01 to DW-014-3-04	Kilgore Road bridge				25.09	40.09	160	4.88	1.59	32	0.36	0.36	101				10.11	23.08	228	21.19	6.11	29	1.53	0.91	60	11.36	11.45	101	0.10	-NA-	-NA-
	DW-055-1-01 to DW-055-3-05	Portage Creek, at Cork Street																						1.66	0.36	22	1.66	0.36	22	2.01	3.30	165
	DW-003-1-01 to DW-003-3-06	Portage Creek, at Alcott Street; pipe under bridge or bridge itself				2.91	0.17	6	7.26	3.23	44	15.33	23.77	155				9.20	13.91	151	9.00	1.85	21	2.34	0.00	0	7.33	3.65	50	0.27	0.30	110
	DW-058-1-01 to DW-058-3-07	Bryant Street, downstream of Bryant Mill Pond	0.66	0.76	115										7.25	1.78	24	7.25	1.78	24												
	DW-054-1-01 to DW-054-3-08	Portage Creek, at Pitcher Street																						6.72	1.40	21	6.72	1.40	21	1.32	0.54	40

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			SPRING			SUMMER															FALL									WINTER		
			April 18-19, 2001			September 9-10, 1999			September 20-21, 1999			July 25-26, 2000			July 31, 2001			SUMMER AVERAGE			October 20-21, 1999			October 17-22, 2000			FALL AVERAGE			January 11, 2000		
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KALAMAZOO RIVER	DW-052-1-01 to DW-052-3-01	Gull Street																						2.32	1.09	47	2.32	1.09	47	0.10	-NA-	-NA-
	DW-053-1-01 to DW-053-3-01	Mosel Avenue	1.57	0.26	16							2.83	2.63	93	11.72	5.67	48	7.28	6.27	86				8.19	2.53	31	8.19	2.53	31	24.18	40.84	169
	DW-017-1-01 to DW-017-3-01	D Avenue bridge	0.37	0.13	36	11.09	4.11	37	13.85	1.62	12	1.34	0.59	44	9.20	1.65	18	8.87	5.26	59	16.55	4.89	30	5.92	1.31	22	11.23	6.65	59			
	DW-018-1-01 to DW-018-3-01	U. S. 131 Highway bridge, near Plainwell	0.19	0.08	40	15.21	4.88	32	12.36	5.57	45	6.20	4.21	68	12.13	5.24	43	11.14	5.38	48	16.07	1.06	7	10.77	3.42	32	13.42	3.68	27			
	DW-019-1-01 to DW-019-3-01	~100 ' downstream of Plainwell Dam	0.22	0.11	51	11.76	2.18	18	19.05	7.44	39	6.29	0.00	0	12.75	1.54	12	13.08	5.56	42	16.62	3.56	21	2.46	3.04	124	9.54	8.30	87			
	DW-020-1-01 to DW-020-3-01	Farmer Street bridge, in Otsego	0.73	0.81	112	18.84	0.72	4	14.80	2.99	20	11.38	2.57	23	20.43	1.03	5	16.14	4.21	26	19.93	3.42	17	4.41	2.91	66	12.17	8.96	74			
	DW-021-1-01 to DW-021-3-01	~200' downstream of Otsego Dam	0.60	0.49	81	16.93	0.00	0	24.54	12.50	51	8.62	1.79	21	37.41	32.91	88	22.87	20.47	90	11.15	4.19	38	7.08	6.43	91	9.12	5.34	59			
	DW-022-1-01 to DW-022-3-01	26th Street bridge / Trowbridge Dam	0.18	0.14	77	24.29	1.54	6	18.55	3.78	20	15.32	2.53	16	21.89	2.51	11	20.01	4.23	21	25.85	4.87	19	4.59	2.01	44	15.22	12.11	80			
	DW-023-1-01 to DW-023-3-01	M-89 bridge, in Allegan	1.36	0.24	18	29.11	0.37	1	30.32	12.51	41	11.24	2.46	22	16.39	1.80	11	21.09	10.36	49	24.48	6.03	25	5.08	3.69	73	14.64	10.53	72			
	DW-027-1-01 to DW-027-3-01	Middle of M-89 bridge at Lake Allegan inlet				32.47	1.21	4										32.47	1.21	4												
	DW-059-1-01 to DW-059-3-01	Grand Street Bridge in Allegan, downstream of Allegan City Dam	0.19	0.08	42										14.10	1.74	12	14.10	1.74	12												
	DW-024-1-01 to DW-024-3-01	~250' upstream of Allegan Dam	0.87	0.50	58	9.43	1.53	16	7.84	1.61	21	7.61	4.22	55	9.14	1.92	21	8.42	2.39	28	11.94	2.89	24	1.23	0.07	6	6.85	5.90	86			
	DW-025-1-01 to DW-025-3-01	M-89 bridge, between Allegan and Fennville	0.89	0.28	31	14.88	13.69	92	10.06	4.42	44	4.97	2.40	48	13.13	11.22	85	10.76	8.77	82	11.78	2.39	20	2.64	0.41	16	7.21	5.23	73			
	DW-026-1-01 to DW-026-3-01	58th Street bridge, downstream of New Richmond	0.34	0.20	60	4.68	1.90	41	8.76	0.61	7	3.34	1.03	31	7.50	3.47	46	6.07	2.86	47	6.78	0.44	6	2.49	0.31	13	4.89	2.17	44			
	DW-028-1-01 to DW-028-3-01	Bluestar Highway bridge, in Douglas	0.10	-NA-	-NA-				13.69	2.38	17	5.58	1.15	21	5.86	1.11	19	8.38	4.24	51	8.58	1.50	17	1.46	0.09	6	5.02	4.01	80			

Notes:
1. SampleID uses a 4-part nomenclature, in the following format: AA-BBB-C-DD. AA is Matrix type (DW-Dry Weather); BBB is the sampling station identification number; C is location on transect (looking downstream, where 1 is Left Bank, 2 is Mid-Channel, and 3 is Right Bank; and DD is sample type (01-first or original sample, 02-blank, 03-duplicate)
2. Value used for non-detects in statistical analyses was one-half of the detection limit (Detection Limit for PCB congener = 0.20 ng/L).
3. "-NA-" denotes sample results were below the limits of detection, so the standard deviation and relative standard deviation are not applicable.
4. "*" denotes total number of samples equals one due to bottle breakage during sample shipment to lab.
5. Kalamazoo River and Portage Creek stations are ordered from upstream to downstream, going top to bottom; Portage Creek stations are positioned after the Kalamazoo Avenue station, which is the location of the confluence.
6. A blank cell means no samples collected at that location.

Table 3-2
Mean Total Suspended Solids in Kalamazoo River and Portage Creek Dry Weather Surface Water Samples

	SampleID[1,4] (ordered from Left to Right bank)	Location	SPRING April 18-19, 2001			SUMMER July 25-26, 2000			SUMMER July 31, 2001			SUMMER AVERAGE			FALL October 17-22, 2000			WINTER January 11, 2000		
			Mean TSS (mg/L)[2]	Standard Deviation (mg/L)[3]	Relative Standard Deviation (%)[3]	Mean TSS (mg/L)[2]	Standard Deviation (mg/L)[3]	Relative Standard Deviation (%)[3]	Mean TSS (mg/L)[2]	Standard Deviation (mg/L)[3]	Relative Standard Deviation (%)[3]	Mean TSS (mg/L)[2]	Standard Deviation (mg/L)[3]	Relative Standard Deviation (%)[3]	Mean TSS (mg/L)[2]	Standard Deviation (mg/L)[3]	Relative Standard Deviation (%)[3]	Mean TSS (mg/L)[2]	Standard Deviation (mg/L)[3]	Relative Standard Deviation (%)[3]
KALAMAZOO RIVER	DW-011-1-01 to DW-011-3-01	Bridge downstream of dam at Ceresco Reservoir				16.2	0.9	5				16.2	0.9	5	6.4	0.2	3			
	DW-057-1-01 to DW-057-3-01	Michigan Avenue, upstream of Morrow Lake inlet, near Galesburg	6.1	0.5	8				11.2	1.3	12	11.2	1.3	12						
	DW-012-1-01 to DW-012-3-01	35th Street bridge, at Morrow Lake				4.6	1.4	30				4.6	1.4	30	4.1	0.6	15			
	DW-013-1-01 to DW-013-3-01	River Road bridge, near Comstock				19.5	3.8	19				19.5	3.8	19	5.9	1.0	17	1.0	-NA-	-NA-
	DW-051-1-01 to DW-051-3-01	Sprinkle Road													5.4	0.6	11	2.1	1.0	48
	DW-016-1-01 to DW-016-3-1	State Route 96, King Highway bridge	4.5	0.8	17	22.0	3.1	14	51.2	60.5	118	36.6	41.5	113	5.4	0.2	4	1.4	0.7	49
	DW-015-1-01 to DW-015-3-01	Kalamazoo Avenue				23.5	0.7	3				23.5	0.7	3	5.2	0.5	10	1.5	0.8	55
PORTAGE CREEK	DW-056-1-01 to DW-056-3-02	Portage Creek, at Garden Lane													5.1	2.3	46	11.7	10.6	91
	DW-060-1-01 to DW-060-3-03	Portage Creek, at Romence Street	1.0	-NA-	-NA-	3.7	0.9	24	8.5	3.7	44	6.1	3.6	58						
	DW-014-1-01 to DW-014-3-04	Kilgore Road bridge				1.3	0.6	43				1.3	0.6	43	4.9	0.4	8	10.9	1.1	10
	DW-055-1-01 to DW-055-3-05	Portage Creek, at Cork Street													8.6	0.9	10	6.9	0.3	4
	DW-003-1-01 to DW-003-3-06	Portage Creek, at Alcott Street; pipe under bridge or bridge itself				9.5	1.3	14				9.5	1.3	14	4.0	0.0	0	5.9	0.5	8
	DW-058-1-01 to DW-058-3-07	Bryant Street, downstream of Bryant Mill Pond	4.3	0.5	12				17.1	1.2	7	17.1	1.2	7						
	DW-054-1-01 to DW-054-3-08	Portage Creek, at Pitcher Street													5.5	2.7	50	8.9	1.1	12

Table 3-2
Mean Total Suspended Solids in Kalamazoo River and Portage Creek Dry Weather Surface Water Samples

	SampleID[1,4] (ordered from Left to Right bank)	Location	SPRING			SUMMER												FALL			WINTER		
			April 18-19, 2001			July 25-26, 2000			July 31, 2001			SUMMER AVERAGE			October 17-22, 2000			January 11, 2000					
			Mean TSS (mg/L)[2]	Standard Deviation (mg/L)[3]	Relative Standard Deviation (%)[3]	Mean TSS (mg/L)[2]	Standard Deviation (mg/L)[3]	Relative Standard Deviation (%)[3]	Mean TSS (mg/L)[2]	Standard Deviation (mg/L)[3]	Relative Standard Deviation (%)[3]	Mean TSS (mg/L)[2]	Standard Deviation (mg/L)[3]	Relative Standard Deviation (%)[3]	Mean TSS (mg/L)[2]	Standard Deviation (mg/L)[3]	Relative Standard Deviation (%)[3]	Mean TSS (mg/L)[2]	Standard Deviation (mg/L)[3]	Relative Standard Deviation (%)[3]			
KALAMAZOO RIVER	DW-052-1-01 to DW-052-3-01	Gull Street													4.5	0.2	5	7.5	7.3	98			
	DW-053-1-01 to DW-053-3-01	Mosel Avenue	5.3	0.6	12	22.3	1.8	8	19.6	1.0	5	21.0	1.9	9	3.7	1.2	32	2.5	0.4	16			
	DW-017-1-01 to DW-017-3-01	D Avenue bridge	5.3	0.6	12	13.2	1.2	9	13.3	1.0	7	13.2	1.0	8	6.9	2.8	41						
	DW-018-1-01 to DW-018-3-01	U. S. 131 Highway bridge, near Plainwell	5.2	0.7	13	7.9	1.7	22	14.1	1.7	12	11.0	3.7	34	4.1	0.5	12						
	DW-019-1-01 to DW-019-3-01	~100 ' downstream of Plainwell Dam	10.8	2.3	21	7.0	0.0	0	18.2	0.5	3	12.1	6.7	55	5.1	2.7	53						
	DW-020-1-01 to DW-020-3-01	Farmer Street bridge, in Otsego	6.0	0.7	12	7.2	0.5	7	16.8	1.4	8	12.0	5.4	45	4.2	0.9	22						
	DW-021-1-01 to DW-021-3-01	~200' downstream of Otsego Dam	7.7	0.8	11	11.7	2.4	21	14.2	0.7	5	13.0	2.1	16	3.5	0.8	21						
	DW-022-1-01 to DW-022-3-01	26th Street bridge / Trowbridge Dam	7.1	1.0	14	12.5	1.0	8	21.5	3.0	14	17.0	5.4	32	41.5	48.9	118						
	DW-023-1-01 to DW-023-3-01	M-89 bridge, in Allegan	9.7	0.8	8	7.5	4.0	54	17.0	1.3	8	12.2	5.8	48	9.4	3.9	42						
	DW-059-1-01 to DW-059-3-01	Grand Street Bridge in Allegan, downstream of Allegan City Dam	7.9	0.3	4				21.9	2.6	12	21.9	2.6	12									
	DW-024-1-01 to DW-024-3-01	~250' upstream of Allegan Dam	8.6	0.6	7	5.8	0.9	15	9.9	0.8	8	7.9	2.4	30	4.9	2.7	56						
	DW-025-1-01 to DW-025-3-01	M-89 bridge, between Allegan and Fennville	12.6	1.4	11	15.6	0.7	5	18.5	0.9	5	17.1	1.8	10	8.9	0.4	5						
	DW-026-1-01 to DW-026-3-01	58th Street bridge, downstream of New Richmond	12.3	3.0	24	15.9	3.1	19	35.3	4.4	12	25.6	11.1	43	4.4	1.4	32						
	DW-028-1-01 to DW-028-3-01	Bluestar Highway bridge, in Douglas	14.3	2.3	16	29.0	8.9	31	31.1	0.8	2	30.1	5.8	19	13.1	1.2	9						

Notes:
1. SampleID uses a 4-part nomenclature, in the following format: AA-BBB-C-DD. AA is Matrix type (DW-Dry Weather); BBB is the sampling station identification number; C is location on transect (looking downstream, where 1 is Left Bank, 2 is Mid-Channel, and 3 is Right Bank; and DD is sample type (01-first or original sample, 02-blank, 03-duplicate)
2. Value used for non-detects in statistical analyses was one-half of the detection limit (Detection Limit for TSS = 2 mg/L).
3. "-NA-" denotes sample results were below the limits of detection, so the standard deviation and relative standard deviation are not applicable.
4. Kalamazoo River and Portage Creek stations are ordered from upstream to downstream, going top to bottom; Portage Creek stations are positioned after the Kalamazoo Avenue station, which is the location of the confluence.
5. A blank cell means no samples collected at that location.

Table 3-3
Mean Total PCB Concentrations for Kalamazoo River and Portage Creek Dry Weather Surface Water Samples Grouped by Reach

	SPRING			SUMMER														
	April 18-19, 2001			September 9-10, 1999			September 20-21, 1999			July 25-26, 2000			July 31, 2001			SUMMER AVERAGE		
Location	**Mean Total PCBs (ng/L)[1]**	**Standard Deviation (ng/L)**	**Relative Standard Deviation (%)**	**Mean Total PCBs (ng/L)[1]**	**Standard Deviation (ng/L)**	**Relative Standard Deviation (%)**	**Mean Total PCBs (ng/L)[1]**	**Standard Deviation (ng/L)**	**Relative Standard Deviation (%)**	**Mean Total PCBs (ng/L)[2]**	**Standard Deviation (ng/L)**	**Relative Standard Deviation (%)**	**Mean Total PCBs (ng/L)[1]**	**Standard Deviation (ng/L)**	**Relative Standard Deviation (%)**	**Mean Total PCBs (ng/L)[1]**	**Standard Deviation (ng/L)**	**Relative Standard Deviation (%)**
Upstream of Morrow Lake to Sprinkle Road	1.02	0.80	78	1.37	0.94	69	5.35	1.96	37	1.21	0.98	81	0.63	0.34	54	2.52	2.37	94
Between State Route 96, King Highway bridge and Lake Allegan, including Portage Creek	0.62	0.58	93	17.68	14.52	82	14.61	9.43	65	6.58	7.65	116	13.33	12.25	92	12.63	11.69	93
Downstream of Lake Allegan Dam	0.44	0.39	88	9.78	10.37	106	10.84	3.36	31	4.63	1.75	38	8.83	6.76	77	8.40	6.16	73

	FALL									WINTER		
	October 20-21, 1999			October 17-22, 2000			FALL AVERAGE			January 11, 2000		
Location	**Mean Total PCBs (ng/L)[1]**	**Standard Deviation (ng/L)**	**Relative Standard Deviation (%)**	**Mean Total PCBs (ng/L)[1]**	**Standard Deviation (ng/L)**	**Relative Standard Deviation (%)**	**Mean Total PCBs (ng/L)[1]**	**Standard Deviation (ng/L)**	**Relative Standard Deviation (%)**	**Mean Total PCBs (ng/L)[1]**	**Standard Deviation (ng/L)**	**Relative Standard Deviation (%)**
Upstream of Morrow Lake to Sprinkle Road	5.47	2.20	40	1.03	0.62	61	2.85	2.66	93	0.35	0.61	175
Between State Route 96, King Highway bridge and Lake Allegan, including Portage Creek	15.74	6.86	44	4.63	3.65	79	10.94	8.55	78	3.65	13.65	374
Downstream of Lake Allegan Dam	9.05	2.61	29	2.36	0.85	36	7.42	4.43	60			

Notes:
1. Value used for non-detects in statistical analyses was one-half of the detection limit.
(Detection Limit for PCB congener = 0.20 ng/L)
2. A blank cell means no samples collected at that location.

Table 3-4
Mean Total Suspended Solids for Kalamazoo River and Portage Creek Dry Weather Surface Water Samples Grouped by Reach

	SPRING			SUMMER									FALL			WINTER		
	April 18-19, 2001			July 25-26, 2000			July 31, 2001			SUMMER AVERAGE			October 17-22, 2000			January 11, 2000		
Location	**Mean TSS (mg/L)[1]**	**Standard Deviation (mg/L)**	**Relative Standard Deviation**	**Mean TSS (mg/L)[1]**	**Standard Deviation (mg/L)**	**Relative Standard Deviation**	**Mean TSS (mg/L)[1]**	**Standard Deviation (mg/L)**	**Relative Standard Deviation**	**Mean TSS (mg/L)[1]**	**Standard Deviation (mg/L)**	**Relative Standard Deviation**	**Mean TSS (mg/L)[1]**	**Standard Deviation (mg/L)**	**Relative Standard Deviation**	**Mean TSS (mg/L)[1]**	**Standard Deviation (mg/L)**	**Relative Standard Deviation**
Upstream of Morrow Lake to Sprinkle Road	6.13	0.46	8	13.43	7.09	53	11.20	1.31	12	12.88	6.15	48	5.47	1.05	19	1.57	0.90	57
Between State Route 96, King Highway bridge and Lake Allegan, including Portage Creek	6.43	2.63	41	11.15	7.03	63	18.73	17.32	92	14.75	13.45	91	7.59	13.46	177	6.37	5.21	82
Downstream of Lake Allegan Dam	13.06	2.20	17	20.19	8.14	40	28.32	7.89	28	24.26	8.83	36	9.35	3.74	40			

Notes:
1. Value used for non-detects in statistical analyses was one-half of the detection limit.
(Detection Limit for TSS = 2 mg/L)
2. A blank cell means no samples collected at that location.

Table 3-5
Mean Total PCB Concentrations in "Rising Limb" Wet Weather Surface Water Samples

			April 21, 2000			April 24, 2001			Overall Average		
	SampleID[1,4] (ordered from Left to Right bank)	Location	Mean Total PCBs (ng/L)[2]	Standard Deviation (ng/L)[3]	Relative Standard Deviation (%)[3]	Mean Total PCBs (ng/L)[2]	Standard Deviation (ng/L)[3]	Relative Standard Deviation (%)[3]	Mean Total PCBs (ng/L)[2]	Standard Deviation (ng/L)[3]	Relative Standard Deviation (%)[3]
KALAMAZOO RIVER	WW-057-1-01 to WW-057-3-01	Michigan Avenue, upstream of Morrow Lake inlet, near Galesburg	3.87	6.41	166	0.10	-NA-	-NA-	1.98	4.55	229
	WW-016-1-01 to WW-016-3-01	State Route 96, King Highway bridge	0.32	0.37	118	0.10	-NA-	-NA-	0.21	0.26	127
PORTAGE CREEK	WW-060-1-01 to WW-060-3-01	Portage Creek, at Romence Street				0.10	-NA-	-NA-	0.10	-NA-	-NA-
	WW-058-1-01 to WW-058-3-01	Bryant Street, downstream of Bryant Mill Pond	0.25	0.26	105	0.16	0.10	65	0.21	0.19	90
KALAMAZOO RIVER	WW-053-1-01 to WW-053-3-01	Mosel Avenue				0.10	-NA-	-NA-	0.10	-NA-	-NA-
	WW-017-1-01 to WW-017-3-01	D Avenue bridge	1.51	1.50	100	0.15	0.08	54	0.83	1.21	146
	WW-018-1-01 to WW-018-3-01	US 131 Highway bridge, near Plainwell	1.91	1.45	76	0.33	0.30	91	1.12	1.27	114
	WW-020-1-01 to WW-020-3-01	Farmer Street bridge, in Otsego	1.12	1.26	112	0.28	0.19	68	0.70	0.93	133
	WW-022-1-01 to WW-022-3-01	26th Street bridge, between Otsego and Allegan				0.10	-NA-	-NA-	0.10	-NA-	-NA-
	WW-023-1-01 to WW-023-3-01	M-89 bridge, in Allegan	1.12	0.49	44	0.70	0.93	133	0.91	0.70	77
	WW-059-1-01 to WW-059-3-01	Grand Street bridge in Allegan, downstream of Allegan City Dam				2.78	0.86	31	2.78	0.86	31
	WW-025-1-01 to WW-025-3-01	M-89 bridge, between Allegan and Fennville	0.46	0.33	71	1.32	1.03	78	0.89	0.83	93
	WW-026-1-01 to WW-026-3-01	58th Street bridge, downstream of New Richmond	0.10	-NA-	-NA-	0.40	0.26	66	0.25	0.24	94
	WW-028-1-01 to WW-028-3-01	Blue Star Highway bridge, in Douglas	0.58	0.23	39	0.60	0.59	98	0.59	0.40	68

Notes:
1. SampleID uses a 4-part nomenclature, in the following format: AA-BBB-C-DD. AA is Matrix type (WW-Wet Weather); BBB is the sampling station identification number; C is location on transect (looking downstream, where 1 is Left Bank, 2 is Mid-Channel, and 3 is Right Bank; and DD is sample type (01-first or original sample, 02-blank, 03-duplicate)
2. Value used for non-detects in statistical analyses was one-half of the detection limit (Detection Limit for PCB congener = 0.20 ng/L)
3. "-NA-" denotes sample results were below the limits of detection, so the standard deviation and relative standard deviation are not applicable.
4. Kalamazoo River and Portage Creek stations are ordered from upstream to downstream, going top to bottom; Portage Creek stations are positioned after the King Highway Bridge station, which is the location of the confluence.
5. A blank cell means no samples collected at that location.

Table 3-6
Mean Total Suspended Solids in "Rising Limb" Wet Weather Surface Water Samples

			April 21, 2000			April 24, 2001			Overall Average		
	SampleID [1,3] (ordered from Left to Right bank)	Location	Mean TSS (mg/L) [2]	Standard Deviation (mg/L)	Relative Standard Deviation (%)	Mean TSS (mg/L) [2]	Standard Deviation (mg/L)	Relative Standard Deviation (%)	Mean TSS (mg/L) [2]	Standard Deviation (mg/L)	Relative Standard Deviation (%)
KALAMAZOO RIVER	WW-057-1-01 to WW-057-3-01	Michigan Avenue, upstream of Morrow Lake inlet, near Galesburg	33.93	10.99	32	26.07	4.28	16	30.00	8.61	29
	WW-016-1-01 to WW-016-3-01	State Route 96, King Highway bridge	19.83	0.81	4	16.80	0.87	5	18.32	1.82	10
PORTAGE CREEK	WW-060-1-01 to WW-060-3-01	Portage Creek, at Romence Street				8.73	2.39	27	8.73	2.39	27
	WW-058-1-01 to WW-058-3-01	Bryant Street, downstream of Bryant Mill Pond	18.33	0.76	4	16.13	1.10	7	17.23	1.47	9
KALAMAZOO RIVER	WW-053-1-01 to WW-053-3-01	Mosel Avenue				16.53	1.21	7	16.53	1.21	7
	WW-017-1-01 to WW-017-3-01	D Avenue bridge	23.83	1.86	8	18.20	1.64	9	21.02	3.46	16
	WW-018-1-01 to WW-018-3-01	US 131 Highway bridge, near Plainwell	38.50	0.87	2	25.00	0.87	3	31.75	7.43	23
	WW-020-1-01 to WW-020-3-01	Farmer Street bridge, in Otsego	48.50	3.77	8	22.67	2.42	11	35.58	14.43	41
	WW-022-1-01 to WW-022-3-01	26th Street bridge, between Otsego and Allegan				23.80	9.38	39	23.80	9.38	39
	WW-023-1-01 to WW-023-3-01	M-89 bridge, in Allegan	81.67	22.48	28	23.27	8.24	35	52.47	35.39	67
	WW-059-1-01 to WW-059-3-01	Grand Street bridge in Allegan, downstream of Allegan City Dam				24.80	2.46	10	24.80	2.46	10
	WW-025-1-01 to WW-025-3-01	M-89 bridge, between Allegan and Fennville	30.50	3.50	11	16.87	1.36	8	23.68	7.84	33
	WW-026-1-01 to WW-026-3-01	58th Street bridge, downstream of New Richmond	62.47	3.56	6	14.67	2.66	18	38.57	26.33	68
	WW-028-1-01 to WW-028-3-01	Blue Star Highway bridge, in Douglas	50.23	6.84	14	34.53	4.90	14	42.38	10.11	24

Notes:
1. SampleID uses a 4-part nomenclature, in the following format: AA-BBB-C-DD. AA is Matrix type (WW-Wet Weather); BBB is the sampling station identification number; C is location on transect (looking downstream, where 1 is Left Bank, 2 is Mid-Channel, and 3 is Right Bank; and DD is sample type (01-first or original sample, 02-blank, 03-duplicate)
2. Value used for non-detects in statistical analyses was one-half of the detection limit (Detection Limit for TSS = 2 mg/L)
3. Kalamazoo River and Portage Creek stations are ordered from upstream to downstream, going top to bottom; Portage Creek stations are positioned after the King Highway Bridge station, which is the location of the confluence.
4. A blank cell means no samples collected at that location.

Table 3-7
Mean Total PCB Concentrations in "Falling Limb" Wet Weather Surface Water Samples

			April 26, 2000			April 26, 2001			Overall Average		
	SampleID [1,4] (ordered from Left to Right bank)	Location	Mean Total PCBs (ng/L) [2]	Standard Deviation (ng/L) [3]	Relative Standard Deviation (%) [3]	Mean Total PCBs (ng/L) [2]	Standard Deviation (ng/L) [3]	Relative Standard Deviation (%) [3]	Mean Total PCBs (ng/L) [2]	Standard Deviation (ng/L) [3]	Relative Standard Deviation (%) [3]
KALAMAZOO RIVER	WW-057-1-01 to WW-057-3-01	Michigan Avenue, upstream of Morrow Lake inlet, near Galesburg	0.10	-NA-	-NA-	0.10	-NA-	-NA-	0.10	-NA-	-NA-
	WW-016-1-01 to WW-016-3-01	State Route 96, King Highway bridge	0.10	-NA-	-NA-	0.65	0.21	32	0.38	0.33	88
PORTAGE CREEK	WW-060-1-01 to WW-060-3-01	Portage Creek, at Romence Street				9.60	16.45	171	9.60	16.45	171
	WW-058-1-01 to WW-058-3-01	Bryant Street, downstream of Bryant Mill Pond	0.10	-NA-	-NA-	1.08	0.61	57	0.59	0.66	112
KALAMAZOO RIVER	WW-053-1-01 to WW-053-3-01	Mosel Avenue				0.33	0.29	88	0.33	0.29	88
	WW-017-1-01 to WW-017-3-01	D Avenue bridge	0.10	-NA-	-NA-	0.36	0.34	93	0.23	0.26	112
	WW-018-1-01 to WW-018-3-01	US 131 Highway bridge, near Plainwell	0.10	-NA-	-NA-	3.55	0.94	26	1.82	1.98	109
	WW-020-1-01 to WW-020-3-01	Farmer Street bridge, in Otsego	0.26	0.14	53	1.34	0.61	45	0.80	0.71	89
	WW-022-1-01 to WW-022-3-01	26th Street bridge, between Otsego and Allegan				4.50	0.60	13	4.50	0.60	13
	WW-023-1-01 to WW-023-3-01	M-89 bridge, in Allegan	1.12	0.73	65	2.51	1.89	75	1.82	1.49	82
	WW-059-1-01 to WW-059-3-01	Grand Street bridge in Allegan, downstream of Allegan City Dam				4.05	1.07	27	4.05	1.07	27
	WW-025-1-01 to WW-025-3-01	M-89 bridge, between Allegan and Fennville	0.67	0.50	74	1.72	1.95	113	1.20	1.40	117
	WW-026-1-01 to WW-026-3-01	58th Street bridge, downstream of New Richmond	0.15	0.09	61	0.27	0.17	62	0.21	0.14	65
	WW-028-1-01 to WW-028-3-01	Blue Star Highway bridge, in Douglas	0.21	0.10	47	2.09	0.90	43	1.15	1.18	103

Notes:
1. SampleID uses a 4-part nomenclature, in the following format: AA-BBB-C-DD. AA is Matrix type (WW-Wet Weather); BBB is the sampling station identification number; C is location on transect (looking downstream, where 1 is Left Bank, 2 is Mid-Channel, and 3 is Right Bank; and DD is sample type (01-first or original sample, 02-blank, 03-duplicate)
2. Value used for non-detects in statistical analyses was one-half of the detection limit (Detection Limit for PCB congener = 0.20 ng/L)
3. "-NA-" denotes sample results were below the limits of detection, so the standard deviation and relative standard deviation are not applicable.
4. Kalamazoo River and Portage Creek stations are ordered from upstream to downstream, going top to bottom; Portage Creek stations are positioned after the King Highway Bridge station, which is the location of the confluence.
5. A blank cell means no samples collected at that location.

Table 3-8
Mean Total Suspended Solids in "Falling Limb" Wet Weather Surface Water Samples

			April 26, 2000			April 26, 2001			Overall Average		
	SampleID [1,3] (ordered from Left to Right bank)	Location	Mean TSS (mg/L) [2]	Standard Deviation (mg/L)	Relative Standard Deviation (%)	Mean TSS (mg/L) [2]	Standard Deviation (mg/L)	Relative Standard Deviation (%)	Mean TSS (mg/L) [2]	Standard Deviation (mg/L)	Relative Standard Deviation (%)
KALAMAZOO RIVER	WW-057-1-01 to WW-057-3-01	Michigan Avenue, upstream of Morrow Lake inlet, near Galesburg	19.97	2.17	11	21.20	3.67	17.29	20.58	2.78	14
	WW-016-1-01 to WW-016-3-01	State Route 96, King Highway bridge	16.53	1.71	10	14.27	2.01	14.11	15.40	2.08	14
PORTAGE CREEK	WW-060-1-01 to WW-060-3-01	Portage Creek, at Romence Street				5.27	1.70	32.30	5.27	1.70	32
	WW-058-1-01 to WW-058-3-01	Bryant Street, downstream of Bryant Mill Pond	11.80	2.11	18	15.67	3.78	24.10	13.73	3.46	25
KALAMAZOO RIVER	WW-053-1-01 to WW-053-3-01	Mosel Avenue				12.60	0.53	4.20	12.60	0.53	4
	WW-017-1-01 to WW-017-3-01	D Avenue bridge	19.17	0.98	5	16.20	0.40	2.47	17.68	1.76	10
	WW-018-1-01 to WW-018-3-01	US 131 Highway bridge, near Plainwell	24.07	5.60	23	26.23	3.31	12.61	25.15	4.28	17
	WW-020-1-01 to WW-020-3-01	Farmer Street bridge, in Otsego	30.67	2.93	10	26.93	2.20	8.18	28.80	3.09	11
	WW-022-1-01 to WW-022-3-01	26th Street bridge, between Otsego and Allegan				23.10	1.65	7.15	23.10	1.65	7
	WW-023-1-01 to WW-023-3-01	M-89 bridge, in Allegan	62.33	14.46	23	17.13	4.10	23.93	39.73	26.52	67
	WW-059-1-01 to WW-059-3-01	Grand Street bridge in Allegan, downstream of Allegan City Dam				23.13	1.02	4.42	23.13	1.02	4
	WW-025-1-01 to WW-025-3-01	M-89 bridge, between Allegan and Fennville	20.83	0.76	4	16.60	3.81	22.96	18.72	3.38	18
	WW-026-1-01 to WW-026-3-01	58th Street bridge, downstream of New Richmond	17.67	0.29	2	17.37	3.71	21.35	17.52	2.36	13
	WW-028-1-01 to WW-028-3-01	Blue Star Highway bridge, in Douglas	30.50	3.97	13	26.00	8.92	34.31	28.25	6.65	24

Notes:
1. SampleID uses a 4-part nomenclature, in the following format: AA-BBB-C-DD. AA is Matrix type (WW-Wet Weather); BBB is the sampling station identification number; C is location on transect (looking downstream, where 1 is Left Bank, 2 is Mid-Channel, and 3 is Right Bank; and DD is sample type (01-first or original sample, 02-blank, 03-duplicate)
2. Value used for non-detects in statistical analyses was one-half of the detection limit (Detection Limit for TSS = 2 mg/L)
3. Kalamazoo River and Portage Creek stations are ordered from upstream to downstream, going top to bottom; Portage Creek stations are positioned after the King Highway Bridge station, which is the location of the confluence.
4. A blank cell means no samples collected at that location.

Table 3-9
Mean Total PCB Concentrations in
"Peak Flow" Wet Weather Surface Water Samples (August 23, 2001)

	SampleID[1,3] (ordered from Left to Right bank)	Location	Mean Total PCBs (ng/L)[2]	Standard Deviation (ng/L)	Relative Standard Deviation (%)
KALAMAZOO RIVER	WW-057-1-01 to WW-057-3-01	Michigan Avenue, upstream of Morrow Lake inlet, near Galesburg	5.16	3.71	72
	WW-016-1-01 to WW-016-3-01	State Route 96, King Highway bridge	1.81	0.32	18
PORTAGE CREEK	WW-060-1-01 to WW-060-3-01	Portage Creek, at Romence Street	0.87	0.12	14
	WW-058-1-01 to WW-058-3-01	Bryant Street, downstream of Bryant Mill Pond	4.41	0.73	16
KALAMAZOO RIVER	WW-053-1-01 to WW-053-3-01	Mosel Avenue	4.00	1.15	29
	WW-017-1-01 to WW-017-3-01	D Avenue bridge	5.16	0.76	15
	WW-018-1-01 to WW-018-3-01	US 131 Highway bridge, near Plainwell	17.47	2.30	13
	WW-020-1-01 to WW-020-3-01	Farmer Street bridge, in Otsego	15.68	3.88	25
	WW-022-1-01 to WW-022-3-01	26th Street bridge, between Otsego and Allegan	23.37	1.80	8
	WW-023-1-01 to WW-023-3-01	M-89 bridge, in Allegan	24.04	6.16	26
	WW-059-1-01 to WW-059-3-01	Grand Street bridge in Allegan, downstream of Allegan City Dam	30.32	1.56	5
	WW-025-1-01 to WW-025-3-01	M-89 bridge, between Allegan and Fennville	16.19	1.11	7
	WW-026-1-01 to WW-026-3-01	58th Street bridge, downstream of New Richmond	6.71	0.80	12
	WW-028-1-01 to WW-028-3-01	Blue Star Highway bridge, in Douglas	7.28	2.01	28

Notes:
1. SampleID uses a 4-part nomenclature, in the following format: AA-BBB-C-DD. AA is Matrix type (WW-Wet Weather); BBB is the sampling station identification number; C is location on transect (looking downstream, where 1 is Left Bank, 2 is Mid-Channel, and 3 is Right Bank; and DD is sample type (01-first or original sample, 02-blank, 03-duplicate)
2. Value used for non-detects in statistical analyses was one-half of the detection limit (Detection Limit for PCB congener = 0.20 ng/L)
3. Kalamazoo River and Portage Creek stations are ordered from upstream to downstream, going top to bottom; Portage Creek stations are positioned after the King Highway Bridge station, which is the location of the confluence.
4. A blank cell means no samples collected at that location.

Table 3-10
Mean Total Suspended Solids in
"Peak Flow" Wet Weather Surface Water Samples (August 23, 2001)

	SampleID[1,3] (ordered from Left to Right bank)	Location	Mean TSS (mg/L)[2]	Standard Deviation (mg/L)	Relative Standard Deviation (%)
KALAMAZOO RIVER	WW-057-1-01 to WW-057-3-01	Michigan Avenue, upstream of Morrow Lake inlet, near Galesburg	29.47	8.22	28
	WW-016-1-01 to WW-016-3-01	State Route 96, King Highway bridge	16.73	1.68	10
PORTAGE CREEK	WW-060-1-01 to WW-060-3-01	Portage Creek, at Romence Street	21.00	3.14	15
	WW-058-1-01 to WW-058-3-01	Bryant Street, downstream of Bryant Mill Pond	20.07	1.31	7
KALAMAZOO RIVER	WW-053-1-01 to WW-053-3-01	Mosel Avenue	19.80	1.00	5
	WW-017-1-01 to WW-017-3-01	D Avenue bridge	24.00	1.31	5
	WW-018-1-01 to WW-018-3-01	US 131 Highway bridge, near Plainwell	36.47	3.03	8
	WW-020-1-01 to WW-020-3-01	Farmer Street bridge, in Otsego	39.70	2.65	7
	WW-022-1-01 to WW-022-3-01	26th Street bridge, between Otsego and Allegan	40.10	5.99	15
	WW-023-1-01 to WW-023-3-01	M-89 bridge, in Allegan	53.30	19.70	37
	WW-059-1-01 to WW-059-3-01	Grand Street bridge in Allegan, downstream of Allegan City Dam	75.93	11.40	15
	WW-025-1-01 to WW-025-3-01	M-89 bridge, between Allegan and Fennville	26.23	1.12	4
	WW-026-1-01 to WW-026-3-01	58th Street bridge, downstream of New Richmond	28.73	2.83	10
	WW-028-1-01 to WW-028-3-01	Blue Star Highway bridge, in Douglas	25.87	3.39	13

Notes:
1. SampleID uses a 4-part nomenclature, in the following format: AA-BBB-C-DD. AA is Matrix type (WW-Wet Weather); BBB is the sampling station identification number; C is location on transect (looking downstream, where 1 is Left Bank, 2 is Mid-Channel, and 3 is Right Bank; and DD is sample type (01-first or original sample, 02-blank, 03-duplicate)
2. Value used for non-detects in statistical analyses was one-half of the detection limit (Detection Limit for TSS = 2 mg/L)
3. Kalamazoo River and Portage Creek stations are ordered from upstream to downstream, going top to bottom; Portage Creek stations are positioned after the King Highway Bridge station, which is the location of the confluence.
4. A blank cell means no samples collected at that location.

Table 3-11
Fish Collected from the Kalamazoo River and Portage Creek
(1999-2006)

	General Location	Fish Species Collected	Number of Fish Collected						
			1999	2000	2001	2002	2003	2004	2006
KALAMAZOO RIVER	Ceresco Reservoir	Adult Smallmouth Bass YOY Smallmouth Bass Adult Carp	11 29 (5 Composites) 11	11 25 (5 Composites) 11	11 30 (5 Composites) 11	-NA-	-NA-	-NA-	11 20 (5 Composites) 11
KALAMAZOO RIVER	Morrow Lake	Adult Smallmouth Bass YOY Smallmouth Bass Adult Carp Adult Channel Catfish	11 25 (5 Composites) 11 -NA-	-NA-	11 27 (5 Composites) 11 1	-NA-	-NA-	-NA-	11 20 (5 Composites) 11
PORTAGE CREEK	Portage Creek - Bryant Mill Pond	Adult Carp YOY Carp Adult White Sucker Yearling White Suckers Adult Brown Trout	-NA-	11 -NA- -NA- 20 (5 Composites) 1	11 20 (5 Composites) 1 9 -NA-	11 21 (5 Composites) -NA- 11 -NA-	-NA-	-NA-	11 0 -NA- 11 -NA-
PORTAGE CREEK	Portage Creek - Monarch Mill Pond	Adult Carp	-NA-	-NA-	11	-NA-	-NA-	-NA-	11
KALAMAZOO RIVER	Kalamazoo Avenue	Adult Smallmouth Bass YOY Smallmouth Bass Adult Carp Northern Pike Rock Bass	-NA-	11 5 (1 Composite) 6 1 1	1 0 0 -NA- -NA-	-NA-	-NA-	-NA-	11 20 (5 Composite) 11 -NA- -NA-
KALAMAZOO RIVER	D Avenue	Adult Smallmouth Bass Adult Carp	-NA-	11 5	-NA-	-NA-	-NA-	-NA-	-NA-
KALAMAZOO RIVER	Plainwell Impoundment	Adult Smallmouth Bass YOY Smallmouth Bass Adult Carp	11 30 (5 Composites) 11	-NA-	11 23 (5 Composites) 11	-NA-	-NA-	-NA-	11 20 (5 Composites) 11
KALAMAZOO RIVER	Otsego City Impoundment	Adult Smallmouth Bass YOY Smallmouth Bass Adult Carp	11 54 (5 Composites) 11	-NA-	11 11 (2 Composites) 11	-NA-	-NA-	-NA-	11 -NA- -NA-
KALAMAZOO RIVER	Otsego Impoundment	Adult Smallmouth Bass YOY Smallmouth Bass Adult Carp	11 30 (5 Composites) 11	-NA-	11 33 (5 Composites) 11	-NA-	-NA-	-NA-	11 -NA- -NA-
KALAMAZOO RIVER	Trowbridge Impoundment	Adult Smallmouth Bass YOY Smallmouth Bass Adult Carp Adult Channel Catfish	11 30 (5 Composites) 11 1	-NA-	11 0 11 -NA-	-NA-	-NA- -NA- 11 -NA-	-NA- -NA- 11 -NA-	11 20 (5 Composites) 11 1
KALAMAZOO RIVER	Allegan City Impoundment	Adult Smallmouth Bass YOY Smallmouth Bass Adult Carp Adult Channel Catfish	11 32 (5 Composites) 11 -NA-	-NA-	11 24 (5 Composites) 11 -NA-	-NA-	-NA-	-NA-	11 -NA- 11 2
KALAMAZOO RIVER	Lake Allegan	Adult Smallmouth Bass YOY Smallmouth Bass Adult Carp Adult Channel Catfish Adult Black Crappie Adult Largemouth Bass Adult Walleye	11 33 (5 Composites) 11 1 -NA- -NA- -NA-	10 25 (5 Composites) 11 -NA- 1 1 2	11 25 (5 Composites) 11 6 -NA- -NA- -NA-	-NA-	-NA-	-NA-	11 20 (5 Composites) 11 11 -NA- -NA- -NA-
KALAMAZOO RIVER	New Richmond	Adult Smallmouth Bass YOY Smallmouth Bass Adult Carp Adult Flathead Catfish Adult Channel Catfish Adult Largemouth Bass Adult Channel Catfish	8 10 (2 Composites) 10 -NA- -NA- 1 1	-NA-	10 18 (5 Composites) 11 4 -NA- -NA- -NA-	-NA-	-NA-	-NA-	11 20 (5 Composites) 11 1 2 -NA- -NA-
KALAMAZOO RIVER	Kalamazoo Lake	Adult Smallmouth Bass YOY Smallmouth Bass Adult Carp Adult Channel Catfish Adult Brown Trout	11 35 (5 Composites) 11 -NA- 1	-NA-	11 16 (5 Composites) 11 2 -NA-	-NA-	-NA-	-NA-	-NA- -NA- 11 -NA- -NA-

Notes:
"-NA-" denotes that a station and/or species was not sampled.
Portage Creek stations are shaded.

Table 3-12
Mean Total Wet-Weight PCB Concentrations (Aroclors) in Adult Carp

	Station ID[2]	Location	1999			2000			2001			2002			2003			2004			2006			Overall Average		
			Mean Total PCB (mg/Kg ww)[1]	Standard Deviation (mg/Kg ww)	Relative Standard Deviation (%)	Mean Total PCB (mg/Kg ww)[1]	Standard Deviation (mg/Kg ww)	Relative Standard Deviation (%)	Mean Total PCB (mg/Kg ww)[1]	Standard Deviation (mg/Kg ww)	Relative Standard Deviation (%)	Mean Total PCB (mg/Kg ww)[1]	Standard Deviation (mg/Kg ww)	Relative Standard Deviation (%)	Mean Total PCB (mg/Kg ww)[1]	Standard Deviation (mg/Kg ww)	Relative Standard Deviation (%)	Mean Total PCB (mg/Kg ww)[1]	Standard Deviation (mg/Kg ww)	Relative Standard Deviation (%)	Mean Total PCB (mg/Kg ww)[1]	Standard Deviation (mg/Kg ww)	Relative Standard Deviation (%)	Mean Total PCB (mg/Kg ww)[1]	Standard Deviation (mg/Kg ww)	Relative Standard Deviation (%)
KALAMAZOO RIVER	31	Ceresco Reservoir	0.09	0.07	80	0.20	0.11	52	0.40	0.29	72										0.14	0.08	59	0.21	0.20	95
KALAMAZOO RIVER	29	Morrow Lake	0.22	0.14	63				0.73	0.50	69										0.59	0.62	104	0.51	0.50	98
PORTAGE CREEK	68	Portage Creek - Monarch Mill Pond							0.17	0.14	80										0.09	0.11	125	0.13	0.13	99
PORTAGE CREEK	61	Portage Creek - Bryant Mill Pond				0.36	0.37	104	0.72	1.01	140	0.23	0.16	68							0.32	0.29	91	0.41	0.58	141
KALAMAZOO RIVER	62	Kalamazoo Avenue				2.98	1.84	62													3.85	2.97	77	3.54	2.60	73
KALAMAZOO RIVER	63	D Avenue				7.76	3.71	48																7.76	3.71	48
KALAMAZOO RIVER	32	Plainwell Impoundment	10.30	6.27	61				9.80	6.22	64										7.90	5.38	68	9.33	5.88	63
KALAMAZOO RIVER	33	Otsego City Impoundment	1.11	0.61	55				2.84	2.18	77										1.84	1.18	64	1.93	1.60	83
KALAMAZOO RIVER	36	Otsego Impoundment	2.54	1.35	53				9.00	13.61	151										1.37	0.62	45	4.30	8.38	195
KALAMAZOO RIVER	37	Trowbridge Impoundment	3.66	4.26	116				3.99	2.15	54				3.15	2.12	67	3.92	2.41	61	1.37	1.23	90	3.22	2.71	84
KALAMAZOO RIVER	38	Allegan City Impoundment	3.34	2.15	65				3.96	1.87	47										3.69	3.73	101	3.66	2.64	72
KALAMAZOO RIVER	30	Lake Allegan	0.69	0.34	49	0.98	1.22	125	1.49	0.83	56										2.32	2.88	124	1.37	1.69	123
KALAMAZOO RIVER	35	New Richmond	1.58	1.19	75				2.34	2.09	89										1.55	1.30	84	1.83	1.58	87
KALAMAZOO RIVER	34	Kalamazoo Lake	2.69	1.81	67				1.63	1.09	67										0.79	0.52	66	1.70	1.45	85

Notes:
1. Value used for non-detects in statistical analyses was one-half of the detection limit (Detection Limit for PCB aroclor = 0.05 mg/kg).
2. Kalamazoo River and Portage Creek stations are ordered from upstream to downstream, going top to bottom; Portage Creek stations are shaded and are positioned after the Kalamazoo Avenue station, which is the location of the confluence.
3. A blank cell means no samples collected at that location.

Table 3-13
Mean Tissue Lipid Content in Adult Carp

	Station ID[2]	Location	1999			2000			2001			2002			2003			2004			2006			Overall Average		
			Mean Lipid Content (%)[1]	Standard Deviation (%)	Relative Standard Deviation (%)	Mean Lipid Content (%)[1]	Standard Deviation (%)	Relative Standard Deviation (%)	Mean Lipid Content (%)[1]	Standard Deviation (%)	Relative Standard Deviation (%)	Mean Lipid Content (%)[1]	Standard Deviation (%)	Relative Standard Deviation (%)	Mean Lipid Content (%)[1]	Standard Deviation (%)	Relative Standard Deviation (%)	Mean Lipid Content (%)[1]	Standard Deviation (%)	Relative Standard Deviation (%)	Mean Lipid Content (%)[1]	Standard Deviation (%)	Relative Standard Deviation (%)	Mean Lipid Content (%)[1]	Standard Deviation (%)	Relative Standard Deviation (%)
KALAMAZOO RIVER	31	Ceresco Reservoir	2.62	1.56	60	3.07	1.31	42	3.28	1.37	42										1.77	0.90	51	2.69	1.39	52
	29	Morrow Lake	1.10	0.66	60				2.32	1.27	55										2.31	2.55	110	1.91	1.73	91
PORTAGE CREEK	68	Portage Creek - Monarch Mill Pond							2.16	1.32	61										1.77	1.43	81	1.96	1.36	69
	61	Portage Creek - Bryant Mill Pond				2.12	0.84	40	3.02	1.87	62	1.81	0.83	46							3.32	2.16	65	2.57	1.62	63
KALAMAZOO RIVER	62	Kalamazoo Avenue				5.14	3.30	64													6.64	4.50	68	6.11	4.07	67
	63	D Avenue				13.83	8.10	59																13.83	8.10	59
	32	Plainwell Impoundment	11.71	6.14	52				8.83	5.65	64										12.76	7.64	60	11.10	6.55	59
	33	Otsego City Impoundment	2.31	0.79	34				2.26	1.54	68										2.81	1.53	55	2.46	1.32	54
	36	Otsego Impoundment	2.93	1.72	59				5.38	4.73	88										1.72	0.62	36	3.34	3.23	97
	37	Trowbridge Impoundment	2.07	1.92	93				2.84	1.31	46				4.52	4.22	93	3.52	2.27	64	2.13	1.78	84	3.02	2.59	86
	38	Allegan City Impoundment	3.85	2.42	63				3.81	2.12	56										3.55	3.65	103	3.73	2.72	73
	30	Lake Allegan	1.42	1.16	81	0.88	0.41	46	1.86	0.95	51										1.24	0.95	76	1.35	0.95	70
	35	New Richmond	4.85	6.37	131				2.40	2.26	94										3.53	4.29	122	3.55	4.52	127
	34	Kalamazoo Lake	11.39	7.83	69				2.10	1.58	75										2.44	1.29	53	5.31	6.29	118

Notes:
1. Value used for non-detects in statistical analyses was one-half of the detection limit (Detection Limit for PCB aroclor = 0.05 mg/kg).
2. Kalamazoo River and Portage Creek stations are ordered from upstream to downstream, going top to bottom; Portage Creek stations are shaded and are positioned after the Kalamazoo Avenue station, which is the location of the confluence.
3. A blank cell means no samples collected at that location.

Table 3-14
Mean Total Lipid-Normalized PCB Concentrations (Aroclors) in Adult Carp

	Station ID[2]	Location	1999			2000			2001			2002			2003			2004			2006			Overall Average		
			Mean Total PCB (mg/Kg L-N)[1]	Standard Deviation (mg/Kg L-N)	Relative Standard Deviation (%)	Mean Total PCB (mg/Kg L-N)[1]	Standard Deviation (mg/Kg L-N)	Relative Standard Deviation (%)	Mean Total PCB (mg/Kg L-N)[1]	Standard Deviation (mg/Kg L-N)	Relative Standard Deviation (%)	Mean Total PCB (mg/Kg L-N)[1]	Standard Deviation (mg/Kg L-N)	Relative Standard Deviation (%)	Mean Total PCB (mg/Kg L-N)[1]	Standard Deviation (mg/Kg L-N)	Relative Standard Deviation (%)	Mean Total PCB (mg/Kg L-N)[1]	Standard Deviation (mg/Kg L-N)	Relative Standard Deviation (%)	Mean Total PCB (mg/Kg L-N)[1]	Standard Deviation (mg/Kg L-N)	Relative Standard Deviation (%)	Mean Total PCB (mg/Kg L-N)[1]	Standard Deviation (mg/Kg L-N)	Relative Standard Deviation (%)
KALAMAZOO RIVER	31	Ceresco Reservoir	3.40	1.21	36	6.63	1.97	30	21.66	40.26	186										8.22	4.13	50	9.98	20.78	208
	29	Morrow Lake	21.29	8.58	40				33.77	12.00	36										26.09	13.98	54	27.05	12.51	46
PORTAGE CREEK	68	Portage Creek - Monarch Mill Pond							8.97	7.57	84										4.18	2.70	65	6.58	6.07	92
	61	Portage Creek - Bryant Mill Pond				15.44	14.22	92	22.91	21.30	93	12.61	4.44	35							9.30	3.25	35	15.06	13.62	90
KALAMAZOO RIVER	62	Kalamazoo Avenue				59.12	14.08	24													58.57	25.61	44	58.76	21.72	37
	63	D Avenue				111.51	124.96	112																111.51	124.96	112
	32	Plainwell Impoundment	91.10	54.16	59				117.73	51.05	43										80.16	76.34	95	96.33	61.72	64
	33	Otsego City Impoundment	47.09	14.51	31				139.45	96.93	70										69.23	21.60	31	85.26	68.89	81
	36	Otsego Impoundment	86.80	25.56	29				134.23	51.81	39										82.66	37.86	46	101.23	45.34	45
	37	Trowbridge Impoundment	167.13	48.74	29				139.48	27.29	20				115.67	78.40	68	112.00	21.21	19	76.95	45.64	59	122.25	55.72	46
	38	Allegan City Impoundment	99.16	59.64	60				111.34	25.16	23										105.73	35.31	33	105.41	41.53	39
	30	Lake Allegan	54.18	17.54	32	107.46	151.78	141	85.76	40.90	48										191.36	254.38	133	109.69	153.33	140
	35	New Richmond	60.53	66.32	110				109.78	82.96	76										57.61	42.14	73	76.45	68.35	89
	34	Kalamazoo Lake	33.12	24.64	74				108.61	95.04	88										35.78	23.78	66	59.17	66.71	113

Notes:
1. Value used for non-detects in statistical analyses was one-half of the detection limit (Detection Limit for PCB aroclor = 0.05 mg/kg).
2. Kalamazoo River and Portage Creek stations are ordered from upstream to downstream, going top to bottom; Portage Creek stations are shaded and are positioned after the Kalamazoo Avenue station, which is the location of the confluence.
3. A blank cell means no samples collected at that location.

Table 3-15
Mean Total Wet-Weight PCB Concentrations (Aroclors) in Adult Smallmouth Bass

	Station ID[2]	Location	1999			2000			2001			2006			Overall Average		
			Mean Total PCBs (mg/Kg ww)[1]	Standard Deviation (mg/Kg ww)	Relative Standard Deviation (%)	Mean Total PCBs (mg/Kg ww)[1]	Standard Deviation (mg/Kg ww)	Relative Standard Deviation (%)	Mean Total PCBs (mg/Kg ww)[1]	Standard Deviation (mg/Kg ww)	Relative Standard Deviation (%)	Mean Total PCBs (mg/Kg ww)[1]	Standard Deviation (mg/Kg ww)	Relative Standard Deviation (%)	Mean Total PCBs (mg/Kg ww)[1]	Standard Deviation (mg/Kg ww)	Relative Standard Deviation (%)
KALAMAZOO RIVER	31	Ceresco Reservoir	0.03	0.00	16	0.03	0.00	3	0.04	0.02	65	0.03	0.01	41	0.03	0.01	44
	29	Morrow Lake	0.16	0.06	38				0.05	0.05	87	0.20	0.07	35	0.13	0.08	62
	62	Kalamazoo Avenue				0.28	0.18	64	0.56	0.00	0	0.33	0.17	52	0.31	0.18	56
	63	D Avenue				0.87	0.59	68							0.87	0.59	68
	32	Plainwell Impoundment	0.72	0.20	28				0.56	0.28	50	0.98	0.51	52	0.75	0.39	51
	33	Otsego City Impoundment	0.52	0.40	76				0.46	0.36	78				0.49	0.37	75
	36	Otsego Impoundment	0.58	0.21	36				0.63	0.25	39				0.60	0.22	37
	37	Trowbridge Impoundment	1.14	0.38	34				1.15	0.65	57	0.82	0.54	66	1.04	0.54	53
	38	Allegan City Impoundment	0.56	0.24	42				0.52	0.21	41	0.21	0.09	42	0.43	0.25	57
	30	Lake Allegan	0.55	0.16	30	0.35	0.21	59	0.49	0.25	51	0.53	0.25	48	0.48	0.23	47
	35	New Richmond	0.72	0.38	52				0.59	0.21	35	0.44	0.17	39	0.57	0.27	48
	34	Kalamazoo Lake	0.53	0.28	52				0.54	0.26	49				0.53	0.26	49

Notes:
1. Value used for non-detects in statistical analyses was one-half of the detection limit (Detection Limit for PCB aroclor = 0.05 mg/kg).
2. Kalamazoo River and Portage Creek stations are ordered from upstream to downstream, going top to bottom; Portage Creek stations are shaded and are positioned after the Kalamazoo Avenue station, which is the location of the confluence.
3. A blank cell means no samples collected at that location.

Table 3-16
Mean Tissue Lipid Content in Adult Smallmouth Bass

	Station ID[2]	Location	1999			2000			2001			2006			Overall Average		
			Mean Lipid Content (%)	Standard Deviation (%)	Relative Standard Deviation (%)	Mean Lipid Content (%)	Standard Deviation (%)	Relative Standard Deviation (%)	Mean Lipid Content (%)	Standard Deviation (%)	Relative Standard Deviation (%)	Mean Lipid Content (%)	Standard Deviation (%)	Relative Standard Deviation (%)	Mean Lipid Content (%)	Standard Deviation (%)	Relative Standard Deviation (%)
KALAMAZOO RIVER	31	Ceresco Reservoir	0.70	0.17	24	0.36	0.20	56	0.94	0.39	42	0.66	0.32	48	0.66	0.34	52
	29	Morrow Lake	0.66	0.23	34				0.32	0.26	81	0.33	0.12	37	0.44	0.26	59
	62	Kalamazoo Avenue				0.47	0.25	52	0.64	0.00	0	0.98	0.45	46	0.72	0.43	59
	63	D Avenue				1.16	0.55	47							1.16	0.55	47
	32	Plainwell Impoundment	0.67	0.25	37				0.81	0.22	27	1.27	0.53	42	0.92	0.44	47
	33	Otsego City Impoundment	0.65	0.33	51				0.42	0.28	66				0.53	0.32	60
	36	Otsego Impoundment	0.48	0.12	25				0.58	0.26	44				0.53	0.20	38
	37	Trowbridge Impoundment	0.70	0.27	38				0.79	0.35	44	0.64	0.20	31	0.71	0.28	39
	38	Allegan City Impoundment	0.50	0.11	21				0.62	0.20	32	0.55	0.16	29	0.56	0.16	29
	30	Lake Allegan	0.90	0.38	42	0.50	0.28	56	0.59	0.30	50	0.56	0.22	39	0.64	0.33	52
	35	New Richmond	1.22	0.89	73				0.67	0.17	25	1.13	0.37	33	0.99	0.56	57
	34	Kalamazoo Lake	1.89	0.65	34				1.62	1.19	73				1.75	0.94	54

Notes:
1. Value used for non-detects in statistical analyses was one-half of the detection limit (Detection Limit for PCB aroclor = 0.05 mg/kg).
2. Kalamazoo River and Portage Creek stations are ordered from upstream to downstream, going top to bottom; Portage Creek stations are shaded and are positioned after the Kalamazoo Avenue station, which is the location of the confluence.
3. A blank cell means no samples collected at that location.

Table 3-17
Mean Total Lipid-Normalized PCB Concentrations (Aroclors) in Adult Smallmouth Bass

	Station ID[2]	Location	1999			2000			2001			2006			Overall Average		
			Mean Total PCBs (mg/Kg L-N)[1]	Standard Deviation (mg/Kg L-N)	Relative Standard Deviation (%)	Mean Total PCBs (mg/Kg L-N)[1]	Standard Deviation (mg/Kg L-N)	Relative Standard Deviation (%)	Mean Total PCBs (mg/Kg L-N)[1]	Standard Deviation (mg/Kg L-N)	Relative Standard Deviation (%)	Mean Total PCBs (mg/Kg L-N)[1]	Standard Deviation (mg/Kg L-N)	Relative Standard Deviation (%)	Mean Total PCBs (mg/Kg L-N)[1]	Standard Deviation (mg/Kg L-N)	Relative Standard Deviation (%)
KALAMAZOO RIVER	31	Ceresco Reservoir	4.44	1.67	38	9.64	5.72	59	4.20	2.28	54	5.55	3.30	59	5.96	4.11	69
	29	Morrow Lake	26.21	17.09	65				17.31	8.24	48	61.84	21.95	35	35.12	25.40	72
	62	Kalamazoo Avenue				62.49	40.84	65	87.37	0.00	0	35.81	18.22	51	50.81	33.92	67
	63	D Avenue				80.70	53.05	66							80.70	53.05	66
	32	Plainwell Impoundment	114.82	38.95	34				70.90	34.25	48	78.34	21.23	27	88.02	36.90	42
	33	Otsego City Impoundment	119.02	116.93	98				101.32	37.91	37				110.17	85.31	77
	36	Otsego Impoundment	127.96	51.00	40				143.80	119.35	83				135.88	89.93	66
	37	Trowbridge Impoundment	167.62	51.53	31				148.68	43.51	29	146.90	121.78	83	154.40	78.40	51
	38	Allegan City Impoundment	112.54	46.27	41				81.70	14.05	17	39.23	15.68	40	77.82	41.70	54
	30	Lake Allegan	70.80	41.82	59	73.06	28.29	39	82.71	20.24	24	96.99	31.11	32	81.07	32.03	40
	35	New Richmond	66.29	25.76	39				89.81	30.88	34	38.25	8.84	23	63.76	31.62	50
	34	Kalamazoo Lake	32.24	24.55	76				37.46	13.07	35				34.85	19.38	56

Notes:
1. Value used for non-detects in statistical analyses was one-half of the detection limit (Detection Limit for PCB aroclor = 0.05 mg/kg).
2. Kalamazoo River and Portage Creek stations are ordered from upstream to downstream, going top to bottom; Portage Creek stations are shaded and are positioned after the Kalamazoo Avenue station, which is the location of the confluence.
3. A blank cell means no samples collected at that location.

Table 3-18
Mean Total Wet-Weight PCB Concentrations (Congeners) in YOY Smallmouth Bass

	Station[2]	Location	1999			2000			2001			2006			Overall Average		
			Mean Total PCB (mg/Kg ww)[1]	Standard Deviation (mg/Kg ww)	Relative Standard Deviation (%)	Mean Total PCB (mg/Kg ww)[1]	Standard Deviation (mg/Kg ww)	Relative Standard Deviation (%)	Mean Total PCB (mg/Kg ww)[1]	Standard Deviation (mg/Kg ww)	Relative Standard Deviation (%)	Mean Total PCB (mg/Kg ww)[1]	Standard Deviation (mg/Kg ww)	Relative Standard Deviation (%)	Mean Total PCB (mg/Kg ww)[1]	Standard Deviation (mg/Kg ww)	Relative Standard Deviation (%)
KALAMAZOO RIVER	31	Ceresco Reservoir	0.15	0.01	7	0.16	0.01	6	0.10	0.02	23	0.13	0.02	12	0.13	0.03	19
	29	Morrow Lake	0.43	0.07	16				0.29	0.04	15	0.35	0.10	27	0.36	0.09	25
	62	Kalamazoo Avenue				1.27	0.00	0				0.93	0.19	20	0.98	0.22	22
	32	Plainwell Impoundment	2.52	0.09	4				1.75	0.28	16	1.59	0.21	13	1.95	0.46	24
	33	Otsego City Impoundment	2.71	0.16	6				1.44	0.30	21				2.35	0.64	27
	36	Otsego Dam Impoundment	3.05	0.46	15				1.16	0.18	15				2.11	1.05	50
	37	Trowbridge Impoundment	3.24	0.47	15							1.39	0.21	15	2.31	1.04	45
	38	Allegan City Impoundment	3.75	0.76	20				1.80	0.55	31				2.77	1.20	43
	30	Lake Allegan	3.57	0.28	8	1.30	0.11	8	1.45	0.23	16	1.24	0.09	7	1.89	1.01	54
	35	New Richmond	1.24	0.10	8				0.95	0.15	16	0.72	0.05	7	0.90	0.22	24
	34	Kalamazoo Lake	1.12	0.13	11				0.99	0.17	17				1.05	0.16	15

Notes:
1. Value used for non-detects in statistical analyses was one-half of the detection limit (Detection Limit for PCB congener = 0.0005 mg/kg).
2. Kalamazoo River and Portage Creek stations are ordered from upstream to downstream, going top to bottom; Portage Creek stations are shaded and are positioned after the Kalamazoo Avenue station, which is the location of the confluence.
3. A blank cell means no samples collected at that location.

Table 3-19
Mean Tissue Lipid Content in YOY Smallmouth Bass

	Station[2]	Location	1999			2000			2001			2006			Overall Average		
			Mean Lipid Content (%)[1]	Standard Deviation (%)	Relative Standard Deviation (%)	Mean Lipid Content (%)[1]	Standard Deviation (%)	Relative Standard Deviation (%)	Mean Lipid Content (%)[1]	Standard Deviation (%)	Relative Standard Deviation (%)	Mean Lipid Content (%)[1]	Standard Deviation (%)	Relative Standard Deviation (%)	Mean Lipid Content (%)[1]	Standard Deviation (%)	Relative Standard Deviation (%)
KALAMAZOO RIVER	31	Ceresco Reservoir	3.58	0.59	17	4.28	0.30	7	3.26	1.05	32	4.32	1.35	31	3.86	0.96	25
	29	Morrow Lake	3.19	0.67	21				1.98	0.25	13	2.29	0.67	29	2.49	0.75	30
	62	Kalamazoo Avenue				4.41	-NA-	-NA-				3.85	0.64	17	3.95	0.62	16
	32	Plainwell Impoundment	4.25	0.62	15				3.52	0.44	12	4.52	0.47	10	4.10	0.65	16
	33	Otsego City Impoundment	3.72	0.74	20				2.51	0.16	6				3.38	0.85	25
	36	Otsego Dam Impoundment	4.07	0.50	12				2.29	0.18	8				3.18	1.00	32
	37	Trowbridge Impoundment	3.63	0.30	8							2.78	0.49	18	3.21	0.59	18
	38	Allegan City Impoundment	3.42	0.40	12				2.63	0.42	16				3.02	0.57	19
	30	Lake Allegan	3.25	0.40	12	3.18	0.33	10	2.54	0.56	22	4.37	0.39	9	3.34	0.78	23
	35	New Richmond	3.46	0.01	0				2.65	0.41	16	3.30	0.24	7	3.06	0.46	15
	34	Kalamazoo Lake	3.66	0.49	14				3.22	0.80	25				3.44	0.67	19

Notes:
1. Value used for non-detects in statistical analyses was one-half of the detection limit (Detection Limit for PCB congener = 0.0005 mg/kg).
2. Kalamazoo River and Portage Creek stations are ordered from upstream to downstream, going top to bottom; Portage Creek stations are shaded and are positioned after the Kalamazoo Avenue station, which is the location of the confluence.
3. A blank cell means no samples collected at that location.
"-NA-" denotes only one sample collected, so the standard deviation and relative standard deviation are not applicable.

Table 3-20
Mean Total Lipid-Normalized PCB Concentrations (Congeners) in YOY Smallmouth Bass

	Station2	Location	1999			2000			2001			2006			Overall Average		
			Mean Total PCB (mg/Kg L-N)[1]	Standard Deviation (mg/Kg L-N)	Relative Standard Deviation (%)	Mean Total PCB (mg/Kg L-N)[1]	Standard Deviation (mg/Kg L-N)	Relative Standard Deviation (%)	Mean Total PCB (mg/Kg L-N)[1]	Standard Deviation (mg/Kg L-N)	Relative Standard Deviation (%)	Mean Total PCB (mg/Kg L-N)[1]	Standard Deviation (mg/Kg L-N)	Relative Standard Deviation (%)	Mean Total PCB (mg/Kg L-N)[1]	Standard Deviation (mg/Kg L-N)	Relative Standard Deviation (%)
KALAMAZOO RIVER	31	Ceresco Reservoir	4.29	0.97	23	3.69	0.20	6	3.42	1.22	36	3.23	1.27	39	3.66	1.01	28
	29	Morrow Lake	14.00	3.44	25				14.94	2.20	15	15.86	3.11	20	14.93	2.85	19
	62	Kalamazoo Avenue				28.75	0.00	0				24.02	2.26	9	24.81	2.79	11
	32	Plainwell Impoundment	59.89	5.88	10				49.68	6.40	13	35.26	2.39	7	48.28	11.51	24
	33	Otsego City Impoundment	74.67	13.00	17				57.16	8.32	15				69.66	14.04	20
	36	Otsego Dam Impoundment	76.15	16.02	21				50.97	7.21	14				63.56	17.70	28
	37	Trowbridge Impoundment	88.86	6.43	7							50.67	8.43	17	69.77	21.33	31
	38	Allegan City Impoundment	109.94	21.82	20				67.18	14.14	21				88.56	28.43	32
	30	Lake Allegan	110.50	11.02	10	41.24	5.89	14	57.94	5.09	9	28.37	2.59	9	59.51	32.67	55
	35	New Richmond	35.97	2.84	8				35.82	1.85	5	22.02	2.47	11	30.09	7.41	25
	34	Kalamazoo Lake	30.73	1.61	5				31.50	6.40	20				31.11	4.42	14

Notes:
1. Value used for non-detects in statistical analyses was one-half of the detection limit (Detection Limit for PCB congener = 0.0005 mg/kg).
2. Kalamazoo River and Portage Creek stations are ordered from upstream to downstream, going top to bottom; Portage Creek stations are shaded and are positioned after the Kalamazoo Avenue station, which is the location of the confluence.
3. A blank cell means no samples collected at that location.
"-NA-" denotes only one sample collected, so the standard deviation and relative standard deviation are not applicable.

Table 3-21
Total PCB (Aroclors) and Tissue Lipid Content in
Flathead and Channel Catfish Collected Between 1999 and 2006
(Wet-Weight and Lipid-Normalized)

Sample ID[1]	Station	Station	Collection Date	Species	Total PCB (mg/Kg ww)[2]	Total PCB (mg/Kg L-N)	Lipid Content (%)
2001043-12	29	Morrow Lake	8/17/2001	Channel Catfish	0.34	8.90	3.83
FW-037-0-29	37	Trowbridge Impoundment	11/4/1999	Channel Catfish	5.09	89.30	5.70
FW-037-0-28			9/22/2006	Channel Catfish	1.53	144.06	1.06
FW-038-0-23	38	Allegan City Impoundment	9/7/2006	Channel Catfish	0.86	44.90	1.92
FW-038-0-24			9/7/2006	Channel Catfish	1.71	110.91	1.54
FW-030-0-12	30	Lake Allegan	10/5/1999	Channel Catfish	0.55	45.83	1.20
2001053-25			8/21/2001	Channel Catfish	3.42	221.95	1.54
2001053-26			8/21/2001	Channel Catfish	1.02	110.29	0.92
2001053-28			8/21/2001	Channel Catfish	3.77	459.44	0.82
2001053-23			8/23/2001	Channel Catfish	3.21	104.12	3.08
2001053-24			8/23/2001	Channel Catfish	1.00	49.90	2.01
2001053-27			8/23/2001	Channel Catfish	0.61	182.06	0.34
FW-030-0-28			9/27/2006	Channel Catfish	3.22	243.94	1.32
FW-030-0-29			9/27/2006	Channel Catfish	1.62	88.10	1.84
FW-030-0-30			9/27/2006	Channel Catfish	0.44	19.51	2.23
FW-030-0-31			9/27/2006	Channel Catfish	1.09	66.63	1.63
FW-030-0-32			9/28/2006	Channel Catfish	0.29	31.86	0.91
FW-030-0-33			9/28/2006	Channel Catfish	1.40	61.09	2.29
FW-030-0-34			9/28/2006	Channel Catfish	0.62	32.14	1.92
FW-030-0-35			9/28/2006	Channel Catfish	3.76	80.26	4.68
FW-030-0-36			9/28/2006	Channel Catfish	1.59	88.44	1.80
FW-030-0-37			9/28/2006	Channel Catfish	2.44	96.83	2.52
FW-030-0-38			9/28/2006	Channel Catfish	0.72	65.18	1.10
2001054-11	35	New Richmond	10/1/2001	Flathead Catfish	0.60	124.90	0.48
2001054-12			10/1/2001	Flathead Catfish	2.24	241.84	0.93
2001054-13			10/2/2001	Flathead Catfish	1.68	158.68	1.06
2001054-14			10/2/2001	Flathead Catfish	3.32	226.05	1.47
FW-035-0-30			10/4/2006	Flathead Catfish	0.14	21.34	0.66
FW-035-0-24			10/27/1999	Channel Catfish	1.70	72.21	2.35
FW-035-0-28			10/3/2006	Channel Catfish	0.42	20.59	2.04
FW-035-0-29			10/3/2006	Channel Catfish	0.37	18.72	1.99
2001055-12	34	Kalamazoo Lake	9/27/2001	Channel Catfish	3.00	112.59	2.66
2001055-13			9/27/2001	Channel Catfish	3.83	288.27	1.33

Notes:

1. CDM SampleID uses a 4-part nomenclature, in the following format: AA-BBB-C-DD. AA is Matrix type (FW-Fish Whole); BBB is the sampling station identification number; C is always zero for fish; and DD is sample number. MDEQ Sample ID uses a 3-part nomenclature, in the following format: AAAABBB-CC. AAAA is the year; BBB is the sampling station identification number; and DD is the sample number.

2. Value used for non-detects in statistical analyses was one-half of the detection limit (Detection Limit = 0.05 mg/kg).

Table 3-22
Mean Total PCB (Aroclors) and Tissue Lipid Content In
Flathead and Channel Catfish Collected Between 1999 and 2006
(Wet-Weight and Lipid-Normalized)

Station ID	Station	Species	Mean Total PCB (mg/Kg ww)[1]	Mean Total PCB (mg/Kg L-N)	Mean Lipid Content (%)
29	Morrow Lake	Channel Catfish	0.34	8.90	3.83
37	Trowbridge Impoundment	Channel Catfish	3.31	116.68	3.38
38	Allegan City Impoundment	Channel Catfish	1.29	77.90	1.73
30	Lake Allegan	Channel Catfish	1.71	113.75	1.79
35	New Richmond	Flathead Catfish	1.60	154.56	0.92
		Channel Catfish	0.83	37.17	2.13
34	Kalamazoo Lake	Channel Catfish	3.41	200.43	2.00

Notes:

1. Value used for non-detects in statistical analyses was one-half of the detection limit (Detection Limit = 0.05 mg/kg).

Table 3-23
Total PCB (Aroclors) and Tissue Lipid Content in Other Fish Collected Between 1999 and 2001
(Wet-Weight and Lipid-Normalized)

	SampleID[1]	Station	Collection Date	Station	Species	Total PCB (mg/Kg ww)[2]	Total PCB (mg/Kg L-N)	Lipid Content (%)
KALAMAZOO RIVER	FW-062-0-14	62	8/29/2000	Kalamazoo Avenue	Rock Bass	0.05	14.93	0.35
	FW-062-0-20	62	11/16/2000	Kalamazoo Avenue	Northern Pike	0.43	130.83	0.33
PORTAGE CREEK	FW-061-0-07	61	8/10/2000	Portage Creek - Bryant Mill Pond	Brown Trout	0.05	6.55	0.80
	2001044-10	61	8/29/2001	Portage Creek - Bryant Mill Pond	White Sucker	0.29	10.73	2.68
KALAMAZOO RIVER	FW-030-0-09	30	9/18/2000	Lake Allegan	Walleye	1.80	109.09	1.65
	FW-030-0-10	30	9/18/2000	Lake Allegan	Walleye	0.32	42.88	0.75
	FW-030-0-24	30	9/19/2000	Lake Allegan	Largemouth Bass	0.31	85.78	0.36
	FW-030-0-23	30	9/19/2000	Lake Allegan	Black Crappie	0.40	69.55	0.57
	FW-035-0-03	35	10/21/1999	New Richmond	Largemouth Bass	0.81	76.95	1.05
	FW-035-0-04	35	10/21/1999	New Richmond	Largemouth Bass	1.09	109.30	1.00
	FW-034-0-27	34	10/20/1999	Kalamazoo Lake	Brown Trout	0.90	13.76	6.55

Notes:

1. CDM SampleID uses a 4-part nomenclature, in the following format: AA-BBB-C-DD. AA is Matrix type (FW-Fish Whole); BBB is the sampling station identification number; C is always zero for fish; and DD is sample number. MDEQ Sample ID uses a 3-part nomenclature, in the following format: AAAABBB-CC. AAAA is the year; BBB is the sampling station identification number; and DD is the sample number.

2. Value used for non-detects in statistical analyses was one-half of the detection limit (Detection Limit=0.05 mg/kg).

Table 3-24
Mean Total PCB Concentrations (Congeners) in Caged Channel Catfish Water Samples

			1999			2000			2001			Overall Average		
	Station[2]	Location	Mean Total PCB (ng/L)[1]	Standard Deviation (ng/L)[3]	Relative Standard Deviation (%)	Mean Total PCB (ng/L)[1]	Standard Deviation (ng/L)[3]	Relative Standard Deviation (%)	Mean Total PCB (ng/L)[1]	Standard Deviation (ng/L)[3]	Relative Standard Deviation (%)	Mean Total PCB (ng/L)[1]	Standard Deviation (ng/L)[3]	Relative Standard Deviation (%)
KALAMAZOO RIVER	1	Ceresco Reservoir, off Dam Site Designs Property	1.32	0.75	57	0.22	0.16	73	1.38	1.27	93	0.97	0.97	100
	2	Morrow Lake, ~150' downstream of 35th Street bridge, along right bank	1.74	1.21	70				1.15	0.81	71	1.41	0.99	70
	67	Kalamazoo River at Kalamazoo Avenue, downstream of bridge, east bank, off broken concrete slabs				0.78	0.40	52	5.28	3.73	71	3.40	3.61	106
PORTAGE CREEK	69	Monarch Mill Pond, upstream of dam on left bank							3.06	1.39	45	3.06	1.39	45
	3	Portage Creek, at Alcott Street; pipe under bridge or bridge itself	12.00	13.32	111				8.33	4.45	53	10.16	9.56	94
KALAMAZOO RIVER	66	Kalamazoo River at D Avenue, downstream of bridge & upstream of launch, east bank				2.39	1.14	48	10.57	7.05	67	6.48	6.42	99
	65	Plainwell, between Meijer and K-Mart				13.93	9.06	65	22.52	17.83	79	17.75	13.44	76
	5	~25' upstream of Otsego City Dam, along left bank	36.86	10.84	29				57.47	45.35	79	48.31	34.50	71
	6	~200' downstream of Otsego Dam, along left bank	20.45	1.10	5				14.34	3.15	22	17.39	3.91	22
	7	Downstream of Trowbridge Dam, at 26th Street bridge, last pillar, left bank	24.89	3.67	15				17.97	6.30	35	21.43	6.08	28
	8	M-89 bridge crossing, in Allegan; downstream side, right bank	31.99	2.11	7				21.00	5.22	25	26.49	6.90	26
	64	Lake Allegan, upstream of dam on west bank in fenced off area				6.17	4.56	74	9.69	4.22	44	7.93	4.54	57
	9	~ 50' downstream of Lake Allegan, along left bank, at end of concrete wall	11.95	3.78	32							11.95	3.78	32
	26	58th Street bridge, downstream of New Richmond							9.65	8.35	87	9.65	8.35	87
	10	Kalamazoo Lake in Douglas; at Blue Star Highway; pilings down stream of bridge, downstream of Pottawatamie Marsh Area	6.42	3.70	58				6.57	4.93	75	6.49	4.11	63

Notes:
1. Value used for non-detects in statistical analyses was one-half of the detection limit (Detection Limit for PCB Congener = 0.02 ng/L).
2. Kalamazoo River and Portage Creek stations are ordered from upstream to downstream, going top to bottom; Portage Creek stations are positioned after the Kalamazoo Avenue station, which is the location of the confluence.
3. Averages of samples collected weekly.
4. A blank cell means no samples collected at that location.

Table 3-25
Mean Total Suspended Solids in Caged Channel Catfish Water Samples

			2000			2001			Overall Average		
	Station[2]	Location	Mean Total PCB (ng/L)[1]	Standard Deviation (ng/L)[3]	Relative Standard Deviation (%)	Mean Total PCB (ng/L)[1]	Standard Deviation (ng/L)[3]	Relative Standard Deviation (%)	Mean Total PCB (ng/L)[1]	Standard Deviation (ng/L)[3]	Relative Standard Deviation (%)
KALAMAZOO RIVER	1	Ceresco Reservoir, off Dam Site Designs Property	10.28	8.89	86	12.68	3.66	29	11.48	6.53	57
	2	Morrow Lake, ~150' downstream of 35th Street bridge, along right bank				14.96	4.72	32	14.96	4.72	32
	67	Kalamazoo River at Kalamazoo Avenue, downstream of bridge, east bank, off broken concrete slabs	10.12	3.69	37	19.37	12.94	67	15.52	10.91	70
PORTAGE CREEK	69	Monarch Mill Pond, upstream of dam on left bank				13.50	8.89	66	13.50	8.89	66
	3	Portage Creek, at Alcott Street; pipe under bridge or bridge itself				34.32	23.74	69	34.32	23.74	69
KALAMAZOO RIVER	66	Kalamazoo River at D Avenue, downstream of bridge & upstream of launch, east bank	10.60	3.64	34	25.00	18.02	72	17.80	14.42	81
	65	Plainwell, between Meijer and K-Mart	19.26	20.08	104	38.58	20.78	54	27.84	21.61	78
	5	~25' upstream of Otsego City Dam, along left bank				21.00	6.67	32	21.00	6.67	32
	6	~200' downstream of Otsego Dam, along left bank				27.82	11.76	42	27.82	11.76	42
	7	Downstream of Trowbridge Dam, at 26th Street bridge, last pillar, left bank				24.00	6.57	27	24.00	6.57	27
	8	M-89 bridge crossing, in Allegan; downstream side, right bank				24.92	7.06	28	24.92	7.06	28
	64	Lake Allegan, upstream of dam on west bank in fenced off area	16.76	6.15	37	15.80	5.97	38	16.28	5.74	35
	9	~ 50' downstream of Lake Allegan, along left bank, at end of concrete wall									
	26	58th Street bridge, downstream of New Richmond				27.44	8.58	31	27.44	8.58	31
	10	Kalamazoo Lake in Douglas; at Blue Star Highway; pilings down stream of bridge, downstream of Pottawatamie Marsh Area				24.46	5.65	23	24.46	5.65	23

Notes:
1. Value used for non-detects in statistical analyses was one-half of the detection limit (Detection Limit for TSS = 2mg/L).
2. Kalamazoo River and Portage Creek stations are ordered from upstream to downstream, going top to bottom; Portage Creek stations are positioned after the Kalamazoo Avenue station, which is the location of the confluence.
3. Averages of samples collected weekly.
4. A blank cell means no samples collected at that location.

Table 3-26
Mean Total Wet-Weight PCB Concentrations (Congeners) in Caged Channel Catfish

			1999			2000			2001			Overall Average		
	Station[2]	Location	Mean Total PCB (mg/Kg ww)[1]	Standard Deviation (mg/Kg ww)	Relative Standard Deviation (%)	Mean Total PCB (mg/Kg ww)[1]	Standard Deviation (mg/Kg ww)	Relative Standard Deviation (%)	Mean Total PCB (mg/Kg ww)[1]	Standard Deviation (mg/Kg ww)	Relative Standard Deviation (%)	Mean Total PCB (mg/Kg ww)[1]	Standard Deviation (mg/Kg ww)	Relative Standard Deviation (%)
	--	Control	0.0068	0.002	32	0.003	0.004	104	0.02	0.00	11	0.01	0.00	49
KALAMAZOO RIVER	1	Ceresco Reservoir, off Dam Site Designs Property	0.03	0.00	8	0.01	0.00	17	0.04	0.01	15	0.03	0.01	50
KALAMAZOO RIVER	2	Morrow Lake, ~150' downstream of 35th Street bridge, along right bank	0.03	0.00	13				0.04	0.02	40	0.04	0.01	32
KALAMAZOO RIVER	67	Kalamazoo River at Kalamazoo Avenue, downstream of bridge, east bank, off broken concrete slabs				0.07	0.02	33	Cage Lost			0.07	0.02	33
PORTAGE CREEK	69	Monarch Mill Pond, upstream of dam on left bank							0.04	0.02	49	0.04	0.02	49
PORTAGE CREEK	3	Portage Creek, at Alcott Street; pipe under bridge or bridge itself	0.14	0.00	0				0.07	0.01	23	0.08	0.03	43
KALAMAZOO RIVER	66	Kalamazoo River at D Avenue, downstream of bridge & upstream of launch, east bank				0.21	0.05	24	0.22	0.02	10	0.21	0.04	17
KALAMAZOO RIVER	65	Plainwell, between Meijer and K-Mart				0.17	0.01	9	0.17	0.02	10	0.17	0.01	9
KALAMAZOO RIVER	4	~ 50' upstream of Plainwell Dam, along concrete finger, right bank	Cage Lost											
KALAMAZOO RIVER	5	~25' upstream of Otsego City Dam, along left bank	0.67	0.09	13				0.48	0.14	29	0.61	0.14	23
KALAMAZOO RIVER	6	~200' downstream of Otsego Dam, along left bank	0.37	0.07	19				0.34	0.27	78	0.36	0.18	51
KALAMAZOO RIVER	7	Downstream of Trowbridge Dam, at 26th Street bridge, last pillar, left bank	0.47	0.05	11				0.37	0.13	36	0.42	0.11	26
KALAMAZOO RIVER	8	M-89 bridge crossing, in Allegan; downstream side, right bank	0.50	0.03	6				0.35	0.05	15	0.43	0.09	21
KALAMAZOO RIVER	64	Lake Allegan, upstream of dam on west bank in fenced off area				0.21	0.03	12	0.38	0.09	23	0.29	0.11	38
KALAMAZOO RIVER	9	~ 50' downstream of Lake Allegan, along left bank, at end of concrete wall	0.40	0.01	4							0.40	0.01	4
KALAMAZOO RIVER	26	58th Street bridge, downstream of New Richmond							0.23	0.06	24	0.23	0.06	24
KALAMAZOO RIVER	10	Kalamazoo Lake in Douglas; at Blue Star Highway; pilings down stream of bridge, downstream of Pottawatamie Mars Area	0.16	0.01	6				0.26	0.05	20	0.20	0.06	30

Notes:
1. Value used for non-detects in statistical analyses was one-half of the detection limit (Detection Limit for PCB congener = 0.0002 mg/kg).
2. Kalamazoo River and Portage Creek stations are ordered from upstream to downstream, going top to bottom; Portage Creek stations are shaded and are positioned after the Kalamazoo Avenue station, which is the location of the confluence.
3. A blank cell means no samples collected at that location.

Table 3-27
Mean Tissue Lipid Content in Caged Channel Catfish

	Station[2]	Location	1999			2000			2001			Overall Average		
			Mean Lipid Content (%)[1]	Standard Deviation (%)	Relative Standard Deviation (%)	Mean Lipid Content (%)[1]	Standard Deviation (%)	Relative Standard Deviation (%)	Mean Lipid Content (%)[1]	Standard Deviation (%)	Relative Standard Deviation (%)	Mean Lipid Content (%)[1]	Standard Deviation (%)	Relative Standard Deviation (%)
	--	Control	5.98	0.95	16	5.05	0.94	19	3.78	0.68	18	4.94	0.86	18
KALAMAZOO RIVER	1	Ceresco Reservoir, off Dam Site Designs Property	4.29	0.37	9	4.22	1.23	29	2.21	0.82	37	3.57	1.29	36
KALAMAZOO RIVER	2	Morrow Lake, ~150' d/s of 35th Street Bridge, along R bank	3.88	0.78	20				2.15	0.96	45	3.01	1.23	41
KALAMAZOO RIVER	67	Kalamazoo River @ Kalamazoo Ave, d/s of bridge, east bank, off broken concrete slabs				3.97	0.65	16	Cage Lost			3.97	0.65	16
PORTAGE CREEK	69	Monarch Mill Pond (Cork St.)							2.20	0.73	33	2.20	0.73	33
PORTAGE CREEK	3	Portage Cr., at Alcot Street; pipe under bridge or bridge itself	5.15	0.00	0				2.53	0.99	39	3.05	1.45	48
KALAMAZOO RIVER	66	Kalamazoo River @ D Ave, d/s of bridge & u/s of launch, east bank				3.19	0.35	11	2.28	0.56	24	2.73	0.65	24
KALAMAZOO RIVER	65	Plainwell, between Meijer's and K-Mart				4.21	0.27	6	2.14	0.81	38	3.18	1.24	39
KALAMAZOO RIVER	4	~50' u/s of Plainwell Dam, along concrete finger, R bank	Cage Lost											
KALAMAZOO RIVER	5	~25' u/s of Otsego City Dam, along L Bank	3.82	0.48	12				2.14	0.70	33	3.26	0.98	30
KALAMAZOO RIVER	6	~200' d/s of Otsego Dam, along L bank	3.82	1.29	34				2.10	0.53	25	2.96	1.30	44
KALAMAZOO RIVER	7	D/s of Trowbridge Dam, at 26th St. bridge, last pillar, L bank	3.44	0.63	18				2.12	0.45	21	2.78	0.87	31
KALAMAZOO RIVER	8	M-89 bridge crossing, in Allegan; d/s side, R bank	4.09	0.57	14				1.84	0.45	25	2.97	1.29	44
KALAMAZOO RIVER	64	Lake Allegan, u/s of dam on west bank in fenced off area				4.38	0.58	13	2.59	0.32	12	3.49	1.05	30
KALAMAZOO RIVER	9	~50' d/s of Lake Allegan, along L bank, at end of concrete wall	3.55	0.49	14							3.55	0.49	14
KALAMAZOO RIVER	26	58th Street Bridge, d/s of New Richmond							2.52	0.89	35	2.52	0.89	35
KALAMAZOO RIVER	10	Kalamazoo Lake in Douglas; at Blue Star Highway; pilings d/s of bridge, d/s of New Richmond	3.64	0.54	15				2.46	0.41	17	3.13	0.77	25

Notes:
1. Value used for non-detects in statistical analyses was one-half of the detection limit (Detection Limit for PCB congener = 0.0002 mg/kg).
2. Kalamazoo River and Portage Creek stations are ordered from upstream to downstream, going top to bottom; Portage Creek stations are shaded and are positioned after the Kalamazoo Avenue station, which is the location of the confluence.
3. A blank cell means no samples collected at that location.

Table 3-28
Mean Total Lipid-Normalized PCB Concentrations (Congeners) in Caged Channel Catfish

			1999			2000			2001			Overall Average		
	Station[2]	Location	Mean Total PCB (mg/Kg L-N)[1]	Standard Deviation (mg/Kg L-N)	Relative Standard Deviation (%)	Mean Total PCB (mg/Kg L-N)[1]	Standard Deviation (mg/Kg L-N)	Relative Standard Deviation (%)	Mean Total PCB (mg/Kg L-N)[1]	Standard Deviation (mg/Kg L-N)	Relative Standard Deviation (%)	Mean Total PCB (mg/Kg L-N)[1]	Standard Deviation (mg/Kg L-N)	Relative Standard Deviation (%)
	--	Control	1.15	0.38	33	0.06	0.06	92	0.63	0.09	14	0.61	0.18	46
KALAMAZOO RIVER	1	Ceresco Reservoir, off Dam Site Designs Property	0.73	0.04	6	0.25	0.07	29	1.88	0.50	27	0.95	0.76	80
KALAMAZOO RIVER	2	Morrow Lake, ~150' d/s of 35th Street Bridge, along R bank	0.89	0.09	10				2.16	0.99	46	1.53	0.94	62
KALAMAZOO RIVER	67	Kalamazoo River @ Kalamazoo Ave, d/s of bridge, east bank, off broken concrete slabs				1.82	0.95	53	Cage Lost			1.82	0.95	53
PORTAGE CREEK	69	Monarch Mill Pond (Cork St.)							1.85	0.47	25	1.85	0.47	25
PORTAGE CREEK	3	Portage Cr., at Alcot Street; pipe under bridge or bridge itself	2.66	0.00	0				2.93	1.26	43	2.88	1.10	38
KALAMAZOO RIVER	66	Kalamazoo River @ D Ave, d/s of bridge & u/s of launch, east bank				6.41	1.19	19	9.88	1.63	16	8.14	2.28	28
KALAMAZOO RIVER	65	Plainwell, between Meijer's and K-Mart				3.99	0.18	4	8.84	2.80	32	6.41	3.18	50
KALAMAZOO RIVER	4	~50' u/s of Plainwell Dam, along concrete finger, R bank	Cage Lost											
KALAMAZOO RIVER	5	~25' u/s of Otsego City Dam, along L Bank	17.57	1.45	8				23.34	6.33	27	19.49	4.51	23
KALAMAZOO RIVER	6	~200' d/s of Otsego Dam, along L bank	10.09	1.97	20				15.80	9.26	59	12.94	6.91	53
KALAMAZOO RIVER	7	D/s of Trowbridge Dam, at 26th St. bridge, last pillar, L bank	13.99	1.78	13				17.34	5.22	30	15.67	4.03	26
KALAMAZOO RIVER	8	M-89 bridge crossing, in Allegan; d/s side, R bank	12.39	1.20	10				19.82	4.89	25	16.10	5.16	32
KALAMAZOO RIVER	64	Lake Allegan, u/s of dam on west bank in fenced off area				4.74	0.69	14	14.59	2.50	17	9.66	5.54	57
KALAMAZOO RIVER	9	~50' d/s of Lake Allegan, along L bank, at end of concrete wall	11.55	1.84	16							11.55	1.84	16
KALAMAZOO RIVER	26	58th Street Bridge, d/s of New Richmond							10.16	4.45	44	10.16	4.45	44
KALAMAZOO RIVER	10	Kalamazoo Lake in Douglas; at Blue Star Highway; pilings d/s of bridge, d/s of New Richmond	4.49	0.45	10				10.56	1.18	11	7.09	3.33	47

Notes:
1. Value used for non-detects in statistical analyses was one-half of the detection limit (Detection Limit for PCB congener = 0.0002 mg/kg).
2. Kalamazoo River and Portage Creek stations are ordered from upstream to downstream, going top to bottom; Portage Creek stations are shaded and are positioned after the Kalamazoo Avenue station, which is the location of the confluence.
3. A blank cell means no samples collected at that location.

Table 3-29
Mean Total Lipid-Normalized PCB Concentrations (Congeners) in SPMDs from 1999 to 2001

	Station[2]	Location	1999			2000			2001			Overall Average		
			Mean Total PCB (mg/kg lipid)[1]	Standard Deviation (mg/kg lipid)	Relative Standard Deviation (%)	Mean Total PCB (mg/kg lipid)[1]	Standard Deviation (mg/kg lipid)	Relative Standard Deviation (%)	Mean Total PCB (mg/kg lipid)[1]	Standard Deviation (mg/kg lipid)	Relative Standard Deviation (%)	Mean Total PCB (mg/kg lipid)[1]	Standard Deviation (mg/kg lipid)	Relative Standard Deviation (%)
KALAMAZOO RIVER	--	Control	0.02	0.00	9	0.02	0.00	10.41	0.01	0.00	24.63	0.02	0.01	45
	1	Ceresco Reservoir, off Dam Site Designs Property	0.41	0.01	3	0.47	0.05	11.20				0.45	0.05	11
	2	Morrow Lake, ~150' downstream of 35th Street bridge, along right bank	0.69	0.03	4.73							0.69	0.03	5
	67	Kalamazoo River at Kalamazoo Avenue, downstream of bridge, east bank, off broken concrete slabs				1.44	0.13	8.95	2.47	0.21	8.69	1.96	0.59	30
PORTAGE CREEK	69	Monarch Mill Pond, upstream of dam on left bank							0.27	0.03	9.59	0.27	0.03	10
	3	Portage Creek, at Alcott Street; pipe under bridge or bridge itself	3.00	0.09	2.89							3.00	0.09	3
KALAMAZOO RIVER	66	Kalamazoo River at D Avenue, downstream of bridge & upstream of launch, east bank				3.42	0.03	0.93	4.49	0.10	2.24	3.96	0.59	15
	65	Plainwell, between Meijer and K-Mart				4.12	0.43	10.54				4.12	0.43	11
	4	~ 50' upstream of Plainwell Dam, along concrete finger, right bank	9.56	0.52	5.47							9.56	0.52	5
	5	~25' upstream of Otsego City Dam, along left bank	18.43	0.57	3.08							18.43	0.57	3
	6	~200' downstream of Otsego Dam, along left bank	7.37	0.28	3.85							7.37	0.28	4
	7	Downstream of Trowbridge Dam, at 26th Street bridge, last pillar, left bank	11.88									11.88		
	8	M-89 bridge crossing, in Allegan; downstream side, right bank	14.34	0.23	1.57							14.34	0.23	2
	64	Lake Allegan, upstream of dam on west bank in fenced off area				4.05	0.30	7.34				4.05	0.30	7
	9	~ 50' downstream of Lake Allegan, along left bank, at end of concrete wall	4.12	0.81	19.61							4.12	0.81	20
	26	58th Street bridge, downstream of New Richmond							2.97	0.13	4.29	2.97	0.13	4
	10	Kalamazoo Lake in Douglas; at Blue Star Highway; pilings down stream of bridge, downstream of Pottawatamie Marsh Area	2.45	0.14	5.83							2.45	0.14	6

Notes:
1. Value used for non-detects in statistical analyses was one-half of the detection limit (Detection Limit for PCB congener = 0.2 ng).
2. Kalamazoo River and Portage Creek stations are ordered from upstream to downstream, going top to bottom; Portage Creek stations are shaded and are positioned after the Kalamazoo Avenue station, which is the location of the confluence.
3. A blank cell means no samples collected at that location.
"-NA-" denotes only one sample collected, so the standard deviation and relative standard deviation are not applicable.

Table 3-30
Total PCB and Dioxin/Furan and Co-Planar PCB TEQ Concentrations in Adult Carp and Adult Smallmouth Bass (2001 through 2004)

						WHO - 1998			WHO - 2005		
Collection Year	Species	Location	Sample ID[1]	Total PCB[6] (mg/kg ww)	Lipids (%)	Dioxin/Furan $TEQ_{WHO\ 1998}$ (ppt)[2,3]	Coplanar PCB $TEQ_{WHO\ 1998}$ (ppt)[2,3]	Total $TEQ_{WHO\ 1998}$ (ppt)[5]	Dioxin/Furan $TEQ_{WHO\ 2005}$ (ppt)[2,4]	Coplanar PCB $TEQ_{WHO\ 2005}$ (ppt)[2,4]	Total $TEQ_{WHO\ 2005}$ (ppt)[2,4,5]
2001	Carp	Plainwell Impoundment	2001048-16	17.8	19.4	17.7	-	17.7	16.0	-	16.0
			2001048-21	20.7	14.8	27.8	-	27.8	25.5	-	25.5
		Otsego Impoundment	2001050-21	49.5	19.0	30.8	-	30.8	29.6	-	29.6
			2001050-22	9.3	5.3	10.0	-	10.0	9.2	-	9.2
		Trowbridge Impoundment	2001051-12	7.3	4.7	4.3	-	4.3	4.3	-	4.3
			2001051-13	6.1	3.9	3.0	-	3.0	3.0	-	3.0
		Allegan City Impoundment	2001052-15	6.4	6.3	10.9	-	10.9	10.1	-	10.1
			2001052-19	6.4	6.8	5.5	-	5.5	5.5	-	5.5
		Lake Allegan	2001053-06	2.8	2.3	1.2	-	1.2	1.2	-	1.2
			2001053-07	2.9	3.1	1.2	-	1.2	1.2	-	1.2
2001	Smallmouth Bass	Trowbridge Impoundment	2001051-01	1.7	1.2	0.7	-	0.7	0.7	-	0.7
			2001051-02	0.6	0.6	0.1	-	0.1	0.1	-	0.1
			2001051-03	0.7	0.4	0.2	-	0.2	0.2	-	0.2
			2001051-04	1.0	0.5	0.1	-	0.1	0.1	-	0.1
			2001051-05	1.0	0.5	0.0	-	0.0	0.0	-	0.0
			2001051-06	0.8	0.7	0.2	-	0.2	0.2	-	0.2
			2001051-07	0.8	0.5	0.1	-	0.1	0.1	-	0.1
			2001051-08	1.1	0.9	0.1	-	0.1	0.1	-	0.1
			2001051-09	2.8	1.4	2.0	-	2.0	2.0	-	2.0
			2001051-10	0.6	0.9	0.2	-	0.2	0.2	-	0.2
			2001051-11	1.6	1.1	0.9	-	0.9	0.9	-	0.9
2003	Carp	Trowbridge Impoundment	FW-037-0-05	5.1	5.7	2.5	32.0	34.5	2.6	51.2	53.8
			FW-037-0-06	1.2	0.9	1.7	28.7	30.4	1.7	45.6	47.3
			FW-037-0-07	7.2	8.4	7.8	74.0	81.8	7.8	107.1	114.9
			FW-037-0-09	1.4	6.8	0.4	31.1	31.5	0.4	48.6	49.0
			FW-037-0-10	2.6	1.2	2.1	29.3	31.4	2.1	50.0	52.2
			FW-037-0-11	2.3	1.5	2.0	31.5	33.5	2.0	50.8	52.8
			FW-037-0-12	2.7	3.5	2.7	28.8	31.5	2.7	46.0	48.7
			FW-037-0-13	3.1	1.2	3.0	23.9	26.9	3.0	39.4	42.4
			FW-037-0-14	1.2	1.8	1.0	13.3	14.3	1.0	23.1	24.1
			FW-037-0-21	6.3	4.1	4.1	77.1	81.3	4.1	109.6	113.7
			FW-037-0-23	1.6	14.7	2.5	19.4	21.9	2.5	31.9	34.4
2004	Carp	Trowbridge Impoundment	FW-037-0-01	3.5	2.9	5.0	39.0	44.0	5.1	71.2	76.3
			FW-037-0-02	1.9	1.6	4.2	36.9	41.1	4.2	63.9	68.1
			FW-037-0-03	3.3	3.8	3.4	42.2	45.6	3.4	64.9	68.3
			FW-037-0-04	2.2	2.2	2.7	45.6	48.2	2.7	68.3	71.0
			FW-037-0-05	2.6	2.6	4.0	46.8	50.8	4.0	71.5	75.5
			FW-037-0-06	3.0	2.7	3.1	40.2	43.4	3.1	60.2	63.3
			FW-037-0-07	1.6	1.6	1.3	54.1	55.4	1.3	66.0	67.3
			FW-037-0-08	4.5	4.0	7.0	89.4	96.4	7.0	120.0	127.0
			FW-037-0-09	3.7	2.9	4.9	55.3	60.3	5.0	77.8	82.8
			FW-037-0-10	9.2	9.7	9.5	314.0	323.5	8.1	364.9	373.0
			FW-037-0-11	7.6	4.7	10.0	296.1	306.1	9.0	341.2	350.2

Notes:

1. CDM SampleID uses a 4-part nomenclature, in the following format: AA-BBB-C-DD. AA is Matrix type (FW-Fish Whole); BBB is the sampling station identification number; C is always zero for fish; and DD is sample number. MDEQ Sample ID uses a 3-part nomenclature, in the following format: AAAABBB-CC. AAAA is the year; BBB is the sampling station identification number; and DD is the sample number.

2. Value used for non-detects in the sum of the TEQ was zero.
3. World Health Organization (WHO) TEF for Mammal (1998) used to calculate TEQ.
4. World Health Organization (WHO) TEF for Mammal (2005) used to calculate TEQ.
5. Values in RED indicate the Total TEQ (sum of dioxin/furan and coplanar PCB TEQs) are above MDCH's 10 ppt trigger level.
6. Values in PURPLE indicate ww PCB results are above MDCH's 2 mg/kg ww general population no consumption trigger level.

Table 4-1
Total PCB Concentrations at Cork Street (Upstream Station)
Pre-TCRA Surface Water Samples

Data Source	Sample Date	Sample ID	BBLID	Location	Method Name	Analyte	Results (ug/L)
BBL	8/24/1993	A64002	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	ND(0.05)
BBL	9/15/1993	A66501	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	ND(0.05)
BBL	9/16/1993	A66503	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	ND(0.05)
BBL	9/16/1993	A66506	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	0.064
BBL	9/16/1993	A66508	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	ND(0.05)
BBL	9/17/1993	A66510	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	ND(0.05)
BBL	9/17/1993	A66512	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	ND(0.05)
BBL	9/17/1993	A66514	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	ND(0.05)
BBL	9/18/1993	A66516	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	ND(0.05)
BBL	10/17/1993	A66522	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	ND(0.051)
BBL	10/17/1993	A66524	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	ND(0.05)
BBL	10/18/1993	A66528	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	ND(0.05)
BBL	10/19/1993	A66532	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	ND(0.051)
BBL	10/19/1993	A66534	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	ND(0.05)
BBL	10/20/1993	A66537	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	ND(2)
BBL	10/20/1993	A66539	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	ND(0.05)
BBL	10/21/1993	A66541	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	ND(0.051)
BBL	12/2/1993	A66543	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	ND(0.05)
BBL	12/2/1993	A66545	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	ND(0.051)
BBL	12/2/1993	A66547	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	ND(0.05)
BBL	12/3/1993	A66549	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	ND(0.051)
BBL	12/3/1993	A66551	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	ND(0.051)
BBL	12/15/1993	A64004	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	ND(0.051)
BBL	12/28/1993	A64006	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	ND(0.05)
BBL	4/11/1994	A66554	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	ND(0.05)
BBL	4/12/1994	A66556	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	ND(0.051)
BBL	4/12/1994	A66558	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	ND(0.05)
BBL	4/12/1994	A66561	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	ND(0.05)
BBL	4/12/1994	A66563	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	ND(0.05)
BBL	4/12/1994	A66569	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	ND(0.05)
BBL	4/13/1994	A66581	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	ND(0.051)
BBL	4/14/1994	A66584	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	ND(0.05)
BBL	4/14/1994	A66586	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	0.095
BBL	4/14/1994	A66588	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	ND(0.051)
BBL	6/9/1994	A64009	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	ND(2)
BBL	9/8/1994	A64010	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	ND(0.05)
BBL	9/21/1994	A64014	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	ND(0.05)
BBL	5/19/1997	A64591	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	ND(0.05)
BBL	6/26/1998	A66595	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	0.071
BBL	7/10/1998	A64016	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	ND(0.05)
BBL	7/15/1998	A64018	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	ND(0.05)
BBL	7/21/1998	A66597	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	ND(0.051)
BBL	7/22/1998	A66599	SWP-1	CORK STREET	PCB Aroclors	Total PCBs	ND(0.051)

Minimum (Detected)	**0.064**
Maximum (Detected)	**0.095**
Average	**0.074**
Median	**0.025**
Std. Deviation	**0.207**
Count	**43**
Number Detected	**3**

Note: (1) One-half the detection limit used for statistical analyses for samples that were non-detect.

Table 4-2
TSS Concentrations at Cork Street (Upstream Station)
Pre-TCRA Surface Water Samples

Data Source	Sample Date	Sample ID	BBLID	Location	Method Name	Analyte	Results (mg/L)
BBL	8/24/1993	A64002	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	5.2
BBL	9/15/1993	A66501	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	16.3
BBL	9/16/1993	A66503	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	10
BBL	9/16/1993	A66506	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	8.4
BBL	9/16/1993	A66508	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	25
BBL	9/17/1993	A66510	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	10.8
BBL	9/17/1993	A66512	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	8.8
BBL	9/17/1993	A66514	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	11.5
BBL	9/18/1993	A66516	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	13
BBL	10/17/1993	A66522	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	12.7
BBL	10/17/1993	A66524	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	11
BBL	10/18/1993	A66528	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	6.1
BBL	10/19/1993	A66532	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	5.8
BBL	10/19/1993	A66534	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	5.4
BBL	10/20/1993	A66537	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	8.6
BBL	10/20/1993	A66539	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	10.3
BBL	10/21/1993	A66541	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	10.6
BBL	12/2/1993	A66543	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	7.3
BBL	12/2/1993	A66545	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	9.1
BBL	12/2/1993	A66547	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	8
BBL	12/3/1993	A66549	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	6.7
BBL	12/3/1993	A66551	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	5.8
BBL	12/15/1993	A64004	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	4.7
BBL	12/28/1993	A64006	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	9.1
BBL	4/11/1994	A66554	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	6.7
BBL	4/12/1994	A66556	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	15
BBL	4/12/1994	A66558	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	14
BBL	4/12/1994	A66561	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	19
BBL	4/12/1994	A66563	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	16
BBL	4/12/1994	A66569	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	230
BBL	4/13/1994	A66581	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	12
BBL	4/14/1994	A66584	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	10.5
BBL	4/14/1994	A66586	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	6.5
BBL	4/14/1994	A66588	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	6.5
BBL	6/9/1994	A64009	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	11.2
BBL	9/8/1994	A64010	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	6.4
BBL	9/21/1994	A64014	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	7.2
BBL	5/19/1997	A64591	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	9.6
BBL	6/26/1998	A66595	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	17
BBL	7/10/1998	A64016	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	9.6
BBL	7/15/1998	A64018	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	9.8
BBL	7/21/1998	A66597	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	12.7
BBL	7/22/1998	A66599	SWP-1	CORK STREET	Total Suspended Solids	Total Suspended Solids	16.8

Minimum (Detected)	**4.7**
Maximum (Detected)	**230.0**
Average	**15.5**
Median	**9.8**
Std. Deviation	**33.8**
Count	**43**
Number Detected	**43**

Note: (1) One-half the detection limit used for statistical analyses for samples that were non-detect.

Table 4-3
Total PCB Concentrations at Cork Street (Upstream Station)
Post-TCRA Surface Water Samples

Data Source	Sample Date	Sample ID	BBLID	Location	Method Name	Analyte	Results (ug/L)
CDM	1/11/00	AD00359	DW-055-1-01	CORK STREET	CONGENER	Total_PCB	ND(0.0002)
CDM	1/11/00	AD00360	DW-055-2-01	CORK STREET	CONGENER	Total_PCB	ND(0.0002)
CDM	1/11/00	AD00361	DW-055-3-01	CORK STREET	CONGENER	Total_PCB	0.006
CDM	10/21/00	AD10334	DW-055-1-01	CORK STREET	CONGENER	Total_PCB	0.002
CDM	10/21/00	AD10335	DW-055-2-01	CORK STREET	CONGENER	Total_PCB	0.001
CDM	10/21/00	AD10336	DW-055-3-01	CORK STREET	CONGENER	Total_PCB	0.002
CDM	6/11/02	AF04087	DW-055-1-01	CORK STREET	CONGENER	Total_PCB	0.003
CDM	6/11/02	AF04088	DW-055-2-01	CORK STREET	CONGENER	Total_PCB	0.002
CDM	6/11/02	AF04089	DW-055-3-01	CORK STREET	CONGENER	Total_PCB	0.002
CDM	8/27/02	AF07044	DW-055-1-01	CORK STREET	CONGENER	Total_PCB	0.002
CDM	8/27/02	AF07045	DW-055-2-01	CORK STREET	CONGENER	Total_PCB	0.002
CDM	8/27/02	AF07046	DW-055-3-01	CORK STREET	CONGENER	Total_PCB	0.002
CDM	8/20/03	AG12022	DW-055-1-01	CORK STREET	CONGENER	Total_PCB	0.001
CDM	8/20/03	AG12023	DW-055-2-01	CORK STREET	CONGENER	Total_PCB	0.002
CDM	8/20/03	AG12024	DW-055-3-01	CORK STREET	CONGENER	Total_PCB	0.001
CDM	4/13/06	AJ04058	IO-055-1-01	CORK STREET	CONGENER	Total_PCB	ND(0.0002)
CDM	4/13/06	AJ04059	IO-055-2-01	CORK STREET	CONGENER	Total_PCB	ND(0.0002)
CDM	4/13/06	AJ04060	IO-055-3-01	CORK STREET	CONGENER	Total_PCB	ND(0.0002)
CDM	8/23/06	AJ10950	IO-055-1-01	CORK STREET	CONGENER	Total_PCB	ND(0.0002)
CDM	8/23/06	AJ10951	IO-055-2-01	CORK STREET	CONGENER	Total_PCB	0.001
CDM	8/23/06	AJ10952	IO-055-3-01	CORK STREET	CONGENER	Total_PCB	ND(0.0002)

Minimum (Detected)	**0.001**
Maximum (Detected)	**0.006**
Average	**0.001**
Median	**0.001**
Std. Deviation	**0.001**
Count	**21**
Number Detected	**14**

Note: (1) One-half the detection limit used for statistical analyses for samples that were non-detect.

Table 4-4
TSS Concentrations at Cork Street (Upstream Station)
Post-TCRA Surface Water Samples

Data Source	Sample Date	Sample ID	BBLID	Location	Method Name	Analyte	Results (mg/L)
CDM	1/11/00	AD00359	DW-055-1-01	CORK STREET	Total Suspended Solids	Total Suspended Solids	7
CDM	1/11/00	AD00360	DW-055-2-01	CORK STREET	Total Suspended Solids	Total Suspended Solids	6.6
CDM	1/11/00	AD00361	DW-055-3-01	CORK STREET	Total Suspended Solids	Total Suspended Solids	7.2
CDM	10/17/00	AD10049	DW-055-3-01	CORK STREET	Total Suspended Solids	Total Suspended Solids	10
CDM	10/21/00	AD10334	DW-055-1-01	CORK STREET	Total Suspended Solids	Total Suspended Solids	8.2
CDM	10/21/00	AD10335	DW-055-2-01	CORK STREET	Total Suspended Solids	Total Suspended Solids	9.6
CDM	10/21/00	AD10336	DW-055-3-01	CORK STREET	Total Suspended Solids	Total Suspended Solids	8
CDM	6/11/02	AF04087	DW-055-1-01	CORK STREET	Total Suspended Solids	Total Suspended Solids	11.4
CDM	6/11/02	AF04088	DW-055-2-01	CORK STREET	Total Suspended Solids	Total Suspended Solids	9.4
CDM	6/11/02	AF04089	DW-055-3-01	CORK STREET	Total Suspended Solids	Total Suspended Solids	8.2
CDM	8/27/02	AF07044	DW-055-1-01	CORK STREET	Total Suspended Solids	Total Suspended Solids	8.8
CDM	8/27/02	AF07045	DW-055-2-01	CORK STREET	Total Suspended Solids	Total Suspended Solids	9.4
CDM	8/27/02	AF07046	DW-055-3-01	CORK STREET	Total Suspended Solids	Total Suspended Solids	8
CDM	8/20/03	AG12022	DW-055-1-01	CORK STREET	Total Suspended Solids	Total Suspended Solids	11.4
CDM	8/20/03	AG12023	DW-055-2-01	CORK STREET	Total Suspended Solids	Total Suspended Solids	11
CDM	8/20/03	AG12024	DW-055-3-01	CORK STREET	Total Suspended Solids	Total Suspended Solids	10.6
CDM	4/13/06	AJ04058	IO-055-1-01	CORK STREET	Total Suspended Solids	Total Suspended Solids	9
CDM	4/13/06	AJ04059	IO-055-2-01	CORK STREET	Total Suspended Solids	Total Suspended Solids	9.8
CDM	4/13/06	AJ04060	IO-055-3-01	CORK STREET	Total Suspended Solids	Total Suspended Solids	8.2
CDM	8/23/06	AJ10950	IO-055-1-01	CORK STREET	Total Suspended Solids	Total Suspended Solids	15
CDM	8/23/06	AJ10951	IO-055-2-01	CORK STREET	Total Suspended Solids	Total Suspended Solids	10.8
CDM	8/23/06	AJ10952	IO-055-3-01	CORK STREET	Total Suspended Solids	Total Suspended Solids	9.4

Minimum (Detected)	**6.6**
Maximum (Detected)	**15.0**
Average	**9.4**
Median	**9.4**
Std. Deviation	**1.9**
Count	**22**
Number Detected	**22**

Note: (1) One-half the detection limit used for statistical analyses for samples that were non-detect.

Table 4-5
Total PCB Concentrations at Alcott Street (Downstream Station)
Pre-TCRA Surface Water Samples

Data Source	Sample Date	Sample ID	BBLID	Location	Method Name	Analyte	Results (ug/L)
BBL	8/24/1993	A64000	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	0.230
BBL	9/15/1993	A66500	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	0.086
BBL	9/16/1993	A66502	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	0.035
BBL	9/16/1993	A66504	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	0.034
BBL	9/16/1993	A66507	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	0.032
BBL	9/17/1993	A66509	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	0.081
BBL	9/17/1993	A66511	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	0.086
BBL	9/17/1993	A66513	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	0.094
BBL	9/18/1993	A66515	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	0.100
BBL	10/17/1993	A66521	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	0.041
BBL	10/17/1993	A66523	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	0.041
BBL	10/18/1993	A66527	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	0.055
BBL	10/19/1993	A66531	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	0.037
BBL	10/19/1993	A66533	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	0.030
BBL	10/20/1993	A66536	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	ND(2)
BBL	10/20/1993	A66538	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	0.067
BBL	10/21/1993	A66540	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	0.071
BBL	12/2/1993	A66542	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	ND(0.05)
BBL	12/2/1993	A66544	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	0.040
BBL	12/2/1993	A66546	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	0.034
BBL	12/3/1993	A66548	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	0.039
BBL	12/3/1993	A66550	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	0.030
BBL	12/15/1993	A64003	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	ND(0.051)
BBL	12/28/1993	A64005	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	0.058
BBL	4/11/1994	A66553	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	0.048
BBL	4/12/1994	A66555	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	0.100
BBL	4/12/1994	A66557	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	0.100
BBL	4/12/1994	A66560	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	0.112
BBL	4/12/1994	A66562	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	0.091
BBL	4/12/1994	A66568	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	0.023
BBL	4/13/1994	A66580	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	0.059
BBL	4/14/1994	A66583	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	0.038
BBL	4/14/1994	A66585	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	ND(0.05)
BBL	4/14/1994	A66587	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	0.062
BBL	6/9/1994	A64008	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	ND(2)
BBL	9/8/1994	A64011	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	0.160
BBL	9/21/1994	A64013	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	0.210
BBL	5/19/1997	A64590	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	0.065
BBL	6/26/1998	A66594	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	ND(0.05)
BBL	7/10/1998	A64015	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	0.098
BBL	7/15/1998	A64017	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	0.120
BBL	7/21/1998	A66596	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	0.059
BBL	7/22/1998	A66598	SWP-2	ALCOTT STREET	PCB Aroclors	Total PCBs	0.033

Minimum (Detected)	**0.023**
Maximum (Detected)	**0.230**
Average	**0.112**
Median	**0.059**
Std. Deviation	**0.204**
Count	**43**
Number Detected	**37**

Note: (1) One-half the detection limit used for statistical analyses for samples that were non-detect.

Table 4-6
TSS Concentrations at Alcott Street (Downstream Station)
Pre-TCRA Surface Water Samples

Data Source	Sample Date	Sample ID	BBLID	Location	Method Name	Analyte	Results (mg/L)
BBL	8/24/1993	A64000	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	20
BBL	9/15/1993	A66500	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	21
BBL	9/16/1993	A66502	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	11.6
BBL	9/16/1993	A66504	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	9.6
BBL	9/16/1993	A66507	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	9.4
BBL	9/17/1993	A66509	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	12.9
BBL	9/17/1993	A66511	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	11.5
BBL	9/17/1993	A66513	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	8.5
BBL	9/18/1993	A66515	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	14.8
BBL	10/17/1993	A66521	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	12.3
BBL	10/17/1993	A66523	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	9.4
BBL	10/18/1993	A66527	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	10.1
BBL	10/19/1993	A66531	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	7
BBL	10/19/1993	A66533	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	5.7
BBL	10/20/1993	A66536	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	9.2
BBL	10/20/1993	A66538	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	11.2
BBL	10/21/1993	A66540	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	14.1
BBL	12/2/1993	A66542	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	9.3
BBL	12/2/1993	A66544	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	12.6
BBL	12/2/1993	A66546	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	10.8
BBL	12/3/1993	A66548	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	7.6
BBL	12/3/1993	A66550	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	6.1
BBL	12/15/1993	A64003	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	3.6
BBL	12/28/1993	A64005	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	10.9
BBL	4/11/1994	A66553	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	8.5
BBL	4/12/1994	A66555	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	27
BBL	4/12/1994	A66557	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	30
BBL	4/12/1994	A66560	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	33
BBL	4/12/1994	A66562	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	30
BBL	4/12/1994	A66568	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	133
BBL	4/13/1994	A66580	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	21
BBL	4/14/1994	A66583	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	14
BBL	4/14/1994	A66585	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	13
BBL	4/14/1994	A66587	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	10.5
BBL	6/9/1994	A64008	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	14.3
BBL	9/8/1994	A64011	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	13.2
BBL	9/21/1994	A64013	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	12.5
BBL	5/19/1997	A64590	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	23.6
BBL	6/26/1998	A66594	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	11.4
BBL	7/10/1998	A64015	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	10.2
BBL	7/15/1998	A64017	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	10.7
BBL	7/21/1998	A66596	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	12.7
BBL	7/22/1998	A66598	SWP-2	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	8.4

Minimum (Detected)	**3.6**
Maximum (Detected)	**133.0**
Average	**16.2**
Median	**11.5**
Std. Deviation	**19.4**
Count	**43**
Number Detected	**43**

Note: (1) One-half the detection limit used for statistical analyses for samples that were non-detect.

Table 4-7
Total PCB Concentrations at Alcott Street/Bryant Street (Downstream Stations)
Post-TCRA Surface Water Samples

Data Source	Sample Date	Sample ID	BBLID	Location	Method Name	Analyte	Results (ug/L)
CDM	9/10/99	AC06154	DW-003-2-01	ALCOTT STREET	CONGENER	Total_PCB	0.003
CDM	9/10/99	AC06155	DW-003-3-01	ALCOTT STREET	CONGENER	Total_PCB	0.003
CDM	9/21/99	AC06687	DW-003-1-01	ALCOTT STREET	CONGENER	Total_PCB	0.007
CDM	9/21/99	AC06689	DW-003-3-01	ALCOTT STREET	CONGENER	Total_PCB	0.010
CDM	9/21/99	AC06688	DW-003-2-01	ALCOTT STREET	CONGENER	Total_PCB	0.004
CDM	10/21/99	AC07612	DW-003-1-01	ALCOTT STREET	CONGENER	Total_PCB	0.008
CDM	10/21/99	AC07613	DW-003-2-01	ALCOTT STREET	CONGENER	Total_PCB	0.008
CDM	10/21/99	AC07614	DW-003-3-01	ALCOTT STREET	CONGENER	Total_PCB	0.011
CDM	1/11/00	AD00350	DW-003-1-01	ALCOTT STREET	CONGENER	Total_PCB	0.001
CDM	1/11/00	AD00351	DW-003-2-01	ALCOTT STREET	CONGENER	Total_PCB	ND(0.0002)
CDM	1/11/00	AD00352	DW-003-3-01	ALCOTT STREET	CONGENER	Total_PCB	ND(0.0002)
CDM	7/25/00	AD06902	DW-003-1-01	ALCOTT STREET	CONGENER	Total_PCB	0.001
CDM	7/25/00	AD06903	DW-003-2-01	ALCOTT STREET	CONGENER	Total_PCB	0.043
CDM	7/25/00	AD06904	DW-003-3-01	ALCOTT STREET	CONGENER	Total_PCB	0.002
CDM	10/22/00	AD10392	DW-003-2-01	ALCOTT STREET	CONGENER	Total_PCB	0.002
CDM	4/18/01	AE02362	DW-058-1-01	BRYANT STREET	CONGENER	Total_PCB	0.000
CDM	4/18/01	AE02364	DW-058-2-01	BRYANT STREET	CONGENER	Total_PCB	0.002
CDM	4/18/01	AE02365	DW-058-3-01	BRYANT STREET	CONGENER	Total_PCB	0.0002
CDM	7/31/01	AE06173	DW-058-1-01	BRYANT STREET	CONGENER	Total_PCB	0.008
CDM	7/31/01	AE06174	DW-058-2-01	BRYANT STREET	CONGENER	Total_PCB	0.005
CDM	7/31/01	AE06175	DW-058-3-01	BRYANT STREET	CONGENER	Total_PCB	0.009
CDM	6/11/02	AF04091	DW-058-1-01	BRYANT STREET	CONGENER	Total_PCB	0.005
CDM	6/11/02	AF04092	DW-058-2-01	BRYANT STREET	CONGENER	Total_PCB	0.007
CDM	6/11/02	AF04093	DW-058-3-01	BRYANT STREET	CONGENER	Total_PCB	0.007
CDM	8/27/02	AF07048	DW-058-1-01	BRYANT STREET	CONGENER	Total_PCB	0.001
CDM	8/27/02	AF07049	DW-058-2-01	BRYANT STREET	CONGENER	Total_PCB	0.002
CDM	8/27/02	AF07050	DW-058-3-01	BRYANT STREET	CONGENER	Total_PCB	0.010
CDM	8/20/03	AG12026	DW-058-1-01	BRYANT STREET	CONGENER	Total_PCB	0.004
CDM	8/20/03	AG12027	DW-058-2-01	BRYANT STREET	CONGENER	Total_PCB	0.003
CDM	8/20/03	AG12028	DW-058-3-01	BRYANT STREET	CONGENER	Total_PCB	0.003
CDM	4/13/06	AJ04061	IO-058-1-01	BRYANT STREET	CONGENER	Total_PCB	ND(0.0002)
CDM	4/13/06	AJ04062	IO-058-2-01	BRYANT STREET	CONGENER	Total_PCB	ND(0.0002)
CDM	4/13/06	AJ04063	IO-058-3-01	BRYANT STREET	CONGENER	Total_PCB	ND(0.0002)
CDM	8/23/06	AJ10953	IO-058-1-01	BRYANT STREET	CONGENER	Total_PCB	0.0002
CDM	8/23/06	AJ10954	IO-058-2-01	BRYANT STREET	CONGENER	Total_PCB	0.002
CDM	8/23/06	AJ10955	IO-058-3-01	BRYANT STREET	CONGENER	Total_PCB	0.002

Minimum (Detected)	**0.0002**
Maximum (Detected)	**0.043**
Average	**0.005**
Median	**0.003**
Std. Deviation	**0.007**
Count	**36**
Number Detected	**31**

Note: (1) One-half the detection limit used for statistical analyses for samples that were non-detect.

Table 4-8
TSS Concentrations at Alcott Street/Bryant Street (Downstream Stations)
Post-TCRA Surface Water Samples

Data Source	Sample Date	Sample ID	BBLID	Location	Method Name	Analyte	Results (mg/L)
CDM	1/11/00	AD00350	DW-003-1-01	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	6.4
CDM	1/11/00	AD00351	DW-003-2-01	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	5.4
CDM	1/11/00	AD00352	DW-003-3-01	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	6
CDM	7/25/00	AD06902	DW-003-1-01	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	9.2
CDM	7/25/00	AD06903	DW-003-2-01	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	11
CDM	7/25/00	AD06904	DW-003-3-01	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	8.4
CDM	10/22/00	AD10392	DW-003-2-01	ALCOTT STREET	Total Suspended Solids	Total Suspended Solids	4
CDM	4/18/01	AE02362	DW-058-1-01	BRYANT STREET	Total Suspended Solids	Total Suspended Solids	3.8
CDM	4/18/01	AE02364	DW-058-2-01	BRYANT STREET	Total Suspended Solids	Total Suspended Solids	4.4
CDM	4/18/01	AE02365	DW-058-3-01	BRYANT STREET	Total Suspended Solids	Total Suspended Solids	4.8
CDM	7/31/01	AE06173	DW-058-1-01	BRYANT STREET	Total Suspended Solids	Total Suspended Solids	18.4
CDM	7/31/01	AE06174	DW-058-2-01	BRYANT STREET	Total Suspended Solids	Total Suspended Solids	16.2
CDM	7/31/01	AE06175	DW-058-3-01	BRYANT STREET	Total Suspended Solids	Total Suspended Solids	16.6
CDM	6/11/02	AF04091	DW-058-1-01	BRYANT STREET	Total Suspended Solids	Total Suspended Solids	29.6
CDM	6/11/02	AF04092	DW-058-2-01	BRYANT STREET	Total Suspended Solids	Total Suspended Solids	26
CDM	6/11/02	AF04093	DW-058-3-01	BRYANT STREET	Total Suspended Solids	Total Suspended Solids	13.8
CDM	8/27/02	AF07048	DW-058-1-01	BRYANT STREET	Total Suspended Solids	Total Suspended Solids	8.2
CDM	8/27/02	AF07049	DW-058-2-01	BRYANT STREET	Total Suspended Solids	Total Suspended Solids	9.6
CDM	8/27/02	AF07050	DW-058-3-01	BRYANT STREET	Total Suspended Solids	Total Suspended Solids	9
CDM	8/20/03	AG12026	DW-058-1-01	BRYANT STREET	Total Suspended Solids	Total Suspended Solids	8.4
CDM	8/20/03	AG12027	DW-058-2-01	BRYANT STREET	Total Suspended Solids	Total Suspended Solids	6.8
CDM	8/20/03	AG12028	DW-058-3-01	BRYANT STREET	Total Suspended Solids	Total Suspended Solids	8.8
CDM	4/13/06	AJ04061	IO-058-1-01	BRYANT STREET	Total Suspended Solids	Total Suspended Solids	7.8
CDM	4/13/06	AJ04062	IO-058-2-01	BRYANT STREET	Total Suspended Solids	Total Suspended Solids	40.6
CDM	4/13/06	AJ04063	IO-058-3-01	BRYANT STREET	Total Suspended Solids	Total Suspended Solids	8.0
CDM	8/23/06	AJ10953	IO-058-1-01	BRYANT STREET	Total Suspended Solids	Total Suspended Solids	11.2
CDM	8/23/06	AJ10954	IO-058-2-01	BRYANT STREET	Total Suspended Solids	Total Suspended Solids	10.6
CDM	8/23/06	AJ10955	IO-058-3-01	BRYANT STREET	Total Suspended Solids	Total Suspended Solids	8.2

Minimum (Detected)	**3.8**
Maximum (Detected)	**40.6**
Average	**11.5**
Median	**8.6**
Std. Deviation	**8.4**
Count	**28**
Number Detected	**28**

Note: (1) One-half the detection limit used for statistical analyses for samples that were non-detect.

Table 4-9
Pre-, During-, and Post-TCRA Mean Total Wet-Weight PCB Concentrations in Resident Fish within the Bryant Mill Pond

Species	Parameter	*Pre-Removal Action*	*Post-Removal Action*					Post Removal Action Overall Average (2000-2006)
		1993[2]	1999[2]	2000[3]	2001[3]	2002[3]	2006[3]	
Yearling White Suckers	Mean Total PCB (mg/Kg ww)[1]	1.96	0.16	0.51	0.29	0.26	0.16	0.24
	Standard Deviation (mg/Kg ww)	0.95	0.09	0.05	0.05	0.06	0.05	0.12
	Relative Standard Deviation (%)	48	59	10	17	23	33	51.42
Adult White Suckers	Mean Total PCB (mg/Kg ww)[1,4]	0.44	---	---	0.29	---	---	0.29
	Standard Deviation (mg/Kg ww)	---	---	---	---	---	---	---
	Relative Standard Deviation (%)	---	---	---	---	---	---	---
YOY Carp	Mean Total PCB (mg/Kg ww)[1]	---	---	---	0.20	0.19	---	0.20
	Standard Deviation (mg/Kg ww)	---	---	---	0.03	0.06	---	0.04
	Relative Standard Deviation (%)	---	---	---	15	31	---	23
Adult Carp	Mean Total PCB (mg/Kg ww)[1]	3.42	---	0.36	0.72	0.23	0.32	0.41
	Standard Deviation (mg/Kg ww)	2.12	---	0.37	1.01	0.16	0.29	0.58
	Relative Standard Deviation (%)	62	---	103	140	68	91	141

Notes:
1. Yearling White Suckers were analyzed for PCB Congeners in 2000, 2002, and 2003, while PCB aroclors in 1993 and 2001. Yearling Carp were analyzed for PCB Congeners in 2001 and 2002, while PCB Aroclors in 1993. Adult Carp were analyzed for PCB Aroclors in all years.
2. Data collected by BBL.
3. Data collected by MDEQ/CDM as part of the LTM program.
4. Only one adult white sucker sample was collected.

Table 4-10
Pre-, During-, and Post-TCRA Mean Tissue Lipids in Resident Fish within the Bryant Mill Pond

Species	Parameter	*Pre-Removal Action*	*Post-Removal Action*					Post Removal Action Overall Average (2000-2006)
		1993[2]	1999[2]	2000[3]	2001[3]	2002[3]	2006[3]	
Yearling White Suckers	Mean Lipid Content (%)	1.10	1.98	2.59	2.78	1.98	1.16	2.00
	Standard Deviation (%)	0.48	0.81	0.35	0.82	0.60	0.36	0.84
	Relative Standard Deviation (%)	43	41	13	30	30	31	42.61
Adult White Suckers	Mean Total PCB (mg/Kg ww)[1,4]	1.12	---	---	2.68	---	---	2.68
	Standard Deviation (%)	---	---	---	---	---	---	---
	Relative Standard Deviation (%)	---	---	---	---	---	---	---
YOY Carp	Mean Lipid Content (%)	---	---	---	3.12	2.34	---	2.73
	Standard Deviation (%)	---	---	---	0.30	0.44	---	0.37
	Relative Standard Deviation (%)	---	---	---	10	19	---	14
Adult Carp	Mean Lipid Content (%)	1.51	---	2.12	3.02	1.81	3.32	2.57
	Standard Deviation (%)	0.46	---	0.84	1.87	0.83	2.16	1.62
	Relative Standard Deviation (%)	30	---	40	62	46	65	63

Notes:
1. Yearling White Suckers were analyzed for PCB Congeners in 2000, 2002, and 2003, while PCB aroclors in 1993 and 2001. Yearling Carp were analyzed for PCB Congeners in 2001 and 2002, while PCB Aroclors in 1993. Adult Carp were analyzed for PCB Aroclors in all years.
2. Data collected by BBL.
3. Data collected by MDEQ/CDM as part of the LTM program.
4. Only one adult white sucker sample was collected.

Table 4-11
Pre-, During-, and Post-TCRA Mean Lipid-Normalized PCB Concentrations in Resident Yearling Fish within the Bryant Mill Pond

Species	Parameter	*Pre-Removal Action*	*Post-Removal Action*					Post Removal Action Overall Average (2000-2006)
		1993[2]	1999[2]	2000[3]	2001[3]	2002[3]	2006[3]	
Yearling White Suckers	Mean Total PCB (mg/Kg L-N)[1,4]	200.85	8.41	19.91	10.98	13.18	14.76	12.78
	Standard Deviation (mg/Kg L-N)	114.73	4.21	4.11	2.80	1.94	5.28	5.05
	Relative Standard Deviation (%)	57	50	21	25	15	36	30.28
Adult White Suckers	Mean Total PCB (mg/Kg L-N)[1,4,5]	39.46	---	---	10.75	---	---	10.75
	Standard Deviation (mg/Kg L-N)	---	---	---	---	---	---	---
	Relative Standard Deviation (%)	---	---	---	---	---	---	---
YOY Carp	Mean Total PCB (mg/Kg L-N)[1,4]	---	---	---	6.57	7.95	---	7.26
	Standard Deviation (mg/Kg L-N)	---	---	---	1.04	1.12	---	1.08
	Relative Standard Deviation (%)	---	---	---	16	14	---	15
Adult Carp	Mean Total PCB (mg/Kg L-N)[1,4]	234.09	---	15.86	22.91	12.61	9.30	15.06
	Standard Deviation (mg/Kg L-N)	141.39	---	13.82	21.30	4.44	3.25	13.62
	Relative Standard Deviation (%)	60	---	87	93	35	35	90

Notes:
1. Yearling White Suckers were analyzed for PCB Congeners in 2000, 2002, and 2003, while PCB aroclors in 1993 and 2001. Yearling Carp were analyzed for PCB Congeners in 2001 and 2002, while PCB Aroclors in 1993. Adult Carp were analyzed for PCB Aroclors in all years.
2. Data collected by BBL.
3. Data collected by MDEQ/CDM as part of the LTM program.
4. Lipid Normalized PCB calculated by dividing the total PCB by the proportion of lipid content.
5. Only one adult white sucker sample was collected.

Table 5-1

Spatial and Temporal Distribution of Sampling Effort for Adult and YOY Carp Within the Kalamazoo River and Portage Creek

Species	Aquatic Biota Sampling Area	LTM Station ID	1983	1984	1985	1986	1987	1990	1991	1992	1993	1994	1997	1999	2000	2001	2002	2003	2004	2006
Adult CARP Fillet Skin Off	Battle Creek	31					9				11		11	11	11	11				11
	Morrow Lake	29			20	20	9				11		11	22		11				11
	Downstream Morrow Lake Dam	62									11									
	Monarch Mill Pond	68														11				11
	Bryant Mill Pond	61			10	21	10				11				11	11	11			11
	Mosel Avenue	63	11		18	20					11			11	6					11
	Plainwell Impoundment	32	11		20	21	9				11		11	22		11				11
	Otsego City Impoundment	33									11			11		11				11
	Otsego Impoundment	36									11			11		11				11
	Trowbridge Impoundment	37									11			22		11		11	11	11
	Allegan City Impoundment	38												11		11				11
	Lake Allegan	30	3		19	81	10	10		9	11	10	11	22	11	11				11
	Downstream Lake Allegan Dam	-									11									
	New Richmond	35									11		12	21		11				11
	Saugatuck (Kalamazoo Lake)	34		11	20	24	9							22		11				11
	Saugatuck River Mouth	-									5									
Adult CARP Fillet Skin On	Battle Creek	-							5											
YOY CARP Whole Body	Bryant Mill Pond	61														5	5			

Notes:

1) Battle Creek station for the LTM program is the Ceresco Reservoir.

Table 5-2

Spatial and Temporal Distribution of Sampling Effort for Adult and YOY Smallmouth Bass Within the Kalamazoo River and Portage Creek

Species	Aquatic Biota Sampling Area	LTM Station ID	1983	1984	1985	1986	1987	1990	1991	1992	1993	1994	1997	1999	2000	2001	2002	2003	2004	2006
Adult SMALLMOUTH BASS Fillet Skin On	Battle Creek	31					1		4		11		11	11	11	11				11
	Morrow Lake	29			4		10				11		11	22		11				11
	Downstream Morrow Lake Dam	62									11									
	Mosel Avenue	63			2						11			11	11	1				11
	Plainwell Impoundment	32			1						11		11	22		11				11
	Otsego City Impoundment	33									11			22		11				
	Otsego Impoundment	36									11			11		11				
	Trowbridge Impoundment	37									11			22		11				11
	Allegan City Impoundment	38												11		11				11
	Lake Allegan	30			3		10				11		11	21	10	11				11
	Downstream Lake Allegan Dam	-									11									
	New Richmond	35									11		11	18		10				11
	Saugatuck (Kalamazoo Lake)	34			1									22		11				
YOY SMALLMOUTH BASS Whole Body	Battle Creek	31											5	5	5	5				5
	Morrow Pond	29											5	5		5				5
	Mosel Avenue	63													1					5
	Plainwell Impoundment	32											5	5		5				5
	Otsego City Impoundment	33												5		2				
	Otsego Impoundment	36												5		5				
	Trowbridge Impoundment	37												5						5
	Allegan City Impoundment	38												5		5				
	Lake Allegan	30											6	5	5	5				5
	Downstream Lake Allegan Dam	-											5	2		5				5
	New Richmond	35												5		5				

Notes:

1) Battle Creek station for the LTM program is the Ceresco Reservoir.

Table 5-3
Decay Rates and Half Times for Recent (1997-2006) and Long Term (1985-2006) Monitoring Periods

Species	Aquatic Biota Sampling Area	Half Time[1] (years)		Decay Rate[1] (mg/kg per year)		Rate[2] Change	SE[3]	Z[4]	p[5]
		1997-2006	1985-2006	1997-2006	1985-2006				
Adult CARP (Skin Off Fillet)	MORROW LAKE (2)	15.4	6.8	-0.0451	-0.1019	0.0568	0.0303	1.88	0.06
	PLAINWELL IMPOUNDMENT (5)	10.1	10	-0.0686	-0.0696	0.001	0.0285	0.04	0.97
	LAKE ALLEGAN (9)	149.6	7.3	-0.0046	-0.0944	0.0897	0.0354	2.54	0.01
	SAUGATUCK (13)	4.3	27.5	-0.1629	-0.0252	-0.1378	0.071	-1.94	0.05
Adult SMALLMOUTH BASS (Skin on Fillet)	MORROW LAKE (2)	-34.9	9.9	0.0199	-0.0702	0.0901	0.0902	1	0.32
	PLAINWELL IMPOUNDMENT (5)	29.4	10.7	-0.0236	-0.0646	0.041	0.028	1.46	0.14
	LAKE ALLEGAN (9)	-8.6	7.5	0.0807	-0.0921	0.1727	0.0365	4.73	0
	SAUGATUCK (13)	-9.1	12.5	0.0763	-0.0556	0.1319	0.1046	1.26	0.21

Notes:

1) Half time and decay rates were estimated after adjusting for PCB covariation with length and lipid content.

2) The rate change is the difference in decay rate for 1997-2006 versus 1985-2006 data. Positive values indicate that decay rates are slowing down, or equivalently, that half times are getting longer.

3) SE represents the standard error for the estimated difference in exponential decay rates (Rate Change).

4) The standard normal random variable, Z, is the ratio of the Rate Change to its standard error (SE). Large values of Z indicate statistically large differences in exponential decay rates.

5) Prob represents the statistical significance of the calculated z value. Small values of Prob (i.e. near 0.05) indicate evidence of differences among decay rates.

Table 5-4
Estimated Time for Carp and Smallmouth Bass Concentrations to Reach Levels Similar to Those Observed at Morrow Lake and Battle Creek in 2006

Species	Sample Type	Aquatic Biota Sampling Area	Exponential Decay Rate[1] (mg/kg per year)	SE[4]	Adjusted Geo-Mean (2006 mg/kg)[5]	Morrow Lake PCB Adjusted Geo-Mean (2006)	Battle Creek PCB Adjusted Geo-Mean (2006)	Ratio of the Current Adjusted Geo-Mean (2006) to Morrow Lake Adjusted Geo-Mean (2006)	Time to Reach Morrow Lake Adjusted Concentrations (years)[2,3]	Time to Reach Battle Creek Adjusted Concentrations (years)[2,3]	Half Time (years)[2,3]
CARP	FILLET SKIN OFF	BATTLE CREEK	0.0014	0.0406	0.18	0.77	0.18	0.2	NA	NA	NA
		MORROW LAKE	-0.0451	0.0316	0.77	0.77	0.18	1.0	0.0	32.8	15.4
		MONARCH MILL POND	-0.1285	0.0678	0.16	0.77	0.18	0.2	NA	NA	NA
		BRYANT MILL POND	-0.0279	0.0897	0.26	0.77	0.18	0.3	NA	NA	NA
		MOSEL AVENUE	-0.1224	0.0557	1.49	0.77	0.18	1.9	5.4	17.5	5.7
		PLAINWELL IMPOUNDMENT	-0.0686	0.0310	1.85	0.77	0.18	2.4	12.8	34.4	10.1
		OTSEGO CITY IMPOUNDMENT	0.0483	0.0623	2.19	0.77	0.18	2.8	ND	ND	ND
		OTSEGO IMPOUNDMENT	0.0616	0.0393	2.07	0.77	0.18	2.7	ND	ND	ND
		TROWBRIDGE IMPOUNDMENT	-0.1129	0.0378	1.36	0.77	0.18	1.8	5.0	18.1	6.1
		ALLEGAN CITY IMPOUNDMENT	0.0019	0.0376	3.15	0.77	0.18	4.1	ND	ND	ND
		LAKE ALLEGAN	-0.0046	0.0364	4.75	0.77	0.18	6.2	392.8	711.9	149.6
		NEW RICHMOND	-0.0377	0.0504	1.29	0.77	0.18	1.7	13.7	52.9	18.4
		SAUGATUCK	-0.1629	0.0727	0.85	0.77	0.18	1.1	0.6	9.7	4.3
SMALLMOUTH BASS	FILLET SKIN ON	BATTLE CREEK	0.0697	0.0266	0.05	0.29	0.05	0.2	NA	NA	NA
		MORROW LAKE	0.0199	0.0921	0.29	0.29	0.05	1.0	NA	NA	NA
		MOSEL AVENUE	-0.1180	0.0283	0.25	0.29	0.05	0.9	NA	13.1	5.9
		PLAINWELL IMPOUNDMENT	-0.0236	0.0312	0.59	0.29	0.05	2.1	30.8	101.9	29.4
		OTSEGO CITY IMPOUNDMENT[5]	0.5440	0.2580	0.89	0.29	0.05	3.1	ND	ND	ND
		OTSEGO IMPOUNDMENT[5]	-0.0413	0.2015	0.55	0.29	0.05	1.9	15.9	56.5	16.8
		TROWBRIDGE IMPOUNDMENT	-0.1187	0.0465	0.65	0.29	0.05	2.3	6.9	21.1	5.8
		ALLEGAN CITY IMPOUNDMENT	-0.1996	0.0644	0.23	0.29	0.05	0.8	NA	7.2	3.5
		LAKE ALLEGAN	0.0807	0.0387	0.62	0.29	0.05	2.2	ND	ND	ND
		NEW RICHMOND	-0.0729	0.0354	0.24	0.29	0.05	0.8	NA	20.6	9.5
		SAUGATUCK[5]	0.0763	0.1092	0.32	0.29	0.05	1.1	ND	ND	ND
SMALLMOUTH BASS	WHOLE BODY	BATTLE CREEK	-0.1556	0.0682	0.16	0.18	0.16	0.9	NA	NA	NA
		MORROW LAKE	-0.0469	0.0282	0.18	0.18	0.16	1.0	0.0	2.8	14.8
		MOSEL AVENUE	-0.0289	0.0218	0.15	0.18	0.16	0.8	NA	NA	NA
		PLAINWELL IMPOUNDMENT	-0.2789	0.1209	0.25	0.18	0.16	1.4	1.3	1.7	2.5
		OTSEGO CITY IMPOUNDMENT[5]	-0.2783	0.0767	0.02	0.18	0.16	0.1	NA	NA	NA
		OTSEGO IMPOUNDMENT[5]	-0.6352	0.4764	0.48	0.18	0.16	2.7	1.6	1.8	1.1
		TROWBRIDGE IMPOUNDMENT	0.1648	0.1388	0.76	0.18	0.16	4.3	ND	ND	ND
		ALLEGAN CITY IMPOUNDMENT[5]	-0.7839	0.6479	0.12	0.18	0.16	0.7	NA	NA	NA
		LAKE ALLEGAN	-0.0472	0.1392	0.70	0.18	0.16	3.9	28.9	31.6	14.7
		NEW RICHMOND	-0.1555	0.0441	1.01	0.18	0.16	5.7	11.2	12.0	4.5
		SAUGATUCK[5]	0.2757	0.2980	0.47	0.18	0.16	2.6	ND	ND	ND

Notes:
1) Estimates are based on length and lipid adjusted concentrations for a fish with average size and lipid content. Estimates based on decay rates calculated from 1997 through 2006.
2) Records marked as NA represent reference areas or areas with estimated adjusted concentrations at or below reference conditions.
3) Records marked as ND represent sampling locations where exponential decay constant is positive, indicating concentrations are not declining.
4) SE represents the standard error for the estimated difference in exponential decay rates (Rate Change).
5) No smallmouth bass (Fillet and/or Whole Body) were collected for these ABSAs in 2006. As a result, the last collection year, i.e. 2001, was used for an adjusted GeoMean concentration in order to calcalute a time to reach Battle Creek and/or Morrow Lake concentrations.

Figures

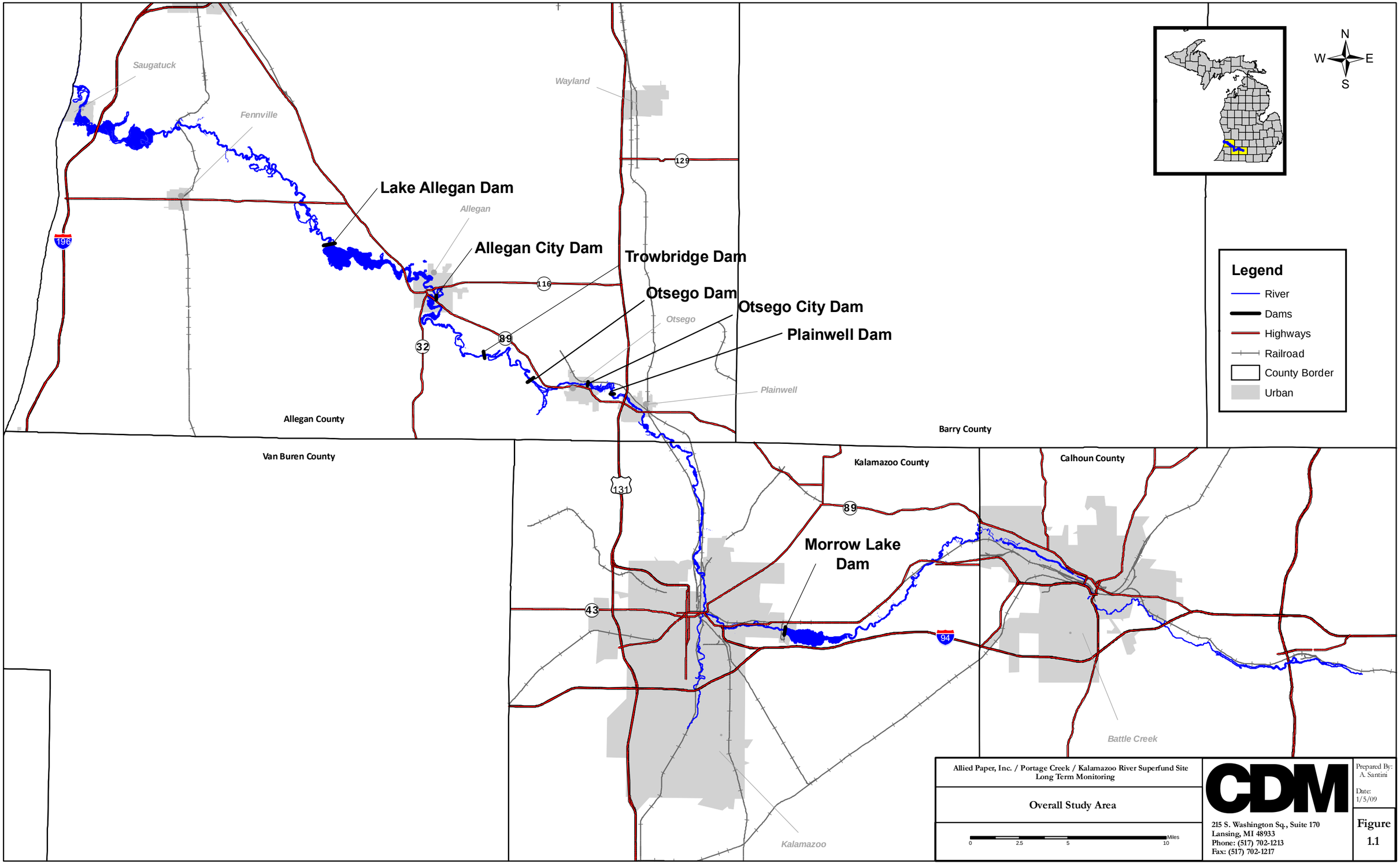

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Figure 1.1