Statewide Michigan Mercury TMDL

Public Review Draft
March 2013

Prepared for:
Michigan Department of Environmental Quality
and
U.S. EPA Region 5

By:
LimnoTech

Under Subcontract to:
Battelle
Duxbury, MA

U.S. EPA Contract No. EP-C-08-001
Task Order 006

LimnoTech
Water | Environment | Scientists | Engineers

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ALA	Anthropogenic Load Allocation
AMV	Aquatic Maximum Value
ANPSL	Anthropogenic Nonpoint Source Load
AOC	Area of Concern
AUID	Assessment Unit Identification
BACT	Best Available Control Technology
BAF	Bioaccumulation Factor
CAA	CAA Clean Air Act
CAIR	Clean Air Interstate Rule
CAMR	Clean Air Mercury Rule
CFR	Code of Federal Regulations
EAF	Electric Arc Furnace
EIF	Electric Induction Furnace
ECOS	Environmental Council of States
EDU	Ecological Drainage Unit
EGU	Electric Generating Unit
FCMP	Fish Contaminant Monitoring Program
FCV	Final Chronic Value
GLLA	Great Lakes Legacy Act
GLRC	Great Lakes Regional Collaboration
GLRI	Great Lakes Restoration Initiative
HNV	Human Non-Cancer Value
HUC	Hydrologic Unit Code
HVAC	Heating, Ventilation and Air Conditioning
LC	Loading Capacity
LA	Load Allocation
LaMP	Lake-wide Management Plan
LCA	Level Currently Achievable
MATS	Mercury and Air Toxics Standards
MCGI	Michigan Center for Geographic Information
MCM	Mercury Cycling Model
MDA	Michigan Dental Association
MDCH	Michigan Department of Community Health
MDEQ	Michigan Department of Environmental Quality
MDV	Multiple Discharge Variance
mg/kg	Milligrams per kilogram; equivalent units are ppm and ug/g
MiSWIM	Michigan Surface Water Information Management System
MOS	Margin of Safety
MPCA	Minnesota Pollution Control Agency
MRLC	Multi-Resolution Land Characteristic Consortium
MS4	Municipal Separate Storm Sewer System
MSWG	Mercury Strategy Work Group

NHD	National Hydrography Dataset
NLA	Natural Load Allocation
NNPSL	Natural Nonpoint Source Load
NPDES	National Pollution Discharge Elimination System
NPL	National Priorities List
NPSL	Nonpoint Source Load
PMP	Pollutant Minimization Program
PSA	Public Service Announcement
PSL	Point Source Load
QSC	Quicksilver Caucus
REMSAD	Regional Modeling System for Aerosols and Deposition
RF	Reduction Factor
TMDL	Total Maximum Daily Load
TSL	Total Source Load
UMAQL	University of Michigan Air Quality Laboratory
U.S. EPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WCMP	Water Chemistry Monitoring Program
WLA	Waste Load Allocation
WQS	Water Quality Standard
WV	Wildlife Value

EXECUTIVE SUMMARY

Mercury is a naturally-occurring metal that is prevalent throughout the global environment including Michigan. The well-known neurotoxic properties of mercury make it dangerous, at high exposure levels, for both humans and wildlife, especially the young. Human exposure through consumption of fish is the principal public health concern with mercury in the environment. Mercury emitted to the atmosphere can be transported short and long distances from its source before being deposited to land and water. The widespread loading of mercury into the Great Lakes region caused mercury-related fish consumption advisories in all of the eight Great Lakes states. Out of the 7,316 water body assessment units across the state of Michigan, 4,709 have been assessed for some impairment. This Total Maximum Daily Load (TMDL) addresses inland water bodies in Michigan. Of the assessed inland water body segments included in this TMDL, 743 are impaired due to mercury. Of these water body segments, 462 are impaired due to mercury in fish tissue, 260 are impaired due to mercury in the water column, and 21 are impaired based on mercury in both fish tissue and the water column (Figure ES-1). Appendix A lists specific water body segments covered by this TMDL.

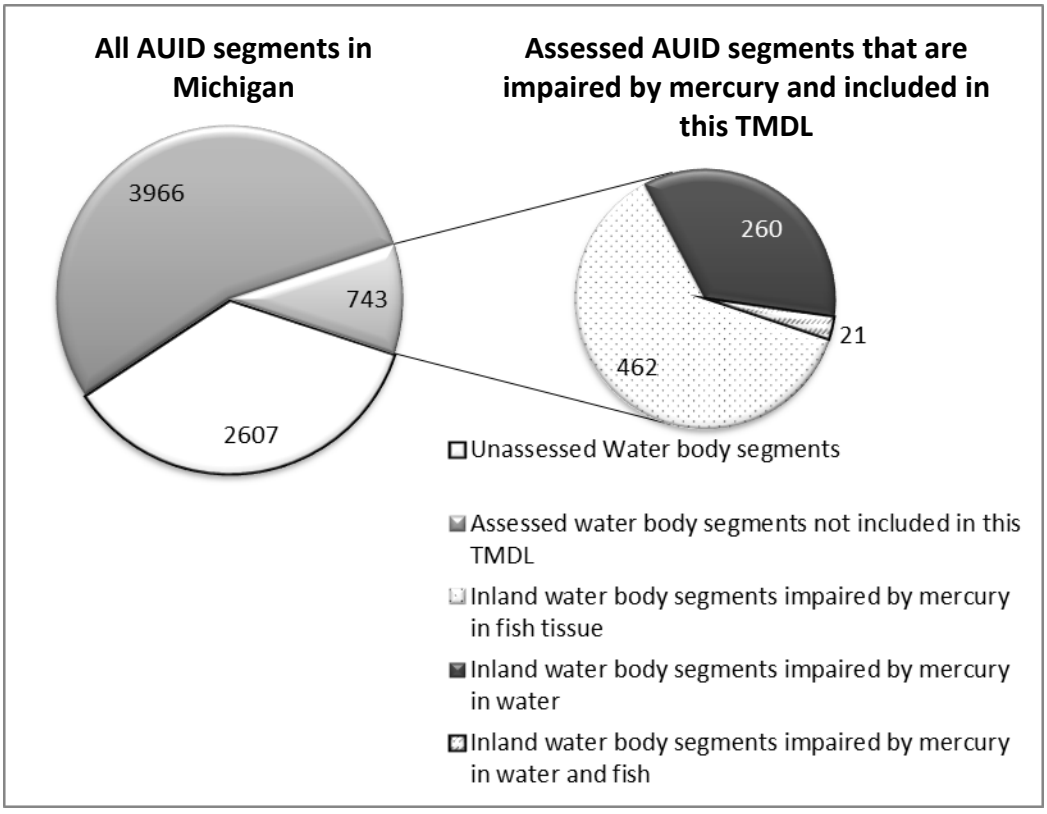


Figure ES-1. Assessed and Mercury-Impaired Water Body Segments in Michigan.
Source: Michigan Department of Environmental Quality (MDEQ), 2012a.

In Michigan, the majority of mercury pollution is a result of atmospheric deposition. A statewide TMDL has been developed to address mercury impairment in Michigan inland water bodies primarily due to atmospheric deposition. Based on a target fish tissue mercury concentration of 0.35 mg/kg , the TMDL establishes a goal for reducing atmospheric mercury loading relative to the 2001 baseline loading.

Atmospheric mercury deposition in Michigan comes from local, regional, national, and global sources that are both anthropogenic and natural in origin. Atmospheric mercury deposition originating from sources within and outside of Michigan was estimated for the baseline year of 2001 using an U.S. EPA model. Based on the assumption that fish mercury concentrations will respond proportionally to reductions in atmospheric mercury loadings, a TMDL and reduction goal were developed to meet the target fish tissue concentration of 0.35 mg/kg. Anthropogenic atmospheric sources of mercury from Michigan must be reduced by 82% from 2001 levels to meet this goal (Table ES-1). Reductions are necessary from mercury sources within Michigan, other U.S. states and global sources. However, this TMDL only addresses reductions from Michigan sources. Progress in achieving this goal in Michigan will be tracked using air emissions from the year 2002 as the baseline, since a complete emissions inventory for the baseline year 2001 is not available. Mercury fish tissue concentrations will also continue to be monitored to determine future progress.

Table ES-1. Summary of TMDL Components.

TMDL Components	Units	Statewide
Target Level and Reduction Factor		
Target Fish Mercury Concentration (Fish Tissue Residue Value)	mg/kg	0.35
Mercury Concentration for Standard Length Northern Pike	mg/kg	1.01
Reduction Factor	65%	
Mercury Load for Baseline Year 2001		
Point Source Load (PSL)	kg/day	0.11
Nonpoint Source Load (NPSL) (REMSAD Model)	kg/day	7.49
Total Source Load (TSL)	kg/day	7.6
Final TMDL		
Margin of Safety	Implicit	
Wasteload Allocation (WLA)	kg/day	0.016
Load Allocation (LA)	kg/day	2.61
Mercury Load Allocation for In-State and Out-of-State Deposition Sources		
In-State Contribution to LA	kg/day	0.11
Out-of-State Contribution to LA	kg/day	2.5
Necessary Reduction from Anthropogenic Emission Sources		82%

Note: numbers may not sum exactly due to rounding

1 INTRODUCTION

Section 303(d) of the federal Clean Water Act and the United States Environmental Protection Agency's (U.S. EPA) Water Quality Planning and Management Regulations (Title 40 of the Code of Federal Regulations [CFR] Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for all category 5[1] water bodies that are not meeting Water Quality Standards (WQS) for a specific pollutant. These water bodies are included on a state's 303(d) list. The TMDL process establishes the allowable loadings of a pollutant to a water body based on the relationship between pollution sources and water quality conditions of a water body. This allowable loading represents the maximum quantity of a pollutant that the water body can receive without exceeding WQS. The TMDL process provides states with the basis for establishing water quality-based controls, which define the pollutant reductions necessary for a water body to attain WQS (U.S. EPA, 1991).

Sections 303(d), 305(b), and 314 of the 2012 Michigan Integrated Report (Michigan Department of Environmental Quality[2] [MDEQ], 2012a) identified 6,712 miles of rivers and streams and 246,271 acres of inland lakes and reservoirs as not supporting their designated uses due to high concentrations of mercury in fish tissue. In addition, 7,068 miles of rivers and streams, and 211 acres of lakes and reservoirs are not supporting their designated use due to mercury in the water column (MDEQ, 2012a).

The scope of this mercury TMDL covers inland water bodies in the state of Michigan primarily impacted by atmospheric deposition of mercury. These water bodies are described further in Section 2 and Appendix A.

This document describes the statewide approach that Michigan has taken to develop a TMDL for mercury. The report covers each step of the TMDL process and is organized as follows:

Section 2: Background

Section 3: Applicable Water Quality Standards and Numeric Targets

Section 4: Modeling Approach

Section 5: Source Assessment

Section 6: TMDL Development

Section 7: Reasonable Assurance and Implementation

Section 8: Post-TMDL Monitoring

[1] Category 5 means available data and/or information indicate that at least one designated use is not being supported or is threatened, and a TMDL is needed.

[2] For a short period of time (October 2009-March 2011) MDEQ was reorganized and known as Michigan Department of Natural Resources and Environment. For consistency, MDEQ is used throughout this document when referencing the agency.

2 BACKGROUND

This section provides background information for mercury TMDL development. It is divided into the following sections:

- Problem Statement
- Data Collection and Assessment of Water Quality
- Scope of Water Bodies Considered Under this TMDL

2.1 PROBLEM STATEMENT

Mercury is a metal that occurs naturally in the environment in the mineral form of cinnabar or metacinnabar (HgS). About 90% of the mercury produced in the U.S. between 1850 and 1980 was mined from the mountains of central-western California (Davis et al., 2003), and most of this mercury was used to assist with the extraction of gold from California mines in the Sierra Nevada mountains.

Over time, the largest uses of mercury in the U.S. have been for batteries, followed by the chlor-alkali process in which liquid mercury acts as a cathode to aide in the electrolysis of salt water (Sznopek and Goonan, 2000). Other major uses of mercury in the U.S. include paint, lighting, switches, instruments, dental and other laboratory uses, and other industrial applications (Sznopek and Goonan, 2000). Local and global anthropogenic activities such as mining, coal combustion, and industrial uses have released mercury in excess of concentrations present in the pre-industrial period, generally in the form of elemental mercury (Hg^0) or ionic (Hg^{2+}) mercury species.

Although health impacts of industrial exposure to high levels of elemental mercury have been documented (Gochfeld, 2003), the primary environmental concern at lower ambient concentrations is with methylmercury, the most bioavailable and bioaccumulative form of mercury. Methylmercury is produced through the addition of a methyl group to Hg^{2+}, a process referred to as methylation (Figure 1). Methylation is performed primarily by sulfate-reducing bacteria (Compeau and Bartha, 1985; Regnell et al., 1996; Gilmour et al., 1998), which are found at zones of transition from oxic (i.e., containing oxygen) to anoxic (i.e., absence of oxygen) conditions in the water column or sediment (Bloom et al., 1999; Gilmour et al., 1998; Devereux et al., 1996; Slotton et al., 1995; Watras et al., 1994; Choi and Bartha, 1993). Net methylmercury production (i.e., methylmercury production in excess of degradation) is the most important environmental process that leads to food web accumulation.

The strong reactivity of methylmercury with sulfhydryl groups of proteins in the body is responsible for its high degree of bioaccumulation in fish and other types of organisms (Beckvar et al., 1996). Phytoplankton can concentrate dissolved methylmercury in the water column approximately 100,000 times greater than water column concentrations, making this a critical step in the bioaccumulation process (Watras et al., 1994). After this initial step, methylmercury concentrations increase approximately three-fold with each additional step in the food chain (Watras et al., 1994), in a process known as biomagnification (Figure 1). In this process, consumers

retain and further concentrate much of the methylmercury of their prey, and subsequently pass the higher levels of mercury on to the next trophic level. Species at high trophic levels in the aquatic food web, such as predatory fish, attain concentrations that can be up to a million times higher than the concentration in water.

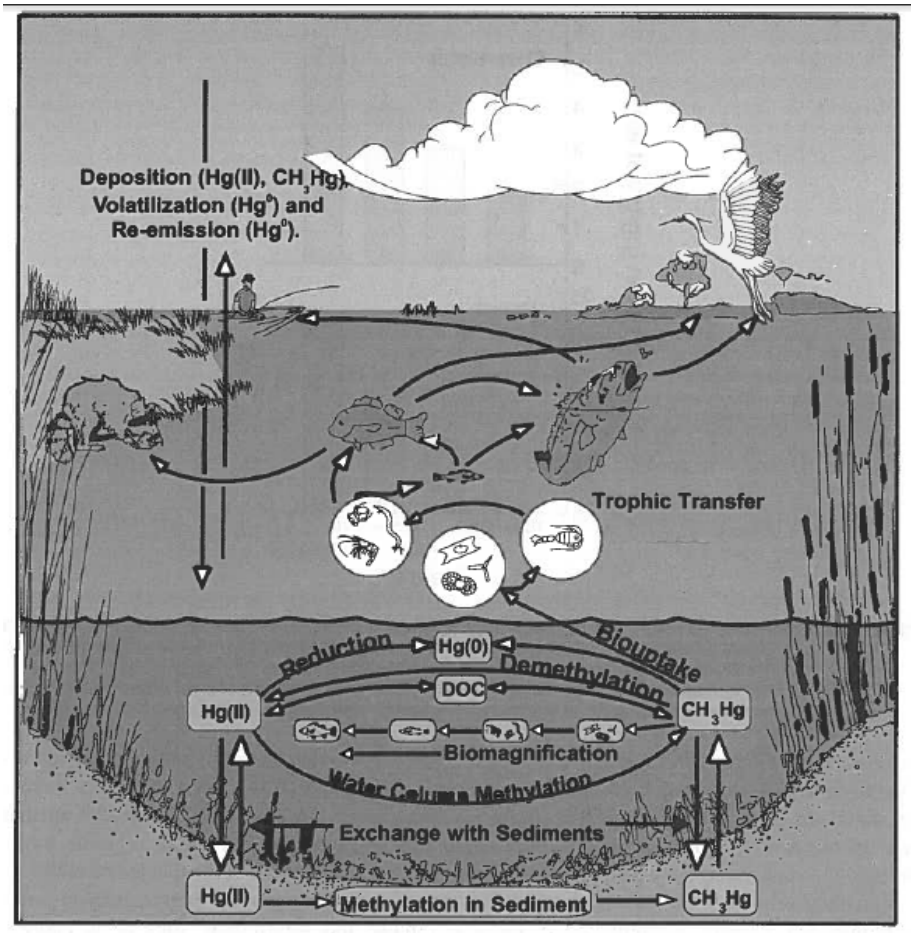


Figure 1. Mercury Processes in the Environment.
Methylation in the sediment leads to uptake through the food chain. Biomagnification results in higher trophic levels accumulating much higher concentrations of mercury. (Source: Wiener et al., 2003)

There are several exposure routes of mercury, including groundwater, air, sediment, and water, but the primary route of methylmercury exposure in humans in the U.S. is via fish consumption (Figure 2). When ingested, methylmercury in fish tissue is almost completely absorbed from the gastrointestinal tract. Once absorbed, methylmercury is distributed throughout the body and is concentrated in the brain, liver, kidneys, peripheral nerves and bone marrow. For pregnant women, methylmercury also concentrates in the placenta, fetus, and particularly the fetal brain (Berlin et al., 2007). The ability of methylmercury to cross the placenta as well as the blood-brain barrier allows methylmercury to accumulate in the brain and fetus, which

are known to be especially sensitive to the toxic effects of this chemical (Klasing and Brodberg, 2008).

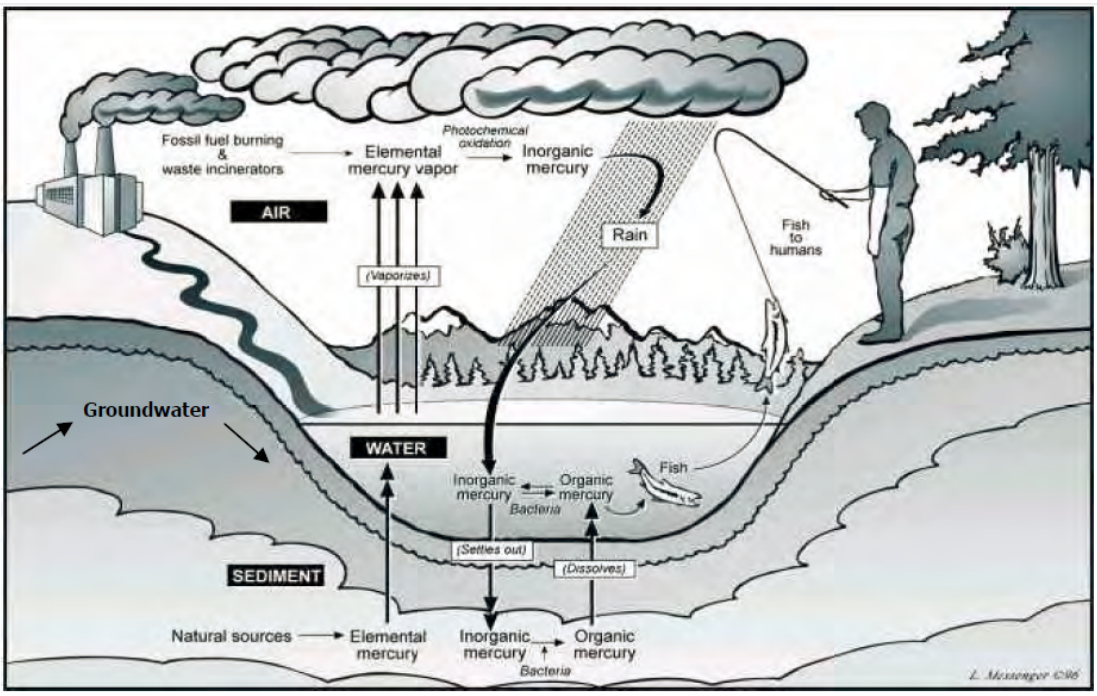


Figure 2. The Mercury Cycle. Source: MDEQ, 2008a.

Fish, birds, and other animals are sensitive to mercury in the environment. Consumption of fish by other animals such as mink, otter, and fish eating birds, is the primary mechanism for methylmercury exposure; therefore, aquatic species are particularly vulnerable to mercury contamination. Toxic effects have been documented in animals that consume fish with a mercury concentration starting at 0.0003 to 0.0007 mg/kg wet weight in the whole body of fish (Wiener et al., 2007). Depew et al. (2012) proposed a threshold of 0.0001 mg/kg wet weight methylmercury in prey fish, for adverse behavioral impacts in adult loons. They also proposed benchmarks of 0.00018 and 0.0004 mg/kg wet weight in prey fish for significant reproductive impairment and for reproductive failure in wild adult loons, respectively.

Due to the wide-ranging use and release of mercury, and consequent impacts on humans and wildlife, the MDEQ convened the Mercury Strategy Work Group (MSWG) in 2006. The MSWG produced a Mercury Strategy for Michigan that included an inventory of releases in Michigan for 2002 (Appendix G of MDEQ, 2008a). A total of 8,440 lbs (3,828 kg) of mercury were estimated to be released into the environment through multiple pathways (e.g., air, land and water) in 2002. The report details emissions for several source categories including fuel combustion, industrial sources, incineration, area sources, and mobile sources. In 2002, the largest industrial source of mercury emissions in Michigan was coal-fired power plants (MDEQ, 2008a).

To reduce future releases, the MSWG set an overall goal of eliminating anthropogenic use and release of mercury in the state. In addition, two interim goals were established. These goals are: 1) by 2010, to reduce mercury use and release to the environment by 50%, and 2) by 2015, to reduce mercury use and release to the environment by 90% (MDEQ, 2008a). Although a similar comprehensive inventory has not yet been compiled for 2010 to determine if the 50% goal has been met, a 2005 mercury air emissions inventory demonstrates a 10% reduction in emissions relative to 2002.

2.1.1 TMDL Development Process

Reducing human and wildlife exposure of mercury is a priority in Michigan (MDEQ, 2008a). The Michigan Department of Community Health (MDCH) continues to issue general fish consumption advisories for all inland lakes in Michigan, and specific recommendations for Lakes Huron, Michigan, and Superior, and several hundred miles of rivers and streams due to mercury concentrations in fish tissue. Because of the widespread impairment of Michigan's waters due to mercury, this statewide TMDL has been developed for inland waters primarily impacted by atmospheric deposition of mercury. This TMDL describes the pollutant reductions necessary to attain WQS.

Considerations used to prioritize water bodies for TMDL development in Michigan include the existing TMDL schedule (i.e., the number of TMDLs currently scheduled for each year), Michigan's five-year rotating watershed monitoring cycle (Figure 3), available staff and monetary resources to complete TMDLs, data and supporting information on quality and quantity of the pollutant causing the impairment, complexity of the problem as well as severity of the pollution, and the U.S. EPA's recommendation to develop TMDLs within 13 years of listing (MDEQ, 2012a). A scheduled completion date for TMDLs to address mercury impairment of inland water bodies was proposed for 2013 in Michigan's 2010 Integrated Report. Great Lakes and connecting channels are currently scheduled for TMDL development in 2015 (MDEQ, 2012a).

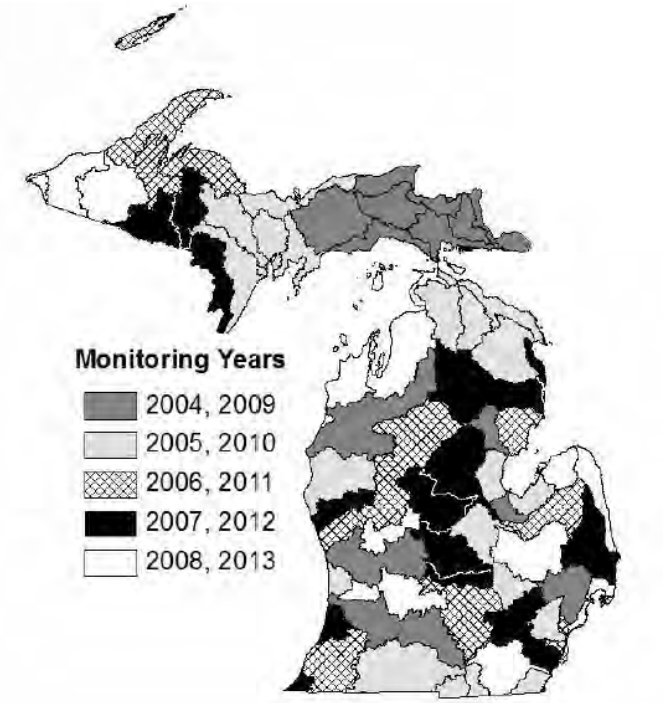


Figure 3. MDEQ's Five-year Rotating Watershed Monitoring Cycle

(Source: MDEQ, 2010a)

2.1.2 Recent Mercury Trends

This section describes recent mercury trends for emissions, atmospheric deposition and fish concentrations.

The Binational Toxics Strategy was a joint U.S.-Canada effort to reduce pollution from toxic contaminants (it has since been replaced by the Great Lakes Restoration Initiative). In a 2006 progress report, U.S. EPA reported that total U.S. emissions of mercury decreased by 47% between 1990 and 2002. Emissions reductions may have been even larger since gold mining and electric arc furnaces were not included in the 1990 inventory. The biggest reductions in mercury emissions came from medical waste incinerators and municipal waste combustors (U.S. EPA, 2006). A more recent report documented a 75% reduction in U.S. mercury emissions between 1990 and 2008 (Quicksilver Caucus, 2012).

Evers et al. (2011) reported long term (1967-2009) trends of decreasing mercury in walleye and largemouth bass fillets, as well as herring gull eggs, across the Great Lakes states as a result of the widespread reduction in mercury emissions. Similar to reductions reported for the entire U.S., a 50 percent reduction in emissions was estimated for the 1990 - 2005 period for the Great Lakes states (Evers et al., 2011).

Trend analyses have been conducted on data sets for fish collected from inland water bodies at an interval of two to five years for Michigan's whole fish trend monitoring program. These data include carp from five inland rivers, and lake trout, walleye and largemouth bass from eight inland lakes. From 1990 to 2007, mercury concentrations in whole body fish samples from three of the thirteen sampled inland water bodies

showed a statistically significant trend—one increasing and two decreasing. The average annual rate of change was minimal, decreasing at 0.8% per year for all fish (Table 1; MDEQ, 2008b).

Table 1. Annual Rates of Change in Fish Tissue Mercury Concentrations for Whole Fish Collected from Fixed Station Trend Monitoring Stations

A "±" symbol indicates no significant trend found (p>0.05). Average and median concentrations calculated using only those inland lakes and rivers with significant trend rates. (Source: MDEQ, 2008b)

Water body	Species	Rate of Change (%)	P Value
Inland Rivers			
Grand River	Carp	±2.9	
Kalamazoo River	Carp	±1.5	
Muskegon River	Carp	±2.9	
River Raisin	Carp	-2.5	<0.01
St. Joseph River	Carp	±1.4	
Inland Lakes			
Grand Sable Lake	Lake Trout	7.6	<0.01
Lake Gogebic	Walleye	-7.4	<0.001
South Manistique Lake	Walleye	±1.5	
Higgins Lake	Lake Trout	±2.4	
Houghton Lake	Largemouth Bass	±1.4	
Gull Lake	Largemouth Bass	±1.1	
Gun Lake	Largemouth Bass	±1.2	
Pontiac Lake	Largemouth Bass	±2.8	
	Average	-0.8	
	Median	-2.5	

Air concentrations of mercury from event precipitation samples were measured over 10 years by the University of Michigan Air Quality Laboratory (UMAQL, 2009) in collaboration with the MDEQ at three sites (Figure 4). There is a clear decreasing spatial trend of wet mercury deposition from south (Dexter, shown on the left for each year) to north (Eagle Harbor, shown on the right for each year), but no statistically significant statewide trend was observed over time (MDEQ, 2008a). Evers et al. (2011) also reported no evidence of appreciable decline in wet deposition in the Great Lakes and Canada between 2002 and 2008.

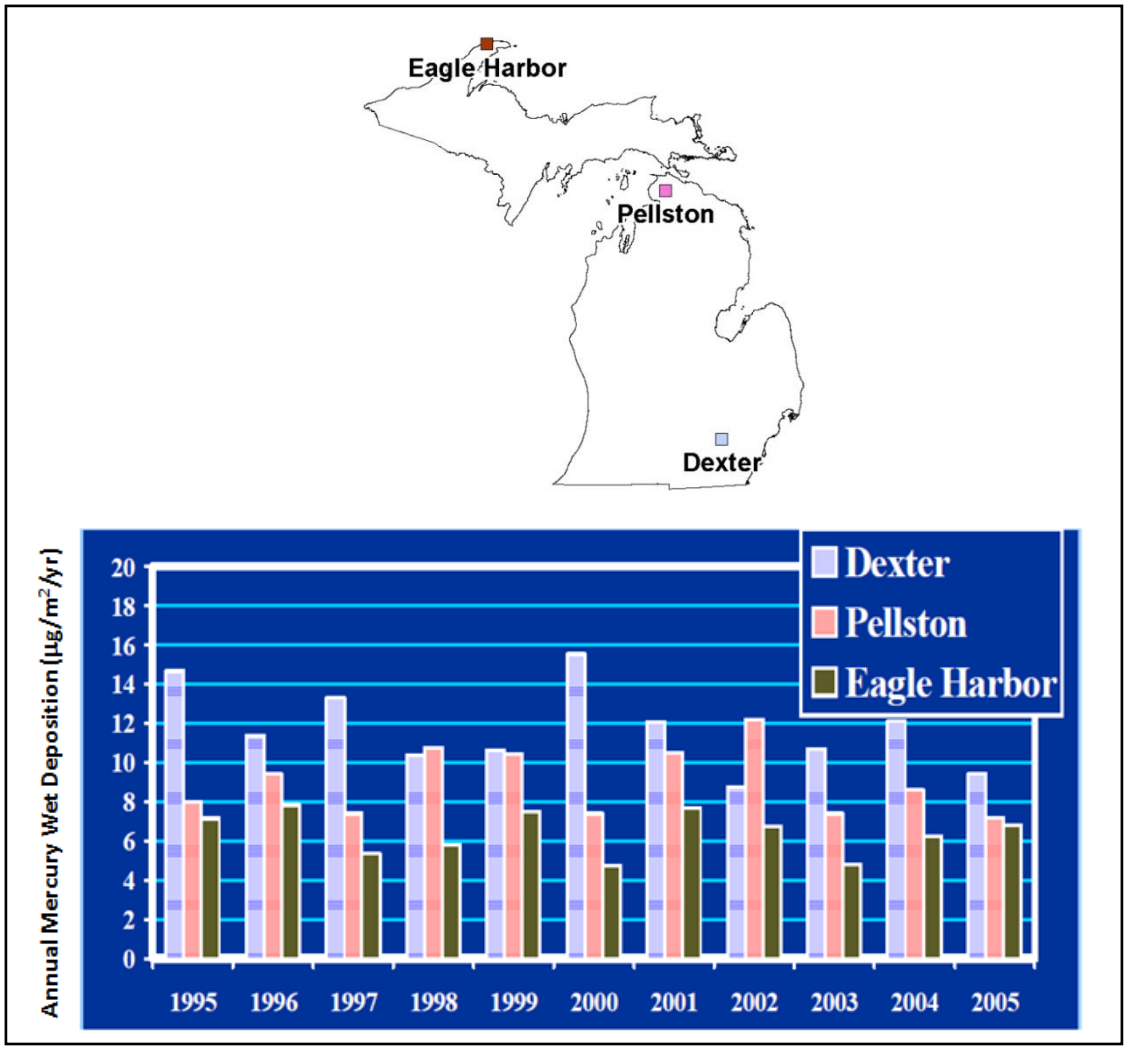


Figure 4. Annual Mercury Wet Deposition (µg/m^2/yr) from Event Precipitation Samples, 1995-2005.
Sampling locations are shown in the accompanying map above. (Source: MDEQ, 2008a)

A recently completed report synthesizing mercury data for the Great Lakes region concluded that the scope of the impacts of mercury on fish and wildlife is much greater than previously recognized, with particular concern for inland waters; however, the science of mercury is complex and it is difficult to draw conclusions across the region or for one state (Evers et al., 2011). In spite of potential difficulties in assessing trends, elevated fish mercury concentrations observed in inland waters and published research (i.e., Chadwick, et al. 2012) are sufficient to support the decisions regarding necessary reductions.

2.2 DATA COLLECTION AND ASSESSMENT OF WATER QUALITY

TMDLs must be developed for all water bodies contained on states' 303(d) lists of impaired waters. This section begins with a discussion of the state's data collection efforts used to support impairment determination, follows with a summary of waters

impaired by mercury, and concludes with a discussion of the scope of water bodies considered under this TMDL.

2.2.1 Data Collection and Summary Analysis

Michigan uses the National Hydrography Dataset (NHD) to organize and identify water bodies for the 303(d) list. The base assessment unit is a 12-digit hydrologic unit code (HUC), which may be split further into sub-assessment units depending on information such as land use, known areas of contamination, specific fish consumption advisories, physical barriers such as dams, etc. Each assessment unit is assigned an assessment unit identification number (AUID) and may consist of all water bodies in a 12-digit HUC (as a maximum) or specific stream segments or lakes located in that HUC (MDEQ, 2012a).

Water column samples analyzed for mercury were collected starting in 1970 and their associated data are stored within the Michigan Surface Water Information Management System (MiSWIM)[3]. Sampling as part of the Water Chemistry Monitoring Program (WCMP) began in 1998 (MDEQ, 2012b). The program consists of monitoring the water column for mercury in Great Lakes connecting channels, and eight tributaries that discharge to Lakes Michigan, Huron, Superior and Erie. A probability sampling design consisting of 250 randomly chosen sites was added to the WCMP in 2005 to establish a water chemistry statistical status and trend program. The statewide median value of total mercury is 1.1 ng/l, with values ranging from 0.15 ng/l to 9.65 ng/l. Approximately 56% of the river miles in Michigan are meeting the WQS of 1.3 ng/l based on the probabilistic data collected from 2005 to 2009.

Fish tissue samples are collected by a variety of agencies to provide data for assessment purposes as part of the Fish Contaminant Monitoring Program (FCMP). These agencies include, but are not limited to, Michigan Department of Natural Resources Fisheries Division, U.S. Fish and Wildlife Service, MDEQ, and tribal agencies. There are two major components of the FCMP: the edible portion monitoring program and the trend monitoring program. The edible portion program is used to make impairment determinations due to mercury in fish tissue, since the primary objective of the edible-portion monitoring program is focused on developing sport fish consumption advisories and commercial fishing restrictions. Therefore, this is the component of the FCMP used for development of the TMDL, and the trend monitoring program will not be discussed (Exponent, 2003). Mercury concentrations in fish tissue are available from the FCMP database for over 30 species of fish collected between 1984 and 2009 from inland water bodies (Table 2).

[3] Available on MDEQ's website at http://www.michigan.gov/miswim.

Table 2. Average Mercury Fish Tissue Concentration for Edible Portion of Fish from Inland Water Bodies in Michigan 1984-2009

Results in bold exceed TMDL target (0.35 mg/kg).
(Data source: FCMP, 2011) **Continued on Next Page.**

Species	Number of Samples	Average Fish Tissue Concentration (mg/kg)
Black Buffalo	5	0.040
Black Bullhead	11	0.139
Black Crappie	238	0.213
Bluegill	134	0.155
Brook Trout	77	0.179
Brown Bullhead	140	0.150
Brown Trout	286	0.156
Bullhead	3	0.120
Burbot	10	**0.409**
Carp	1,743	0.178
Channel Catfish	236	0.185
Crappie	16	0.174
Freshwater Drum	20	**0.371**
Gizzard Shad	10	0.037
Goldfish	1	0.100
Lake Herring	34	0.236
Lake Trout	221	**0.408**
Lake Whitefish	44	0.131
Largemouth Bass	1,420	**0.401**
Longnose Sucker	1	**0.500**
Mirror Carp	1	0.050
Muskellunge	7	**0.483**
Northern Hogsucker	8	0.119
Northern Pike	1,941	**0.576**
Pumpkinseed	10	0.089
Rainbow Trout	38	0.141
Redear Sunfish	10	0.061
Redhorse Sucker	263	0.229
Rock Bass	580	0.223

Table 2 (Continued). Average Mercury Fish Tissue Concentration for Edible Portion of Fish from Inland Water Bodies in Michigan 1984-2009

Species	Number of Samples	Average Fish Tissue Concentration (mg/kg)
Smallmouth Bass	720	0.294
Splake	35	0.158
Sunfish	5	0.352
Tiger Muskie	4	0.230
Walleye	1,913	0.474
White Bass	45	0.288
White Crappie	2	0.245
White Sucker	865	0.153
Yellow Bullhead	36	0.303
Yellow Perch	302	0.317

The average fish tissue concentrations in Table 2 were calculated by considering fish of all sizes from all inland water bodies in the state. The average values could be somewhat different if only results from fish above minimum legal size for consumption were considered. For example, 47% of the northern pike sampled in the Michigan inland waters were above the statewide minimum legal length of 24 inches. The average concentration of all northern pike exceeding 24 inches is 0.646 mg/kg.

The MDCH uses fish tissue monitoring data and the U.S. Food and Drug Administration's mercury trigger level of 0.5 mg/kg to determine issuance of fish consumption advisories when developing advisories for the general population (Table 3). The MDCH advises the general population to limit their consumption of fish to one meal per week if mercury concentrations exceed 0.5 mg/kg, and advises no consumption for concentrations above 1.5 mg/kg. In addition to general population advisories, the MDCH advises women of child-bearing years, and children less than 15 years of age, to eat no more than one meal per month if total median mercury concentrations exceed 0.5 mg/kg (Table 3) (MDEQ, 2010a).

Table 3. Trigger Levels Used by the Michigan Department of Community Health to Establish Fish Consumption Advisories

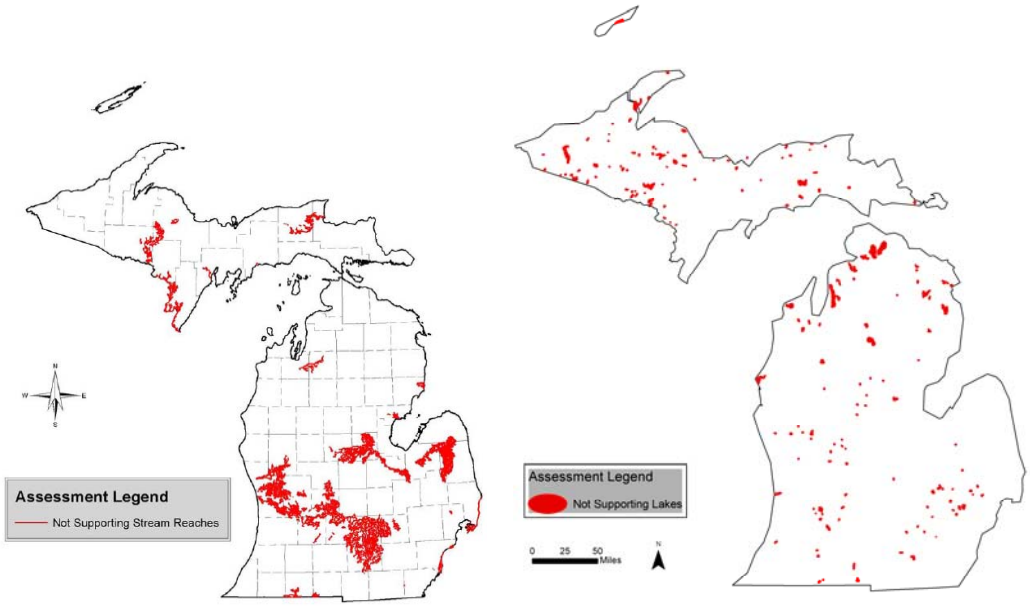
(Source: MDEQ, 2010a)

Group	Consumption Level	MDCH Trigger Level (Mercury, mg/kg)
General Population	1 Meal Per Week	0.5
	No Consumption	1.5
Women of Child-bearing Age and Children Under 15 Years	1 Meal Per Month	0.5

2.2.2 Discussion of 303(d) Listings

MDEQ used the data described in Section 2.2.1 to assess water bodies in the State as either attaining the water quality standards for mercury, or not supporting a water body's designated uses. Out of a total of 7,316 AUIDs across the state, 4,709 of those are listed as assessed waters. Rivers and streams are assessed as impaired based on mercury in both fish and water column, while lakes are assessed as impaired based on fish data, since water column concentrations of mercury in inland lakes are low, and data is limited. Impaired water bodies are shown in Figures 5 and 6.

MDEQ's methodology for assessing use support is described in Section 3.2 and the mercury-impaired AUIDs covered by this TMDL are described in Section 2.3.



a **b**

Figure 5. Mercury-impaired Rivers and Streams (a) and Lakes (b), Based on Fish Tissue Data

(Data source: MDEQ, 2012a)

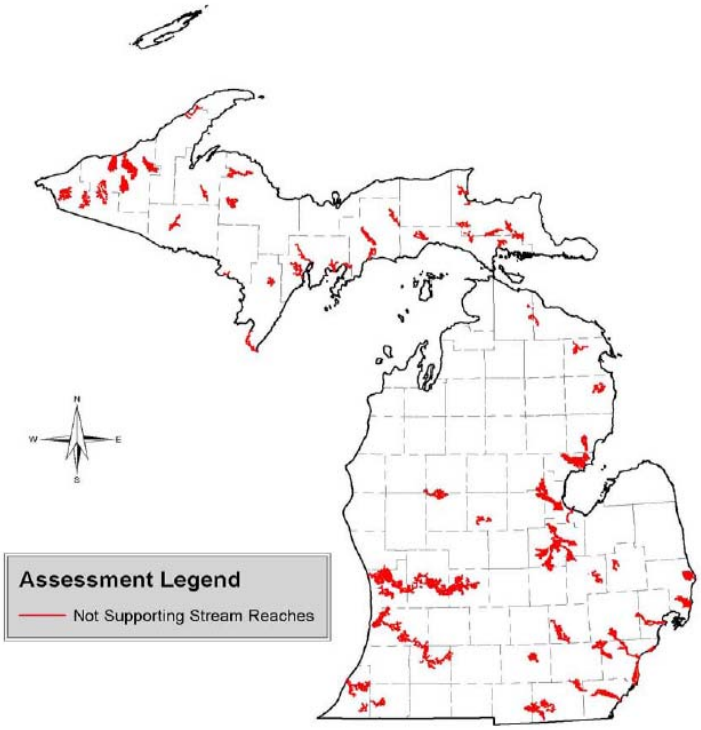


Figure 6. Mercury-impaired Rivers and Streams Based on Water Column Data
(Data source: MDEQ, 2012a)

2.3 SCOPE OF WATER BODIES CONSIDERED UNDER THIS TMDL

As discussed in Section 2.1.1, the 2012 Integrated Report proposed a schedule for completion of TMDLs to address mercury impairment of inland water bodies, Great Lakes, and connecting channels (MDEQ, 2012a). The State of Michigan's plan for addressing waters impaired by mercury is summarized below:

1. This statewide mercury TMDL will cover all mercury-impaired inland water bodies of the State that are listed in Appendix A. Water bodies listed in Appendix A are expected to meet WQS after implementing source reductions.
2. The following waters are not covered by this TMDL:
    a. The Great Lakes and connecting channels (i.e., Lake St. Clair, the St. Clair River, the St. Mary's River, the Detroit River, and the Keweenaw waterway) will likely benefit from the atmospheric reductions called for in this TMDL. The level of pollutant reduction required to achieve WQSwill be different than for inland waters, due to different atmospheric deposition rates and much longer response times. These water bodies will be considered under a separate TMDL focused on the Great Lakes that is scheduled for development in 2015. Contaminated legacy sites (i.e., AOCs and Superfund sites) impacted by mercury are not covered by this TMDL. Formal clean-up plans are in place at these sites, and the water bodies are expected to meet the TMDL target once clean-up plans are complete, and reductions described in this TMDL are met.
    b. Few inland water bodies impaired primarily by atmospheric sources are expected to not meet WQS after the reductions in atmospheric loading called for in this TMDL are achieved. Separate TMDLs may be developed for these water bodies as needed.

The water bodies that will attain the WQS under this TMDL and which are submitted for approval are included in Appendix A.

3 APPLICABLE WATER QUALITY STANDARDS AND NUMERIC TARGETS

Water quality standards are comprised of the designated uses of the water body, water quality criteria to protect designated uses, and an antidegradation policy to maintain and protect existing uses and high quality waters. This section consists of the following sections:

- Water Quality Standards
- Designated Use Support
- Numeric TMDL Target

3.1 WATER QUALITY STANDARDS

The Clean Water Act Section 303(c)(2)(A) requires states to identify appropriate water uses for all water bodies, and provide, where attainable, water quality (in the form of WQS) for the protection and propagation of fish, shellfish, and wildlife, and recreation in and on the water. Designated uses describe the various uses of waters that are considered desirable, and identify those waters that should be protected. At a minimum, all surface waters in Michigan are designated and protected for all of the following uses: agriculture, navigation, industrial water supply, warm water fishery, other indigenous aquatic life and wildlife, partial body contact recreation, total body contact recreation (May 1 to October 31) and fish consumption. A select group of rivers and inland lakes are designated and protected for coldwater fisheries and public water supply (R 323.1100, Designated Uses of the Part 4 Rules, WQS, promulgated under Part 31, Water Resources Protection of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended [Act 451]).[4]

The WQS for water column mercury concentration are 0.0013 µg/L (or 1.3 ng/L) for the protection of wildlife, 0.0018 µg/L (or 1.8 ng/L) for the protection of human health, and 0.77 µg/L (as dissolved), and 1.4 µg/L (as dissolved) for the protection of aquatic life from adverse effects due to acute and chronic toxicity, respectively (R 323.1057, Toxic Substances of the Part 4 Rules, WQS, promulgated under Part 31, Water Resources Protection of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended [Act 451]).

3.2 DESIGNATED USE SUPPORT

Every two years, the State of Michigan evaluates the extent to which waters of the state are attaining their designated uses. The principle of independent applicability is used when making a support determination for each water body. To be protective, site-specific water column and fish tissue data are used together to determine fish consumption designated use support. For example, if data for more than one parameter are available (i.e., water column and fish tissue concentrations), and both are used to determine support for the same designated use, then each data type is evaluated independently to determine support for the designated use. If either type indicates that the designated use is not supported, then the water body is generally

[4] http://michigan.gov/documents/deq/wb-swas-rules-part4_254149_7.pdf

listed as not supporting the designated use (Table 4) (MDEQ, 2012a). Many of Michigan's surface waters are impaired due to mercury and consequently, do not support the other indigenous aquatic life and wildlife designated use and/or the fish consumption designated use (MDEQ, 2012a). These are the impaired designated uses addressed by this TMDL.

Table 4. Fish Consumption Designation Support Determination Using Fish Tissue and Water Column Data.
(Source: MDEQ, 2012a)

Status Based on Water Column Data	Status Based on Fish Tissue Data	Overall Fish Consumption Designated Support Determination
Supporting	Supporting	Supporting
Supporting	Not Supporting	Best Professional Judgment
Supporting	Not Assessed/Insufficient Information	Supporting
Not Supporting	Any Determination	Not Supporting
Not Assessed/Insufficient Information	Supporting	Supporting
Not Assessed/Insufficient Information	Not Supporting	Not Supporting
Not Assessed/Insufficient Information	Not Assessed/Insufficient Information	Not Assessed/Insufficient Information

3.3 NUMERIC TMDL TARGET

TMDL targets are established at a level that attains and maintains the applicable WQS, including designated uses, numeric and narrative criteria, and antidegradation policy [40 CFR §130.7(c)(1)]. TMDL submittals must include a description of any applicable water quality standard, and must also identify numeric water quality targets, which are quantitative values used to measure whether or not applicable WQS are being attained. Depending on the designated use being addressed, a TMDL target may be based on human health, aquatic life, or wildlife criteria (U.S. EPA, 2008a). Where possible, the water quality criterion for the pollutant causing impairment is used as the numeric water quality target when developing the TMDL. Because consumption of fish by humans and wildlife is the most significant route of exposure, the fish tissue residue value (based on a Trophic Level 4 fish) for mercury of 0.35 mg/kg was chosen as the target for this TMDL. Trophic Level 4 refers to the position in the food chain occupied by predatory species that consume other carnivores. Northern pike is representative of Trophic Level 4 fish and is also distributed throughout Michigan inland waters. Therefore, northern pike is selected as the target fish for this TMDL. Mercury concentration in northern pike and derivation of the 90th percentile mercury concentration are described in Section 4.0..

Michigan derived the fish tissue mercury residue value of 0.35 mg/kg for edible fish portions using the same Reference Dose (0.1 µg/kg/day) used by the U.S. EPA to derive a national fish tissue residue value of 0.30 mg/kg. Rather than using the national fish consumption rate and relative source contribution used by the U.S. EPA

in their calculations, the region-specific fish consumption rate and relative source contribution that were used in the derivation of the human non-cancer value (1.8 ng/l) for mercury were used to generate Michigan's fish tissue residue value, and is consistent with federal requirements for the Great Lakes basin (U.S. EPA, 2001c). The methodology used to derive the fish tissue residue value of 0.35 mg/kg for mercury is consistent with the methodology used by the U.S. EPA to derive their fish tissue residue value.

Because the WQS protective of wildlife (1.3 ng/l) is lower than the value used to protect human health (1.8 ng/l), an evaluation was conducted by MDEQ to determine whether the fish tissue residue value of 0.35 mg/kg would be protective of wildlife species such as loons, bald eagles, and mink that consumed smaller whole fish from the same waters. Based on this evaluation, MDEQ determined that a mercury concentration of 0.35 mg/kg in edible fish portions from a legal size Trophic Level 4 fish would be protective of wildlife species consuming smaller whole fish from the same waters (MDEQ, 2012c).

4 MODELING APPROACH

This section describes the modeling approach for calculating the statewide mercury TMDL. It consists of the following sections:

- Relating Atmospheric Loading to Fish Tissue Concentration
- Atmospheric Deposition of Mercury
- Applying the Numeric TMDL Target
- Regionalization
- Required Overall Reduction Percentage

4.1 RELATING ATMOSPHERIC LOADING TO FISH TISSUE CONCENTRATION

The approach for linking pollutant loads to environmental concentrations for this TMDL is patterned after the statewide mercury TMDL developed by the Minnesota Pollution Control Agency (MPCA, 2007) and a regional mercury TMDL for the Northeast U.S. (NEIWPCC, 2007).

Consistent with the Minnesota and Northeast U.S. TMDLs, this TMDL is based on the following assumptions: 1) a reduction in mercury emissions will result in a proportional reduction in the rate of mercury deposition; 2) a reduction in mercury deposition will result in a proportional decrease in mercury loading to water bodies; and 3) ultimately, a proportional reduction in loading in water bodies will result in a proportional decrease in mercury concentrations in fish.

The proportionality approach is based on the linear relationship between mercury levels in air and water, along with a bioaccumulation factor (BAF) to relate fish tissue concentrations to water column concentrations. The mercury concentrations in fish resulting from the mercury bioaccumulation process can be expressed as follows (U.S. EPA, 2001b; NEIWPCC, 2007):

$$C_{fish_{t_1}} = BAF * C_{water_{t_1}}$$

Where:
$C_{fish_{t_1}}$ and $C_{water_{t_1}}$ represent mercury concentrations in fish (mg/kg) and water (ng/l) at time t_1, respectively. BAF represents the bioaccumulation factor which is constant for a given age and length in a specific water body.

For a future time, t_2, when mercury concentrations have changed, but all other parameters remain constant, the following equation applies:

$$C_{fish_{t_2}} = BAF * C_{water_{t_2}}$$

Where:
$C_{fish_{t_2}}$ and $C_{water_{t_2}}$ represent mercury concentrations in fish and water at that future time t_2, respectively and $C_{fish_{t_2}}$ is for a fish that is the same age, length, and species as for $C_{fish_{t_1}}$.

Combining the two equations produces the following:

$$\frac{C_{fish_{t_2}}}{C_{fish_{t_1}}} = \frac{C_{water_{t_2}}}{C_{water_{t_1}}}$$

Because water column mercury concentrations are proportional to mercury air deposition load, the above equation can be expressed as follows:

$$\frac{C_{fish_{t_2}}}{C_{fish_{t_1}}} = \frac{L_{air_{t_2}}}{L_{air_{t_1}}}$$

Where:

$L_{air_{t_1}}$ and $L_{air_{t_2}}$ are the air deposition mercury loads to the water body at time t_1 and t_2, respectively.

Thus it is reasonable to predict that, under long-term steady-state conditions and a linear relationship assumption, mercury fish concentrations will likely be reduced from current levels in direct proportion to reductions in the deposition load.

The steady state conditions represented in the model correspond to long-term average concentrations expected to eventually occur in response to long-term reduction in loading. Therefore, it is not expected that the proportional relationship between atmospheric deposition reductions and fish tissue reductions will be observed immediately. However, it is expected that the proportional response will be seen over the long-term, once the systems have achieved steady-state. Several dynamic, ecosystem scale models including the Mercury Cycling Model (MCM) and IEM-2M model assume that, at steady-state, reductions in fish concentrations will be proportional to reductions in mercury inputs (U.S. EPA, 2001b). Application of the E-MCM[6] model to the Florida Everglades predicted a linear relationship between atmospheric mercury deposition and mercury concentrations in largemouth bass (Atkeson et al., 2003). In this study, mercury levels in largemouth bass were predicted to attain 50% of their long-term steady state response in about 10 years, given continued reductions in mercury loads. In 30 years, mercury levels in largemouth bass are predicted to attain 90% of their long-term steady state response.

4.2 ATMOSPHERIC DEPOSITION OF MERCURY

Estimates of total atmospheric deposition (both wet and dry) of mercury for Michigan were obtained from U.S. EPA's Regional Modeling System for Aerosols and Deposition (REMSAD; U.S. EPA, 2008b) model (Figure 7). REMSAD is a "three-dimensional grid model designed to calculate the concentrations of both inert and chemically reactive pollutants by simulating the physical and chemical processes in the atmosphere that affect pollutant concentrations" (U.S. EPA, 2008b). REMSAD simulates both wet and dry deposition of mercury. Wet deposition occurs as a result of precipitation scavenging, in which mercury is removed from the air by attaching to water vapors or rain/snow. Dry deposition occurs when gas phase and particulate-bound mercury are deposited on terrestrial surfaces. The Particle and Precursor

[6] E-MCM is the modified version of MCM developed for the Florida Everglades.

Tagging Methodology feature of REMSAD allows the user to tag or track emissions from selected sources or groups of sources, and quantify their contribution to mercury deposition throughout the modeling domain and simulation period.

The REMSAD model was applied at a national scale. The year 2001 was chosen as the annual simulation year because REMSAD model inputs (emissions and meteorology) were primarily derived from the 2001 Clean Air Interstate Rule (CAIR) database, which U.S. EPA used in the evaluation of the CAIR and the Clean Air Mercury Rule (CAMR).

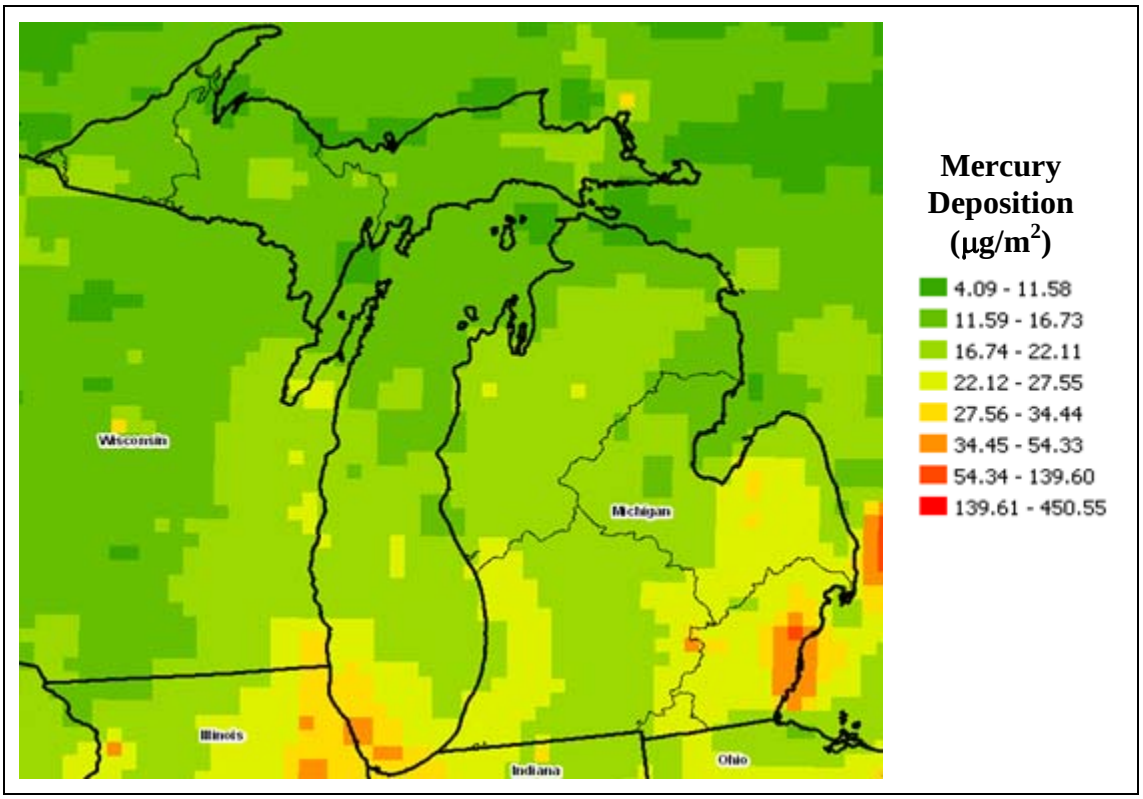


Figure 7. Mercury Deposition Predicted for Michigan (2001) by REMSAD.

(Source: U.S. EPA, 2012)

Although 2001was used for calculating reductions, progress toward meeting the TMDL will be tracked from a 2002 air emissions baseline developed as part of the MDEQ Mercury Strategy (MDEQ, 2008a). There are three reasons for tracking the progress of this TMDL using 2002 emission inventory: 1) Michigan does not have a detailed mercury emissions inventory for 2001; 2) it is likely that the deposition values did not change significantly between 2001 and 2002; and 3) mercury reductions will be primarily tracked by emissions measurements because there is currently no funding for measuring mercury deposition in the state.

Based on the MDEQ mercury emissions for 2002, MDEQ determined that the emission inputs corresponding to Michigan sources were likely underestimated in the REMSAD model by approximately 2,000 pounds. The underestimate was due to the omission of “area sources”, which include leakage and volatilization from breakage

and disposal of mercury-containing products such as thermometers, switches, and fluorescent light bulbs (MDEQ, 2008a)[7].

To evaluate the spatial differences in atmospheric mercury concentrations across the state, Ecological Drainage Units (EDUs; Higgins et al., 2005) were used to aggregate areas of the state containing similar mercury atmospheric deposition rates. EDUs are a method of spatially organizing the state based on areas of similar biotic and abiotic characteristics such as freshwater fish and invertebrate species composition and distribution, climate, and physiography. They generally range in size from 1,000 to 10,000 km^2 in size, but can be much bigger. The largest EDU in Michigan is about 38,000 km^2. Although the EDU boundaries align with watershed boundaries, such that no impaired stream segments will span multiple regions, they are not necessarily true watershed boundaries (Higgins et al., 2005). The EDUs in Michigan are shown in Figure 8.

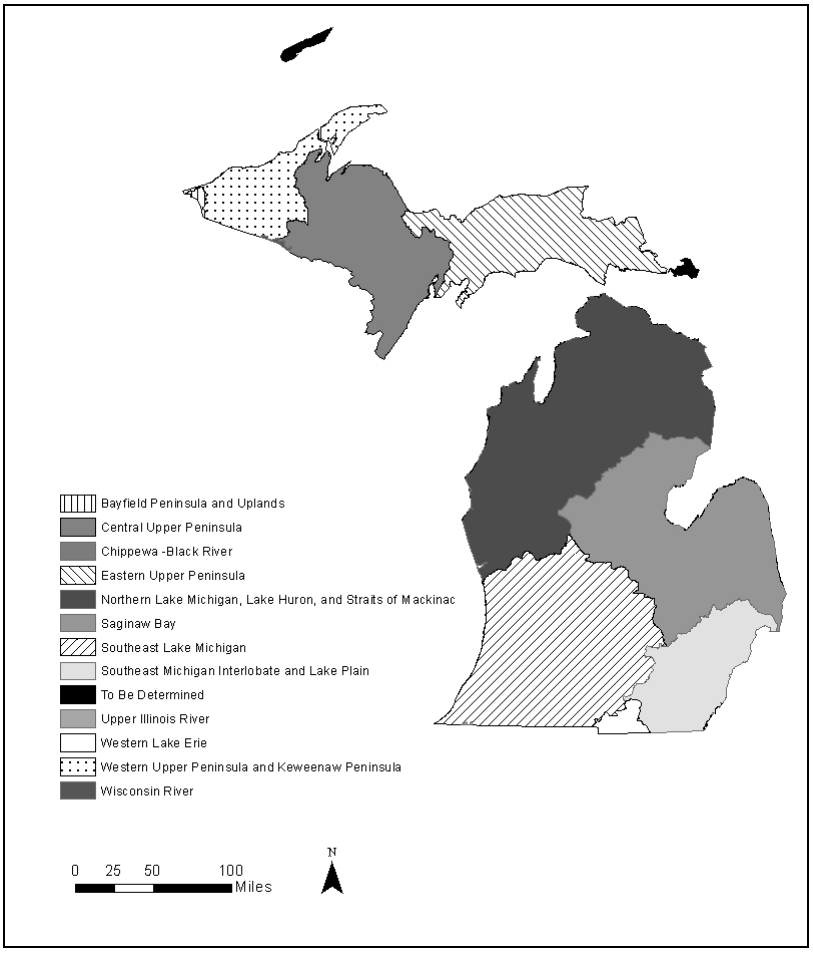


Figure 8. **Ecological Drainage Units in Michigan**
(Source: Higgins et al., 2005)

[7] The reduction needed for this TMDL will not be affected by the underestimate because the reduction is based on fish tissue concentrations (See Section 4.5). The use of the 2002 emissions inventory for tracking reductions addresses this underestimate by requiring a similar reduction from all sources covered under this TMDL, including those omitted from the REMSAD modeling.

Table 5 summarizes the REMSAD-predicted atmospheric mercury deposition for 2001 across each EDU in the state. The deposition rates are mapped in Figure 9. The total statewide deposition rate (18.6 $\mu g/m^2$) was calculated as the mass of total mercury deposited over the sum of all the EDU areas. Deposition rates are seen in Table 5 to vary widely by EDU. This variability is discussed in Section 4.4.

Table 5. 2001 Annual Atmospheric Mercury Deposition for the State Resolved by EDU
(Source: U.S. EPA, 2012)

Ecological Drainage Unit	Area	Mercury Deposition	Deposition Rate
	(km^2)	(g)	($\mu g/m^2$)
Bayfield Peninsula and Uplands	238	3,885	16.3
Chippewa - Black River	1	21	17.5
Wisconsin River	108	1,619	15.0
Western Upper Peninsula and Keweenaw Peninsula	8,575	127,537	14.9
Central Upper Peninsula	17,421	247,112	14.2
Eastern Upper Peninsula	15,266	220,133	14.4
To Be Determined	302	4,157	13.7
Northern Lake Michigan, Lake Huron, and Straits of Mackinac	38,004	665,083	17.5
Saginaw Bay	26,494	541,046	20.4
Southeast Lake Michigan	29,063	629,632	21.7
Upper Illinois River	19	457	23.8
Southeast Michigan Interlobate and Lake Plain	10,579	267,022	25.2
Western Lake Erie	1,172	26,156	22.3
Totals	147,243	2,733,859	18.6

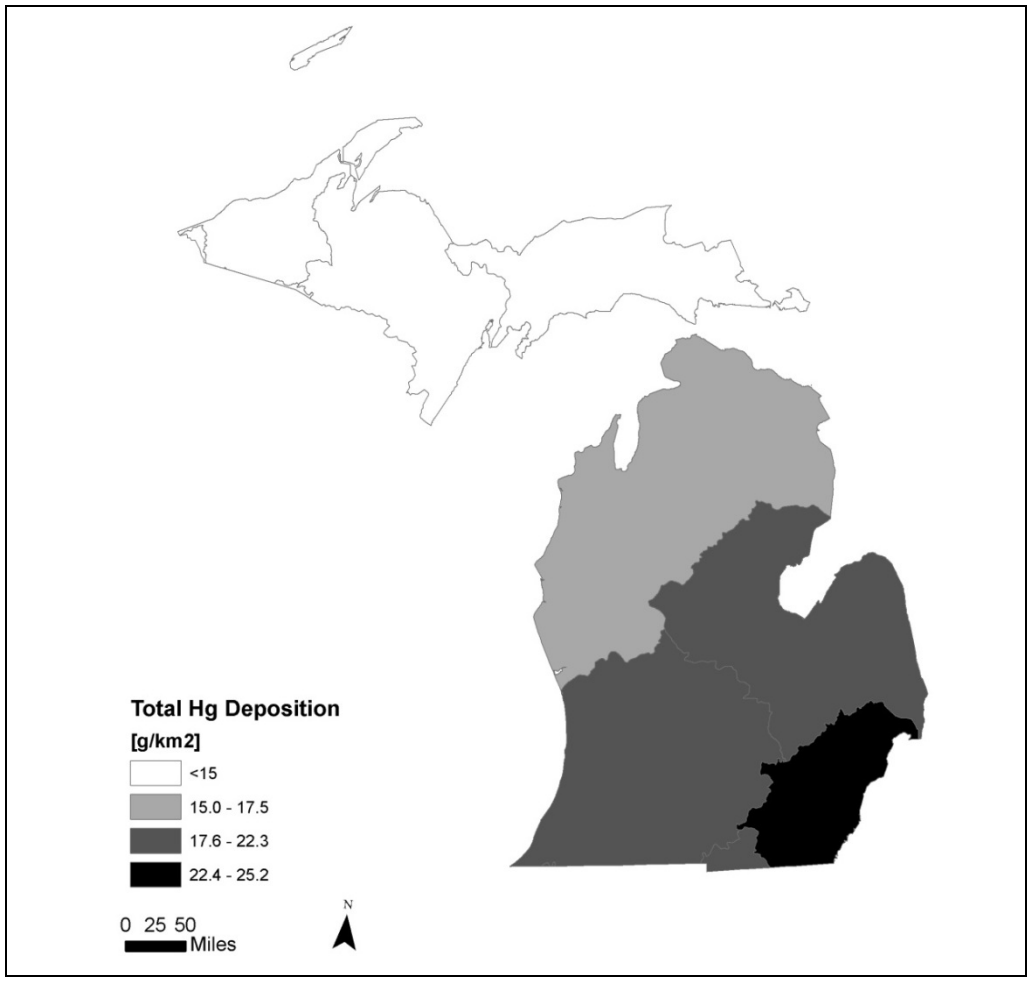


Figure 9. Modeled Mercury Deposition Rate by EDU for 2001 Conditions
(Source: U.S. EPA, 2012)

4.3 APPLYING THE NUMERIC TMDL TARGET

The selection of a numeric fish tissue target requires the selection of a fish tissue residue value, an appropriate fish species, and a statistical level at which to base compliance with the TMDL once reductions of atmospheric mercury concentrations have been made. Achieving the target level for the 90th percentile in those fish species with the highest mercury concentration ensures that the overwhelming majority of species in lower trophic levels will meet the target level.

Because the mercury TMDL is applied statewide and considers a wide range of fish tissue concentrations, it would not be practical to base TMDL reductions on the requirement that every fish in the state be in compliance with the fish tissue residue value of 0.35 mg/kg. A recommended approach is to base reductions in mercury concentrations in fish tissue on an appropriate level of protection. The 90th percentile has been deemed to provide an appropriate level of protection for the mercury TMDL, since ninety percent of the waters in the state would have a lower fish tissue concentration than the target (0.35 mg/kg) value. It is expected that ninety percent of Michigan inland waters containing a top predator species with the highest mercury

concentration would attain water quality standards after the TMDL is implemented. Reductions in mercury required by the TMDL will be based on the decrease of 90th percentile mercury concentration of an appropriate fish species to meet the target fish tissue value of 0.35 mg/kg[9].

The TMDL target is therefore applied by selecting an appropriate fish species, and defining the group of impaired waters statewide to be addressed by the TMDL once reductions of environmental mercury concentrations have been achieved. The following sections describe the selection of northern pike (*Esox lucius*) (Figure 10) as an appropriate fish species and selection of a 90th percentile statistical level for defining TMDL reductions.

Figure 10. Photo of a Northern Pike.
(Photo credit: Tim Cwalinski)

4.3.1 Selection of a Target Fish Species

Michigan's FCMP database, which includes mercury data in fish tissue collected from 1984 to 2009, was used to identify which fish species would serve as the basis for required TMDL loading reductions. No statistical trend has been observed in mercury concentrations monitored in fish from inland lakes since 1990 through MDEQ's trend monitoring program (MDEQ, 2008b). Therefore, the entire fish data set from 1984 to 2009 was used in the TMDL analysis. Only data from the edible portion (i.e., skin-on and skin-off fillets) monitoring program were considered since these are the data that support the fish consumption designated use. Fish tissue mercury concentrations have been sampled in a wide range of species across Michigan, and show varying degrees of bioaccumulation. Furthermore, several different species serve as the basis for fish consumption advisories across the state.

[9] Section 4.3.2 contains further discussion for selection of the 90th percentile fish tissue residue value as the TMDL target.

Fish tissue mercury concentration data available for 11,435 samples, from 39 species of fish, spanning the collection period of 1984 to 2009, were used in the evaluation. The distribution of concentrations suggested that northern pike have the highest mercury concentrations of all species (Table 2). Using all of the mercury data available for northern pike (1,941 fish fillet tissue samples) an average mercury concentration of 0.576 mg/kg was calculated. **Northern pike was selected as the target species for this TMDL since this species represents a top-predator species, has the highest mercury concentrations of fish species evaluated, and are widely distributed throughout the state.**

The accumulation of mercury in fish tissue increases with age and length of the fish. To account for this size-dependency of mercury concentration, it is necessary to statistically standardize the data such that mercury concentrations can be compared for fish of the same size referred to as standard size, or standard length fish. To avoid biases caused by different prevailing fish sizes and growth rates at different sampling times and places, standardized-length northern pike mercury concentrations were calculated for each sampling event. **The standardized northern pike length used in this TMDL was 24 inches (61centimeters (cm)), which corresponds to the minimum legal size for this species in Michigan.** This standard size also compares well with the overall average northern pike length of 23.8 inches (60.5 cm) from inland lakes and impoundments in the FCMP database. The mercury concentration in a standard length fish was calculated from the available northern pike data for each field collection date using a linear regression statistical procedure. Fish datasets were first stratified by water body and collection date. Then linear regression was conducted on fish tissue mercury concentrations versus length. When statistically significant ($P < 0.05$) regressions were obtained, regression results were used to predict standard length fish concentrations. Approximately fifty percent of the regression results were statistically significant. An example length-concentration regression for northern pike in Torch Lake is shown in Figure 11. Average concentrations of mercury in fish tissue were used when regressions were not statistically significant.

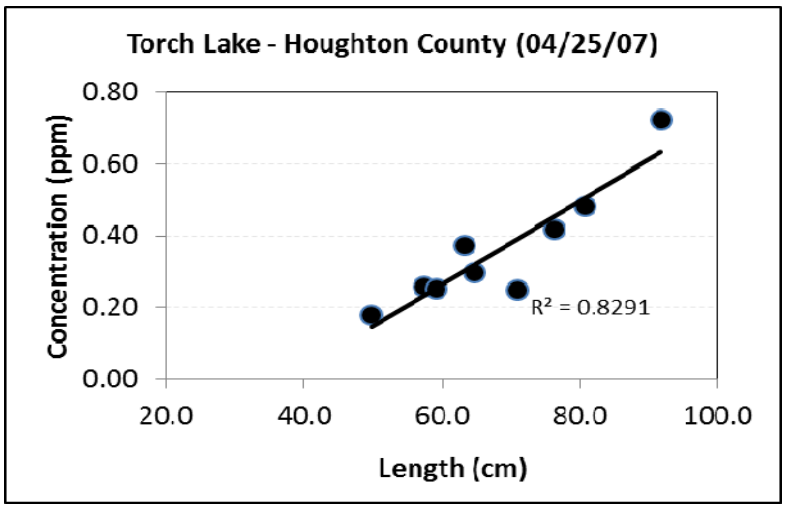


Figure 11. A Regression of Fish Length vs. Fish Tissue Concentrations for Northern Pike from Torch Lake in Houghton County, Michigan.

4.3.2 Selection of a Statistical Level for Defining TMDL Reductions

A cumulative frequency distribution of length-standardized northern pike mercury concentrations across Michigan inland water bodies was developed (Figure 12). The 90th percentile concentration obtained from the frequency distribution plot was selected for determining the mercury load reduction in this TMDL. Both the Minnesota and the Northeast U.S. mercury TMDLs used the 90th percentile as the basis of their TMDL. The justification given for selecting the 90th percentile included:

- The 90th percentile of samples from a given water body has been used as assessment guidance by the U.S. EPA (i.e., no more than 10% of the samples can exceed the standard) (U.S. EPA, 2000).
- Targets were based on tissue concentrations for fish species shown to be top predators with high mercury bioaccumulation potential. Achieving the target level for the 90th percentile of the fish species (northern pike) with the highest mercury concentration ensures that the overwhelming majority of species in lower trophic levels will meet the target level.
- As fish mercury levels are reduced and the 90th percentile approaches the target value, the concentration difference between the 90th and higher percentiles is likely to be very small.

The 90th percentile of length-standardized mercury concentrations in northern pike is shown graphically in Figure 12.

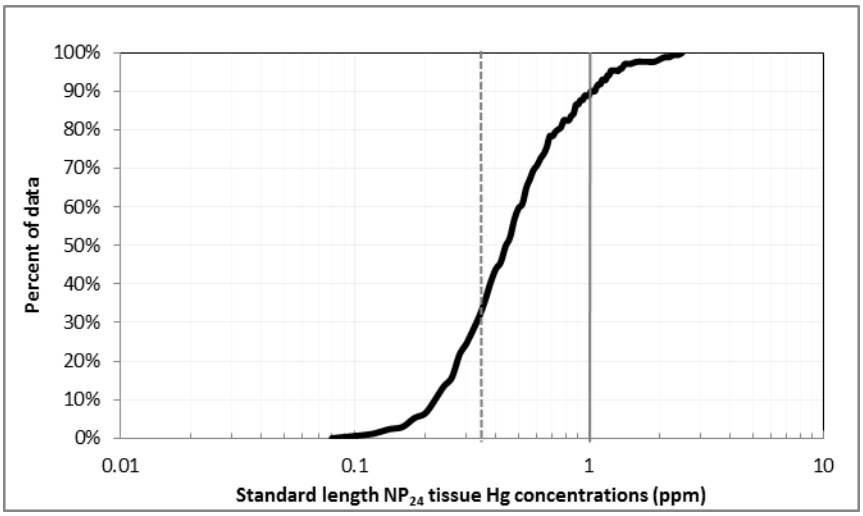


Figure 12. Cumulative Distribution of Length-Standardized Mercury Concentrations in Northern Pike.

The dashed vertical line indicates the target concentration (0.35 ppm); the solid line indicates the 90th percentile (1.012 ppm) concentration.

Mercury load reductions required by this statewide Mercury TMDL will be based on the decrease in fish tissue mercury concentrations, of a standard length northern pike, NP_{24}, necessary to meet a fish tissue residue value of 0.35 mg/kg in the 90th percentile of water bodies. Achieving the fish tissue residue value for the 90th percentile of standardized northern pike will ensure that smaller predator fish and fish species at lower trophic levels, will meet the fish tissue residue target established for this mercury TMDL (MPCA, 2007).

4.4 REGIONALIZATION

Statewide TMDLs can be developed either using a single statewide average loading reduction or by dividing the state into geographic regions to produce a loading reduction unique to each region. Detailed investigations were made into a variety of potential regionalization schemes, and a single, statewide average reduction percentage for atmospheric mercury deposition was selected. In Michigan, higher mercury bioaccumulation in fish occurs in the northern part of the state (Figure 13), but a corresponding higher atmospheric deposition rate of mercury does not occur in the same area (Figure 9). Studies have found that higher mercury concentrations in fish in the north do not necessarily correspond to higher atmospheric mercury deposition. It was therefore determined that other site-specific processes were responsible for higher fish tissue concentrations within individual lakes, such as water chemistry (i.e., nutrients and sulfides), and spatial land cover and land use, which can affect the uptake of mercury in fish, and transport of mercury from the surrounding watershed, respectively. A policy decision was made by MDEQ to calculate a single, statewide average reduction percentage for atmospheric mercury deposition. As discussed in Section 2.3, the water bodies where it can not be established that fish tissue target concentrations will be met after implementing air deposition reductions

called for in this TMDL will be studied and addressed by other means, such as site-specific TMDLs or other enforceable mechanisms. These water bodies will not be addressed in this TMDL. If future monitoring shows that these water bodies are in compliance with WQS, then no further work will be required. The establishment of the overall reduction percentage for the Statewide mercury TMDL for inland waters is further described below.

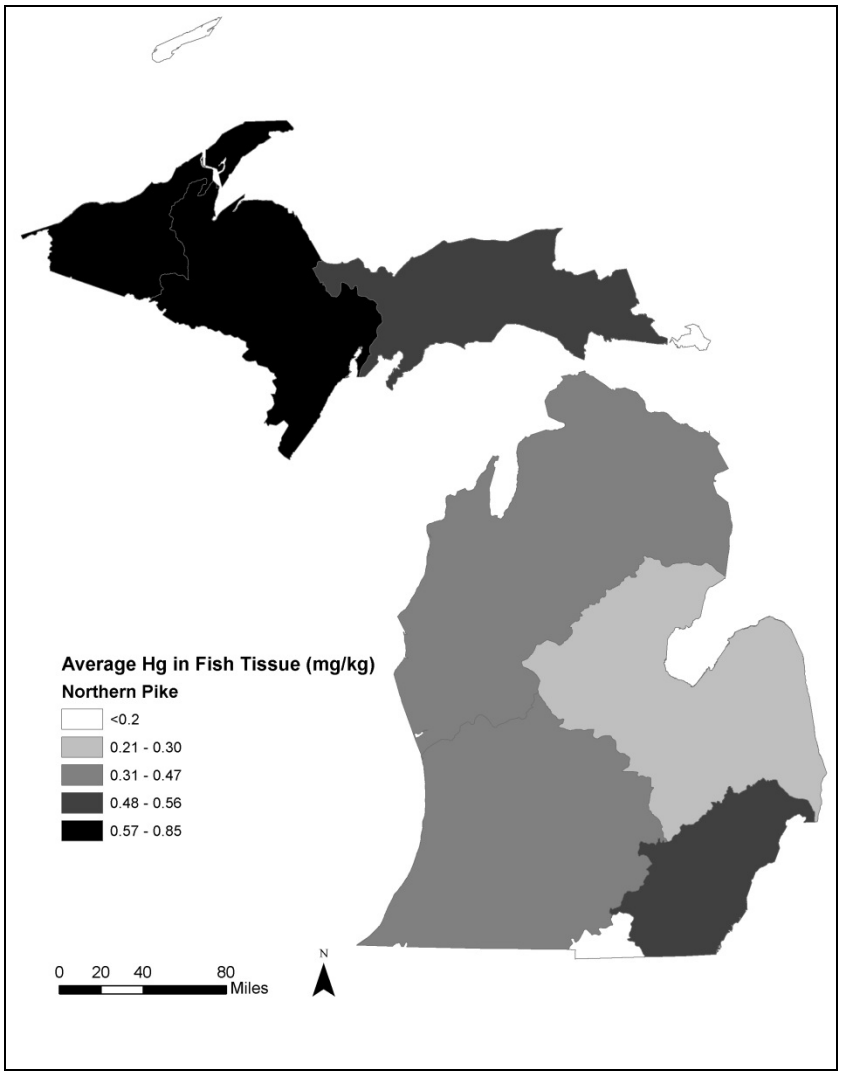


Figure 13. Average Mercury Concentration in Edible Portions of Northern Pike by EDU.
(Data Source: FCMP, 2011)

4.5 REQUIRED OVERALL REDUCTION PERCENTAGE

The overall reduction percentage required to meet TMDL targets were determined through the following steps:

1. Calculating the average 90th percentile mercury fish tissue concentration in edible portions of northern pike for the state;

2. Calculating the reduction factor (RF) to determine the percentage by which the existing mercury fish tissue concentration would need to be reduced to attain the 0.35 mg/kg fish tissue target statewide; and
3. Applying this reduction percentage to the 2001 atmospheric mercury deposition based on the assumption that there is a linear load-response relationship between fish tissue, atmospheric mercury deposition, and mercury emissions.

The calculation of the reduction factor is based on the reductions necessary to achieve the target fish tissue mercury concentration compared to the 90th percentile existing mercury concentration in fish tissue. (Equation 1)

$$RF = (NP24_{90} - TF)/ NP24_{90} \quad \textbf{(1)}$$

Where:
$NP24_{90}$ is the 90th percentile fish tissue mercury concentration in 24 inch northern pike and TF is the target fish tissue mercury concentration of 0.35 mg/kg,

The 90th percentile fish tissue mercury concentration for a 24 inch northern pike is 1.012 mg/kg. Applying the target concentration of 0.35 mg/kg in the equation above results in a reduction factor of 0.6542 (65.42%). Because not all of the atmospheric sources are controllable (due to contribution from natural sources), details of how the reduction factor was applied to atmospheric deposition is explained in Section 6.

5 SOURCE ASSESSMENT

This section summarizes the sources of mercury in Michigan and the data compiled to develop the TMDL. Sub-sections include:

- Sources of Mercury in Michigan Fish
- Compilation of Source Data

5.1 SOURCES OF MERCURY

The two major sources of mercury that contribute to atmospheric loadings to Michigan's inland water bodies are natural sources from geologic origins, and anthropogenic sources.

It is possible to categorize mercury sources by origin. The REMSAD model estimated that in 2001, 75.3% of atmospheric mercury deposition to Michigan originated from background sources. "Background" refers to natural sources as well as anthropogenic sources outside of North America. Surrounding states and Canada (i.e., regional sources) contribute 9.7% of atmospheric deposition, while other U.S. states and Mexico contribute 3.8%. About 3.4% of mercury deposition comes from re-emission (defined as previously deposited mercury which has been volatilized from water, land or vegetation). The remaining 7.8% of atmospheric mercury deposition is contributed by sources within Michigan (Figure 14; Table 6).

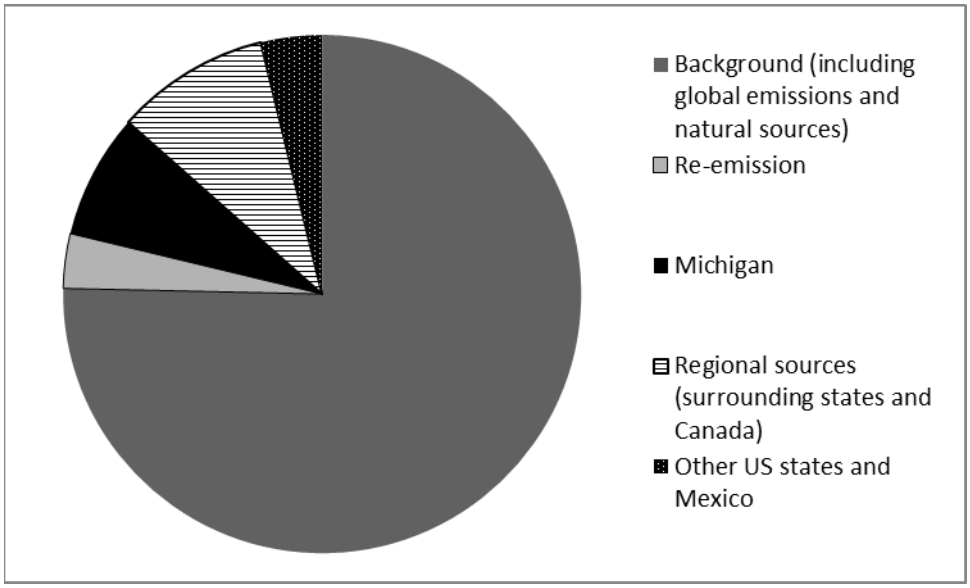


Figure 14. Distribution of Sources of Atmospheric Mercury Deposition to Michigan.
(Source: U.S. EPA, 2012)

Table 6. Atmospheric Mercury Load by Source Category for Michigan, Surrounding States, Canada, and Mexico

(Source: U.S. EPA, 2012)

Source Category of Atmospheric Mercury	Load (kg)	Load (lbs)	% Load
Background	2,060	4542	75.3%
Re-emission	93	205	3.4%
Michigan	213	470	7.8%
Loading from surrounding states and Canada (total)	264	582	9.7%
Illinois	*58*	*128*	*2.1%*
Indiana	*41*	*90*	*1.5%*
Minnesota	*5*	*11*	*0.2%*
Ohio	*62*	*137*	*2.3%*
Wisconsin	*32*	*71*	*1.2%*
Canada	*66*	*146*	*2.4%*
Loading from other US states and Mexico	104	229	3.8%
Total	2,734	6,027	100.0%

5.1.1 Natural Sources

There are no significant natural sources of mercury in Michigan, unlike other parts of the U.S. such as California, where certain mountain ranges are rich in cinnabar deposits. Atmospheric releases of mercury from forest fires, volcanoes and geothermal sources in other areas of the U.S. and around the world can result in atmospheric deposition in Michigan (MDEQ, 2008a). In Michigan, forest fires and "background" soils (that have low mercury concentrations and have not been enriched by geologic process) can re-emit previously-deposited mercury back to the atmosphere (MDEQ, 2008a).

5.1.2 Anthropogenic Sources

As described in Section 2, anthropogenic sources of mercury are varied and widespread despite recent efforts to reduce releases. Throughout the U.S. electrical production, coal combustion, paint formulated with phenyl mercuric acetate, laboratory use, and combustion of crude oil were the largest sources of mercury air emissions from 1930 to 2000, with a significant overall drop in emissions occurring in 1990 (MPCA, 2007), due primarily to a reduction of mercury in products such as paints. Based on the MDEQ's 2002 emissions inventory, the single largest source sector of mercury emissions to the atmosphere was coal combustion from coal fired power plants, also known as electrical generating units. Based on the emission inventory conducted in 2002, this source contributes approximately 37% of Michigan's total air emissions (Figure 15). Other major anthropogenic sources are the use and disposal of mercury containing products, metal processing and cement manufacturing. When scrap metal containing mercury switches is melted down for re-

use, mercury can be released into the air or leached into the water at metal recycling facilities. Mercury is also released to inland water bodies through wastewater treatment plants. Mercury-containing amalgam used in some dental fillings is one of the primary sources of mercury in wastewater (MDEQ, 2008a). Mercury can also be found in regulated stormwater effluent, and in biosolids applied to the land. In 2008, MDEQ documented at least 3,000 sites where ongoing mercury contamination was occurring, from industrial applications such as former chlor-alkali processes, cement kiln dust, manufactured gas plants, petroleum refineries, mining, and concrete and manufacturing plants (MDEQ, 2008a). It should be noted that the estimate for natural gas combustion in 2002 was an over estimate; current emissions are much less than 1% of the emissions inventory.

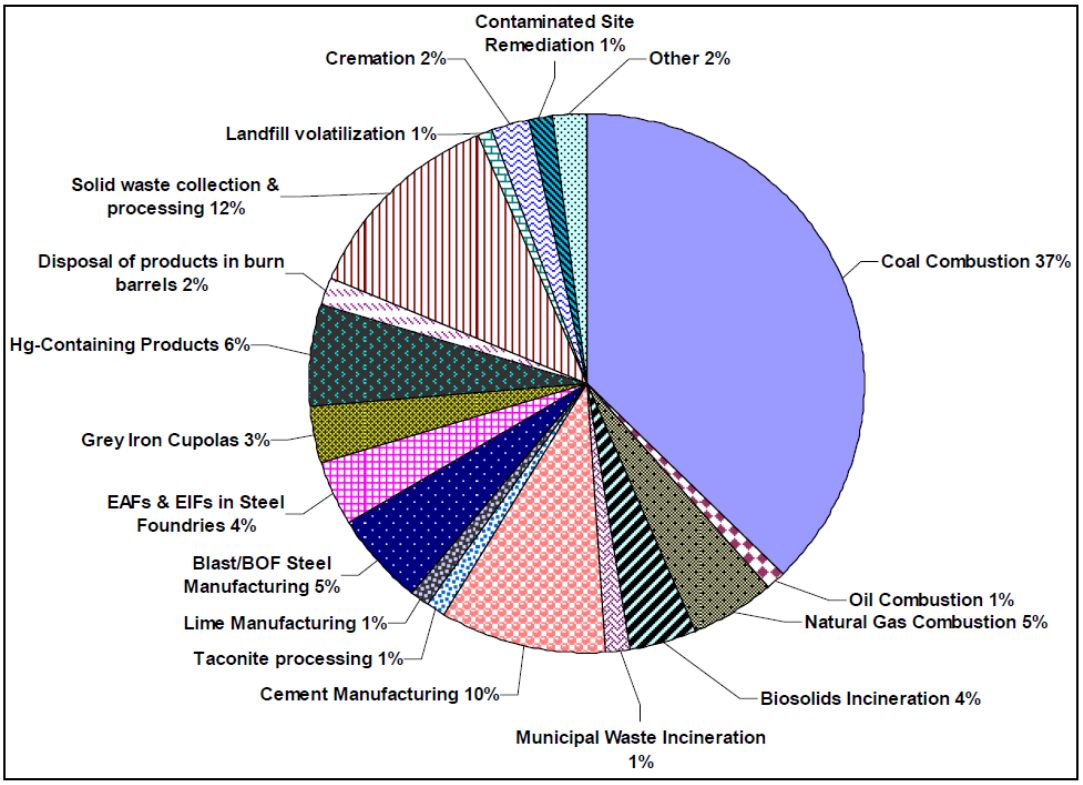


Figure 15. 2002 Estimates of Anthropogenic Mercury Air Emissions in Michigan by Source Category.

EAFs: electric arc furnaces; EIFs: electric induction furnaces. (Source: MDEQ, 2008a)

The locations of permitted mercury air sources in Michigan for 2002 are identified in Figure 16 and the reported mercury emissions (in lbs) for 2002 are identified in Figure 17.

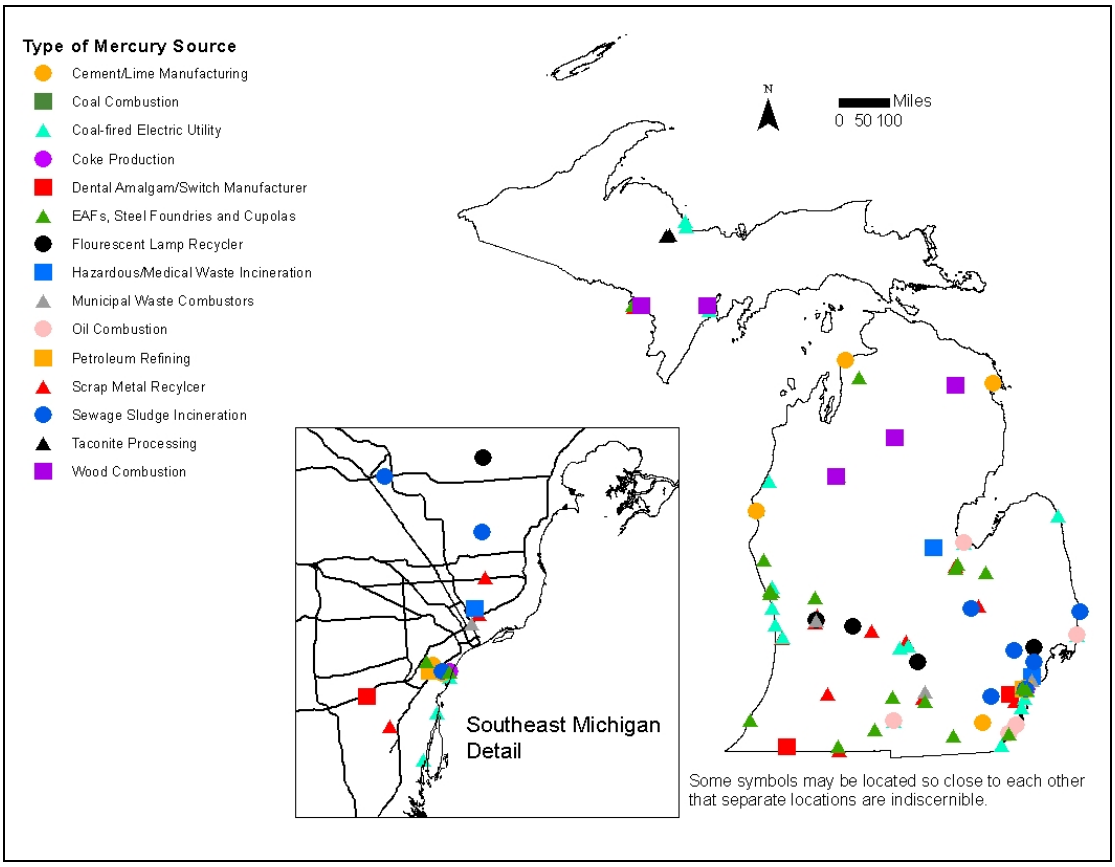


Figure 16. Permitted Air Sources of Mercury by Type of Facility.
(Data Source: MDEQ, 2008a)

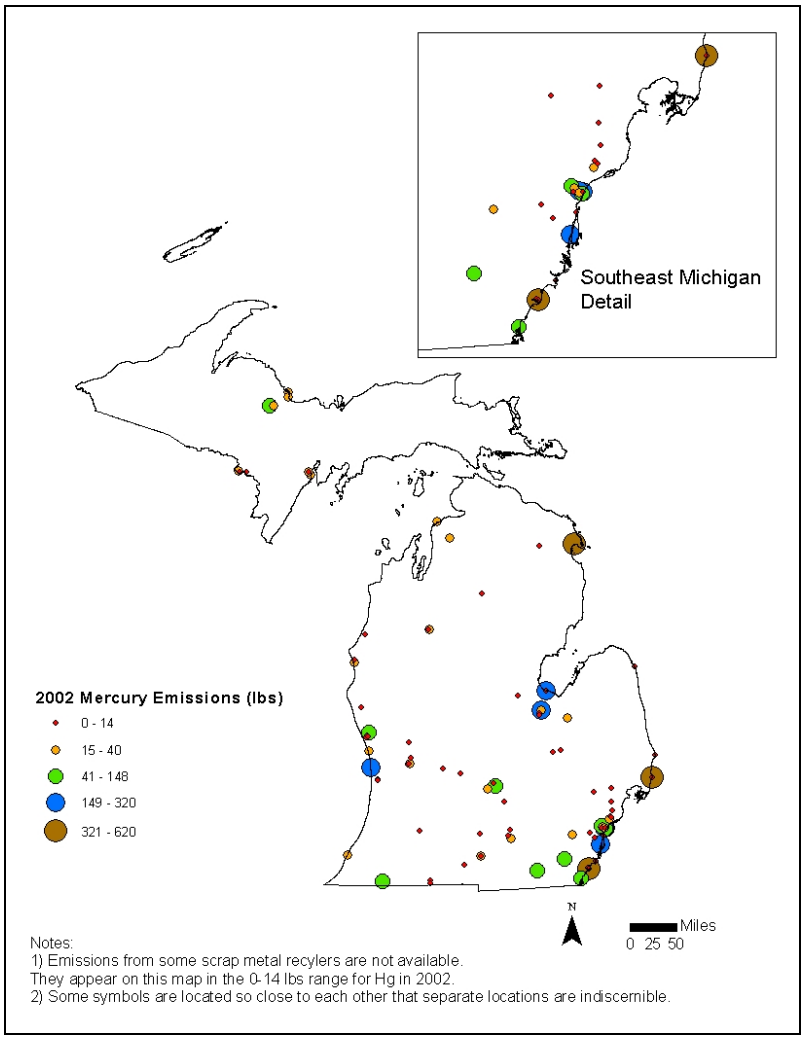


Figure 17. Annual Permitted Mercury Air Emissions for 2002.
(Data source: MDEQ, 2008a)

5.2 COMPILATION OF SOURCE DATA

All readily available information describing sources of mercury released to the environment was compiled including point sources (e.g., NPDES permitted stormwater and wastewater dischargers), nonpoint sources (e.g., atmospheric deposition), and sites of environmental contamination (e.g., Superfund and Areas of Concern [AOCs]). Sources for these data are summarized in Table 7. In addition to environmental data, geographic datasets were also obtained to understand the spatial variation in mercury impairment, and other relevant contributing factors such as land cover (Table 8).

Table 7. Datasets Used for Mercury Source Analysis

Description of Data	Data Source
NPDES Permitted Discharges of Mercury to Inland Water bodies (2012)	MDEQ
Mercury Emissions to the Air (2002)	MDEQ
Atmospheric Deposition of Mercury to Michigan	REMSAD model (U.S. EPA, 2012)
Location of Superfund Sites where Mercury is a Contaminant of Concern	MDEQ
Location of AOCs where Mercury is a Contaminant of Concern	http://www.epa.gov/greatlakes/aoc/

Table 8. Geographic Datasets Obtained

Description of data	Type of Dataset	Source
Ecoregion boundaries for the state of Michigan	Ecoregion Boundaries	Michigan Center for Geographic Information (MCGI), 2011[12]
Streams and Rivers (lines) from version 10a of the Michigan Geographic Framework dataset.	Hydrography	MCGI, 2011
Lakes and Rivers (polygons) from version 10a of the Michigan Geographic Framework dataset.	Hydrography	MCGI, 2011
Lake polygons for the State of Michigan.	Hydrography	MCGI, 2011
Lake contour data for lakes managed for recreational boating access	Hydrography	MCGI, 2011
Polygons representing the boundaries of cities in Michigan.	Political	MCGI, 2011
Polygons representing the boundaries of counties in Michigan.	Political	MCGI, 2011
Polygons representing Michigan village boundaries.	Political	MCGI, 2011
2006 National Land Cover data for the entire State of Michigan.	Land Cover	MRLC, 2006
High resolution NHD data for the State of Michigan.	Hydrography	U.S. Geological Survey (USGS), 2011[13]
High resolution NHD data for the State of Michigan: HUC boundaries.	Watershed Boundaries	USGS, 2011
Assessment Unit IDs	Hydrography	MCGI, 2011
Impaired water body segments	Hydrography	MDEQ
Ecological drainage units	Ecoregion Boundaries	Kendra Cheruvelil (Michigan State University)[14]

[12] Data were obtained from MCGI's website http://www.mcgi.state.mi.us/mgdl/ in April 2011.
[13] Data were obtained from the NHD website ftp://nhdftp.usgs.gov/DataSets/Staged/States/FileGDB/HighResolution/ in April 2011
[14] Data were obtained via email from Kendra Cheruvelil to Kat Ridolfi on August 10, 2011.

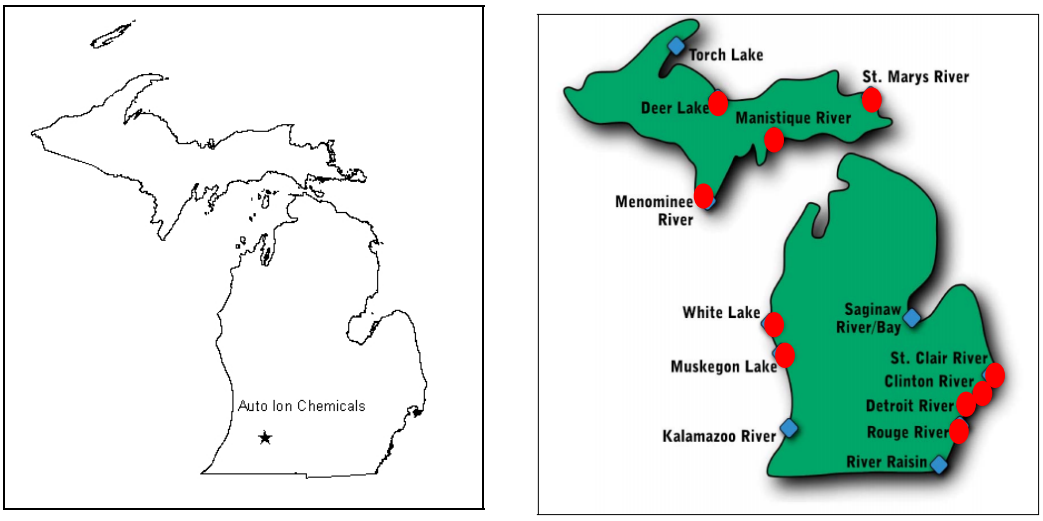
5.2.1 Data Gap Analysis

After compiling the appropriate databases, two data gaps were identified: mining sources that could release mercury and specific load or concentrations of mercury from legacy point sources. To fill these data gaps, NPDES discharge data were reviewed from mines with mercury limits in their permits. Based on a lack of available data and the minimal contribution of mercury from mining sources compared to other atmospheric sources of mercury, it was determined that no further effort would be expended to fill this data gap.

5.2.2 Nonpoint Sources of Mercury

Diffuse, or nonpoint sources of mercury consist mostly of atmospheric deposition, groundwater, land-applied biosolids, and stormwater runoff from the landscape. Biosolids are defined as solid, semisolid, or liquid residues generated during primary, secondary, or advanced treatment of domestic sanitary sewage (MDEQ, 2008a). Mercury that enters a wastewater treatment plant is concentrated in biosolids during treatment and is disposed of by land spreading. Some of the land applied mercury may, over time, volatilize to the atmosphere which can then be deposited into lakes and streams, methylated, and ingested by fish, eventually reaching wildlife and humans. Diffuse stormwater runoff is considered to be minimal, compared to other sources. In addition, the primary source of mercury in diffuse stormwater is assumed to be the atmosphere, so any reductions to atmospheric sources will address nonpoint stormwater as well. Contaminated groundwater originates from contaminated sites such as Superfund sites and AOCs, which are in the process of being addressed by separate clean-up plans.

The location of Superfund sites and AOCs impacted by mercury are shown in Figure 18. Some of the mercury-impaired water bodies in Michigan are influenced by legacy mercury from these locations. Water bodies influenced by legacy sites that have clean-up plans in place are expected to meet the TMDL target once the clean-up plan is complete and the reductions described in this TMDL are met. These water bodies will be placed under the 4b category in Michigan's Integrated Report until such time that monitoring reflects the waters are in compliance with the WQS. Category 4b is intended for water bodies with a pollution control program in place that is expected to solve the pollution problems, such as Superfund and AOC clean-up plans.



a) Auto Ion Superfund Site. b) Areas of Concern in Michigan[15]

Figure 18. Location of Legacy Mercury-Polluted Sites in Michigan.

Areas of Concern impacted by mercury are indicated by red dots.

5.2.3 Point Sources of Mercury to Water

Point sources of mercury consist of NPDES-permitted discharges to surface water; for example, discharges from wastewater treatment plants, industrial manufacturing facilities, power plants, Superfund clean-up sites, and municipal stormwater. Similar to nonpoint stormwater runoff, the primary source of mercury in permitted municipal stormwater is atmospheric deposition. NPDES dischargers that have permit limits for mercury, and which discharge to inland waters in 2012, were identified by MDEQ. There are 139 NPDES permitted facilities that discharge to receiving waters addressed under the statewide mercury TMDL, and that have an NPDES permit limitation for mercury. The list of permitted facilities includes wastewater treatment plants, power plants, auto parts manufacturers, landfills, and other permitted dischargers (Table 9). As of 2012, the total annual NPDES-permitted mercury load to waters addressed under this TMDL is 39.3 kg (86.6 lbs), with wastewater treatment plants, power plants, and steel manufacturing facilities comprising the majority of the load. A detailed list of NPDES-permitted point sources that discharge mercury to inland waters and that have permit limitations for mercury, is provided in Appendix B.

[15] Source: MDEQ, 2010c. Strategy for Delisting Michigan's Great Lakes Areas of Concern http://www.michigan.gov/documents/deq/wb-AOC-delisting-strategy_306163_7.pdf

Table 9. NPDES-permitted Dischargers of Mercury to Inland Water bodies.
(Data Source: MDEQ)

Type of Discharge	# Facilities	Annual NPDES-Permitted Mercury Load (lbs/yr)	Annual NPDES-Permitted Mercury Load (kg/yr)
Auto Parts Manufacturers	3	0.017	0.008
Landfills	3	0.035	0.016
Mining-related	4	0.498	0.226
Paper Mills	6	2.90	1.31
Power Plants	9	17.2	7.80
Other[1]	4	0.059	0.027
Steel Manufacturers	2	20.7	9.41
Wastewater Treatment Plants	108	45.2	20.5
Total	139	86.6	39.3

[1] Includes Biofuel, Glass Manufacturing, Scrap Metal Recycling, Ott-Story Clean-Up

5.2.4 Mercury Permitting Strategy for Point Sources

The MDEQ established a Mercury Permitting Strategy (Strategy) in February 2000 that established a multiple discharger variance (MDV) for mercury consistent with Rule R323.1103 of the Part 4 WQS. The rule allows for a temporary variance from a WQS that is the basis for a water quality-based effluent limit (WQBEL) in an NPDES permit where various conditions prevent the attainment of WQS. However, it is important to note that an MDV is only a temporary measure and does not take the place of the state WQS. The need for a mercury variance became apparent when it was determined, through the implementation of a lower quantification level for mercury in 1999, that the majority of ambient waters sampled for mercury, as well as most NPDES permitted discharges, exceed the mercury WQS of 1.3 ng/l. The WQS of 1.3 ng/l developed to protect wildlife, also ensures protection of human health and aquatic life. To address potential widespread noncompliance with the mercury WQS in NPDES permits, a mercury permitting strategy, including an MDV consistent with the requirements of the variance rule (R 323.1103(9)) was developed.

Establishment of an MDV requires inclusion in the NPDES permit of an effluent limitation that represents a level currently achievable (LCA) by the permittee, consistent with R 323.1103(6), and implementation of a pollutant minimization program (PMP) that furthers efforts to meet the mercury WQS of 1.3 ng/l. The MDEQ established a policy for developing discharge-specific LCAs to be included in NPDES permits effective October 1, 2008. The total annual NPDES-permitted mercury load identified in Table 9 is based on the sum of the mercury loads calculated from either the individual LCA for a facility, or the WQS of 1.3 ng/l if a discharge of mercury is meeting WQS.

6 TMDL DEVELOPMENT

A TMDL calculates the maximum amount of a pollutant allowed to enter a water body so that the water body will meet water quality standards for that particular pollutant (in this case, mercury). The TMDL allocates the maximum allowable load to point sources (Wasteload Allocation or WLA), and nonpoint sources (Load Allocation or LA), which include both anthropogenic and natural background sources of the pollutant. TMDLs must also include a margin of safety (MOS) to account for uncertainty in the relationship between pollutant loading and receiving water quality, and account for seasonal variations.

The TMDL is typically defined by the equation:

$$TMDL\ (LC) = \Sigma LA + \Sigma WLA + MOS \quad \textbf{(2)}$$

Where

TMDL = total maximum daily load (i.e., the loading capacity (LC) of the receiving water)

ΣLA = sum of all load allocation for non-point sources

ΣWLA = sum of all wasteload allocation for point sources

MOS = Margin of safety

The process to determine the TMDL includes:

1) Determine the LC of the receiving water(s) (i.e., the maximum pollutant load that the water body can assimilate and attain WQS)
2) Allocate this loading capacity among the three categories shown in Equation 2.

Equation 3 is used to calculate the TMDL using the existing combined load of mercury from point and non-point sources, defined as the "total source load" (TSL), and the reduction factor (RF):

$$TMDL = TSL * (1 \quad RF) \quad \textbf{(3)}$$

Where TMDL is total maximum daily load as an annual load (kg/yr); TSL is the total source load during the baseline year of 2001 (including all air sources and NPDES permitted discharges of mercury); and RF is the reduction factor. The RF is based on the reductions needed to achieve target fish mercury concentrations (see Equation 1 in Section 4.5). An annual load is the most appropriate way to express this mercury TMDL because the goal is to address long term mercury bioaccumulation, rather than track short term effects. Consistent with the Northeast U.S. and Minnesota mercury TMDLs, a daily load can be estimated by dividing the annual load by 365 (MPCA, 2007, NEIWPCC, 2007) (Equation 4).

$$TMDL\ (kg/day) = [TMDL\ (kg/day)]/365 \quad \textbf{(4)}$$

This section presents the calculation of the TMDL, and is divided into the following sections:

- Baseline Mercury Load
- Load Allocation
- Wasteload Allocation
- Margin of Safety, and
- Critical Conditions and Seasonal Variation.

6.1 BASELINE MERCURY LOAD

As explained above, the TSL is the sum of the existing combined nonpoint and point source loads of mercury for the baseline year (Equation 5). The year 2001 was used for calculating reductions based on the availability of the modeling results from REMSAD (Section 4.2). A 2002 emissions inventory baseline will be used to track reduction progress because the MDEQ does not have a 2001 emissions inventory for mercury and it is likely that the deposition values did not change significantly between 2001 and 2002. The TSL was calculated for 2001 as follows,

$$TSL = PSL + NPSL \quad \textbf{(5)}$$

where PSL is the point source load and NPSL is the nonpoint source load.

6.1.1 Baseline Nonpoint Source Load

The NPSL includes contributions from natural (NNPSL) and anthropogenic sources (ANPSL) of mercury deposition.

$$NPSL = NNPSL + ANPSL \quad \textbf{(6)}$$

The Minnesota Mercury TMDL assumed that mercury deposition is 30% natural and 70 % anthropogenic in origin. These proportions were based on an inferred pre-industrial deposition rate of 3.7 $\mu g/m^2$ relative to the total atmospheric deposition of 12.5 $\mu g/m^2$ for Minnesota in 1990. The pre-anthropogenic deposition of 3.7 $\mu g/m^2$ used in the Minnesota TMDL was also consistent with the value of 3.1 $\mu g/m^2$ inferred from a Lake Michigan study showing consistency between different venues of research (Rossmann, 2010). The atmospheric deposition rate for Michigan in 2001 is 18.6 $\mu g/m^2$ based on REMSAD modeling results. The differences in atmospheric deposition rates between Minnesota (12.5 $\mu g/m^2$) and Michigan (18.6 $\mu g/m^2$) result in a higher anthropogenic percentage for Michigan than Minnesota. Therefore, for the Michigan TMDL, mercury deposition is assumed to be 20% natural and 80% anthropogenic (since 3.7 $\mu g/m^2$ is 20% of 18.6 $\mu g/m^2$).

6.1.2 Baseline Point Source Load

The PSL consists of regulated wastewater and stormwater discharges (including permitted municipal separate storm sewer system (MS4) discharges). Stormwater regulated under the NPDES storm water program (i.e., Phase I and Phase II) is

traditionally considered to be a point source. However, information from NPDES regulated storm water discharges is not detailed enough to estimate mercury loadings for specific outfalls. Since loading to stormwater is primarily from atmospheric sources, the stormwater load is implicitly included in the NPSL. Michigan has a well-developed program to address and control stormwater pollution through the implementation of best management practices as required by the Clean Water Act. Any mercury in stormwater that is not addressed by reductions in atmospheric sources implemented in accordance with this TMDL will be addressed by state municipal and industrial stormwater permit regulations.

The PSL was estimated based on the sum of mercury loads calculated from either the individual LCA for a facility, or the WQS of 1.3 ng/l if a discharge of mercury was meeting WQS (Table 9). The NPDES-permitted facilities and the individual authorized facility flows used to calculate the PSL can be found in Appendix B. Point source loads of mercury from NPDES permittees discharging mercury to the Great Lakes and connecting channels will be addressed in a subsequent Great Lakes TMDL for mercury.

6.1.3 Baseline Total Source Load

The 2001 TSL is the sum of the PSL (from 2001) and NPSL (from 2012). Because the only significant nonpoint source of mercury is from atmospheric deposition, the NPSL is equal to the atmospheric load of mercury for 2001 provided by the REMSAD model. Based on these calculations, the **TSL for 2001 is 2,773 kg/yr**. The PSL for 2012 is 1.4% of the TSL (Table 10).

Table 10. Total Source Load (TSL) for Mercury Baseline Year 2001

Portion of Total Source Load (TSL)	Units	Statewide
Point Source Load (PSL; NPDES permitted discharge)	kg/yr	39.3
Nonpoint Source Load (NPSL; atmospheric deposition)	kg/yr	2,734
*Natural Nonpoint Source (NNPSL = 0.2 * NPSL)*	*kg/yr*	*547*
Anthropogenic Nonpoint Source (ANPSL = NPSL - NNPSL)	*kg/yr*	*2,187*
Total Source Load (TSL)	kg/yr	2,773

6.2 TMDL CALCULATION

The TSL described in Section 6.1 and RF described in Section 4.5, are used to define the TMDL by applying the RF to the TSL, as shown in Equation 7 below.

$$TMDL = TSL \times (1\text{-}RF)$$

$$959 = 2{,}773 \times (1 - 0.6542) \qquad \textbf{(7)}$$

Inserting TSL (2,773) and RF (65.42%) into Equation 7 yields a TMDL of 959 kg/yr (2,114 lbs/yr). The daily equivalent load equals the annual load divided by 365, or 2.6 kg/day (5.8 lbs/day). This is the daily allowable load of mercury that, over time, is

expected to result in meeting the fish tissue target for mercury of 0.35 mg/kg, and attaining WQS.

6.3 WASTELOAD ALLOCATION

The WLA is defined as the portion of the loading capacity allocated to NPDES-permitted point sources. The WLA is equal to the sum of the authorized design flows for facilities listed in Appendix B (3,075 mgd), multiplied by the WQS of 1.3 ng/l, which is equal to an annual aggregate WLA of 5.51 kg/yr. In addition, a reserve capacity of 10% of the WLA, or 0.5 kg/yr has been added to the WLA of 5.5 kg/yr, which resulted in a final aggregate WLA of 6.0 kg/yr (Table 11). The addition of the reserve capacity will allow for permitting of new discharges of mercury that must meet the WQS of 1.3 ng/l. Existing discharges of mercury will be covered under the existing MDV approach. As stated in Section 5.2.3., establishment of the MDV requires inclusion in the NPDES permit of an effluent limitation that represents a level currently achievable (LCA) by the permittee, consistent with R 323.1103(6), and implementation of a pollutant minimization program (PMP) that furthers efforts to meet the mercury WQS of 1.3 ng/l. Implementation of PMPs will continue to be required for all NPDES-permitted mercury discharges.

Table 11. Mercury Waste Load Allocation

Portion of TMDL Calculation	Annual Result
Loading capacity	959 kg/yr
WLA	6.0 kg/yr

6.4 LOAD ALLOCATION

The LA for nonpoint sources is calculated by subtracting the WLA from the LC. The average annual LA for mercury is equal to 953 kg/yr. .

$$LA = LC - WLA \quad \textbf{(8)}$$

The LA includes both natural (NLA) and anthropogenic (ALA) load allocations. Since natural sources cannot be controlled, NLA is set at the same level as NNPSL, which is 547 kg/yr. Therefore, the remaining 406 kg/yr is allocated as an anthropogenic load (Table 12).

Table 12. Mercury Load Allocation

Portion of Load Allocation	Annual Result
Load Allocation (LA)	953 kg/yr
Natural Load Allocation (NLA = NNPSL)	*547 kg/yr*
Anthropogenic load allocation (ALA = LA – NLA)	*406 kg/yr*

Table 13 provides a summary of the individual components of the TMDL.

Table 13. Summary of TMDL Components.

TMDL Components	Units	Statewide
Target Level and Reduction Factor		
Target Fish Mercury Concentration (Fish Tissue Residue Value)	mg/kg	0.35
Mercury Concentration for Standard Length Northern Pike	mg/kg	1.01
Reduction Factor	65%	
Mercury Load for Baseline Year 2001		
Point Source Load (PSL)	kg/day	0.11
Nonpoint Source Load (NPSL)	kg/day	7.49
Total Source Load (TSL)	kg/day	7.60
Final TMDL		
Margin of Safety	Implicit	
Wasteload Allocation (WLA)	kg/day	0.016
Load Allocation (LA) (includes natural and anthropogenic sources)	kg/day	2.61
Mercury Load Allocation for In-State and Out-of-State Deposition Sources		
In-State Contribution to LA (anthropogenic)	kg/day	0.11
Out-of-State Contribution to LA (natural and anthropogenic)	kg/day	2.50
Necessary Reduction from Anthropogenic Emission Sources		82%

MDEQ only has authority to take actions to reduce sources of mercury originating from within the State of Michigan. For that reason, it is necessary to divide the LA into separate components corresponding to 1) out-of-state sources and 2) within-state sources. The contribution of "in-state" and "out of state" sources of mercury deposition in Michigan is provided by the REMSAD results. "In-state" represents mercury deposition load due to Michigan sources. The "out of state" load is the sum of the remaining categories: surrounding states, other U.S. states, Mexico, Canada, and background sources (including global and natural sources) (Table 6, Figure 14). **In-state sources make up 7.8% of the state's atmospheric mercury load, while out of state sources make up the remaining 92.2%** (Table 6).

In addition to considering out-of-state sources, it is important to consider the amount of atmospheric mercury that comes from anthropogenic versus natural sources. Since natural sources are uncontrollable and are expected to remain at the same level, all reductions must come from anthropogenic sources. The in-state contribution to total mercury deposition is 7.8%. Since Michigan's deposition sources are 20% natural and 80% anthropogenic, this translate to 9.75% of the anthropogenic deposition (7.8%÷80% = 9.75%). Therefore, the in-state (i.e., anthropogenic) contribution of the LA is 40 kg/yr (88 lbs/yr) and the out-of-state (i.e., natural and background) contribution is 913 kg/yr (2,013 lbs/yr). The anthropogenic share of the 913 kg/yr out-of-state load allocation is 367 kg/yr (Table 14).

Table 14. Load Allocations for In-State and Out-of-State Anthropogenic Sources of Mercury Deposition

Portion of Load Allocation	Atmospheric Mercury Load Annual Result
Proportion of deposition due to anthropogenic sources	80%
Michigan's fraction of anthropogenic sources (7.8%÷80%)	9.75%
In-state contribution to LA [0.0975*ALA]	40 kg/yr
Out-of-state contribution to LA [(1-0.0975)*ALA]	367 kg/yr

The State's load reduction goal can be translated to emission reduction goals based on the 2002 baseline year for emissions and 2001 baseline year for deposition load. As shown in Table 6, Michigan's in-state contribution for the baseline year of 2001 is 213 kg/yr (469 lbs/yr). A reduction of 65% of total deposition is necessary to achieve the LA allocation of 953 kg/yr. A 65% reduction in total deposition translates to 82% reduction in anthropogenic deposition. Michigan's contribution to emission must be reduced 82% to meet the in-state LA of 40 kg/yr. The same degree of reduction (82%) in "out-of-state" anthropogenic sources contributing to Michigan deposition is necessary to meet the overall 65% reduction goal. Because tracking in-state reductions will be based on 2002 estimated emissions, the reduction goal for Michigan is 82% of the 2002 mercury emissions, which is 589 kg/yr (1,299 lbs/yr; Table 15).

Table 15. Summary of Baseline and Target Mercury Emissions from Michigan In-State Anthropogenic Sources.

Category	Unit	Atmospheric Mercury Emissions
2002 Estimated Emissions	kg/yr	3,272
Target Reduction Rate in Michigan's Anthropogenic Emissions		82%
Target Emissions [2002 emissions * (1- 0.82 reduction)]	kg/yr	589

6.5 MARGIN OF SAFETY

The MOS is a required part of the TMDL to account for technical uncertaintiessuch as model predictions, analysis of technical data, and the relationship between pollutant loading and receiving water quality, . The MOS can be either explicit (e.g., stated as an additional percentage load reduction) or implicit (i.e., conservative assumptions in the TMDL calculations or overall approach) in the calculations of the TMDL, or a combination of the two. For this mercury TMDL, the MOS is implicit due to the use of northern pike as the target fish species. Northern pike are large

piscivorous fish, meaning that they occupy a high position in the food web and have the highest average fish tissue mercury concentrations in the state relative to other species (Table 2). Therefore, most fish in the state will have a lower fish tissue mercury concentration. Calculating the TMDL based on this high average mercury tissue concentration incorporates an implicit MOS into the analysis.

6.6 CRITICAL CONDITIONS AND SEASONAL VARIATION

TMDLs are required to consider seasonal variations and critical environmental conditions [40 CFR§130.7(c)(1)]. Mercury concentrations in the atmosphere and water column can fluctuate seasonally. However, accumulation of mercury in fish tissue over time masks any seasonal variations. Due to the extremely slow response time of water and fish concentrations to changes in atmospheric loads, essentially no seasonal variation occurs in fish mercury concentrations due to seasonal variations in atmospheric concentrations. The mercury concentration in the fish represents an integration of all temporal variation up to the time of sample collection. Variability among fish because of differences in size, diet, habitat, and other undefined factors are expected to be greater in sum than seasonal variability (MPCA, 2007).

There are critical conditions in the sense that certain water bodies and fish species are more likely to bioaccumulate mercury because of individual water chemistry characteristics, and the biochemistry of individual fish species. This aspect of critical conditions has been addressed in this TMDL by using a top predator fish species known to have high bioaccumulation potential. Thus, the critical conditions are assumed to be adequately addressed in the existing analysis.

7 REASONABLE ASSURANCE AND IMPLEMENTATION

This TMDL assumes that atmospheric nonpoint source mercury loads to Michigan waters will be reduced in the future. TMDLs that allow for reductions from sources for which an NPDES permit is not required should provide a reasonable assurance that the controls will be implemented and maintained. In addition, controls of mercury through issuances of NPDES permits will continue into the future. As discussed below, there are numerous state and federal regulations and other activities that are expected to reduce future mercury concentrations to levels consistent with the TMDL.

This section provides those reasonable assurances, both for mercury use and release and legacy sources. It is divided into separate discussions of:

- Clean-up of Legacy Sources
- Voluntary Activities
- Regulatory Activities
    - Federal and State Regulations
    - Michigan Legislation
- NPDES Program Control of Mercury to Surface Waters

7.1 CLEAN-UP OF LEGACY SOURCES

Formal clean-up plans are in place at several sites influenced by legacy sources. The Great Lakes Legacy Act (GLLA) was signed into law in 2002, and authorized by Congress in 2008, to provide funding to clean up contaminated sediment in AOCs in the Great Lakes region[16]. While these AOCs focus primarily on Great Lakes waters not considered by the TMDL, many of the clean-up plans extend inland to waters covered by this TMDL.

The Comprehensive Environmental Response, Compensation and Liability Act of 1980 provides a federal "Superfund" to clean up uncontrolled or abandoned hazardous waste sites. Sites eligible for long-term cleanup action under the Superfund program are located on the National Priorities List (NPL), a list of environmentally contaminated sites, published by U.S. EPA, which pose an immediate or significant public health threat to the local community. Michigan currently has 86 sites on the NPL[17] , many of which include contamination by mercury. Clean-up plans are in place for all of these sites. The remediation of these legacy sites will provide two mechanisms to help achieve the TMDL target. First, these clean-ups will allow designated uses to be attained at legacy sites after atmospheric mercury emissions are reduced to levels outlined by the TMDL. Second, these clean-ups will contribute to the necessary reduction of local atmospheric mercury emissions, as volatilization of mercury from legacy sites can serve as a source of mercury to the atmosphere.

[16] https://www.epa.gov/great-lakes-legacy-act
[17] https://www3.epa.gov/region5/cleanup/index.htm

7.2 VOLUNTARY ACTIVITIES

7.2.1 Michigan Mercury Strategy

The MDEQ Mercury Strategy Staff Report finalized on January 3, 2008, has a goal to eliminate anthropogenic mercury use and emissions within the state of Michigan.

The Strategy contains over 60 recommendations, and 10 recommendations are prioritized. One of the priority recommendations is to implement a mercury TMDL, which this document fulfills.

The Mercury Strategy for Michigan summarizes pollution prevention programs, and their successes. Between 1994 and 2007, these programs successfully recovered 19,000 lbs (8,618 kg) of mercury that would have otherwise been potentially released to the environment. Programs that recovered the largest share of mercury during this time period include the Groundwater Stewardship Clean Sweep Program (nearly 8,000 lbs), Detroit Edison Hg P2 Initiative (2,745 lbs), Consumers Energy (1,488 lbs), and a joint agency Dental Mercury Removal Program (1,400 lbs) (MDEQ, 2008a).

MDEQ received an U.S. EPA Great Lakes Restoration Initiative (GLRI) grant to implement the Strategy in 2010, which contains further voluntary and regulatory activities to reduce mercury in Michigan.

Funded by the GLRI grant, MDEQ worked cooperatively with the MDCH on efforts to reduce mercury use and educate the public on proper ways to dispose of mercury-containing items and to help distribute the newly developed fish consumption guidelines to various stakeholders.[18] Mercury spill workshops have been funded in the state and public service announcements (PSAs) have been developed to help educate Michigan's citizens on the concern with mercury. PSAs have been developed primarily by MDCH and Michigan State University via the EPA grant to implement the state-wide MDEQ Mercury Strategy and aired at the Michigan Secretary of State offices from October 2012 to early November 2012. These video clips are available on MDCH's YouTube channel.[19]

These five videos describe the need for mercury-containing items to be removed from homes, concern for spills, costs and exposure and fish consumption. There will be more videos developed in the future regarding the mercury fish consumption guidelines and compact fluorescent light bulbs. The MDEQ developed brochures on mercury-containing products that are shared with local and state health departments. The brochures include:

- Common Mercury Items
- Mercury Spills
- Recycle Mercury – Get Rid of Mercury Safely
- Eliminate Mercury in Schools
- Mercury & Plumbing
- Mercury & Electrical Trades

[18] Go to http://www.michigan.gov/mercury to view this information and click on "more on mercury".
[19] Go to www.youtube.com/michigandch to view the videos

- Mercury & Heating, Ventilation and Air Conditioning (HVAC) Work
- Mercury & Antiques
- Mercury & Renovation Work

Future outreach is planned to encourage recycling by municipality water and treatment plants, marinas, and scrap yards, with a focus on the recycling of appliances.[20].

7.2.2 Regional/National Efforts

The Great Lakes Regional Collaboration (GLRC) served as a foundation for the development of the Great Lakes Restoration Initiative (GLRI) and has continued the successful efforts of the Great Lakes Binational Toxics Strategy. Under the GLRC, two specific mercury strategies were developed for the Great Lakes region, one on products and the other on emissions[21]. Both of these strategies are available at: http://www.glrc.us/

Continued implementation of these strategies will help to meet the goals of this TMDL. Additionally, the Great Lakes Water Quality Agreement led to the Lake Superior Binational Program that is serving as a demonstration area where no point source discharge of any persistent toxics chemical will be permitted. U.S. EPA, Environment Canada and the states (MDEQ) work together on this Binational Program to virtually eliminate toxics (mercury). This Binational program has a goal of 100% reduction (for mercury) by 2020 as compared to a 1990 baseline[22]. The Lake Superior Lake-wide Management Plan (LaMP) is the vehicle used for implementation. Remediation plans and implementation for the AOCs contaminated with mercury will further mercury reduction efforts at these contaminated sites[23].

7.2.2 Mercury Monitoring

The MDEQ participates with the Environmental Council of States Quicksilver Caucus (QSC) on various national mercury issues that address air, water, waste and pollution prevention. MDEQ staff have worked on a variety of reports including the most recent national mercury compendium. The QSC works together to further reduce mercury releases to the environment by developing educational materials, policy documents and has ongoing dialogue with U.S. EPA on mercury regulations[24].

The GLRI funding is also allowing MDEQ to be a member of Interstate Mercury Education and Reduction Clearinghouse which provide critical information on use and compliance reporting with various legislation in the nation[25].

[20] Go to http:www.michigan.gov/mercuryp2 for more information.
[21] Both of these strategies are available at: http://www.glrc.us/
[22] Go to http://www.epa.gov/greatlakes/lakesuperior/index.html to view progress on the efforts of this program.
[23] Go to http://www.epa.gov/greatlakes/aoc/index.html for information on remediation plans.
[24] Go to http://www.ecos.org/documents/letter-to-u-s-epa-and-omb-on-mercury/ for information on the QSC.
[25] http://www.newmoa.org/prevention/mercury/imerc.cfm

Currently, several programs are in place to reduce and monitor mercury in the state including the following summarized from MDEQ (2008a):

- Tri-State Mercury Monitoring Project (Michigan, Minnesota, and Wisconsin)
- Michigan Water Chemistry Monitoring Project
- Surface Water Monitoring (data stored in MiSWIM)
- Michigan Wildlife Contaminant Monitoring Project
- Michigan FCMP

7.3 REGULATORY ACTIVITIES

7.3.1 Air - State

Michigan utilizes its air quality regulatory programs to reduce mercury released from point sources through the air permitting process. In 1994, the MDEQ Air Quality Division (AQD) implemented the air toxics rules to address the release of toxic air pollutants. Any new or modified source of mercury emissions must go through a best available control technology (BACT) for toxics review (commonly called T-BACT), although these rules do not apply to existing sources. New or modified sources are required to demonstrate the maximum degree of mercury emission reduction reasonably achievable taking into account energy, environmental, economic impacts, and other costs. New or modified sources of mercury emissions must also go through a health-based screening review that uses modeling of source emissions to predict the ambient impact of a toxic chemical. Predicted ambient impacts can be no greater than health-based screening levels and indirect exposure can be also considered[26].

MDEQ-AQD can also incorporate special conditions in air permits to reduce mercury emissions. Examples include metal shredders that must document the removal of mercury-containing switches, electric arc furnaces that must test for mercury, and other new and/or modified sources in Michigan that have required air emission limits and stack tests. From 2006 to 2011, 223,452 automobile mercury-containing switches were recycled in Michigan[27].

7.3.2 Air – Federal

The federal Clean Air Act (CAA) section 112 requires U.S. EPA to regulate emissions of toxic air pollutants, including mercury, from a published list of industrial sources referred to as "source categories." As required under the CAA, U.S. EPA has developed a list of source categories that must meet control technology requirements for these toxic air pollutants. U.S. EPA is required to develop regulations (rules or standards) for all industries that emit one or more of the pollutants in significant quantities. Table 3-2 in the Mercury Strategy (MDEQ, 2008a) lists U.S. EPA's promulgated standards under 40 CFR and their potential impact on mercury reduction. Under 112(l) of CAA, U.S. EPA has approved delegation to MDEQ to

[26] See http://www.michigan.gov/deq/0,4561,7-135-3310_4105---,00.html for more information related to air toxics program in Michigan

[27] See http://www.eqonline.com/Services-We-Provide/Recycling/ELVS-Mercury-Switch-Program.aspx and http://www.epa.gov/mercury/switch.htm for more information on switch recycling programs.

implement these standards for major sources. After promulgating rules for iron and steel foundries, electric arc furnaces, and aluminum, copper, and other non-ferrous foundries specifically to address mercury emissions, MDEQ-AQD will seek delegation from U.S. EPA. MDEQ-AQD has already taken delegation for four area source rules: chromium electroplating, Portland cement manufacturing, secondary aluminum production, and publicly owned treatment works.

The MDEQ developed new air pollution control rules addressing mercury emissions from coal-fired electric generating units (EGUs). The rules under Part 15 Emission Limitations and Prohibitions - Mercury, went into effect October 16, 2009.

On June 1, 2012, the Department approved a variance to the permitting requirements under Rule 1512[28] because of the issuance by U.S. EPA of the "Mercury and Air Toxics Standards[29]. (MATS). MDEQ-AQD is pursuing revisions to the Part 15 rules to achieve greater consistency with the MATS. These regulations will lead to further reductions of mercury from EGUs.

Finally, for cement plants in Michigan, MDEQ will be following the federal National Emissions Standards for Hazardous Air Pollutants (NESHAP) rule to control mercury emissions from Portland cement plants.

7.3.3 Michigan Legislation to Reduce Mercury Waste

Michigan has passed several pieces of legislation to reduce the use and release of mercury into the air and waters of the state. These include:

- Dental Mercury Amalgam Separators (Public Act 503, 2008)

A portion of the MDEQ GLRI U.S. EPA grant funds were provided to the Michigan Dental Association (MDA) to offer incentives to dental offices to install dental amalgam separators to comply with Michigan's regulations. In 2011 a Memorandum of Understanding was developed between MDEQ and MDA for $270,000 and as of May 2012, 870 dentists in Michigan have installed dental amalgam separators. The requirements for dental amalgam separator installation become effective December 31, 2013.

- Mercury-free State Purchasing (Public Act 193, 2008)
- Mercury Phase Out in Schools (Public Act 376, 2000)

Significant efforts have been made by MDEQ, MDCH and the Michigan Department of Education to educate schools about this legislation. Several letters have been sent out to Michigan principals, science teachers, library/media specialists and superintendents since the law became final. Fact sheets and educational CDs were developed and distributed to the schools. Additionally, MDEQ participated with U.S. EPA on collecting mercury from schools in several cities.

- Mercury Thermometer Sales Ban (Public Act 578, 2002)

[28] See http://epa.gov/mats/

[29] See http://www.michigan.gov/documents/deq/deq-aqd-aqe-Rules-1512-Variance_389359_7.pdf and http://www7.dleg.state.mi.us/orr/Files/AdminCode/104_58_AdminCode.pdf for information on the rules impacting coal-fired electric generating units.

- Mercury Thermostat Sales Ban (Public Act 492, 2006)

In 2011, 15,939 thermostats were collected. Collection increased with expanded outreach due to a grant from MDEQ to Michigan Energy Options (the typical amount before the outreach effort was about 3,000/year).

From 2010 to 2013, the MDEQ is funding Michigan Energy Options to conduct outreach and participation by HVAC contractors, wholesalers, and retailers in the thermostat recycling program. A web site has been created under the grant to provide contractors and residents information on how to find a collection location[31].

- Mercury Blood Pressure Device Sales/Use Ban (Public Act 493, 2006)
- Mercury-containing Medical Devices Sales Ban (Public Act 494, 2006)[32]
- Trash Burning Restrictions (Public Act 102 of 2012)

Michigan recently passed legislation (signed April 19, 2012) to limit the uncontrolled open burning of household waste. Open burning of household waste that may contain mercury is not allowed. The list of banned materials includes plastic, rubber, foam, chemically treated wood, textiles, electronics, chemicals, and hazardous materials. The law went into effect October 16, 2012[33].

If anyone is caught selling the banned items listed above, criminal prosecution could occur. If someone is selling mercury-containing items that are banned, it should be reported to the MDEQ Criminal Investigators to investigate and it will be determined if the Attorney General, or the local prosecutor will take the case.

7.3.4 NPDES Program Control of Mercury to Surface Waters

Rule R 323.1103(9) of the Part 4 WQS provides the conditions under which an MDV may be granted. Specifically, an MDV may be granted due to widespread WQS compliance issues, including the presence of ubiquitous pollutants or naturally high background levels of pollutant in a watershed. Due to ubiquitous mercury concentrations in many of Michigan's inland waters at levels exceeding WQS, as described above, many facilities will not be able to comply with the mercury WQS in a cost-effective manner. Michigan has concluded that, in general, end-of-pipe treatment for mercury is not the most cost-effective method to reduce mercury loadings to achieve WQS. Michigan supports the U.S. EPA position that pollution prevention and waste minimization programs for mercury should be the first steps in restoring water quality before considering extraordinary treatment alternatives.

Rule R 323.1201 of the Part 8 Rules, Water Quality-Based Effluent Limit Development for Toxic Substances, promulgated under Part 31 of the Natural

[31] See https://www.thermostat-recycle.org/zipsearch to find a recycling location near you.

[32] See either http://www.michigan.gov/deq/0,1607,7-135-3307_29693_4175-160230--,00.html or http://www.michigan.gov/deq/0,4561,7-135-3307_29693_4175-160230--,00.html for more information on thermostat recycling programs.

[33] See http://www.michigan.gov/deq/0,4561,7-135-3310_4106_70665_70668-234558--,00.html for more information on trash burning restrictions.

Resources and Environmental Protection Act, describes Michigan's commitment to the use of pollution prevention, source control, and other waste minimization programs to achieve compliance with low WQBELs. As such, each NPDES permit that includes a variance for mercury contains a requirement to develop and implement a PMP for mercury, with the goal of attaining WQS.

8 POST-TMDL MONITORING

Post-TMDL monitoring consists of collecting and analyzing data to evaluate how well a TMDL is working towards attaining WQS. This monitoring can assist in determining whether planned control actions are sufficient to attain WQS, or whether further measures need to be implemented. This section describes monitoring to measure mercury concentrations in fish, water, land, and air to track TMDL effectiveness.

8.1 MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY MONITORING

Three of the four monitoring goals described in MDEQ's Water Quality Monitoring Strategy directly align with post-TMDL monitoring goals. These are: 1) assess the current status and condition of water of the state and determine whether WQS are being met; 2) measure spatial and temporal water quality trends; and 3) evaluate the effectiveness of water quality prevention and protection programs. These goals are assessed through evaluation of a variety of data. For post-TMDL monitoring, MDEQ should analyzefish tissue and water samples for mercury (MDEQ, 2005). In addition to the programs described below, mercury data collected through the Michigan Wildlife Contaminant Monitoring Program may also be used to assess trends.

8.1.1 Fish Contaminant Monitoring Program

The FCMP is part of MDEQ's comprehensive water quality monitoring strategy. Edible portion fish contaminant data are used by the MDCH to develop the Michigan Fish Advisory. Whole fish data are used to track contaminant trends and caged fish data are used to identify sources of pollutants and evaluate spatial trends of contaminant concentrations (MDEQ, 2008b). Approximately 20 to 30 lakes in Michigan are sampled annually for mercury in fish tissue with specific locations driven by programmatic need and sample availability. Both the edible and whole fish sampling programs will generate data that can be used to evaluate TMDL effectiveness.

8.1.2 Water Chemistry Monitoring Program

MDEQ's WCMP includes mercury analysis and is comprised of the following elements that are relevant to post-TMDL monitoring:

- Fixed station trend (31 tributaries)
- A probability sampling component;
- Watershed surveys (consistent with the 5-year basin cycle);
- Minimally impacted sites; and
- Special studies (TMDLs, nonpoint source issues, statewide mercury assessment, etc.).

The probability sampling component of the WCMP will continue as long as funding is available and will be used to determine the statistical status and trend of mercury in Michigan waters. Fixed station trend data will continue to be collected and

disseminated to the public in annual reports. Data collected as part of the 5-year watershed surveys are summarized in watershed reports. Data collected as part of TMDL sampling are summarized in individual reports prepared for each applicable water body, and are considered during the State's two year integrated report cycling (MDEQ, 2012a).

8.1.3 NPDES Monitoring Program

As part of the NPDES permitting program, mercury is monitored in effluent and reported for those NPDES-permitted facilities that have effluent mercury limits and/or reporting requirements. These monitoring data are provided by the facilities to the MDEQ, and are used to determine whether the facilities are in compliance with permit limitations. Typically, effluent monitoring for mercury ranges from monthly to quarterly, depending on a facility's current effluent concentration. Generally, those facilities with a mercury effluent concentration greater than 5 ng/l are required to monitor effluent on a monthly basis. Facilities with an effluent concentration of less than 5 ng/l are required to monitor effluent quarterly. In addition, effluent monitoring is required as part of the PMP requirement of NPDES permits that contain mercury effluent limitations.

8.2 ATMOSPHERIC MERCURY MONITORING

Atmospheric mercury deposition is no longer monitored in Michigan. From 1995 to 2005 UMAQL measured mercury deposition during precipitation events at three sites throughout the state (Figure 4; MDEQ, 2008a). Though funding for this program has ceased, it provides a good baseline from which to compare future atmospheric wet deposition, if funding becomes available. Until funding is identified, other air monitoring networks that do not have monitoring sites located in Michigan but which can assist in estimating deposition to Michigan include the Mercury Deposition Network[34] and the Canadian Atmospheric Mercury Measurement Network[35].

Additional atmospheric modeling is underway through the U.S. EPA GLRI utilizing an updated emissions inventory which will be completed by Fall 2013.

8.3 BIOSOLIDS MONITORING

The Part 24 Rules, Land Application of Biosolids, promulgated under Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended [Act 451], establish standards consisting of general requirements, pollutant limits, management practices and operational requirements for the beneficial land application of biosolids. In compliance with the provisions of the Part 24 Rules, biosolids generated by facilities that hold individual "certificates of coverage" are authorized to be land applied in accordance with the limitations, monitoring requirements and other conditions set forth in the NPDES general permit, General Permit Authorizing Land Application of Biosolids[36]. Biosolids are typically sampled and analyzed according to the amount generated, with the frequency of

[34] Go to http://nadp.sws.uiuc.edu/mdn/ for more information.
[35] Go to http://www.ec.gc.ca/natchem/default.asp?lang=En&n=BFF7F7EE-1 for more information.
[36] Go to http://www.michigan.gov/deq/0,4561,7-135-3313_3682_3713-10252--,00.html

sampling ranging from monthly to annually (Table 16). Since 1981 the concentration of mercury in biosolids has decreased (Figure 19).

Table 16. Frequency of Monitoring for Biosolids Based on Tonnage.
(Source: Part 24 Rules, R 323.2412[37])

Dry Tons (per year)	Frequency
Greater than zero, but Less than 319	Annually (Once per year)
Equal to or greater than 319, but less than 1,650	Quarterly (4 times per year)
Equal to or greater than 1,650, but less than 16,500	Once per 60 days (6 times per year)
Equal to or greater than 16,500	Monthly (12 times per year)

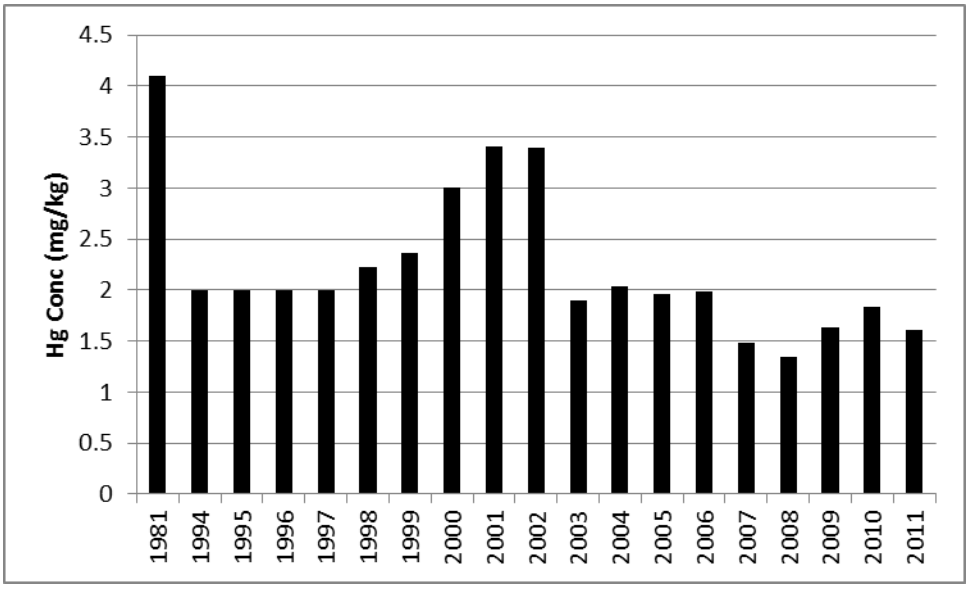


Figure 19. Mercury Concentration in Biosolids 1981-2011.
(Data Source: MDEQ)

8.4 NEW MONITORING AND ASSESSMENT DATA

As part of Michigan's monitoring and assessment programs, new data, including fish tissue data, are continually being collected. New fish tissue data are typically considered during the State's two year integrated reporting cycle pursuant to Sections 305(b) and 303(d) of the Clean Water Act. There are four possible outcomes of the State's assessment of new fish tissue data for any lake or river assessment unit:

1. The data show the fish tissue mercury concentration is less than or equal to the target concentration (0.35 mg/kg) or the water column concentration is less

[37] See http://www.michigan.gov/documents/deq/deq-swq-biosolids-Part_24_249771_7.doc for details on Biosolids rules.

than or equal to the water column target concentration (1.3 ng/l). These waters are not impaired due to mercury;

2. The data are insufficient to determine the status of the assessment unit, and the unit is therefore placed in Category 2 or 3 of Michigan's Integrated Report;
3. The data show the fish tissue mercury concentration is greater than 0.35 mg/kg or greater than the water column target concentration (1.3 ng/l) and are less than the 1.01 mg/kg 90th percentile fish tissue concentration. These waters are impaired due to mercury and placed in Category 5 of Michigan's Integrated Report and are eligible to be added to the statewide Mercury TMDL; or
4. The data show the fish tissue mercury concentration is greater than 0.35 mg/kg or greater than the water column target concentration (1.3 ng/l) and are greater than the 1.01 mg/kg 90th percentile fish tissue concentration. These waters are impaired due to mercury and placed in Category 5 of Michigan's Integrated Report and are not eligible to be added to the statewide Mercury TMDL.

8.5 TMDL REVISION

Revision of this TMDL document is expected to occur during Michigan's Integrated Report process. MDEQ will identify new waters to add to the Mercury TMDL and those waters will be placed on a revised list in Appendix A. MDEQ plans to request public review of the updated list of mercury impaired waters concurrent with the public notice of the Michigan Integrated Report.

The public notice will note if the State is making any revisions (after consulting with U.S. EPA) to the TMDL targets, reduction factors, loading capacities, allocations, reduction goals or any other element established in this TMDL. Only those elements being changed will be subject to public review. These items cannot be changed without consulting U.S. EPA.

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APPENDIX A.
LIST OF MERCURY-IMPAIRED INLAND WATER BODIES SUBMITTED FOR APPROVAL UNDER THIS TMDL

AUID	Assessment Unit Name	Location Description	Source of Impairment
040201010109-01	Rivers/Streams in HUC 040201010109	Includes: West Branch Duck Creek	Water
040201010109-02	Rivers/Streams in HUC 040201010109	Includes: Lake Superior Coastal Tributaries	Water
040201010205-01	Rivers/Streams in HUC 040201010205	Includes: Abitosse Creek, Black River, Kallander Creek and Sunset Creek	Water
040201010205-02	Rivers/Streams in HUC 040201010205	Includes: Powder Mill Creek	Water
040201010205-03	Rivers/Streams in HUC 040201010205	Includes: Powder Mill Creek	Water
040201010301-03	POMEROY LAKE	SE of Marenisco E. of Route 525.	Fish
040201010304-03	ORMES LAKE	8 miles SE of Marenisco.	Fish
040201010306-01	Rivers/Streams in HUC 040201010306	Includes: Brotherton Creek	Water
040201010306-02	Rivers/Streams in HUC 040201010306	Includes: Little Presque Isle River, Monarch Creek, Veron Creek and Wolf Mountain Creek	Water
040201020101-02	CISCO LAKE CHAIN	West of Watersmeet, not including Thousand Island Lake	Fish
040201020101-03	THOUSAND ISLAND LAKE	SW of Watersmeet.	Fish
040201020104-02	BEATONS LAKE	Ottawa National Forest NE of Stickley.	Fish
040201020111-01	Rivers/Streams in HUC 040201020111	Includes: Cedar Creek, Farmer Creek, Junco Creek, Maple Leaf Creek, Mulligan Creek and South Branch Ontonagon River	Water
040201020201-04	DUCK LAKE	SW of Watersmeet.	Fish
040201020204-03	MARION LAKE	W. of Watersmeet.	Fish
040201020205-02	BOND FALLS FLOWAGE	Bond Falls Flowage is an impoundment in the headwaters of the Middle Br. Ontonagon River. NE of Sylvania on Rt. 2. and Watersmeet on Rt. 45.	Fish
040201020303-02	TEPEE LAKE	7 miles S. of Kenton off Forest Hwy. 16.	Fish
040201020307-04	BOB LAKE	SE of Pori and 9 miles west of the Baraga/Houghton County Line and 1 mile S. of the Ontonagon/Houghton County Line (Ottawa National Forest).	Fish
040201020404-01	Rivers/Streams in HUC 040201020404	Includes: Bingham Creek, Hendrick Creek, Knute Creek and Montgomery Creek	Water

AUID	Assessment Unit Name	Location Description	Source of Impairment
040201020404-03	LAKE GOGEBIC	Vicinity of Bergland and Lake Gogebic.	Fish
040201020407-01	Rivers/Streams in HUC 040201020407	Includes: Gleason Creek, Russell Creek, Stindt Creek, Trestle Creek, West Branch Ontonagon River, Whisky Hollow Creek and Woodpecker Creek	Water
040201020408-02	VICTORIA RESERVOIR	SW of Rockland.	Fish
040201020409-01	Rivers/Streams in HUC 040201020409	Includes: West Branch Ontonagon River, Austin Creek, East Branch Mill Creek, Gates Creek, Irish Creek, Mill Creek, Ontonagon River, Patty Creek, Plover Creek, Rockland Creek, Sandstone Creek and Sucker Creek	Water
040201020409-02	Rivers/Streams in HUC 040201020409	Includes: Unnamed Tributary to Ontonagon River	Water
040201020409-03	Rivers/Streams in HUC 040201020409	Includes: Ontonagon River	Water
040201030104-01	Rivers/Streams in HUC 040201030104	Includes: Dishinaw Creek, Silver Creek and West Branch Firesteel River	Water
040201030104-02	SUDDEN LAKE	E. of Forest Hwy. 16, S. of Rt. 38 - 19 miles west of Baraga.	Fish
040201030104-03	Rivers/Streams in HUC 040201030104	Includes: West Branch Firesteel River and Tributaries	Water
040201030303-07	Rivers/Streams in HUC 040201030303	Includes: Hammell Creek	Water
040201030304-01	TORCH LAKE	In the vicinity of the communities of Hubbell and Lake Linden.	Fish
040201030307-08	PORTAGE LAKE	Vicinity of Houghton and Hancock.	Fish
040201030401-01	Rivers/Streams in HUC 040201030401	Includes: Hills Creek upstream of Gratiot River Road to headwaters	Water
040201030401-03	Rivers/Streams in HUC 040201030401	Includes: Muggun Creek	Water
040201030401-04	Rivers/Streams in HUC 040201030401	Includes: Sevenmile Creek	Water
040201030401-05	Rivers/Streams in HUC 040201030401	Includes: Hills Creek	Water
040201030401-06	Rivers/Streams in HUC 040201030401	Includes: Various Tributaries to Lake Superior	Water
040201030403-01	Rivers/Streams in HUC 040201030403	Includes: Silver Creek and various Lake Superior Tributaries	Water

AUID	Assessment Unit Name	Location Description	Source of Impairment
040201030501-03	LAKE MEDORA	4.5 miles SW of Copper Harbor.	Fish
040201030505-01	RICE LAKE	SW of Traverse Bay on Keweenaw Peninsula.	Fish
040201040101-02	Rivers/Streams in HUC 040201040101	Includes: Tioga River	Water
040201040102-02	VERMILAC LAKE (AKA: WORM LAKE)	E. of Covington.	Fish
040201040102-03	KING LAKE	E. of Vermilac.	Fish
040201040104-02	MARTEN LAKE	Ottawa National Forest. 2 miles south of Houghton/Baraga county line.	Fish
040201040104-05	PERCH LAKE	N. of Iron River.	Fish
040201040207-04	EMILY LAKE	Mishwabic State Forest S. of Twin Lakes.	Fish
040201040207-06	SIX MILE LAKE	W. of Nisula.	Fish
040201040208-01	Rivers/Streams in HUC 040201040208	Includes: Ebers Creek	Water
040201040208-02	Rivers/Streams in HUC 040201040208	Includes: Bart Creek, North Branch Bart Creek, North Branch Otter River and Small Bear Creek	Water
040201040208-03	Rivers/Streams in HUC 040201040208	Includes: North Branch Bear Creek and South Branch Bear Creek	Water
040201040209-02	OTTER LAKE	Vicinity of Askel.	Fish
040201050101-01	Rivers/Streams in HUC 040201050101	Includes: Carp Creek, Cooper Creek and Larson Creek upstream of Ishpeming	Fish and Water
040201050101-04	Rivers/Streams in HUC 040201050101	Includes: Carp Creek from Ishpeming to Deer Lake	Fish and Water
040201050102-01	Rivers/Streams in HUC 040201050102	Includes: Carp River from Deer Lake upstream	Water
040201050102-02	Rivers/Streams in HUC 040201050102	Includes: Unnamed Tributary to the Carp River	Water
040201050105-01	Rivers/Streams in HUC 040201050105	Includes: Big Garlic River, Sawmill Creek and Wilson Creek	Water
040201050205-01	FORESTVILLE BASIN	From the Tourist Park Dam u/s to the powerhouse at the west end of the Forestville Reservoir.	Fish
040201050301-01	Rivers/Streams in HUC 040201050301	Includes: Yellow Dog River	Water
040201050301-02	Rivers/Streams in HUC 040201050301	Includes: Yellow Dog River	Water

AUID	Assessment Unit Name	Location Description	Source of Impairment
040201050302-03	Rivers/Streams in HUC 040201050302	Includes: Yellow Dog River	Water
040201050303-02	LAKE INDEPENDENCE	Vicinity of Big Bay.	Fish
040201050401-02	Rivers/Streams in HUC 040201050401	Includes: Salmon Trout River	Water
040201050606-01	Rivers/Streams in HUC 040201050606	Includes: Slate River	Water
040202010101-02	Rivers/Streams in HUC 040202010101	Includes: East Branch Chocolay River including Tributaries	Water
040202010112-01	AU TRAIN LAKE	W. of Munising.	Fish
040202010207-02	NAWAKWA LAKE	N. of Lavender Corners and Rt. 77.	Fish
040202010209-04	GRAND SABLE LAKE	Grand Sable State forest.	Fish
040202010211-02	MUSKALLONGE LAKE	18 miles E. of Grand Marais off Rt. 407 in Lake Superior State Forest.	Fish
040202010302-02	PRETTY LAKE	Reaches contained in HUC 040202010302	Fish
040202020106-01	DOLLARVILLE FLOODING	Vicinity of Dollarville and Newberry. Dollarville Flooding is an impoundment of the Tahquamenon River.	Fish
040202020106-02	Rivers/Streams in HUC 040202020106	Includes: Silver Creek and Tahquamenon River	Fish
040202020107-01	Rivers/Streams in HUC 040202020107	Includes: Sixteen Creek, Tahquamenon River and Thirtynine Creek	Fish
040202020301-01	Rivers/Streams in HUC 040202020301	Includes: Quinn Creek	Water
040202020301-02	Rivers/Streams in HUC 040202020301	Includes: Hendrie River and Naugle Creek	Water
040202020502-01	Rivers/Streams in HUC 040202020502	Includes: Gimlet Creek	Fish
040202020504-01	Rivers/Streams in HUC 040202020504	Includes: Hiawatha Creek and Tahquamenon River	Fish
040202020505-01	Rivers/Streams in HUC 040202020505	Includes: Baird Creek, Freeman Creek, Penny Creek, Popps Creek and Tahquamenon River	Fish
040202020506-01	Rivers/Streams in HUC 040202020506	Includes: Callam Creek, Linton Creek, Middle Branch Linton Creek, North Branch Linton Creek, Rose Creek, South Branch Linton Creek and Tahquamenon River	Fish

AUID	Assessment Unit Name	Location Description	Source of Impairment
040202020507-01	Rivers/Streams in HUC 040202020507	Includes: Anchard Creek and Bowers Creek	Fish
040202020508-01	Rivers/Streams in HUC 040202020508	Includes: Lynch Creek and Tahquamenon River	Fish and Water
040202020508-02	Rivers/Streams in HUC 040202020508	Includes: Cheney Creek	Water
040202030102-02	Rivers/Streams in HUC 040202030102	Includes: Ankodosh Creek and Bearpen Creek	Water
040202030203-01	Rivers/Streams in HUC 040202030203	Includes: West Branch Waishkey River - McMahen, Clear, White, Horseshoe, Bons, Sylvester Creeks	Water
040203000001-02	SISKIWIT LAKE	Isle Royale.	Fish
040203000001-03	ECHO LAKE	On Grand Island located offshore of the communities of Christmas and Munising.	Fish
040301060205-02	CABLE LAKE	Copper Country State Forest.	Fish
040301060307-06	SUNSET LAKE	NE of Iron River.	Fish
040301060401-01	Rivers/Streams in HUC 040301060401	Includes: Silver Creek	Water
040301060401-02	Rivers/Streams in HUC 040301060401	Includes: Edna Creek, McColman Creek, Paint River, and Unnamed Tributary to Edna Creek	Water
040301060405-02	CHICAGON LAKE	Vicinity of Chicagon.	Fish
040301060405-03	LONG LAKE	6 miles NW of Crystal Falls.	Fish
040301060405-04	LAKE EMILY	N. of Chicagon.	Fish
040301060407-03	FORTUNE LAKE (SECOND LAKE)	Vicinity of Fortune Lake.	Fish
040301060408-02	RUNKLE LAKE	East of Crystal Falls.	Fish
040301060409-02	PAINT RIVER POND	Brule Dam (NE of Florence, Wisconsin) u/s to the Paint River inlet.	Fish
040301070102-02	UNNAMED LAKE	Located SE of Crooked Lake.	Fish
040301070106-01	BEAUFORT LAKE	Vicinity of Three Lakes.	Fish
040301070108-01	Rivers/Streams in HUC 040301070108	Includes: Michigamme River	Fish
040301070109-01	Rivers/Streams in HUC 040301070109	Includes: Michigamme River and Trout Falls Creek	Fish
040301070110-01	Rivers/Streams in HUC 040301070110	Includes: Caps Creek, Gambles Creek and Michigamme River	Fish
040301070110-02	PERCH LAKE	SE of Republic.	Fish

AUID	Assessment Unit Name	Location Description	Source of Impairment
040301070111-01	Rivers/Streams in HUC 040301070111	Includes: Michigamme River and Wilson Creek	Fish
040301070111-02	Rivers/Streams in HUC 040301070111	Includes: Michigamme River	Fish
040301070205-01	Rivers/Streams in HUC 040301070205	Includes: Fence River, McMillan Creek and Threemile Creek	Fish
040301070302-02	Rivers/Streams in HUC 040301070302	Includes: Deer River	Fish
040301070303-01	Rivers/Streams in HUC 040301070303	Includes: Michigamme River	Fish
040301070303-02	Rivers/Streams in HUC 040301070303	Includes: Squaw Creek	Fish
040301070304-01	Rivers/Streams in HUC 040301070304	Includes: Crescent Pond Outlet and Michigamme River	Fish
040301070304-02	SILVER LAKE	6 miles NE of Channing off Rt. 95 in Copper Country State Forest).	Fish
040301070305-01	Rivers/Streams in HUC 040301070305	Includes: Clarks Creek and Michigamme River	Fish
040301070305-03	MICHIGAMME RESERVOIR	Michigamme River impoundment upstream of the Way Dam NE of Kelso Junction and Crystal Falls.	Fish
040301070305-04	Rivers/Streams in HUC 040301070305	Includes: Margeson Creek, trib to Michigamme Reservoir	Fish
040301070306-01	Rivers/Streams in HUC 040301070306	Includes: Camp Six Creek	Fish
040301070306-02	Rivers/Streams in HUC 040301070306	Includes: Clarks Creek, Kelso Creek, Kelso River, Kukura Creek and Michigamme River	Fish
040301070306-03	Rivers/Streams in HUC 040301070306	Includes: Parks Creek	Fish
040301070307-01	Rivers/Streams in HUC 040301070307	Includes: Camp Five Creek, Davison Creek, Larson Creek and Michigamme River	Fish
040301070307-02	PEAVY POND	4.0 miles u/s from Brule River confluence and east of Iron County Airport.	Fish
040301070308-01	Rivers/Streams in HUC 040301070308	Includes: Gages Creek and Michigamme River	Fish
040301080401-02	SOUTH GROVELAND POND	12 miles NE. of Iron Mountain in the Copper Country State Forest.	Fish

AUID	Assessment Unit Name	Location Description	Source of Impairment
040301080407-01	HAMILTON LAKE	SE of Loretto.	Fish
040301080408-01	Rivers/Streams in HUC 040301080408	Includes: Black Creek and Sturgeon River	Fish
040301080408-02	HANBURY LAKE	Reaches contained in HUC 040301080408	Fish
040301080705-01	Rivers/Streams in HUC 040301080705	Includes: Fumee Creek and Menominee River	Fish and Water
040301080705-02	FUMEE LAKE	North of Quinnesec.	Fish
040301080706-01	Rivers/Streams in HUC 040301080706	Includes: Menominee River	Fish
040301080706-02	Rivers/Streams in HUC 040301080706	Includes: White Creek and Unnamed Tributary to Menominee River	Fish
040301080707-01	Rivers/Streams in HUC 040301080707	Includes: Brandts Creek, Carlson Creek, Harter Creek, Menominee River, Mullen Creek and Seynor Creek	Fish
040301080707-02	Rivers/Streams in HUC 040301080707	Includes: Faithorn Creek	Fish
040301080708-01	Rivers/Streams in HUC 040301080708	Includes: Bird Creek, Blom Creek, DeHaas Creek, Hammond Brook and Pemene Creek	Fish
040301080710-01	Rivers/Streams in HUC 040301080710	Includes: Goodman Brook, Kading Creek and Menominee River	Fish
040301080710-02	Rivers/Streams in HUC 040301080710	Includes: Miscauna Creek	Fish
040301080711-01	CHALK HILLS IMPOUNDMENT	Chalk Hill Dam u/s to Miscauno Island.	Fish
040301080711-02	Rivers/Streams in HUC 040301080711	Includes: Menominee River, Rosebush Creek and Sawbridge Creek	Fish
040301080712-01	Rivers/Streams in HUC 040301080712	Includes: Menominee River	Fish
040301080803-01	Rivers/Streams in HUC 040301080803	Includes: Boyle Creek and Hays Creek	Water
040301080805-01	Rivers/Streams in HUC 040301080805	Includes: Hugos Brook, Little Cedar River and Little Kelley Creek	Fish
040301080902-01	Rivers/Streams in HUC 040301080902	Includes: Longrie Creek and Shakey River	Fish
040301080902-02	LONG LAKE	W. of Stephenson. Shakey Lakes County Park (Escanaba State Forest).	Fish

AUID	Assessment Unit Name	Location Description	Source of Impairment
040301080906-01	Rivers/Streams in HUC 040301080906	Includes: Menominee River	Fish
040301080907-01	Rivers/Streams in HUC 040301080907	Includes: Harding Creek, Phillips Creek and Woods Creek	Fish
040301080908-01	Rivers/Streams in HUC 040301080908	Includes: Koss Creek and Menominee River	Fish
040301080908-02	Rivers/Streams in HUC 040301080908	Includes: Burke Creek	Fish
040301080909-01	Rivers/Streams in HUC 040301080909	Includes: Menominee River	Fish
040301080913-01	Rivers/Streams in HUC 040301080913	Includes: Chappee Creek, Menominee River, Pine Creek and Sobiesky Creek	Fish and Water
040301080913-02	Rivers/Streams in HUC 040301080913	Includes: Menominee River	Fish and Water
040301090106-01	Rivers/Streams in HUC 040301090106	Includes: Helps Creek, Skidmore Creek, South Branch Ford River and West Branch Ford River	Water
040301090203-01	Rivers/Streams in HUC 040301090203	Includes: Tenmile Creek	Water
040301090404-01	Rivers/Streams in HUC 040301090404	Includes: Indian Creek and Wilson Creek	Water
040301090404-03	Rivers/Streams in HUC 040301090404	Includes: Alder Brook	Water
040301100101-03	ROUND LAKE	2.5 miles north of Champion, within the Escanaba River State Forest.	Fish
040301100102-01	Rivers/Streams in HUC 040301100102	Includes: Black River and Bruce Creek	Water
040301100105-02	GREENWOOD RESERVOIR	Impoundment of the Middle Branch Escanaba River.	Fish
040301100106-02	SCHWEITZER RESERVOIR	Five miles S. of Ishpeming.	Fish
040301100206-02	SHAG LAKE	Three miles SW of Gwinn and located in the headwaters of the Escanaba River watershed.	Fish
040301100303-01	Rivers/Streams in HUC 040301100303	Includes: Chynes Creek, Lindsey Creek, Little West Branch Escanaba River and Lone Pine Creek	Water
040301100308-01	Rivers/Streams in HUC 040301100308	Includes: Bichler Creek, Escanaba River and Silver Creek	Water

AUID	Assessment Unit Name	Location Description	Source of Impairment
040301100308-02	Rivers/Streams in HUC 040301100308	Includes: Escanaba River	Fish and Water
040301100308-03	Rivers/Streams in HUC 040301100308	Includes: Escanaba River and Reno Creek	Water
040301110101-01	Rivers/Streams in HUC 040301110101	Includes: Huber Creek, McMaster Creek, Sucker Creek and West Branch Whitefish River	Water
040301110104-01	Rivers/Streams in HUC 040301110104	Includes: Dexter Creek	Water
040301110205-01	Rivers/Streams in HUC 040301110205	Includes: Tacoosh River	Water
040301120106-01	Unassessed Rivers/Streams in HUC 040301120106	Waters only 'assessed' for Navigation, Agriculture, and Industrial Water Supply	Water
040301120201-02	ROUND LAKE	19 miles SW of Munising in the Hiawatha National Forest.	Fish
040301120204-01	Rivers/Streams in HUC 040301120204	Includes: Eighteenmile Creek, Johnson Creek and Mink Creek	Water
040301120207-01	Rivers/Streams in HUC 040301120207	Includes: Bull Run and Sturgeon River	Water
040301120207-02	Rivers/Streams in HUC 040301120207	Includes: Sturgeon River	Water
040500010104-02	COLDWATER LAKE	S. of Coldwater.	Fish
040500010111-02	RANDALL LAKE CHAIN	Vicinity NW of Coldwater.	Fish
040500010111-04	RANDALL LAKE CHAIN	Vicinity NW of Coldwater.	Fish
040500010111-07	RANDALL LAKE CHAIN	Vicinity NW of Coldwater.	Fish
040500010201-01	Rivers/Streams in HUC 040500010201	Includes: Beebe Creek and all tributaries from Impoundment upstream of Lake Pleasant Road to headwaters.	Water
040500010404-03	PALMER LAKE	Vicinity of Colon.	Fish
040500010502-07	GOURDNECK LAKE	S. of Poratge.	Fish
040500010805-02	Rivers/Streams in HUC 040500010805	Includes: Fawn River and all tributaries from Hinebaugh Drain upstream to Indiana line.	Fish
040500010806-03	Rivers/Streams in HUC 040500010806	Includes: Unnamed Tributary to Fawn River	Fish
040500010807-03	Rivers/Streams in HUC 040500010807	Includes: Fawn River	Fish
040500010808-02	KLINGER LAKE	E. of White Pigeon and W. of Sturgis.	Fish
040500010808-03	THOMPSON LAKE	4 miles NW of Sturgis.	Fish

AUID	Assessment Unit Name	Location Description	Source of Impairment
040500010809-01	Rivers/Streams in HUC 040500010809	Includes: Fawn River and all tributaries, except Sherman Mill Creek, from St. Joseph River confluence upstream to Pickerel Lake outlet.	Fish
040500011107-01	Rivers/Streams in HUC 040500011107	Includes: Pigeon River and all tributaries in Michigan from St. Joseph River confluence upstream to Indiana stateline.	Fish
040500011304-01	Rivers/Streams in HUC 040500011304	Includes: St Joseph River from Mill Creek upstream to Fawn River confluence, includes Black Run.	Water
040500011304-02	Rivers/Streams in HUC 040500011304	Includes: St Joseph River from Pigeon River upstream to Mill Creek	Water
040500012306-01	Rivers/Streams in HUC 040500012306	Includes: Pokagon Creek	Water
040500012503-01	RUSH LAKE	3 miles NW of Hartford.	Fish
040500012503-02	VAN AUKEN LAKE	3 miles NW of Hartford.	Fish
040500012602-01	Rivers/Streams in HUC 040500012602	Includes: Saint Joseph River and Spring Valley Drain	Water
040500012605-01	Rivers/Streams in HUC 040500012605	Includes: Pipestone Creek	Water
040500012605-02	Rivers/Streams in HUC 040500012605	Includes: Pipestone Creek	Water
040500012608-01	Rivers/Streams in HUC 040500012608	Includes: Saint Joseph River	Water
040500012608-02	Rivers/Streams in HUC 040500012608	Includes: Saint Joseph River	Water
040500012608-03	Rivers/Streams in HUC 040500012608	Includes: BIG MEADOW DRAIN	Water
040500012608-05	Rivers/Streams in HUC 040500012608	Includes: Unnamed Tributary to Lake Michigan (Saint Joseph)	Water
040500020201-02	HUTCHINS LAKE	SW of Fennville.	Fish
040500020302-01	Rivers/Streams in HUC 040500020302	Includes: Unnamed Tributary to Bass Creek and Unnamed Tributary to Pigeon River	Fish and Water
040500020302-02	Rivers/Streams in HUC 040500020302	Includes: BLENDON AND OLIVE DRAIN (PIGEON RIVER HEADWATERS)	Water
040500020302-03	Rivers/Streams in HUC 040500020302	Includes: Pigeon River and Sawyer Creek	Water
040500020402-01	Rivers/Streams in HUC 040500020402	Includes: South Branch Macatawa River	Water

AUID	Assessment Unit Name	Location Description	Source of Impairment
040500020408-01	LAKE MACATAWA	Vicinity of Holland (Park and Holland Twps.).	Fish
040500030507-04	GULL LAKE	Vicinity of Midland Park, Yorkville and MSU's Kellogg Biological Station.	Fish
040500030508-01	Rivers/Streams in HUC 040500030508	Includes: Kalamazoo River tributaries from Gull Creek upstream to Wabascon Creek Confluence.	Water
040500030508-04	Rivers/Streams in HUC 040500030508	Includes: WHITFORD LAKE OUTLET downstream to the Kalamazoo River.	Water
040500030508-05	Rivers/Streams in HUC 040500030508	Includes: Unnamed Tributary to Kalamazoo River in Ft. Custer.	Water
040500030508-07	Rivers/Streams in HUC 040500030508	Includes: Kalamazoo River (only-no tributaries) from Gull Creek upstream to Wabascon Creek Confluence.	Water
040500030508-08	Rivers/Streams in HUC 040500030508	Includes: Eagle Creek	Water
040500030509-01	Rivers/Streams in HUC 040500030509	Includes: Kalamazoo River tributaries from Morrow Pond Dam upstream to Gull Creek.	Water
040500030509-03	Rivers/Streams in HUC 040500030509	Includes: Kalamazoo River from Morrow Pond Dam upstream to Gull Creek (Morrow Pond is excluded).	Water
040500030602-04	EAGLE LAKE	W. of Kalamazoo.	Fish
040500030604-01	Rivers/Streams in HUC 040500030604	Includes: Kalamazoo River from Portage Creek confluence upstream to Morrow pond dam. Includes one unnamed tributary below Morrow dam.	Water
040500030604-02	Rivers/Streams in HUC 040500030604	Includes: Davis Creek from Kalamazoo River confluence to Cork Street	Water
040500030604-03	Rivers/Streams in HUC 040500030604	Includes: Davis Creek from Cork Street upstream	Water
040500030606-01	Rivers/Streams in HUC 040500030606	Includes: Kalamazoo River from tributary upstream of G Avenue upstream to Portage Creek confluence. Includes trib from Spring Valley.	Water
040500030606-03	Rivers/Streams in HUC 040500030606	Includes: Kalamazoo River	Water
040500030606-04	Rivers/Streams in HUC 040500030606	Includes: Arcadia Creek	Water

AUID	Assessment Unit Name	Location Description	Source of Impairment
040500030607-01	Rivers/Streams in HUC 040500030607	Includes: Kalamazoo River and some, but not all, tributaries from old Plainwell Dam (downstream of Plainwell) upstream to Spring Brook confluence.	Water
040500030607-02	Rivers/Streams in HUC 040500030607	Includes: Kalamazoo River south split around Plainwell	Water
040500030607-03	Rivers/Streams in HUC 040500030607	Includes: Unnamed Tributary to Kalamazoo River downstream of Kalamazoo at the Kalamazoo Nature Center	Water
040500030607-04	Rivers/Streams in HUC 040500030607	Includes: Silver Creek from Kalamazoo River confluence upstream to headwaters	Water
040500030607-05	Rivers/Streams in HUC 040500030607	Includes: Unnamed Tributary to Kalamazoo River (Chart Creek)	Water
040500030607-06	PINE LAKE	W. of Prairieville.	Fish
040500030701-08	GUN LAKE	Yankee Springs State Recreation Area.	Fish
040500030702-01	FENNER LAKE	NW of Martin (T2N, R11W, S15).	Fish
040500030702-08	FISH LAKE	East of Orangeville.	Fish
040500030803-01	SELKIRK LAKE	Vicinity of Shelbyville	Fish
040500030905-01	Rivers/Streams in HUC 040500030905	Includes: Osgood Drain from Kalamazoo River confluence upstream to Osgood Lake.	Water
040500030905-02	Rivers/Streams in HUC 040500030905	Includes: Kalamazoo River and tributaries, except Pine Creek, Gun River, and Schnable Brook, from Osgood Drain upstream to old dam (removed in 2008) downstream of Plainwell.	Water
040500030906-01	Rivers/Streams in HUC 040500030906	Includes: Kalamazoo River and tributaries from Rossman Creek upstream to Osgood Drain.	Water
040500030907-01	Rivers/Streams in HUC 040500030907	Includes: Kalamazoo River exclusively from Lake Allegan Dam upstream to Rossman Creek.	Water
040500030907-02	Rivers/Streams in HUC 040500030907	Includes: Dumont Creek and tributaries from Kalamazoo River confluence upstream to Dumont Lake.	Water
040500030907-03	Rivers/Streams in HUC 040500030907	Includes: Rossman Creek and tributaries from Kalamazoo River confluence upstream to headwaters.	Water
040500030909-01	Rivers/Streams in HUC 040500030909	Includes: Kalamazoo River from Rabbit River confluence upstream to Lake Allegan Dam.	Water

AUID	Assessment Unit Name	Location Description	Source of Impairment
040500030909-02	Rivers/Streams in HUC 040500030909	Includes: Bear Creek and tributaries from Kalamazoo River confluence upstrean to headwaters.	Water
040500030909-03	Rivers/Streams in HUC 040500030909	Includes: Sand Creek and tributaries from Kalamazoo River confluence upstream to headwaters.	Water
040500030909-04	Rivers/Streams in HUC 040500030909	Includes: Unnamed Tributary to isolated Unnamed Lake	Water
040500030911-01	Rivers/Streams in HUC 040500030911	Includes: Kalamazoo River from Mann Creek upstream to Rabbit River includes an UnNamed Tributary between these points.	Water
040500030911-02	Rivers/Streams in HUC 040500030911	Includes: Peach Orchard Creek and tributaries from Kalamazoo River confluence upstream to headwaters.	Water
040500030911-03	Rivers/Streams in HUC 040500030911	Includes: Kalamazoo River and tributaries from Peach Orchard Creek upstream to Mann Creek.	Water
040500040101-01	Rivers/Streams in HUC 040500040101	Includes: Unnamed Tributary to Willow Creek and Unnamed Tributaries to Little Wolf Lake and Wolf Lake	Fish
040500040102-01	Rivers/Streams in HUC 040500040102	Includes: Grass Lake Drain, Unnamed Tributaries to Grass Lake Drain, Unnamed Tributaries to Center Lake, Grass Lake, Leoni Millpond, and Tims Lake	Fish
040500040103-01	Rivers/Streams in HUC 040500040103	Includes: North Branch Grand River from confluence with Main Branch of Grand River to Center Lake outlet, and Unnamed Tributary to Little Olcott Lake	Fish
040500040103-05	Rivers/Streams in HUC 040500040103	Includes: Unnamed Tributary to Gilletts Lake	Fish
040500040104-01	Rivers/Streams in HUC 040500040104	Includes: Grand River	Fish
040500040105-01	Rivers/Streams in HUC 040500040105	Includes: Grand River and Sharp Creek	Fish and Water
040500040106-01	Rivers/Streams in HUC 040500040106	Includes: Grand River	Fish
040500040106-03	Rivers/Streams in HUC 040500040106	Includes: Grand River	Fish

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040500040201-01	Rivers/Streams in HUC 040500040201	Includes: Cahaogan Creek	Fish
040500040202-01	Rivers/Streams in HUC 040500040202	Includes: Portage River	Fish
040500040203-01	Rivers/Streams in HUC 040500040203	Includes: Thornapple Creek	Fish
040500040204-01	Rivers/Streams in HUC 040500040204	Includes: Honey Creek and Portage River	Fish
040500040204-03	PORTAGE LAKE	NE of Jackson.	Fish
040500040205-01	Rivers/Streams in HUC 040500040205	Includes: Batteese Creek	Fish
040500040206-01	Rivers/Streams in HUC 040500040206	Includes: Batteese Creek and Portage River	Fish
040500040207-01	Rivers/Streams in HUC 040500040207	Includes: Portage River and Wildcat Creek	Fish and Water
040500040208-01	Rivers/Streams in HUC 040500040208	Includes: Huntoon Creek	Fish
040500040209-01	Rivers/Streams in HUC 040500040209	Includes: Grand River, Pleasant Lake Drain, Shaw Branch, Western Creek and Whitney Drain	Fish
040500040210-01	Rivers/Streams in HUC 040500040210	Includes: Albrow Creek and Grand River	Fish
040500040210-02	Rivers/Streams in HUC 040500040210	Includes: Albrow Creek	Fish
040500040301-01	Rivers/Streams in HUC 040500040301	Includes: Sandstone Creek	Fish
040500040302-01	Rivers/Streams in HUC 040500040302	Includes: Mackey Brook and Sandstone Creek	Fish
040500040303-01	Rivers/Streams in HUC 040500040303	Includes: Sandstone Creek	Fish
040500040304-01	Rivers/Streams in HUC 040500040304	Includes: North Onondaga Drain	Fish
040500040305-01	Rivers/Streams in HUC 040500040305	Includes: Otter Creek and Spring Brook	Fish
040500040306-01	Rivers/Streams in HUC 040500040306	Includes: Spring Brook and Willow Creek	Fish
040500040307-01	Rivers/Streams in HUC 040500040307	Includes: Booth Drain and Spring Brook	Fish

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040500040307-02	Rivers/Streams in HUC 040500040307	Includes: Spring Brook	Fish
040500040308-01	Rivers/Streams in HUC 040500040308	Includes: Grand River and Spring Brook	Fish
040500040308-02	Rivers/Streams in HUC 040500040308	Includes: Grand River	Fish
040500040401-01	Rivers/Streams in HUC 040500040401	Includes: Red Cedar River	Fish
040500040401-02	Rivers/Streams in HUC 040500040401	Includes: Red Cedar River	Fish
040500040402-01	Rivers/Streams in HUC 040500040402	Includes: Middle Branch Red Cedar River	Fish and Water
040500040403-01	Rivers/Streams in HUC 040500040403	Includes: Red Cedar River	Fish
040500040403-02	Rivers/Streams in HUC 040500040403	Includes: Red Cedar River	Fish
040500040404-01	Rivers/Streams in HUC 040500040404	Includes: West Branch Red Cedar River	Fish
040500040405-01	Rivers/Streams in HUC 040500040405	Includes: West Branch Red Cedar River	Fish
040500040405-02	Rivers/Streams in HUC 040500040405	Includes: West Branch Red Cedar River	Fish
040500040406-01	Rivers/Streams in HUC 040500040406	Includes: Kalamink Creek	Fish
040500040407-01	Rivers/Streams in HUC 040500040407	Includes: Red Cedar River	Fish
040500040407-02	Rivers/Streams in HUC 040500040407	Includes: Wolf Creek	Fish
040500040407-03	WOLF CREEK	From Morrice Road upstream to headwaters.	Fish
040500040408-01	Rivers/Streams in HUC 040500040408	Includes: Doan Creek	Fish
040500040409-01	Rivers/Streams in HUC 040500040409	Includes: Dietz Creek	Fish
040500040410-01	Rivers/Streams in HUC 040500040410	Includes: Doan Creek and Doan Deer Creek	Fish
040500040411-01	Rivers/Streams in HUC 040500040411	Includes: Red Cedar River and Sullivan Creek	Fish

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040500040411-02	Rivers/Streams in HUC 040500040411	Includes: Red Cedar River	Fish
040500040411-03	Rivers/Streams in HUC 040500040411	Includes: Squaw Creek	Fish
040500040501-01	Rivers/Streams in HUC 040500040501	Includes: Deer Creek	Fish
040500040502-01	Rivers/Streams in HUC 040500040502	Includes: Sloan Creek	Fish
040500040502-02	Rivers/Streams in HUC 040500040502	Includes: Sloan Creek	Fish
040500040503-01	Rivers/Streams in HUC 040500040503	Includes: Unnamed Tributary to Red Cedar River	Fish
040500040503-02	Rivers/Streams in HUC 040500040503	Includes: Deer Creek	Fish
040500040503-03	Rivers/Streams in HUC 040500040503	Includes: Coon Creek and Red Cedar River	Fish
040500040504-01	Rivers/Streams in HUC 040500040504	Includes: Pine Lake Outlet	Fish
040500040505-01	Rivers/Streams in HUC 040500040505	Includes: Mud Creek	Fish
040500040506-01	Rivers/Streams in HUC 040500040506	Includes:Talmadge Drain and Sycamore Creek	Fish
040500040506-04	Rivers/Streams in HUC 040500040506	Includes: Cook and Thorburn Drain from Cedar Lake upstream	Fish
040500040507-01	Rivers/Streams in HUC 040500040507	Includes: Banta Drain and Sycamore Creek	Fish
040500040508-01	Rivers/Streams in HUC 040500040508	Includes: Herron Creek	Fish
040500040508-02	Rivers/Streams in HUC 040500040508	Includes: Red Cedar River	Fish
040500040508-03	Rivers/Streams in HUC 040500040508	Includes: Red Cedar River	Fish
040500040701-01	Rivers/Streams in HUC 040500040701	Includes: Columbia Creek	Fish
040500040702-01	Rivers/Streams in HUC 040500040702	Includes: Grand River	Fish
040500040702-02	Rivers/Streams in HUC 040500040702	Includes: Harris Drain, Skinner Extension Drain and Spicer Creek	Fish

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040500040703-01	Rivers/Streams in HUC 040500040703	Includes: Grand River upstream of Waverly Rd	Fish
040500040703-02	MOORES PARK IMPOUNDMENT	Vicinity of Lansing from the Moores Park Dam u/s to Waverly Road.	Fish
040500040703-03	Rivers/Streams in HUC 040500040703	Includes: Grand River	Fish
040500040704-01	Rivers/Streams in HUC 040500040704	Includes: Unnamed Tributaries to the Grand River	Fish
040500040704-02	Rivers/Streams in HUC 040500040704	Includes: Carrier Creek	Fish
040500040704-03	Rivers/Streams in HUC 040500040704	Includes: Grand River downstream of Waverly Rd, extending to confluence of Carrier Creek	Fish
040500040705-01	Rivers/Streams in HUC 040500040705	Includes: Miller Creek	Fish
040500040705-02	Rivers/Streams in HUC 040500040705	Includes: Grand River	Fish
040500040705-03	Rivers/Streams in HUC 040500040705	Includes: Sandstone Creek	Fish
040500040706-01	Rivers/Streams in HUC 040500040706	Includes: Grand River	Fish
040500040706-03	Rivers/Streams in HUC 040500040706	Includes: Frayer Creek and Grand River	Fish
040500040707-01	Rivers/Streams in HUC 040500040707	Includes: Sebewa Creek, Winchell and Union Drains	Fish
040500040708-01	Rivers/Streams in HUC 040500040708	Includes: Sebewa Creek	Fish
040500040709-01	Rivers/Streams in HUC 040500040709	Includes: Grand River	Fish
040500040710-01	Rivers/Streams in HUC 040500040710	Includes: Friend Brook and Grand River	Fish
040500040710-02	Rivers/Streams in HUC 040500040710	Includes: Goose Creek	Fish
040500050104-03	OVID LAKE	SW. of St. Johns off Price Road.	Fish
040500050301-02	NEVINS LAKE	3 miles SW of Stanton.	Fish
040500060104-03	MONTCALM LAKE	4 miles SW of Six Lakes.	Fish
040500060105-03	RAINBOW LAKE	E. of Trufant.	Fish
040500060107-04	LINCOLN LAKE	NW of Greenville.	Fish

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040500060201-02	WABASIS LAKE, BIG	N. of Grattan.	Fish
040500060202-02	CLIFFORD LAKE	2 miles E. of Langston.	Fish
040500060204-02	LONG LAKE	NE of Belding and W. of Shiloh.	Fish
040500060301-01	Rivers/Streams in HUC 040500060301	Includes: Libhart Creek	Fish
040500060302-01	Rivers/Streams in HUC 040500060302	Includes: Libhart Creek	Fish
040500060302-02	Rivers/Streams in HUC 040500060302	Includes: Ayers Branch and Little Libhart Creek	Fish
040500060302-03	Rivers/Streams in HUC 040500060302	Includes: Libhart Creek	Fish
040500060303-01	Rivers/Streams in HUC 040500060303	Includes: Bacon Creek and Prairie Creek	Fish
040500060304-01	Rivers/Streams in HUC 040500060304	Includes: Prairie Creek	Fish
040500060304-02	Rivers/Streams in HUC 040500060304	Includes: Prairie Creek	Fish
040500060305-01	Rivers/Streams in HUC 040500060305	Includes: Unnamed Tributary to Prairie Creek and Unnamed Tributary near Meade Road	Fish
040500060306-01	Rivers/Streams in HUC 040500060306	Includes: Prairie Creek	Fish
040500060307-01	Rivers/Streams in HUC 040500060307	Includes: Grand River	Water
040500060308-01	Rivers/Streams in HUC 040500060308	Includes: Sessions Creek	Fish
040500060308-03	Rivers/Streams in HUC 040500060308	Includes: Sessions Creek	Fish
040500060308-04	Rivers/Streams in HUC 040500060308	Includes: Sessions Creek	Fish
040500060309-01	Rivers/Streams in HUC 040500060309	Includes: Bellamy Creek, Grand River and Tibbetts Creek	Water
040500060310-01	Rivers/Streams in HUC 040500060310	Includes: Grand River	Water
040500060310-02	Rivers/Streams in HUC 040500060310	Includes: Crooked Creek	Water
040500060310-03	Rivers/Streams in HUC 040500060310	Includes: Red Creek	Water

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040500060310-04	Rivers/Streams in HUC 040500060310	Includes: Timberland Creek	Water
040500060311-01	Rivers/Streams in HUC 040500060311	Includes: Leary Drain, Unnamed Tributary to Morrison Lake, and Unnamed Tributary near Clarksville Road	Fish
040500060311-02	Rivers/Streams in HUC 040500060311	Includes: Lake Creek and Little Creek	Fish
040500060312-01	Rivers/Streams in HUC 040500060312	Includes: Grand River	Water
040500060312-02	Rivers/Streams in HUC 040500060312	Includes: Toles Creek	Water
040500060313-01	Rivers/Streams in HUC 040500060313	Includes: Grand River	Water
040500060313-02	Rivers/Streams in HUC 040500060313	Includes: Lee Creek	Water
040500060313-03	Rivers/Streams in HUC 040500060313	Includes: Unnamed Tributary to Grand River	Water
040500060313-04	Rivers/Streams in HUC 040500060313	Includes: Unnamed Tributary to Grand River	Water
040500060401-03	BILLS LAKE	S. of Croton.	Fish
040500060405-06	Long Lake	Kent County - Entire Lake	Fish
040500060501-01	Rivers/Streams in HUC 040500060501	Includes: Bear Creek and Waddell Creek	Fish
040500060501-02	Rivers/Streams in HUC 040500060501	Includes: Armstrong Creek, Bear Creek and Stout Creek	Fish
040500060502-01	Rivers/Streams in HUC 040500060502	Includes: Bear Creek and Grand River	Water
040500060502-02	Rivers/Streams in HUC 040500060502	Includes: Honey Creek	Water
040500060502-03	Rivers/Streams in HUC 040500060502	Includes: Egypt Creek	Water
040500060502-04	Rivers/Streams in HUC 040500060502	Includes: Unnamed Tributary to Grand River	Water
040500060502-05	Rivers/Streams in HUC 040500060502	Includes: Sunny Creek	Water
040500060503-01	Rivers/Streams in HUC 040500060503	Includes: Unnamed Tributary to Mill Creek	Fish

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040500060503-02	Rivers/Streams in HUC 040500060503	Includes: Strawberry Creek	Fish
040500060503-03	Rivers/Streams in HUC 040500060503	Includes: Mill Creek	Fish
040500060503-04	Rivers/Streams in HUC 040500060503	Includes: Mill Creek	Fish
040500060504-01	Rivers/Streams in HUC 040500060504	Includes: Brandywine Creek and Indian Mill Creek	Fish
040500060504-02	Rivers/Streams in HUC 040500060504	Includes: Indian Mill Creek	Fish and Water
040500060505-01	Rivers/Streams in HUC 040500060505	Includes: Unnamed Tributaries to Plaster Creek	Fish
040500060505-02	Rivers/Streams in HUC 040500060505	Includes: Plaster Creek	Fish
040500060506-01	Rivers/Streams in HUC 040500060506	Includes: Echo Lake Outlet and Unnamed Tributary to Unnamed Lake	Fish
040500060506-02	Rivers/Streams in HUC 040500060506	Includes: Little Plaster Creek, Plaster Creek and Whisky Creek	Fish
040500060507-01	Rivers/Streams in HUC 040500060507	Includes: Grand River	Water
040500060507-02	Rivers/Streams in HUC 040500060507	Includes: York Creek	Water
040500060507-03	Rivers/Streams in HUC 040500060507	Includes: Scott Creek	Water
040500060507-04	Rivers/Streams in HUC 040500060507	Includes: Lamberton Creek	Water
040500060507-05	Rivers/Streams in HUC 040500060507	Includes: LAMBERTON CREEK	Fish and Water
040500060507-06	Rivers/Streams in HUC 040500060507	Includes: Grand River	Water
040500060508-01	Rivers/Streams in HUC 040500060508	Includes: Buck Creek and Sharps Creek	Fish
040500060509-01	Rivers/Streams in HUC 040500060509	Includes: East Branch Rush Creek	Fish
040500060509-02	Rivers/Streams in HUC 040500060509	Includes: East Branch Rush Creek	Fish
040500060510-01	Rivers/Streams in HUC 040500060510	Includes: Unnamed Tributary to Buck Creek	Fish

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040500060510-02	Rivers/Streams in HUC 040500060510	Includes: Buck Creek and Pine Hill Creek	Fish
040500060511-01	Rivers/Streams in HUC 040500060511	Includes: Rush Creek	Fish
040500060511-02	Rivers/Streams in HUC 040500060511	Includes: Rush Creek	Fish
040500060511-04	Rivers/Streams in HUC 040500060511	Includes: Unnamed Tributary to Rush Creek	Fish
040500060512-01	Rivers/Streams in HUC 040500060512	Includes: Grand River	Water
040500060512-02	Rivers/Streams in HUC 040500060512	Includes: Unnamed Tributary to Grand River	Water
040500060512-03	Rivers/Streams in HUC 040500060512	Includes: Grand River	Water
040500060601-01	CROCKERY LAKE	3 miles NE of Conklin.	Fish
040500060601-03	Rivers/Streams in HUC 040500060601	Includes: North Branch Crockery Creek, west of Newaygo Rd.	Fish
040500060601-04	Rivers/Streams in HUC 040500060601	Includes: North Branch Crockery Creek	Fish
040500060601-05	Rivers/Streams in HUC 040500060601	Includes: North Branch Crockery Creek, east of Newaygo Rd	Fish
040500060602-01	Rivers/Streams in HUC 040500060602	Includes: Crockery Creek	Fish
040500060602-04	Rivers/Streams in HUC 040500060602	Includes: Unnamed Tributary to Crockery Creek	Fish
040500060602-05	Rivers/Streams in HUC 040500060602	Includes: Crockery Creek and Ovidhall Lake Creek	Fish
040500060602-06	Rivers/Streams in HUC 040500060602	Includes: Crockery Creek	Fish
040500060603-01	Rivers/Streams in HUC 040500060603	Includes: Crockery Creek	Fish
040500060603-02	Rivers/Streams in HUC 040500060603	Includes: Rio Grande Creek	Fish
040500060604-01	Rivers/Streams in HUC 040500060604	Includes: Crockery Creek	Fish
040500060604-02	Rivers/Streams in HUC 040500060604	Includes: Crockery Creek	Fish

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040500060605-01	Rivers/Streams in HUC 040500060605	Includes: Brandy Creek and Crockery Creek	Fish and Water
040500060701-01	Rivers/Streams in HUC 040500060701	Includes: East Fork Sand Creek and Unnamed Tributaries to East Fork Sand Creek	Fish
040500060702-01	Rivers/Streams in HUC 040500060702	Includes: Sand Creek	Fish
040500060703-01	Rivers/Streams in HUC 040500060703	Includes: Sand Creek	Fish
040500060704-01	Rivers/Streams in HUC 040500060704	Includes: Beaver Creek, Deer Creek and Little Deer Creek	Fish
040500060705-01	Rivers/Streams in HUC 040500060705	Includes: Grand River	Water
040500060705-03	Rivers/Streams in HUC 040500060705	Includes: Ottawa Creek	Water
040500060706-01	Rivers/Streams in HUC 040500060706	Includes: Bass Creek	Fish
040500060707-01	Rivers/Streams in HUC 040500060707	Includes: Bass Creek, Bass River and Little Bass Creek	Fish
040500060707-02	Rivers/Streams in HUC 040500060707	Includes: Bear Creek	Fish
040500060708-01	Rivers/Streams in HUC 040500060708	Includes: Grand River, not including tributaries	Water
040500060708-02	Rivers/Streams in HUC 040500060708	Includes: Tributaries to Grand River	Water
040500060709-01	Rivers/Streams in HUC 040500060709	Includes: Unnamed Tributaries to Pottawattomie Bayou	Fish
040500060710-01	Rivers/Streams in HUC 040500060710	Includes: Norris Creek	Fish
040500060711-02	Rivers/Streams in HUC 040500060711	Includes: Beckwith Brook, Stevens Creek, Vincent Creek and Willow Hill Creek	Fish
040500060711-03	Rivers/Streams in HUC 040500060711	Includes: Norris Creek	Fish
040500060712-02	Rivers/Streams in HUC 040500060712	Includes: Black Creek, Grand River and Lloyd Bayou	Water
040500070105-01	Rivers/Streams in HUC 040500070105	Includes: Thornapple River	Fish

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040500070201-01	Rivers/Streams in HUC 040500070201	Includes: Thornapple River	Fish
040500070201-03	Rivers/Streams in HUC 040500070201	Includes: Darken and Boyer Drain, Cole Wright Helms Drain, and Unnamed Tributaries to Darken and Boyer Drain	Fish
040500070202-01	Rivers/Streams in HUC 040500070202	Includes: Lacey Creek and Unnamed Tributary near Carlisle Highway	Fish
040500070209-01	Rivers/Streams in HUC 040500070209	Includes: High Bank Creek	Fish
040500070209-02	Rivers/Streams in HUC 040500070209	Includes: Mud Creek	Fish
040500070209-04	FINE LAKE	E. of Hickory Corners.	Fish
040500070209-05	BRISTOL LAKE	1 mile SE of Bristol Corners.	Fish
040500070211-01	THORNAPPLE LAKE	SE of Hastings.	Fish
040500070301-01	Rivers/Streams in HUC 040500070301	Includes: Tupper Creek	Fish
040500070301-02	JORDAN LAKE	In the vicinity of Lake Odessa.	Fish
040500070303-01	Rivers/Streams in HUC 040500070303	Includes: Coldwater River, Kart Creek and Messer Brook	Fish
040500070305-01	Rivers/Streams in HUC 040500070305	Includes: Kilgus Branch	Fish
040500070307-03	Rivers/Streams in HUC 040500070307	Includes: Coldwater River	Fish
040500070402-03	Rivers/Streams in HUC 040500070402	Includes: Butler Creek	Fish
040500070402-04	Rivers/Streams in HUC 040500070402	Includes: Pratt Creek and Unnamed Tributary to Pratt Creek	Fish
040500070404-01	Rivers/Streams in HUC 040500070404	Includes: Thornapple River	Fish
040500070405-01	Rivers/Streams in HUC 040500070405	Includes: Duncan Lake Outlet and Wilson Drain	Fish
040500070405-03	Rivers/Streams in HUC 040500070405	Includes: Hanna Lake Outlet and Unnamed Tributary to Hanna Lake	Fish
040500070406-01	Rivers/Streams in HUC 040500070406	Includes: Hill Creek and Thornapple River	Fish
040500070407-02	Rivers/Streams in HUC 040500070407	Includes: Krafts Lake Outlet	Fish

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040500070407-03	Rivers/Streams in HUC 040500070407	Includes: McCords Creek	Fish
040500070407-04	Rivers/Streams in HUC 040500070407	Includes: UNNAMED TRIBUTARY TO THORNAPPLE RIVER	Fish
040601010104-02	HAMLIN LAKE	Vicinity of Hamlin Lakes.	Fish
040601010503-02	Rivers/Streams in HUC 040601010503	Includes: Baldwin River and Bray Creek	Water
040601010503-03	Rivers/Streams in HUC 040601010503	Includes: Sanborn Creek	Water
040601010504-05	Rivers/Streams in HUC 040601010504	Includes: Pere Marquette River	Water
040601010506-01	Rivers/Streams in HUC 040601010506	Includes: Pere Marquette River, not including tributaries	Water
040601010506-02	Rivers/Streams in HUC 040601010506	Includes: Pere Marquette River	Water
040601010507-03	Rivers/Streams in HUC 040601010507	Includes: Pere Marquette River	Water
040601010508-01	Rivers/Streams in HUC 040601010508	Includes: Pere Marquette River	Water
040601010508-02	Rivers/Streams in HUC 040601010508	Includes: Swan Creek	Water
040601010508-03	Rivers/Streams in HUC 040601010508	Includes: India Creek	Water
040601010508-04	Rivers/Streams in HUC 040601010508	Includes: Pere Marquette River	Water
040601010702-01	Rivers/Streams in HUC 040601010702	Includes: Fivemile Creek	Water
040601010704-01	Rivers/Streams in HUC 040601010704	Includes: Rattlesnake Creek and South Branch White River	Water
040601010704-02	Rivers/Streams in HUC 040601010704	Includes: BLACK (DELONG) CREEK	Water
040601010704-03	Rivers/Streams in HUC 040601010704	Includes: BLACK (DELONG) CREEK	Water
040601010704-04	ROBINSON LAKE	Vicinity of Jugville 4 miles SW of White Cloud.	Fish
040601010704-05	Rivers/Streams in HUC 040601010704	Includes: Robinson Creek	Water
040601010901-03	BIG BLUE LAKE	N. of Lakewood.	Fish

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040601010904-01	WHITE LAKE	Vicinity of Montague and Whitehall.	Fish
040601011007-01	Rivers/Streams in HUC 040601011007	Includes: FLOWER CREEK (EXCLUDING N. BR.)	Water
040601011007-02	Rivers/Streams in HUC 040601011007	Includes: FLOWER CREEK	Water
040601011007-03	Rivers/Streams in HUC 040601011007	Includes: North Branch Flower Creek	Water
040601020101-02	HIGGINS LAKE	Vicinity of Roscommon.	Fish
040601020302-05	LAKE MITCHELL	W. of Cadillac.	Fish
040601020501-03	LILY LAKE	NE of Lake George.	Fish
040601020603-03	TODD LAKE	W. of Slaybaugh Corner.	Fish
040601020701-01	Rivers/Streams in HUC 040601020701	Includes: Brown Creek and Unnamed Tributaries near One Mile Road (Osceola County) and 130th Ave (Mecosta County)	Water
040601020701-02	Rivers/Streams in HUC 040601020701	Includes: Blodgett Creek, Buckhorn Creek and Muskegon River	Water
040601020806-02	LITTLE WHITEFISH LAKE	3 miles NW of Pierson.	Fish
040601020809-01	Rivers/Streams in HUC 040601020809	Includes: Rice Creek and Tamarack Creek	Water
040601020901-02	CROTON DAM POND	Vicinity of Croton and Croton Heights.	Fish
040601020902-02	Rivers/Streams in HUC 040601020902	Includes: Bigelow Creek and Cold Creek	Fish
040601020903-01	Rivers/Streams in HUC 040601020903	Includes: Muskegon River excluding 1 mile stretch below Croton Dam	Fish
040601020903-04	SYLVAN LAKE AND EMERALD LAKES	Reaches contained in HUC 040601020903	Fish
040601020903-05	Rivers/Streams in HUC 040601020903	Includes: Muskegon River from Croton dam downstream 1 mile	Fish
040601020904-01	Rivers/Streams in HUC 040601020904	Includes: Fourmile Creek and Muskegon River	Fish
040601020904-02	Rivers/Streams in HUC 040601020904	Includes: Brooks Creek	Fish
040601020905-03	FREMONT LAKE	SHERIDAN TWP., near city of Freemont (T12N, R14W, S2,3,4,9,10,11)	Fish
040601020905-04	Rivers/Streams in HUC 040601020905	Includes: Brooks Creek and Cow Creek	Fish

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040601020905-11	Rivers/Streams in HUC 040601020905	Includes: Butler Creek and Williams Creek	Water
040601020906-01	Rivers/Streams in HUC 040601020906	Includes: Greenwood Creek and Muskegon River	Fish
040601020906-02	Rivers/Streams in HUC 040601020906	Includes: Sand Creek	Fish
040601020906-03	Rivers/Streams in HUC 040601020906	Includes: Minnie Creek	Fish
040601020906-04	Rivers/Streams in HUC 040601020906	Includes: Minnie Creek	Fish
040601021002-04	Rivers/Streams in HUC 040601021002	Includes: Maple River, Middle Channel Muskegon River, Mosquito Creek, Muskegon River and Spring Creek	Fish
040601021004-03	Rivers/Streams in HUC 040601021004	Includes: Middle Channel Muskegon River	Fish
040601030104-04	LAKE MARGRETHE	SW of Grayling.	Fish
040601030301-01	Rivers/Streams in HUC 040601030301	Includes: Anderson Creek and West Branch Anderson Creek	Water
040601030307-01	Rivers/Streams in HUC 040601030307	Includes: Perkins Creek and Slagle Creek	Water
040601030505-01	Rivers/Streams in HUC 040601030505	Includes: Bear Creek, Boswell Creek, Cedar Creek, Chicken Creek and Podunk Creek	Water
040601040103-04	NORTH LAKE LEELANAU	Vicinity of Leland.	Fish
040601040202-01	LAKE ANN	Vicinity of Lake Ann.	Fish
040601040302-03	GREEN LAKE	Vicinity of Interlochen.	Fish
040601040402-01	GLEN LAKE	South of Glen Arbor.	Fish
040601040405-02	PORTAGE LAKE	Vicinity of Onekama.	Fish
040601050102-02	WALLOON LAKE	Vicinity of Walloon Lake.	Fish
040601050204-02	DEER LAKE	3 miles SE of Boyne City.	Fish
040601050301-03	SIX MILE LAKE	4 miles SW of East Jordan.	Fish
040601050302-06	ELLSWORTH LAKE	Vicinity of Ellsworth.	Fish
040601050304-08	LAKE BELLAIRE	Vicinity of Bellaire.	Fish
040601050305-01	TORCH LAKE	Vicinity of Eastport.	Fish
040601050404-02	ELK LAKE	Vicinity of Elk Rapids.	Fish
040601050501-01	Rivers/Streams in HUC 040601050501	Includes: Crofton Creek, Failing Creek, Hauenstein Creek, North Branch Boardman River and Palmer Creek	Fish

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040601050502-01	Rivers/Streams in HUC 040601050502	Includes: South Branch Boardman River and Taylor Creek	Fish
040601050503-01	Rivers/Streams in HUC 040601050503	Includes: North Branch Boardman River	Fish
040601050504-01	Rivers/Streams in HUC 040601050504	Includes: Boardman River, Carpenter Creek and Twentytwo Creek	Fish
040601050504-02	BROWN BRIDGE POND	Impoundment of the Boardman River NE of Mayfield.	Fish
040601050506-02	ARBUTUS LAKE	SE of Traverse City.	Fish
040601050507-05	BASS LAKE	SW of Traverse City.	Fish
040601050507-07	SILVER LAKE	6 miles SW of Traverse City.	Fish
040601060103-03	MANISTIQUE LAKE	13 miles SW of Dollarville.	Fish
040601060201-02	WEST BRANCH LAKES	T48N, R14W, Sec. 31.	Fish
040601060207-01	Rivers/Streams in HUC 040601060207	Includes: Dead Creek	Water
040601060402-02	BOOT LAKE	13 miles NW of Hiawatha.	Fish
040601060411-01	Rivers/Streams in HUC 040601060411	Includes: Bear Slough, Brace Creek, Hay Meadow Creek, Hiawatha Creek and Stutts Creek	Water
040601060603-03	Dodge Lake	1 Mile South of Hiawatha	Fish
040601060604-01	Rivers/Streams in HUC 040601060604	Includes: Manistique River	Water
040601060604-02	Rivers/Streams in HUC 040601060604	Includes: Manistique River	Fish and Water
040601070203-01	Rivers/Streams in HUC 040601070203	Includes: Doe Creek	Water
040601070203-02	Rivers/Streams in HUC 040601070203	Includes: Furlong Creek	Water
040601070203-03	Rivers/Streams in HUC 040601070203	Includes: East Branch Furlong Creek, West Branch Furlong Creek, and Furlong Creek	Water
040601070204-05	MILLECOQUINS LAKE	NW of Naubinway.	Fish
040601070209-01	MILAKOKIA LAKE	W. of Gould City.	Fish
040601070211-05	GULLIVER LAKE	Vicinity of Gulliver, S of R#2.	Fish
040700010201-01	Rivers/Streams in HUC 040700010201	Includes: Munuscong River	Water
040700010204-01	Rivers/Streams in HUC 040700010204	Includes: Munuscong River	Water

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040700020101-01	Rivers/Streams in HUC 040700020101	Includes: Carp River and Ozark Creek	Water
040700020101-02	CARP LAKE (AKA: TROUT LAKE)	Vicinity of the community of Trout Lake (SW corner of Chippewa Co.).	Fish
040700020207-01	Rivers/Streams in HUC 040700020207	Includes: Bear Creek and Little Bear Creek	Water
040700020207-02	Rivers/Streams in HUC 040700020207	Includes: Bear Creek	Water
040700020211-01	Rivers/Streams in HUC 040700020211	Includes: Crooked Creek, Garden Hill Creek, Home Creek, Pine River and Rock Spring Creek	Water
040700020211-02	Rivers/Streams in HUC 040700020211	Includes: Pine River	Water
040700020301-03	CARIBOU LAKE	West of DeTour Village.	Fish
040700030201-02	EMMA LAKE	15 miles SW of Rogers City, E. of Rt. F21.	Fish
040700030202-02	NETTIE LAKE	SE of Millersburg.	Fish
040700030202-03	LOST LAKE	West of Hawks, east of Nettie Lake.	Fish
040700040202-02	PICKEREL LAKE	SE of Alanson.	Fish
040700040208-05	CROOKED LAKE	Vicinity of Oden and Ponshewaing.	Fish
040700040209-06	BURT LAKE	Vicinity of Indian River.	Fish
040700040403-06	MULLETT LAKE	S. of Cheboygan and E. of Burt Lake.	Fish
040700050302-02	Rivers/Streams in HUC 040700050302	Includes: Black River, Fisher Creek and Stewart Creek	Water
040700060101-02	BEAVER LAKE	SE of Fletcher Pond and SW of Alpena.	Fish
040700060204-02	FLETCHER POND	16 miles SW of Alpena.	Fish
040700060301-02	GAYLANTA LAKE	1 mile W. of Bigelow.	Fish
040700060401-02	ESS LAKE	13 miles NE of Atlanta in Mackinaw State Forest.	Fish
040700060401-03	LONG LAKE	5.5 miles NW of Hillman.	Fish
040700060503-01	Rivers/Streams in HUC 040700060503	Includes: Fish Creek, Pettis Creek, Sucker Creek and Vincent Creek	Water
040700060504-02	HUBBARD LAKE	Vicinity of Backus Beach.	Fish
040700060603-01	Rivers/Streams in HUC 040700060603	Includes: Gaffney Creek and Thunder Bay River	Water
040700060604-01	LAKE WINYAH (AKA: SEVEN MILE POND) OF THUNDER BAY RIVER	7 Miles NW of Alpena.	Fish
040700060605-01	LAKE BESSER	Vicinity of Alpena u/s from Ninth Street Dam.	Fish

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040700060605-03	FOURMILE POND	Thunder Bay area.	Fish
040700070704-01	ALCONA DAM POND	Vicinity of the Alcona County Park NW of Bamfield and Glennie off Hwy-F32.	Fish
040700070709-01	Rivers/Streams in HUC 040700070709	Includes: Au Sable River below Foote dam and Old Au Sable River	Fish
040801010203-01	Rivers/Streams in HUC 040801010203	Includes: Guiley Creek	Water
040801010203-02	Rivers/Streams in HUC 040801010203	Includes: Picket Creek	Water
040801010204-01	Rivers/Streams in HUC 040801010204	Includes: Manary Creek, Saddler Creek and Sand Creek	Water
040801010204-02	FLOYD LAKE	8.5 miles NW of Tawas City.	Fish
040801010307-01	Rivers/Streams in HUC 040801010307	Includes: Au Gres River and Burnt Drain	Water
040801010307-02	Rivers/Streams in HUC 040801010307	Includes: Old Channel East Branch Au Gres and Tributaries	Water
040801010410-04	HARDWOOD LAKE	NW corner of Richland Twp.	Fish
040801010411-01	Rivers/Streams in HUC 040801010411	Includes: Saverine Creek and Unnamed Tributaries to Saverine Creek	Fish
040801010412-01	Rivers/Streams in HUC 040801010412	Includes: Rifle River and Unnamed Tributaries to Rifle River	Fish
040801010412-03	Rivers/Streams in HUC 040801010412	Includes: Rifle River	Fish and Water
040801010501-01	Rivers/Streams in HUC 040801010501	Includes: Chub Creek and Plains Creek	Water
040801010502-01	Rivers/Streams in HUC 040801010502	Includes: Old Channel (Rifle River) and Unnamed Tributaries to Old Channel (Rifle River)	Fish
040801020201-01	Rivers/Streams in HUC 040801020201	Includes: Kawkawlin Creek and North Branch Kawkawlin River	Water
040801020205-01	Rivers/Streams in HUC 040801020205	Includes: Crump Drain, Kawalski Drain, Monison Drain, North Branch Kawkawlin River and Renner Drain	Water
040801020205-02	Rivers/Streams in HUC 040801020205	Includes: Bedell Drain and North Branch Kawkawlin River	Water
040801020205-03	Rivers/Streams in HUC 040801020205	Includes: Hembling Drain, McNally Drain, and Unnamed Tributaries to Hembling Drain	Water

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040801040101-01	Rivers/Streams in HUC 040801040101	Includes: East Branch Willow Creek	Water
040802010201-07	CRANBERRY LAKE	NE of Harrison.	Fish
040802010203-02	PRATT LAKE	4 miles NW of Gladwin.	Fish
040802010303-03	FIVE LAKES	NW of Clare.	Fish
040802010402-01	Rivers/Streams in HUC 040802010402	Includes: South Branch Little Sugar River	Water
040802010407-02	WIXOM LAKE	Impoundment of Tittabawassee River u/s of Edenville and Rt. 30 and about 16 miles NW of Midland.	Fish
040802010408-01	Rivers/Streams in HUC 040802010408	Includes: Tittabawassee River and Varity Creek	Fish
040802010408-02	Rivers/Streams in HUC 040802010408	Includes: Black Creek	Fish
040802010408-03	SANFORD LAKE	NW of Midland at Sanford.	Fish
040802010507-01	Rivers/Streams in HUC 040802010507	Includes: Salt River	Water
040802010601-01	Rivers/Streams in HUC 040802010601	Includes: Carrol Creek Drain	Fish
040802010602-01	Rivers/Streams in HUC 040802010602	Includes: Grass Creek and Sturgeon Creek	Fish
040802010603-01	Rivers/Streams in HUC 040802010603	Includes: Unnamed Tributary to Newell Drain	Fish
040802010603-02	Rivers/Streams in HUC 040802010603	Includes: Branch Number Two, Jacobs Drain, Miller Drain, Newell Drain and Sturgeon Creek	Fish
040802010604-02	Rivers/Streams in HUC 040802010604	Includes: Averill Creek, Prairie Creek, and Tittabawassee River	Fish
040802010604-03	Rivers/Streams in HUC 040802010604	Includes: Tittabawassee River downstream from 460 feet downstream of Poseyville Road	Fish
040802010605-01	Rivers/Streams in HUC 040802010605	Includes: Bullock Creek, Duncan Drain, Kneeland Drain, and Unnamed Tributaries to Bullock Creek	Fish
040802010606-01	Rivers/Streams in HUC 040802010606	Includes: Tittabawassee River	Fish
040802010606-02	Rivers/Streams in HUC 040802010606	Includes: Tittabawassee River	Fish

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040802010606-03	Rivers/Streams in HUC 040802010606	Includes: Lingle Drain, Sarle Drain, Shaffner Drain, Brown and Mills Drain	Fish
040802010607-01	Rivers/Streams in HUC 040802010607	Includes: Tittabawassee River	Fish and Water
040802010607-02	Rivers/Streams in HUC 040802010607	Includes: Tributaries to the Tittabawassee River	Fish and Water
040802020204-03	LITTLEFIELD LAKE	N. of Weidman.	Fish
040802020204-07	COLDWATER LAKE	NW Mt. Pleasant and S. of Weidman.	Fish
040802020205-04	STEVENSON LAKE	5 miles SW of Clare W. of US-27.	Fish
040802020207-01	Rivers/Streams in HUC 040802020207	Includes: Chippewa River, Johnson Creek and Stony Brook	Water
040802020207-02	Rivers/Streams in HUC 040802020207	Includes: Chippewa River	Fish
040802020207-03	Rivers/Streams in HUC 040802020207	Includes: Chippewa River	Fish
040802020207-04	Rivers/Streams in HUC 040802020207	Includes: Chippewa River	Fish
040802020207-05	Rivers/Streams in HUC 040802020207	Includes: Cedar Creek	Fish
040802020304-02	Rivers/Streams in HUC 040802020304	Includes: UNNAMED TRIBUTARY TO WOLF CREEK	Water
040802020304-04	ROCK LAKE	NW of Vestaburg. E. of Pine Grove; E. of Pine Grove Road and N. or M-46.	Fish
040802020312-03	ALMA IMPOUNDMENT	Impoundment of the Pine River in the vicinity of Alma.	Fish
040802020403-01	Rivers/Streams in HUC 040802020403	Includes: Pine River	Water
040802020403-02	Rivers/Streams in HUC 040802020403	Includes: Sugar Creek	Water
040802020403-03	Rivers/Streams in HUC 040802020403	Includes: Pine River	Water
040802020403-04	ST. LOUIS IMPOUNDMENT	St. Louis Impoundment of Pine River in the vicinity of St. Louis.	Fish and Water
040802020403-05	Rivers/Streams in HUC 040802020403	Includes: Horse Creek	Water
040802020501-01	Rivers/Streams in HUC 040802020501	Includes: Chippewa River and Mission Creek	Fish

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040802020502-01	Rivers/Streams in HUC 040802020502	Includes: Parcher Drain and Salt Creek	Fish
040802020503-01	Rivers/Streams in HUC 040802020503	Includes: Childs Creek and Salt Creek	Fish
040802020504-01	Rivers/Streams in HUC 040802020504	Includes: Onion Creek and Potter Creek	Fish
040802020504-02	Rivers/Streams in HUC 040802020504	Includes: Potter Creek	Fish
040802020505-01	Rivers/Streams in HUC 040802020505	Includes: Black Creek, Salt Creek and Thrasher Creek	Fish
040802020506-01	Rivers/Streams in HUC 040802020506	Includes: Little Salt Creek	Fish
040802020506-02	Rivers/Streams in HUC 040802020506	Includes: Little Salt Creek	Fish
040802020507-01	Rivers/Streams in HUC 040802020507	Includes: Little Salt Creek and Turkey Creek	Fish
040802020508-01	Rivers/Streams in HUC 040802020508	Includes: Chippewa River	Fish
040802020508-02	Rivers/Streams in HUC 040802020508	Includes: Chippewa River	Fish
040802020508-03	Rivers/Streams in HUC 040802020508	Includes: Chippewa River	Fish
040802020508-04	Rivers/Streams in HUC 040802020508	Includes: Chippewa River	Fish
040802030104-01	Rivers/Streams in HUC 040802030104	Includes: Bogue Creek	Fish
040802030104-02	THOMPSON LAKE	Vicinity of Howell.	Fish
040802030108-08	LAKE PONEMAH	NW of Fenton.	Fish
040802030108-09	FENTON LAKE	Vicinity of Fenton.	Fish
040802030109-05	LOBDELL LAKE	2 miles SW of Linden (Argentine Twp.).	Fish
040802030209-01	Rivers/Streams in HUC 040802030209	Includes: Shiawassee River	Water
040802030309-01	Rivers/Streams in HUC 040802030309	Includes: Bad River and Shad Creek	Water
040802030310-01	Rivers/Streams in HUC 040802030310	Includes: South Fork Bad River	Water
040802030410-02	Rivers/Streams in HUC 040802030410	Includes: Ferguson Bayou	Water

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040802030410-03	Rivers/Streams in HUC 040802030410	Includes: Shiawassee River	Water
040802030410-04	Rivers/Streams in HUC 040802030410	Includes: Unnamed Tributaries to Shiawassee River	Water
040802030410-05	Rivers/Streams in HUC 040802030410	Includes: Marsh Creek	Water
040802030410-06	Rivers/Streams in HUC 040802030410	Includes: Shiawassee River	Water
040802040104-03	LAKE NEPESSING	SW of Lapeer, Elba Twp.	Fish
040802040106-01	Rivers/Streams in HUC 040802040106	Includes: Sand Hill Drain and South Branch Flint River	Water
040802040302-02	BIG SEVEN LAKE (SEVEN LAKES)	2.5 miles NW of Holly.	Fish
040802040303-05	WILDWOOD LAKE	5 miles E. of Holly.	Fish
040802040306-01	Rivers/Streams in HUC 040802040306	Includes: Thread Creek	Water
040802040306-02	Rivers/Streams in HUC 040802040306	Includes: Bush Creek, Pierson Branch and Thread Creek	Water
040802040408-01	Rivers/Streams in HUC 040802040408	Includes: Chipmunk Creek and Kearsley Creek	Water
040802040408-02	Rivers/Streams in HUC 040802040408	Includes: Kearsley Creek	Water
040802040513-01	Rivers/Streams in HUC 040802040513	Includes: Atwell Drain, Flint River, Pitch Creek and Spring Brook Drain	Water
040802040513-02	Rivers/Streams in HUC 040802040513	Includes: Flint River	Water
040802050101-01	Rivers/Streams in HUC 040802050101	Includes: South Branch Cass River	Fish
040802050102-01	Rivers/Streams in HUC 040802050102	Includes: Carter Drain and Unnamed Tributaries to Carter Drain	Fish
040802050102-02	Rivers/Streams in HUC 040802050102	Includes: Duff Creek and South Branch Cass River	Fish
040802050103-01	Rivers/Streams in HUC 040802050103	Includes: South Branch Cass River	Fish
040802050104-01	Rivers/Streams in HUC 040802050104	Includes: Argyle Drain, Carson Drain, Hartel Drain, Middle Branch Cass River and Sanderson Drain	Fish

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040802050105-01	Rivers/Streams in HUC 040802050105	Includes: Hawksworth Drain, Kramp Drain, McIntyre Drain, Middle Branch Cass River, Swan Drain and Wheeler Drain	Fish
040802050106-01	Rivers/Streams in HUC 040802050106	Includes: South Branch Cass River and Stony Creek	Fish
040802050106-02	Rivers/Streams in HUC 040802050106	Includes: Ryder Drain and Turtle Creek	Fish
040802050106-03	Rivers/Streams in HUC 040802050106	Includes: Beaver Creek, Kirby Drain, Middle Branch Cass River, South Branch Cass River, Tank Drain and Temple Drain	Fish
040802050107-01	Rivers/Streams in HUC 040802050107	Includes: Brown Drain, Osentoski Branch, Schiestel Drain and South Fork Cass River	Fish
040802050108-01	Rivers/Streams in HUC 040802050108	Includes: North Branch Cass River	Fish
040802050109-01	Rivers/Streams in HUC 040802050109	Includes: North Branch Cass River and Sanilac Huron Creek	Fish
040802050110-01	Rivers/Streams in HUC 040802050110	Includes: Greenman Creek and South Branch Cass River	Fish
040802050205-01	Rivers/Streams in HUC 040802050205	Includes: Cass River	Fish
040802050207-01	Rivers/Streams in HUC 040802050207	Includes: Cass River	Fish
040802050207-02	Rivers/Streams in HUC 040802050207	Includes: Butternut Creek, Cass River, and Tributaries to the Cass River	Fish
040802050208-01	Rivers/Streams in HUC 040802050208	Includes: Cass River	Fish
040802050208-02	CARO IMPOUNDMENT	Vicinity of Caro u/s.	Fish
040802050301-02	MURPHY LAKE	NE of Millington and SW of Mayville.	Fish
040802050303-01	Rivers/Streams in HUC 040802050303	Includes: Millington Creek	Water
040802050303-02	Rivers/Streams in HUC 040802050303	Includes: Cass River	Water
040802050304-01	Rivers/Streams in HUC 040802050304	Includes: Carpenter Branch, Dead Creek and Zehender Drain	Fish
040802050304-02	Rivers/Streams in HUC 040802050304	Includes: Dead Creek	Fish
040802050305-01	Rivers/Streams in HUC 040802050305	Includes: Cass River, not including tributaries.	Fish

AUID	Assessment Unit Name	Location Description	Source of Impairment
040802050305-03	Rivers/Streams in HUC 040802050305	Includes: Cass River	Fish
040802050305-04	Rivers/Streams in HUC 040802050305	Includes: Unnamed trib to the Cass River, east of Frankenmuth	Fish
040802050305-05	Rivers/Streams in HUC 040802050305	Includes: Coles Creek and Unnamed Tributaries to the Cass River	Fish
040802050306-01	Rivers/Streams in HUC 040802050306	Includes: Cass River	Fish and Water
040802050306-03	Rivers/Streams in HUC 040802050306	Includes: Cass River	Fish and Water
040802060201-01	Rivers/Streams in HUC 040802060201	Includes: Saginaw River and Unnamed Tributaries to Saginaw River	Water
040802060204-01	Rivers/Streams in HUC 040802060204	Includes: Saginaw River	Water
040802060204-03	Rivers/Streams in HUC 040802060204	Includes: Saginaw River and Unnamed Tributaries to Saginaw River	Water
040900010214-01	Rivers/Streams in HUC 040900010214	Includes: Black River, Brandymore Drain, Howe Drain, Price Drain, Stocks Creek, Unnamed Tributaries to Black River, Unnamed Tributaries to Brandymore Drain, Unnamed Tributaries to Howe Drain, and Unnamed Tributariest to Stocks Creek	Water
040900010214-02	Rivers/Streams in HUC 040900010214	Includes: Black River	Water
040900010407-01	Rivers/Streams in HUC 040900010407	Includes: Belle River Including Tributaries	Water
040900010407-02	Rivers/Streams in HUC 040900010407	Includes: WEBSTER DRAIN	Water
040900030103-08	MACEDAY LAKE	Vicinity of Waterford.	Fish
040900030106-02	LAKEVILLE LAKE	Vicinity of Lakeville NW of Romeo.	Fish
040900030108-03	CASS LAKE	Vicinity of Keego Harbor and West Bloomfield.	Fish
040900030109-02	STONY CREEK IMPOUNDMENT	Stony Creek Metropolitan Park, vicinity of Romeo.	Fish
040900030306-01	Rivers/Streams in HUC 040900030306	Includes: Armada and Ray Drain, Coon Creek, Priest Drain, Tupper Brook, Unnamed Tributaries to Coon Creek, and Unnamed Tributary to Priest Drain	Water

AUID	Assessment Unit Name	Location Description	Source of Impairment
040900030309-01	Rivers/Streams in HUC 040900030309	Includes: Bannister Drain, Crittenden Drain, Decker Drain, Dunn Drain, Harris Drain, Kenner Drain, Lewis Drain, Longstaff Drain, Longstaff Drain Number Two, Shoemaker Drain, Unnamed Tributary to Middle Branch Clinton River, and Utica Drain	Water
040900030310-02	Rivers/Streams in HUC 040900030310	Includes: North Branch Clinton River and Wyman Drain	Fish
040900030402-01	Rivers/Streams in HUC 040900030402	Includes: Clinton River and Unnamed Tributaries to Clinton River	Water
040900030402-02	Rivers/Streams in HUC 040900030402	Includes: Clinton River from Gratiot Avenue downstream to the mouth	Water
040900030402-03	Rivers/Streams in HUC 040900030402	Includes: Clinton River	Water
040900030402-04	Rivers/Streams in HUC 040900030402	Includes: Clinton River, Cranberry Marsh Drain, Faulman Drain, Hildebrandt Drain, Kukuk Drain, and Unnamed Tributaries to Clinton River	Water
040900040103-01	Rivers/Streams in HUC 040900040103	Includes: Smith Drain and Upper River Rouge	Water
040900040103-02	Rivers/Streams in HUC 040900040103	Includes: Seeley Drain	Water
040900040103-03	Rivers/Streams in HUC 040900040103	Includes: Minnow Pond Drain	Water
040900040201-01	Rivers/Streams in HUC 040900040201	Includes: Johnson Drain	Water
040900040201-02	Rivers/Streams in HUC 040900040201	Includes: Sump Drain	Water
040900040201-03	Rivers/Streams in HUC 040900040201	Includes: Johnson Drain	Water
040900040203-05	WALLED LAKE	Vicinity of Novi.	Fish
040900040203-09	NEWBURGH LAKE	Middle River Rouge impoundment in the vicinity of Plymouth.	Fish
040900040301-01	Rivers/Streams in HUC 040900040301	Includes: Fellows Creek, Green Drain, Ingall Drain, North Branch Fellows Creek, South Branch Fellows Creek and Truesdell Drain	Water
040900040406-01	Rivers/Streams in HUC 040900040406	Includes: Ashcroft-Sherwood Drain, Rouge, River and Shaw Drain	Water

AUID	Assessment Unit Name	Location Description	Source of Impairment
040900040407-01	Rivers/Streams in HUC 040900040407	Includes: Rouge, River	Water
040900050102-07	MIDDLE STRAITS LAKE	W. of W. Bloomfield.	Fish
040900050102-08	UNION LAKE	7 miles SW of Pontiac.	Fish
040900050104-02	WHITE LAKE	SW of White Lake.	Fish
040900050105-04	UPPER PROUD LAKE	W. of W. Bloomfield. Proud Lake State Recreation Area.	Fish
040900050203-03	FOUR MILE LAKE	West of Dexter and NE of Chelsea in the Chelsea State Game Area.	Fish
040900050301-02	WHITMORE LAKE	Vicinity of Whitmore Lake.	Fish
040900050303-01	Rivers/Streams in HUC 040900050303	Includes: Honey Creek and Unnamed Tributary to Honey Creek	Water
040900050303-03	Rivers/Streams in HUC 040900050303	Includes: HONEY CREEK	Water
040900050306-10	SOUTH LAKE	N. of Lyndon Center.	Fish
040900050307-12	BISHOP LAKE	Brighton State Recreation Area.	Fish
040900050307-18	Chenango Lake	Entire Lake	Fish
040900050308-02	SECOND SISTER LAKE	W. of Ann Arbor.	Fish
040900050403-01	UNNAMED LAKE	S. of Ford Lake in the NE corner of Sec. 26, T3S, R7E (Textile Road and Burton Road).	Fish
040900050407-01	Rivers/Streams in HUC 040900050407	Includes: WAGNER-PINK DRAIN	Water
040900050407-02	Rivers/Streams in HUC 040900050407	Includes: Huron River, Bancroft Noles Drain, Brook Drain, Hale Drain, Regan Drain, Vandecar Drain, Unnamed Tributary to Huron River, and Warner Drain	Water
040900050407-03	Rivers/Streams in HUC 040900050407	Includes: Huron River	Water
040900050407-04	Rivers/Streams in HUC 040900050407	Includes: Huron River	Water
040900050407-05	Rivers/Streams in HUC 040900050407	Includes: Baker and Green Drain, Port Creek, Unnamed Tributary to Port Creek, and Van Hountin Drain	Water
041000010107-01	Rivers/Streams in HUC 041000010107	Includes: AMOS PALMER DRAIN, N. BR.	Water
041000010107-02	Rivers/Streams in HUC 041000010107	Includes: Stony Creek including Tributaries	Water

AUID	Assessment Unit Name	Location Description	Source of Impairment
041000010107-03	Rivers/Streams in HUC 041000010107	Includes: Ross Drain	Water
041000010201-01	Rivers/Streams in HUC 041000010201	Includes: PLUM CREEK	Water
041000010302-01	Rivers/Streams in HUC 041000010302	Includes: HALFWAY CREEK	Water
041000020101-03	CLARK LAKE	NW of Brooklyn.	Fish
041000020106-02	SAND LAKE	8 miles west of Clinton off US-12.	Fish
041000020106-03	WAMPLERS LAKE	Vicinity of Oak Shade Park.	Fish
041000020202-01	Rivers/Streams in HUC 041000020202	Includes: Cadmus Drain, Harrison Drain, Nash Drain, South Branch River Raisin, Stony Creek, Unnamed Tributary to Harrison Drain, and Unnamed Tributaries to South Branch River Raisin	Water
041000020302-01	Rivers/Streams in HUC 041000020302	Includes: Bear Creek	Water
041000020302-02	Rivers/Streams in HUC 041000020302	Includes: Bear Creek	Water
041000020302-03	Rivers/Streams in HUC 041000020302	Includes: Camp Drain, J B Drain, Hudson Lake from the outlet upstream to include Bear Creek, Hennings Drain, Tucker Drain, and Unnamed Tribs	Water
041000020302-05	Rivers/Streams in HUC 041000020302	Includes: Baker and May Drain, Hoadley Drain, and Unnamed Tributaries to Baker and May Drain	Water
041000020302-06	Rivers/Streams in HUC 041000020302	Includes: Rice Lake Drain	Water
041000020306-01	Rivers/Streams in HUC 041000020306	Includes: Big Meadow Drain, Grinnel Drain, Bixby Drain, and Unnamed Tribs	Water
041000020306-02	Rivers/Streams in HUC 041000020306	Includes: Unnamed Tributary to Big Meadow Drain	Water
041000020306-03	Rivers/Streams in HUC 041000020306	Includes: Big Meadow Drain	Water
041000020310-01	Rivers/Streams in HUC 041000020310	Includes: River Raisin	Fish
041000020404-01	Rivers/Streams in HUC 041000020404	Includes: MACON CREEK	Water

AUID	Assessment Unit Name	Location Description	Source of Impairment
041000020410-01	Rivers/Streams in HUC 041000020410	Includes: Barnaby Drain, Brost Drain, Brown Drain, Burdeau Drain, Karm Drain, Mason Run, Middle Branch Willow Run, Moore Drain, North Branch Willow Run, River Raisin, Sietz Drain, Unnamed Tributary to River Raisin, and Willow Run	Water
041000020410-02	Rivers/Streams in HUC 041000020410	Includes: River Raisin and Unnamed Tributary to River Raisin	Water
041000020410-03	Rivers/Streams in HUC 041000020410	Includes: River Raisin and Unnamed Tributary to River Raisin	Water
041000060106-01	Rivers/Streams in HUC 041000060106	Includes: BEAN CREEK	Water
041000060106-02	Rivers/Streams in HUC 041000060106	Includes: BEAN CREEK	Water
041000060106-03	Rivers/Streams in HUC 041000060106	Includes: MEDINA DRAIN	Water

APPENDIX B.
POINT SOURCES WITH NPDES PERMIT LIMITATIONS FOR MERCURY

Facility Name	Permit No.	Monitoring Point	Permitted Flow (MGD)
Mt Pleasant WWTP	M00023655	001A	4.14
New Page Corp-Escanaba Paper Co	MI0000027	001A	50
Grand Haven BL&P-J B Sims	MI0000728	003A	0.052
Grand Haven BL&P-J B Sims	MI0000728	002A	0.4
Grand Haven BL&P-J B Sims	MI0000728	005A	67
E B Eddy Paper Inc	MI0002160	008A	1.6
Federal Mogul Corp-Greenville	MI0002836	002A	1.2
Manistique Papers Inc	MI0003166	005A	8
Manistique Papers Inc	MI0003166	006A	8
Wolverine Power Supply-Vandyke	MI0004162	001A	0.104
Copper Range Co	MI0006114	001A	12
Stone Container	MI0006122	001A	11.95
Reed City WWTP	MI0020036	001A	0.95
West Branch WWTP	MI0020095	001A	0.7
Coldwater WWTP	MI0020117	001A	3.2
Gogebic-Iron WW Authority WWTP	MI0020125	001A	3.4
Lanse WWTP	MI0020133	001A	0.72
Holly WWTP	MI0020184	001A	1.35
Norway WWTP	MI0020214	001A	0.5
Sandusky WWTP	MI0020222	001A	0.95
Cadillac WWTP	MI0020257	001A	3.2
Alma WWTP	MI0020265	001A	2.5
South Lyon WWTP	MI0020273	001A	2.5
Flushing WWTP	MI0020281	001A	3
Cheboygan WWTP	MI0020303	001A	2.5
Lowell WWTP	MI0020311	001A	1.42
South Haven WWTP	MI0020320	001A	2.19
Manistee WWTP	MI0020362	001A	1.3
Greenville WWTP	MI0020397	001A	1.5
Mason WWTP	MI0020435	001A	1.5
Sturgis WWTP	MI0020451	002A	2.8
Lapeer WWTP	MI0020460	001A	2.3
Plainwell WWTP	MI0020494	001A	1.3
Zeeland WWTP	MI0020524	001A	1.65
Allegan WWTP	MI0020532	001A	1.2
Hastings WWTP	MI0020575	001A	2
Tecumseh WWTP	MI0020583	001A	1.61

Pinconning WWTP	MI0020711	001A	0.5
Charlotte WWTP	MI0020788	001A	1.8
Grand Ledge WWTP	MI0020800	001A	1.5
Berlin Twp WWTP	MI0020826	001A	1.8
Brighton WWTP	MI0020877	001A	2.25
Three Rivers WWTP	MI0020991	001A	2.75
Marlette WWTP	MI0021024	001A	0.62
Ionia WWTP	MI0021041	001A	4
Croswell WWTP	MI0021083	001A	0.5
Tawas Utility Authority WWTP	MI0021091	001A	2.4
Howell WWTP	MI0021113	001A	2.45
Rockwood WWTP	MI0021181	001A	1
Grand Haven-Spring Lake WWTP	MI0021245	001A	6.67
Negaunee WWTP	MI0021296	001A	1.2
Ludington WWTP	MI0021334	001A	7.5
KI Sawyer WWTP-Marquette Co	MI0021423	001A	0.65
St Louis WWTP	MI0021555	001A	1.6
Milan WWTP	MI0021571	001A	2.5
Romeo WWTP	MI0021679	001A	2.1
Hillsdale WWTP	MI0022136	001A	2
Adrian WWTP	MI0022152	001A	7
Albion WWTP	MI0022161	001A	4
Alpena WWTP	MI0022195	001A	5.5
Ann Arbor WWTP	MI0022217	001A	29.5
Battle Creek WWTP	MI0022276	001A	18
Bay City WWTP	MI0022284	004A	12
Benton Harbor-St Joseph WWTP	MI0022322	001A	15.3
Big Rapids WWTP	MI0022381	001A	2.4
Bridgeport Twp WWTP	MI0022446	001A	3.41
Buchanan WWTP	MI0022489	001A	1.5
Buena Vista Twp WWTP	MI0022497	001A	2.2
Caro WWTP	MI0022551	001A	1.2
Cass City WWTP	MI0022594	001A	1
Delhi Twp WWTP	MI0022781	001A	4
Delta Twp WWTP	MI0022799	001A	6
Detroit WWTP	MI0022802	050A	830
Dowagiac WWTP	MI0022837	001A	2.5
East Lansing WWTP	MI0022853	001A	18.75
Eaton Rapids WWTP	MI0022861	001A	1.2
Flint WWTP	MI0022926	001A	50

Frankenmuth WWTP	MI0022942	001A	1.8
Genesee Co-Ragnone WWTP	MI0022977	001B	60
Genesee Co #3 WWTP	MI0022993	001A	11
Gladwin WWTP	MI0023001	001A	0.65
Grandville WWTP	MI0023027	001A	4.4
Hartford WWTP	MI0023094	001A	0.35
Holland WWTP	MI0023108	001A	12
Holland WWTP	MI0023108	002A	12
Holland WWTP	MI0023108	003A	12
Iron Mountain-Kingsford WWTP	MI0023205	001A	3.3
Jackson WWTP	MI0023256	001A	19
Kalamazoo WWTP	MI0023299	001A	53.5
Manchester WWTP	MI0023507	001A	0.55
Manistique WWTP	MI0023515	001A	1.5
Marquette WWTP	MI0023531	001A	3.85
Marshall WWTP	MI0023540	001A	3
Midland WWTP	MI0023582	001A	10
New Baltimore WWTP	MI0023680	001A	1.75
Niles WWTP	MI0023701	001A	5.8
Owosso/Mid Shiawassee Co WWTP	MI0023752	001A	6
Paw Paw Lake Area WWTP	MI0023779	001A	2.2
Pontiac WWTP	MI0023825	001A	30.6
Richmond WWTP	MI0023906	001A	0.9
Saginaw Twp WWTP	MI0023973	001A	6.5
Saline WWTP	MI0024023	001A	1.81
Standish WWTP	MI0024139	003A	0.65
Vassar WWTP	MI0024252	001A	0.7
Warren WWTP	MI0024295	001B	36
Wyoming WWTP	MI0024392	001A	22
Saginaw WWTP	MI0025577	001A	32
Menominee WWTP	MI0025631	001A	3.2
Grand Rapids WWTP	MI0026069	001A	61.1
St Johns WWTP	MI0026468	001A	1.9
Hemlock Semiconductor Corp	MI0027375	002A	1.5
Muskegon Co WWMS Metro WWTP	MI0027391	002A	4.2
Muskegon Co WWMS Metro WWTP	MI0027391	001A	43
Rollin-Woodstock WWTP	MI0027669	001A	1.2
Galien River SD Auth WWTP	MI0027987	001A	3
Gerdau MacSteel-Jackson	MI0028461	001A	0.15
DECO-Greenwood Plt	MI0036978	001A	17

Guardian Ind-Carleton Plant	MI0037001	001A	0.546
DECO-Fermi-2 Plt	MI0037028	011A	0.216
DECO-Belle River Plt	MI0038172	002A	0.3836
Mich South Cen Power Agency	MI0039608	002A	0.5674
Verso Paper Corp-Quinnesec	MI0042170	001A	22.5
West Bay Co Regional WWTP	MI0042439	001A	10.28
Gun Lake WWTP	MI0042501	001A	1.2
YCUA Regional WWTP	MI0042676	001A	46
YCUA Regional WWTP	MI0042676	003A	51.2
West Iron Co SA WWTP	MI0043281	001A	2
Severstal Dearborn LLC	MI0043524	004C	5.1
Severstal Dearborn LLC	MI0043524	002A	14
Severstal Dearborn LLC	MI0043524	004D	26
Severstal Dearborn LLC	MI0043524	04E0	30
Severstal Dearborn LLC	MI0043524	001A	102
Severstal Dearborn LLC	MI0043524	006A	150
Severstal Dearborn LLC	MI0043524	004B	348
Ishpeming Area WWTP	MI0044423	001A	2.34
Hillman Power Company	MI0044563	001A	0.15
Leoni Twp WWTP	MI0045942	001A	3
Leoni Twp WWTP	MI0045942	001A	3
MDEQ-RRD-Ott/Story SF	MI0053309	001A	1.728
Fibrek-Menominee	MI0053601	001A	4
Mich Pwr LP	MI0053767	001A	0.7752
Saginaw Twp-Center Rd LF	MI0054739	004A	0.024
Penda Corporation-Lapeer	MI0055972	001A	0.02
Marquette Co-Solid Waste LF	MI0056171	001A	0.002367123
Dearborn Ind Generation Plt	MI0056235	006C	241
Dearborn Ind Generation Plt	MI0056235	04B0	241
Kalamazoo Lake WWTP	MI0056324	001A	1
Kinross Twp WWTP	MI0057776	001A	1.2
Lacks Enterprises Inc-GWCU	MI0057849	001A	0.35
Carbon Green Bioenergy	MI0057989	001A	0.184
Kennecott-Humboldt Mill	MI0058649	001A	0.82
Orchard Hill LF-Watervliet	MI0058853	001A	0.05
OmniSource-Bay City	MI0058884	001A	0.05
Copperwood Mine	MI0058969	001A	0.504

APPENDIX C. 2002 AIR EMISSIONS

Source Record Number (SRN)	Category in Emissions Inventory (EI)	Facility Name	Pounds Mercury/yr (2002)
A4750	Auto Shredder	FERROUS PROCESSING AND TRADING CO. (SLC RECYCLING)	0.4
B3240	Auto Shredder	FRITZ ENTERPRISES INC	1
A2457	Auto Shredder	LOUIS PADNOS IRON & METAL	5.6
N0844	Auto Shredder	Rifkin Scrap Iron and Metal Company	2.7
N6293	Auto Shredder	STRONG STEEL PRODUCTS LLC	1
B1982	Auto Shredder	Louis Padnos Iron & Metal	Not Available
B2281	Auto Shredder	JACKSON IRON & METAL	Not Available
B4372	Auto Shredder	OmniSource Sturgis	Not Available
B4884	Auto Shredder	PADNOS SUMMIT STEEL	Not Available
B7634	Auto Shredder	WEST MICHIGAN IRON & METAL	Not Available
N1340	Auto Shredder	Portland Iron & Metal Inc	Not Available
N1373	Auto Shredder	KALAMAZOO METAL RECYCLERS	Not Available
N3753	Auto Shredder	EAST KINGSFORD IRON & METAL	Not Available
N6823	Auto Shredder	SPOONER METALS LLC	Not Available
B1743	Cement Manufacturing	HOLCIM (US) INC.	80
B1477	Cement Manufacturing	LAFARGE MIDWEST INC.	582
B1559	Cement Manufacturing	St. Marys Cement, Inc. (U.S.)	32
A7809	Coke Production	U S STEEL GREAT LAKES WORKS (coke)	2.6
B2178	Cupola	Cadillac Casting, Inc	24.5
B1909	Cupola	CWC Textron	6
A0767	Cupola	East Jordan Iron Works	33.5
B1991	Cupola	GM POWERTRAIN GROUP - SAGINAW METAL CASTING	26.5
A3934	Cupola	Great Lakes Castings LLC	13.5
B1577	Cupola	GREDE LLC - IRON MOUNTAIN	16.5
A4302	Cupola	MAHLE industries Inc.	3.5
B2043	Cupola	Metavation Vassar, LLC (Grede in '02)	16
B2404	Cupola	Robert Bosch LLC	15.5
B1961	Cupola	Rothbury Steel, Inc.	2
N5795	Cupola	Sparta Foundry, Inc.	12
B2022	Cupola	Sturgis Foundry Corporation	3
B2658	Dental Amalgam	Kerr Corporation	4
A6177	EAF (Grey Iron)	EATON CORP	1.2
B1547	EAF (Grey Iron)	Hayes-Albion Corporation	6
N5814	EAF and EIF (Grey Iron)	ASAMA COLDWATER MANUFACTURING, INC.	10.3
B2836	Electrical Utility	B. C. Cobb Plant	84.7

Source Record Number (SRN)	Category in Emissions Inventory (EI)	Facility Name	Pounds Mercury/yr (2002)
	(Coal Combustion)		
B2840	Electrical Utility (Coal Combustion)	Consumers Energy Karn-Weadock Facility	215
B2815	Electrical Utility (Coal Combustion)	Detroit Edison Harbor Beach Power Plant	8.7
B2810	Electrical Utility (Coal Combustion)	DETROIT EDISON RIVER ROUGE	120
B2811	Electrical Utility (Coal Combustion)	DETROIT EDISON TRENTON CHANNEL	200
B2816	Electrical Utility (Coal Combustion)	Detroit Edison Monroe Power	620
B1573	Electrical Utility (Coal Combustion)	Escanaba Power Plant	36
B2357	Electrical Utility (Coal Combustion)	Holland BPW, Generating Station & WWTP	7.1
B2835	Electrical Utility (Coal Combustion)	J. H. Campbell Plant	317.6
B1976	Electrical Utility (Coal Combustion)	J.B. Sims Generating Station	16
B2846	Electrical Utility (Coal Combustion)	J.R. WHITING CO	70.8
B2647	Electrical Utility (Coal Combustion)	LBWL, Eckert & Moores Park Station	102.3
B4001	Electrical Utility (Coal Combustion)	LBWL, Erickson Station	27.7
B1833	Electrical Utility (Coal Combustion)	MARQUETTE BOARD OF LIGHT & POWER	18
B6611	Electrical Utility (Coal Combustion)	MI SO CENTRAL POWER AGENCY	13
B2796	Electrical Utility (Coal Combustion)	ST. CLAIR / BELLE RIVER POWER PLANT	561
N1685	Electrical Utility (Coal Combustion)	TES Filer City Station	5.4
B4261	Electrical Utility (Coal Combustion)	WISCONSIN ELECTRIC POWER COMPANY	18.5
B2132	Electrical Utility (Coal Combustion)	WYANDOTTE DEPT MUNI POWER PLANT	11.2
B2840	Electrical Utility (Oil Combustion)	Consumers Energy Karn-Weadock Facility (oil)	3.55
B2816	Electrical Utility (Oil Combustion)	Detroit Edison Monroe Power	1.20163
B6611	Electrical Utility (Oil Combustion)	MI SO CENTRAL POWER AGENCY	39.9331
B2796	Electrical Utility (Oil Combustion)	ST. CLAIR / BELLE RIVER POWER PLANT	1.20329
N1395	Electrical Utility	Cadillac Renewable Energy Facility	1.9451

Source Record Number (SRN)	Category in Emissions Inventory (EI)	Facility Name	Pounds Mercury/yr (2002)
	(Wood Fired)		
N2388	Electrical Utility (Wood Fired)	GRAYLING GENERATING STATION LTD PTNR	1.4822
N1266	Electrical Utility (Wood Fired)	HILLMAN POWER CO	1.0626
N5549	Flourescent Lamp Recycler	GREENLITES LAMP RECYCLING	1.55
N5948	Flourescent Lamp Recycler	GREENLITES LAMP RECYCLING	1.5
N6821	Flourescent Lamp Recycler	Reliable Relamping Inc	0.19
N5614	Flourescent Lamp Recycler	VALLEY CITY DISPOSAL INC	see N5942
N5941	Flourescent Lamp Recycler	VALLEY CITY DISPOSAL INC	0.231
N5942	Flourescent Lamp Recycler	VALLEY CITY DISPOSAL INC	see N5942
A4033	Hazardous Waste Incineration	The Dow Chemical Company U.S.A., Midland	11
M4139	Hospital Waste Incineration	MEDICAL WASTE SERVICES LLC	3
A0884	Industrial/Commercial (coal combustion)	ESCANABA PAPER COMPANY	15.4346
B7192	Industrial/Commercial (coal combustion)	INTERNATIONAL PAPER	1.2268
A0884	Industrial/Commercial (wood combustion)	ESCANABA PAPER COMPANY	1.31776
B7192	Industrial/Commercial (wood combustion)	INTERNATIONAL PAPER (wood)	1.49969
B2169	Lime Manufacturing	CARMEUSE LIME Inc, RIVER ROUGE OPERATION	26.9
B3520	Lime Manufacturing	CARMEUSE/DETROIT LIME	27.4
B1846	Lime Manufacturing	Occidental Chemical Corporation ((Dow Chemical in '02)	19.5
M4148	Municipal Waste Incineration	DETROIT RENEWABLE POWER, LLC	38
N1125	Municipal Waste Incineration	JACKSON COUNTY RESOURCE RECOVERY FACILITY	6
N1604	Municipal Waste Incineration	Kent County Waste to Energy Facility	21
A9831	Petroleum Refining	MARATHON PETROLEUM COMPANY LP	4.14
B2103	Sewage Sludge Incineration	DETROIT WASTEWATER TREATMENT PLANT	226
B1598	Sewage Sludge Incineration	FLINT WATER POLLUTION CONTROL FACILITY	9

Source Record Number (SRN)	Category in Emissions Inventory (EI)	Facility Name	Pounds Mercury/yr (2002)
B1950	Sewage Sludge Incineration	PONTIAC WWTP	5
L0058	Sewage Sludge Incineration	PORT HURON WWTP	2
B1792	Sewage Sludge Incineration	Warren Waste Water Treatment Plant	12
B6237	Sewage Sludge Incineration	YPSILANTI COMM. UTILITIES AUTHORITY	32
B1754	Steel Foundry	ERVIN AMASTEEL DIVISION	71
B1991	Steel Foundry	GM POWERTRAIN GROUP - SAGINAW METAL CASTING	206
B1929	Steel Foundry	MICHIGAN STEEL, INC.	5
A8640	Steel Manufacturing (Basic Oxygen Furnaces)	SEVERSTAL DEARBORN LLC	76
A7809	Steel Manufacturing (Basic Oxygen Furnaces)	U S STEEL GREAT LAKES WORKS	320
B7061	Steel Manufacturing (Electric Arc Furnaces)	Gerdau MacSteel Monroe	13
B4306	Steel Manufacturing (Electric Arc Furnaces)	Gerdau Special Steel North America - Jackson Mill	18
N5886	Switch Manufacturer	MERCURY DISPLACEMENT INDUSTRIES	148
B1827	Taconite Processing	EMPIRE IRON MINING PARTNERSHIP	16
B4885	Taconite Processing	TILDEN MINING COMPANY LC	72