Illinois Lake Michigan (nearshore) Mercury Final Draft TMDL Report

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List of Acronyms

BAF	Bioaccumulation Factor
BMP	Best Management Practice
CAA	Clean Air Act
CAIR	Clean Air Interstate Rule
CAWS	Chicago Area Waterway System
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
CSO	Combined Sewer Overflow
EGU	Electric Generating Unit
FCMP	Fish Contaminant Monitoring Program
GLCFS	Great Lakes Coastal Forecasting System
HPV	Health Protection Value
IDNR	Illinois Department of Natural Resources
IEPA	Illinois Environmental Protection Agency
LA	Load Allocation
LaMP	Lakewide Management Plan
LC	Load Capacity
LEE	Low Emitting Electric Generating Unit
MACT	Maximum Achievable Control Technology
MATS	Mercury and Air Toxics Standards
MeHg	Methylmercury
MCM	Mercury Cycling Model
MOS	Margin of Safety
MPCA	Minnesota Pollution Control Agency
MS4	Municipal Separate Storm Sewer System
MW	Megawatts
MWRDGC	Metropolitan Water Reclamation District of Greater Chicago
NEI	National Emissions Inventory
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination system

NSWRD	North Shore Water Reclamation District
RATA	Relative Accuracy Test Audits
REMSAD	Regional Modeling System for Aerosols and Deposition
RF	Reduction Factor
TMDL	Total Maximum Daily Load
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WLA	Wasteload Allocation
WQS	Water Quality Standards

Executive Summary

Mercury is a naturally-occurring metal that is prevalent throughout the global environment and in Illinois. The well-known neurotoxic properties of mercury make it dangerous to both humans and wildlife, especially the young. Human exposure through the consumption of fish is the principal public health concern with mercury in the environment. Mercury emitted to the atmosphere can be transported long-distances from its source before being deposited to land and water. The widespread loading of mercury into the Great Lakes region is responsible for mercury-related fish consumption advisories in all of the eight Great Lakes states. This Total Maximum Daily Load (TMDL) report addresses mercury impairments in 56 waterbody segments located in the Illinois Lake Michigan nearshore. Appendix A lists specific waterbody segments covered by this TMDL.

The majority of mercury pollution in the study area waterbodies is a result of atmospheric deposition. This TMDL uses a target fish tissue concentration of 0.06 mg/kg, the concentration used by the Fish Contaminant Monitoring Program (FCMP) as the starting point for issuing a "one meal per week" advisory. This was used to set a reduction target for atmospheric mercury loading in order to achieve compliance with the fish consumption use.

Atmospheric mercury deposition in the study area 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 Illinois was estimated for the baseline year of 2001[1] using a United States Environmental Protection Agency (USEPA) model. Based on the assumption that fish mercury concentrations will respond proportionally to reductions in atmospheric mercury loadings, a TMDL and a reduction goal were developed to meet the target fish tissue concentration of 0.06 mg/kg. Anthropogenic atmospheric sources of mercury from Illinois must be reduced by 89.29 percent from 2001 levels to meet this goal (Table ES-1). Reductions are necessary from mercury sources within Illinois and in other U.S. states, and from global sources. However, this TMDL only addresses reductions from Illinois sources. Progress on achieving this goal in Illinois will be tracked using air emissions from the year 2002 as a baseline (because a complete emissions inventory for the baseline year 2001 is not available), and through the analysis of mercury in fish collected within the project study area.

[1] The year 2001 was selected as a baseline because that was the year for which model results were available.

Table ES-1. Summary of TMDL Components

TMDL Components	Results
Target Level and Reduction Factor	
Target Fish Mercury Concentration (Fish Tissue Residue Value)[2]	0.06 mg/kg
Baseline Mercury Concentration for Largemouth Bass	0.28 mg/kg
Reduction Factor (RF)	78.57%
Final TMDL	
Loading Capacity (LC)	0.02 kg/day
Margin of Safety (MOS)	Implicit
Wasteload Allocation (WLA)	0.0004 kg/day
Load Allocation (LA)	0.02 kg/day
Mercury Load Allocation for In-State and Out-of-State Deposition Sources	
In-State Contribution to LA[a]	0.0036 kg/day
Out-of-State Contribution to LA[b]	0.0160 kg/day
Necessary Reduction from Anthropogenic Emission Sources	89.29%

Note: numbers may not sum exactly due to rounding

[a] Anthropogenic sources only

[b] Anthropogenic and natural sources

[2] . The 0.06-mg/kg fish tissue concentration is used by the Fish Contaminant Monitoring Program as the starting point for issuing a one meal/week advisory.

1 Introduction

Section 303(d) of the Federal Clean Water Act and the USEPA's Water Quality Planning and Management Regulations (Title 40 of the Code of Federal Regulations [CFR] Part 130) require states to develop TMDLs for all category 5[3] waterbodies that are not meeting Water Quality Standards (WQS) for a specific pollutant. These waterbodies are included on a state's 303(d) list. The TMDL process establishes the allowable loadings of a pollutant to a waterbody based on the relationship between pollution sources and water quality conditions of a waterbody. This allowable loading represents the maximum quantity of a pollutant that the waterbody can receive without exceeding WQS. The TMDL process provides states with the basis for establishing water quality-based controls, which provide the pollutant reductions necessary for a waterbody to attain WQS (USEPA, 1991).

Within the Illinois Lake Michigan Basin, the Illinois Environmental Protection Agency (IEPA) has identified 56 nearshore beach/shoreline, harbor, and open water segments that are impaired due to concentrations of mercury in fish tissue and the water column (IEPA, 2014). All of these waterbody segments are impaired for fish consumption use, and one segment (Waukegan Harbor North) is also impaired for aquatic life use. These impaired waters are included on the Illinois Integrated Water Quality Report and Clean Water Act Section 303(d) list (IEPA, 2014).

The scope of this mercury TMDL covers the 56 nearshore beach/shoreline, harbor, and open water segments impaired due to mercury. It quantifies the pollutant load reductions needed to reduce mercury levels in fish tissue and the water column so that the waterbodies can meet water quality standards. This TMDL is based on a "Level One" approach, which allows for the data from all segments to be considered together as one area (Section 5). The resulting total load then applies to the entire study area (and not to each impaired waterbody segment).

The Illinois Lake Michigan Nearshore Mercury TMDL considers the following source categories for their contribution to overall mercury loads: hydrodynamic transport from the main lake; atmospheric loading; Municipal Separate Storm Sewer System (MS4) stormwater loading, flow reversals from the Chicago Area Waterway System (CAWS); and other point source discharges. The report covers each step of the TMDL process and is organized as follows:

- Section 2. Background
- Section 3. Applicable water quality standards and TMDL targets
- Section 4. Source assessment
- Section 5. Modeling approach
- Section 6. TMDL development
- Section 7. Implementation plan and monitoring recommendations
- Section 8. Public participation

[3] 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.

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2 Background

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

- Problem statement
- Study area and impaired waterbodies
- Data compilation and assessment of water quality

2.1 Problem Statement

Mercury is a naturally occurring element that is a silver-colored liquid at room temperature. Mercury has historically been valued for its ability to conduct electricity, measure pressure and temperature, and form alloys with almost all other metals.

Because of these diverse properties, mercury has been used in a large number of household, commercial, medical, and industrial applications, including the following:

- Medical instruments and equipment, such as blood pressure gauges, thermometers, and x-ray machines
- Fluorescent lights
- Electrical switches and relays used in certain devices and equipment, such as lighting, thermostats, pumps, space heaters and computers
- Dental amalgam

Although mercury use in the United States has declined, the USEPA estimates that manufacturers use 500-600 metric tons of mercury annually as part of their production processes or to create products that rely on mercury's chemical and physical properties (USEPA, 2004).

On a global scale, numerous sources of both natural and anthropogenic origins release mercury to the atmosphere. Mercury releases from natural sources include the continuous and ubiquitous natural weathering of mercury-containing rocks, geothermal activity, or mercury emitted during episodic events such as volcanic eruptions (AMAP/UNEP, 2013). Anthropogenic sources of mercury released to the atmosphere include power plants, metals manufacturing facilities, caustic soda production plants, active or abandoned mines, ore processing facilities, incinerators for urban, medical and industrial wastes, cement plants, and chemicals production facilities. In addition, previously deposited mercury can be re-emitted from terrestrial and aquatic surfaces through natural processes including biomass burning and emissions from soil, inland waters, oceans, and vegetation. Once mercury enters the atmosphere, it becomes part of a global cycle of mercury among land, water, and the atmosphere. The atmosphere serves as the most important pathway for the worldwide dispersion and transport of mercury (Fitzgerald et al., 1998; Mason et al., 1994; Mason and Sheu, 2002). Airborne mercury returns to the

terrestrial and aquatic environments via wet and dry deposition. Mercury undergoes complex biogeochemical cycling in terrestrial and aquatic environments.

Mercury exists in three forms: elemental mercury, inorganic mercury, and organic mercury. Under certain environmental conditions, inorganic mercury can be combined with carbon to form organic mercury compounds, of which methylmercury (MeHg) is the most abundant. The formation of MeHg is an important step in mercury cycling (Ullrich et al., 2001). Although all chemical forms of mercury are toxic, public health concerns focus on methylmercury. This is because MeHg can be bioaccumulated through the food web and reach high concentrations in aquatic organisms. Methylmercury is produced through the addition of a methyl group to Hg2+, a process referred to as methylation (Figure 2-1). 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., not containing 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.

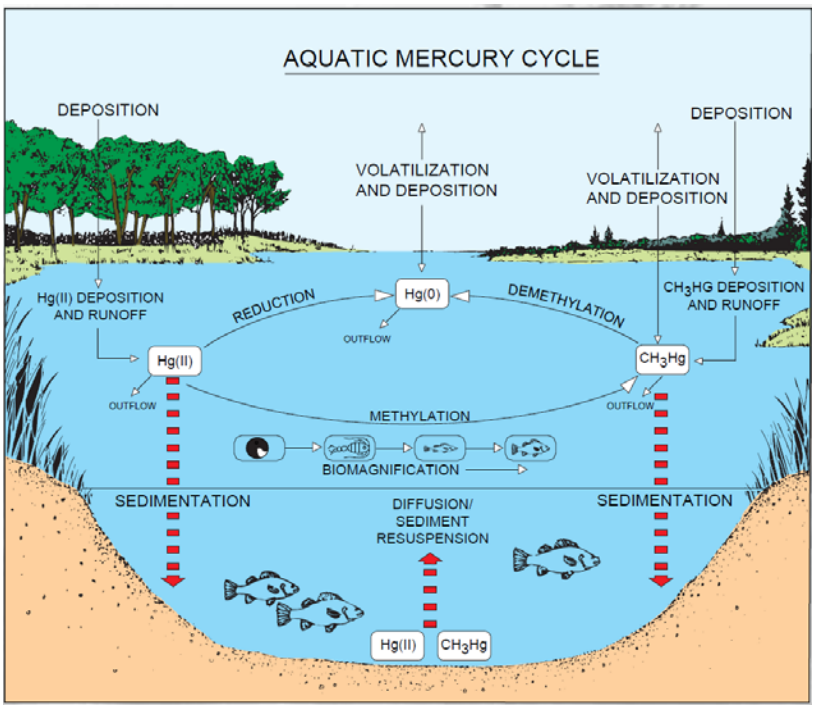

Figure 2-1. Mercury Cycling Pathways in Aquatic Environments (Source: United States Geological Survey (USGS), 2012)

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 2-2). 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 methylmercury concentrations that can be up to a million times higher than the concentration in water.

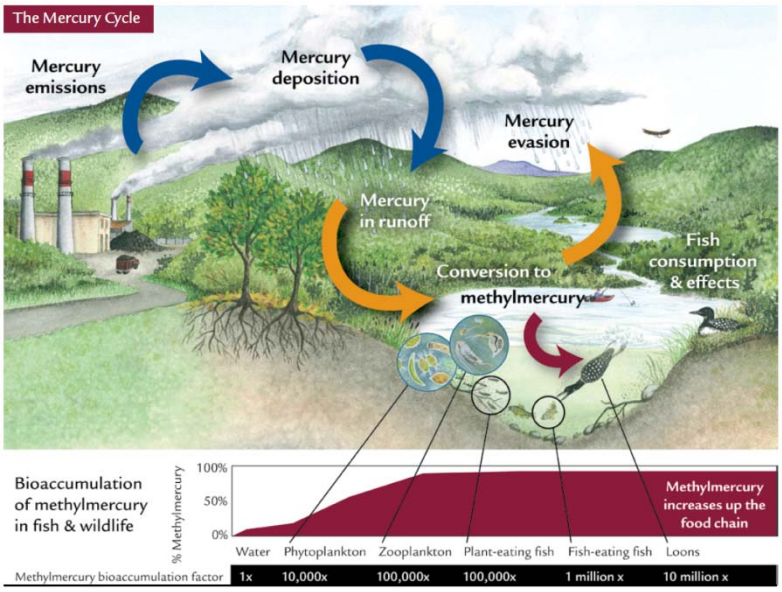

Figure 2-2. A Simplified Mercury Cycle Showing How Mercury Enters and Cycles through Ecosystems, Biomagnifies up the Foodweb and Bioaccumulates in Fish and Wildlife (Source: Evers et al., 2011)

One of the major routes of human exposure to methylmercury is through the consumption of contaminated fish (Clarkson and Magos, 2006). Globally, the ingestion of fish contaminated with MeHg is the most common means of mercury poisoning (BRI and IPEN, 2013). Even low levels of prenatal MeHg exposure may cause early childhood neurocognitive effects (Karagas et al., 2012). 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). Methylmercury is a known neurotoxicant. 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). In the United States alone, it is estimated that over 300,000 newborns each year may be at risk of adverse neurodevelopmental effects due to *in utero* exposure to MeHg (Mahaffey et al., 2004).

Fish, birds, and other animals are also sensitive to mercury in the environment. Consumption of fish by other animals is the primary mechanism for methylmercury exposure; therefore, aquatic species are particularly vulnerable to mercury contamination. Toxic effects have been documented in animals who consume fish with a mercury concentration starting at 0.3 to 0.7 µg/g wet weight in the whole body of fish (Wiener et al., 2007). Depew et al. (2012) proposed a threshold of 0.1 µg/g wet weight methylmercury in prey fish, for adverse behavioral impacts in adult loons. They also proposed benchmarks of 0.18 and 0.4 µg/g wet weight in prey fish for significant reproductive impairment and for reproductive failure, respectively, in wild adult loons.

2.1.1 Recent Mercury Trends

Recent estimates of annual global mercury emissions corresponding to the year 2010 are in the range of 6,000–9,000 MT/yr (Pirrone et al., 2010; AMAP/UNEP, 2013; Holmes et al., 2010). Approximately 2,000 MT/yr of mercury emissions to the air are from anthropogenic sources. Natural emission (geogenic origin) contributes to about 80–600 MT/yr to annual global emissions. Re-emission accounts for roughly 4,000–6,000 MT/yr of the global annual mercury emissions to air. Re-emissions are the result of environmental accumulation of mercury from legacy releases to air, land, and water. Although original sources of re-emitted mercury cannot be determined, the bulk of re-emitted mercury is from historical anthropogenic sources. Mercury emissions sources in developed countries such as the United States and Europe are better known than those in developing countries. In North America and Europe, the highest contribution to mercury emissions originates from fossil fuel combustion (Pirrone et al., 2010). China contributes one-third of the global anthropogenic total. A large fraction of the anthropogenic mercury emission from China is attributed to coal combustion. Asia contributes roughly 50 percent of the global total anthropogenic emission (UNEP, 2013). Mercury emissions in the United States and Europe have declined over the past several decades due to the implementation of pollution control technologies, while emissions from Asia are increasing largely due to expanding energy generation from coal-fired power plants. Global anthropogenic mercury emissions are expected to remain stable at current levels of around 2,000 MT/yr or increase only slightly, with decreases in North America and Europe being offset by increases in Asia (Pirrone et al., 2010; Wilson et al., 2010; UNEP, 2013).

Mercury emissions in the United States have declined from 250 tons in 1990 to 100 tons in 2005 (Schmeltz et al., 2011). Approximately 60 tons of mercury were emitted to the air, based on the 2008 emissions inventory (AMAP/UNEP, 2013). Similarly, mercury emission in the Great Lakes region declined from approximately 70 tons in the 1990 to 35 tons in 2005 (Evers et al., 2011). Most of the declines during this period were attributed to decreases in mercury emissions from medical and municipal waste incinerators. Currently, coal-fired power plants are the single largest source of mercury emissions nationwide and in the Great Lakes region (Evers et al., 2011; Schmeltz et al., 2011).

Recently, Risch et al. (2012) reported on mercury wet deposition patterns across 37 sites in the Great Lakes region from 2002 to 2008. During this period, annual mercury wet deposition was largely unchanged in the Great Lakes region. Local trends of decreasing mercury concentrations in precipitation and increasing precipitation depths were observed at several sites. Overall, it was suggested that any observed declines in mercury concentration were offset by increases in precipitation amount, and as such the total wet deposition amount remained largely unchanged. In general, wet deposition of mercury was highest in Indiana, Ohio, Illinois, eastern and northwestern Pennsylvania, southern Michigan, and southeastern Wisconsin, overlapping with areas with relatively high emissions of mercury from anthropogenic sources. The highest mean annual mercury wet deposition was reported for much of Indiana and Southern Illinois (12 – 14 $\mu g/m^2/yr$). The lowest was in northern Minnesota, eastern Ontario, Quebec, and parts of New York (4 – 6 $\mu g/m^2/yr$).

Evers et al. (2011) evaluated long-term mercury trends in fish in the Great Lakes region. Mercury concentrations in walleye and largemouth bass were evaluated from across multiple sites in the Great Lakes and inland waterbodies in the Great Lakes states. Results from this study have shown an overall decline in fish mercury concentration in the Great Lakes region from 1967 to 2009. Much of this decrease has been attributed to reductions in regional mercury emissions. There have been several studies on the long-term (since 1970's) temporal trends in mercury levels in whole-body lake trout and walleye collected from the Great Lakes (Bhavsar et al., 2010; Environment Canada and the USEPA,

2014). These studies found that generally, in all five Great Lakes, fish mercury concentrations declined approximately until the mid-1990s, after which the declines ceased and mercury concentrations started to increase.

2.2 Study Area and Impaired Waterbodies

The project study area, shown in Figure 2-3, includes one nearshore open water segment, 51 beach/shoreline segments, and four harbors that are identified by the IEPA (IEPA, 2014) as being impaired due to mercury. All 56 impaired waters are in Lake and Cook Counties, Illinois. All segments are classified as *Not Supporting* for fish consumption use, and Waukegan Harbor North is also classified as *Not Supporting* for aquatic life use. Appendix A contains a full listing of the impaired segments and causes. How these segments are identified is further defined in Section 3 of the TMDL.

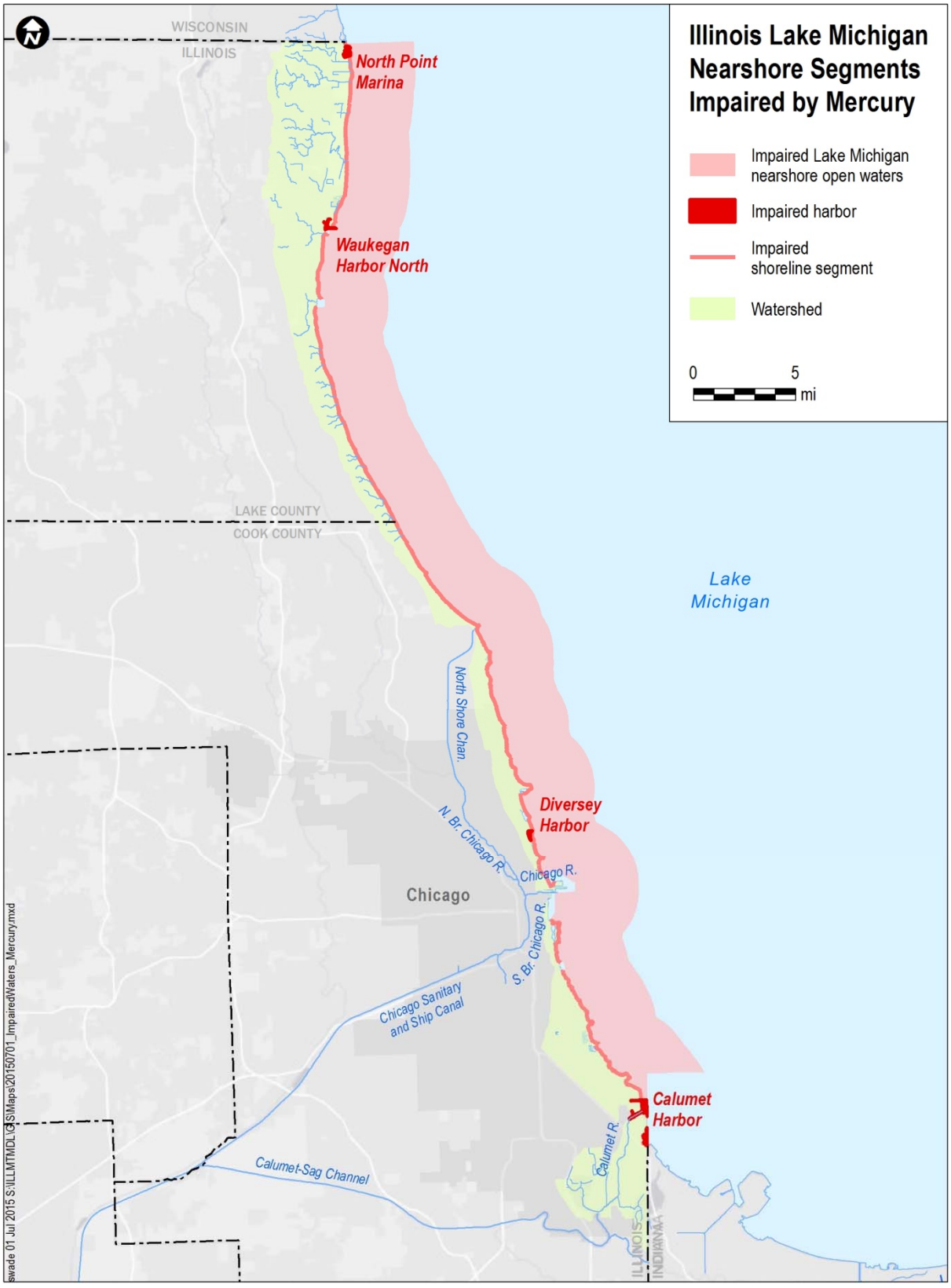

Figure 2-3. Project Study Area and Impaired Segments

2.2.1 Watershed Description

The study area watershed is long and narrow and encompasses roughly 100 square miles within Lake and Cook Counties, Illinois, that drain to Lake Michigan. The study area watershed is highly developed, and land use is roughly distributed as 73 percent residential, 4 percent industrial, 4 percent commercial, and 19 percent open space. The watershed includes portions of the following municipalities: Wilmette, Winnetka, Kenilworth, Winthrop Harbor, Chicago, Burnham, Highland Park, Lake Bluff, Beach Park, Highwood, Waukegan, North Chicago, Zion, Evanston, Glencoe and Lake Forest. All of the listed municipalities except Burnham have MS4 permits to discharge to Lake Michigan. The MS4 permits for these municipalities, together with the MS4 permits for the Cook County Highway Department, Illinois Department of Transportation, Lake County, Shields Township, and Waukegan Township, cover roughly 100 percent of this drainage. A number of additional National Pollutant Discharge Elimination System (NPDES)-permitted point sources also discharge to the study area waterbodies. Only one of these, the North Shore Water Reclamation District (NSWRD) Waukegan Water Reclamation Facility, has a mercury effluent permit limit.

The waterbodies within the watershed are generally small streams and ravines that carry intermittent stormwater and surface drainage to Lake Michigan. Within Lake County, the watershed boundary extends inland farther than it does in Cook County, narrowing near the south end of Lake County due to the diversion of flows into the CAWS. The CAWS is heavily altered from its natural state, including a diversion of the Chicago River (in 1900), and the Little and Grand Calumet River (in 1922) away from Lake Michigan via the CAWS. The CAWS is a major component of the study area, comprising both manmade and natural waterways. In addition to navigation, these waterways convey a variety of point-source and precipitation-related flows, including water reclamation plant effluents, combined sewer overflows (CSOs), and stormwater runoff. While the direction of flow in the CAWS is typically toward the Des Plaines River watershed and away from the study area waterbodies, extreme wet weather conditions can create storm flows large enough to cause flow reversals in the CAWS and discharge into Lake Michigan. These discharges occur via three control works locations: the Wilmette Pumping Station, the Chicago River Lock and Controlling Works, and the O'Brien Lock and Controlling Works on the Calumet River (Figure 2-4). These discharges from the CAWS to Lake Michigan are of interest because mercury in stormwater and CSO, which discharge into the CAWS, can contribute to the impairment of the Lake Michigan study area waters.

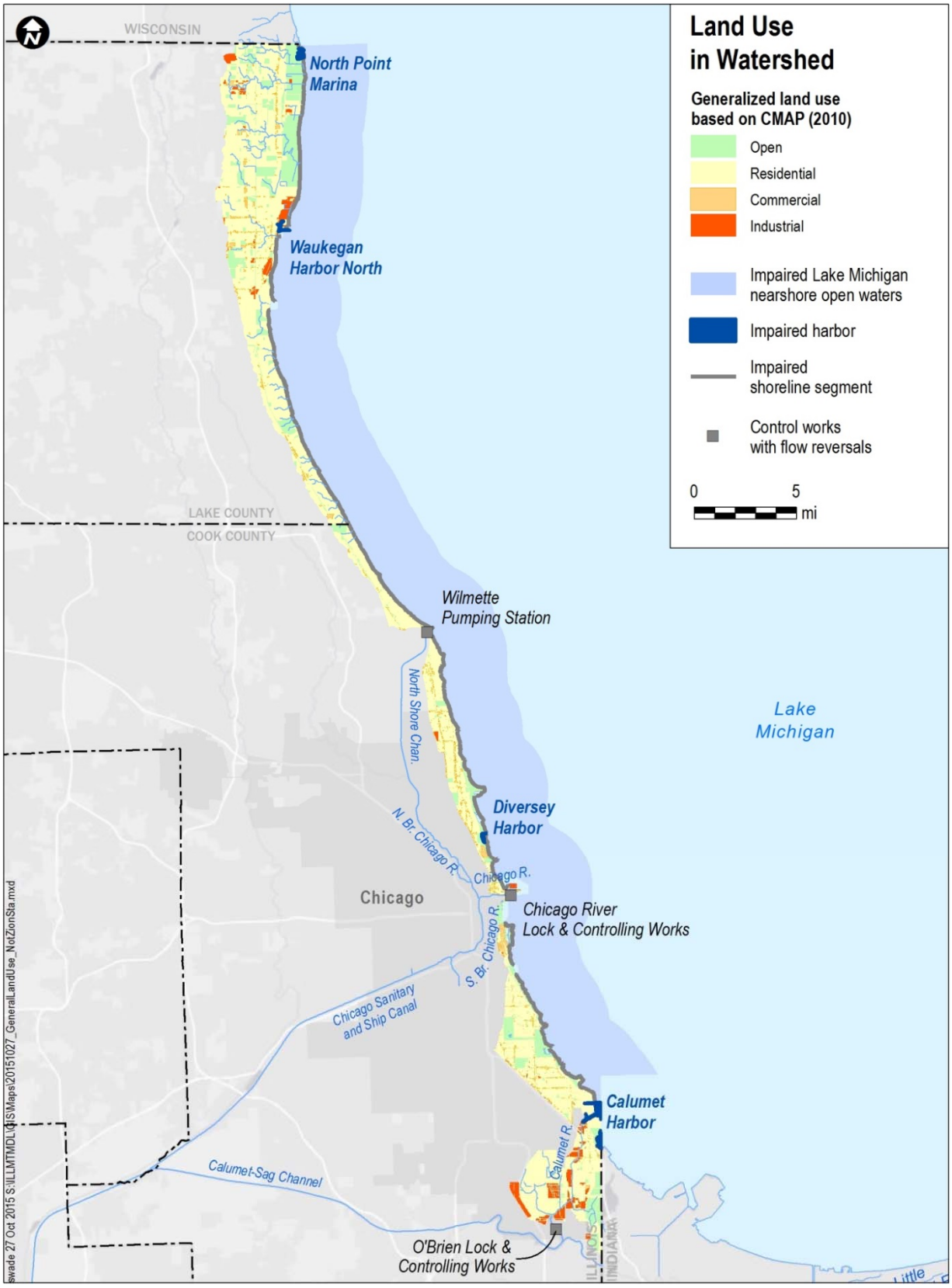

Figure 2-4. Study Area Land Use

2.2.2 Impaired Waterbody Description

A total of 56 segments are impaired due to mercury. The impaired nearshore open water segment is 180 square miles in size, extending 5 km into Lake Michigan from the Illinois Lake Michigan shoreline, with Lake Michigan serving as its eastern boundary (Figure 2-3). Additionally, 51 shoreline (beach) segments are identified as impaired due to concentrations of mercury in fish tissue. One segment, Waukegan Harbor North, is also listed as impaired due to mercury concentrations in the water column. The term *shoreline segment* is used in this document, because not all of the segments have beaches. The total length of these shoreline segments is approximately 63.5 miles, with segment lengths ranging from 0.07 to 5.5 miles.

Interspersed with the shoreline segments are four harbors that are impaired due to mercury: Waukegan Harbor North (~0.07 square miles), North Point Marina (~0.12 square miles), Diversey Harbor (~0.05 square miles), and Calumet Harbor (~2.4 square miles). These harbors, shown in Figure 2-5, are described briefly below.

Waukegan Harbor, a federally authorized navigation project in Waukegan, Illinois, is used for both industrial and recreational activities. This manmade harbor is approximately 40 miles north of the city of Chicago (Illinois Department of Natural Resources; IDNR, 2012). The United States Army Corps of Engineers (USACE) has been involved with dredging operations at this harbor since 1889. With the exception of some intermittent harbor deepening projects, the vast majority of the dredging operations have focused on maintaining navigable conditions, primarily within the approach channel (USACE Chicago District, 2013), which is beyond the extent of the impaired area shown in Figure 2-5. Waukegan Harbor sediments were dredged in 1992 and 1993, and again in 2012 and 2013, to remove PCB-contaminated sediments (USEPA, 2015).

North Point Marina, in Winthrop Harbor, Illinois, is the largest marina on the Great Lakes (IDNR, 2015a). **Diversey Harbor** is in Lincoln Park, within Lake Shore Drive. Due to bridge restrictions, Diversey Harbor can only accommodate power boaters (Chicago Harbors, 2015).

Calumet Harbor and the Calumet River include an approach channel, an outer harbor channel, an entrance channel, and a river channel. The approach and outer harbor channels are located primarily in Indiana. The entrance channel and river channel are located in Illinois and extend approximately 6.7 miles up the Calumet River to Lake Calumet (USACE Chicago and Rock Island Districts, 2015). Calumet Harbor is a deep draft commercial harbor that is protected by 12,153 linear feet of steel sheetpile and timber crib breakwater structures (USACE Detroit District, 2015). This is the largest of the study area's four impaired harbors, and Calumet Harbor and River are the third busiest port on the Great Lakes by tonnage, moving an annual average of over 14 million tons of commodities (USACE Detroit District, 2015). At Calumet Harbor and River, an average of approximately 50,000 cubic yards of sediment is dredged annually, and this dredging requirement is expected to continue (USACE Chicago and Rock Island Districts, 2015).

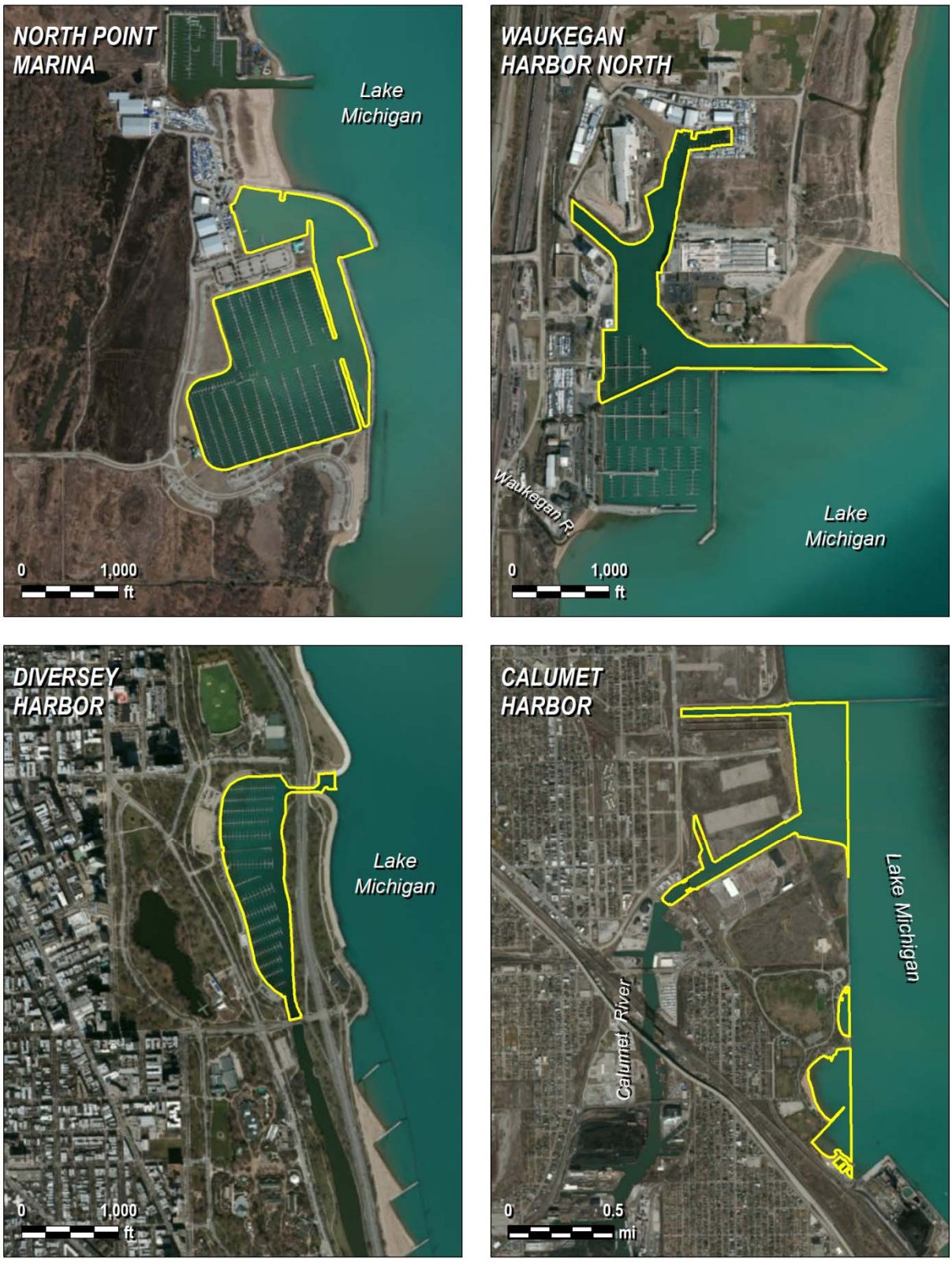

Figure 2-5. Impaired Harbor Segments

2.3 Data Compilation and Assessment of Water Quality

Water column, fish, and sediment data collected from 2000 to the present were inventoried, compiled, and reviewed to form the project database for this mercury TMDL. Data were reviewed to ensure they were relevant to the project and met the quality objectives and criteria outlined in the project's Quality Assurance Project Plan (LimnoTech, 2014).

The potentially useful sources of data were identified based on project team knowledge, including much input from IEPA and USEPA staff, internet queries, and communication with agencies and Great Lakes researchers familiar with the project study area. In addition, the project team led a webcast on September 17, 2014, to present the objectives of the study to a much broader audience and to solicit input on additional studies or datasets that could be relevant to this project. The project team followed up on all leads identified as a result of the webcast.

Agencies contacted for data included the USEPA Great Lakes National Program Office; USEPA Office of Research and Development, Grosse Ile, Michigan; USEPA Superfund Division; USEPA Water Division; IEPA Toxicity Assessment Unit; IEPA Bureau of Water; Illinois Fish Contaminant Monitoring Program; Illinois Department of Natural Resources; Wisconsin Water Science Center of the U.S. Geological Survey (USGS); National Oceanic and Atmospheric Administration (NOAA); Environment Canada; Area of Concern project managers; USACE; U.S. Navy; Waukegan Citizens Advisory Group; North Shore Sanitary District; Illinois Lake Michigan Fisheries Program; and researchers at Loyola University and the University of Iowa.

2.3.1 Summary of Data by TMDL Zone

The project database contains fish tissue and sediment data. Fish fillet data are summarized in this section because those are the samples used to support the development of the TMDL. One segment of the study area (Waukegan Harbor North) is also listed as impaired due to water column concentrations. That listing is based upon older data, which are no longer available. While this section provides data by individual TMDL zone, the TMDL development is based on an approach that allows for the data from all segments to be considered together as in one area

Sampling locations for all fish and sediment data in the database were paired with impaired segment(s), with input from IEPA, reflecting which sampling stations are located within the impaired segments. The nearshore open water segment was assessed based on samples collected in the nearshore open water segment. The 51 shoreline segments were similarly assessed based on samples collected in the nearshore open water segment. Because the data collected in the nearshore open water were used to assess the nearshore as well as the 51 shoreline segments, these segments are collectively referred to as being within the "nearshore open water/shoreline" TMDL Zone (see Tables 2.1 and 2.2). Each fish sample collected within the impaired harbors was assigned to the appropriate harbor.

Tables 2-1 and 2-2 summarize the number of samples available in the project database for the study area. A count of mercury fillet samples by fish species and TMDL zone is shown in Table 2-1. Table 2-2 presents a count of sediment mercury samples by TMDL zone. Note that there are no water column mercury concentrations available for the study area. The locations at which the mercury fish fillet samples were taken are shown in Figure 2-6.

Table 2-1. Count of Fish Mercury Fillet Samples by Species and TMDL Zone

Fish Species	TMDL Zone				Grand Total
	Nearshore open water/ shoreline	Calumet Harbor	North Point Marina	Waukegan Harbor	
Black bullhead	-	-	-	2	2
Brown trout	1	-	-	-	1
Largemouth bass	-	-	3	-	3
Rainbow trout	2	-	-	-	2
Rock bass	-	1	4	4	9
Smallmouth bass	-	5	2	-	7
Sunfish	-	-	3	2	5
White sucker	-	-	2	2	4

Table 2-2. Count of Mercury Sediment Samples by TMDL Zone

Media[a]	TMDL Zone				Grand Total
	Nearshore open water/ shoreline	Calumet Harbor	North Point Marina	Waukegan Harbor	
Sediment	-	6	2	4	12

[a] There were no mercury water column samples for study area waterbodies.

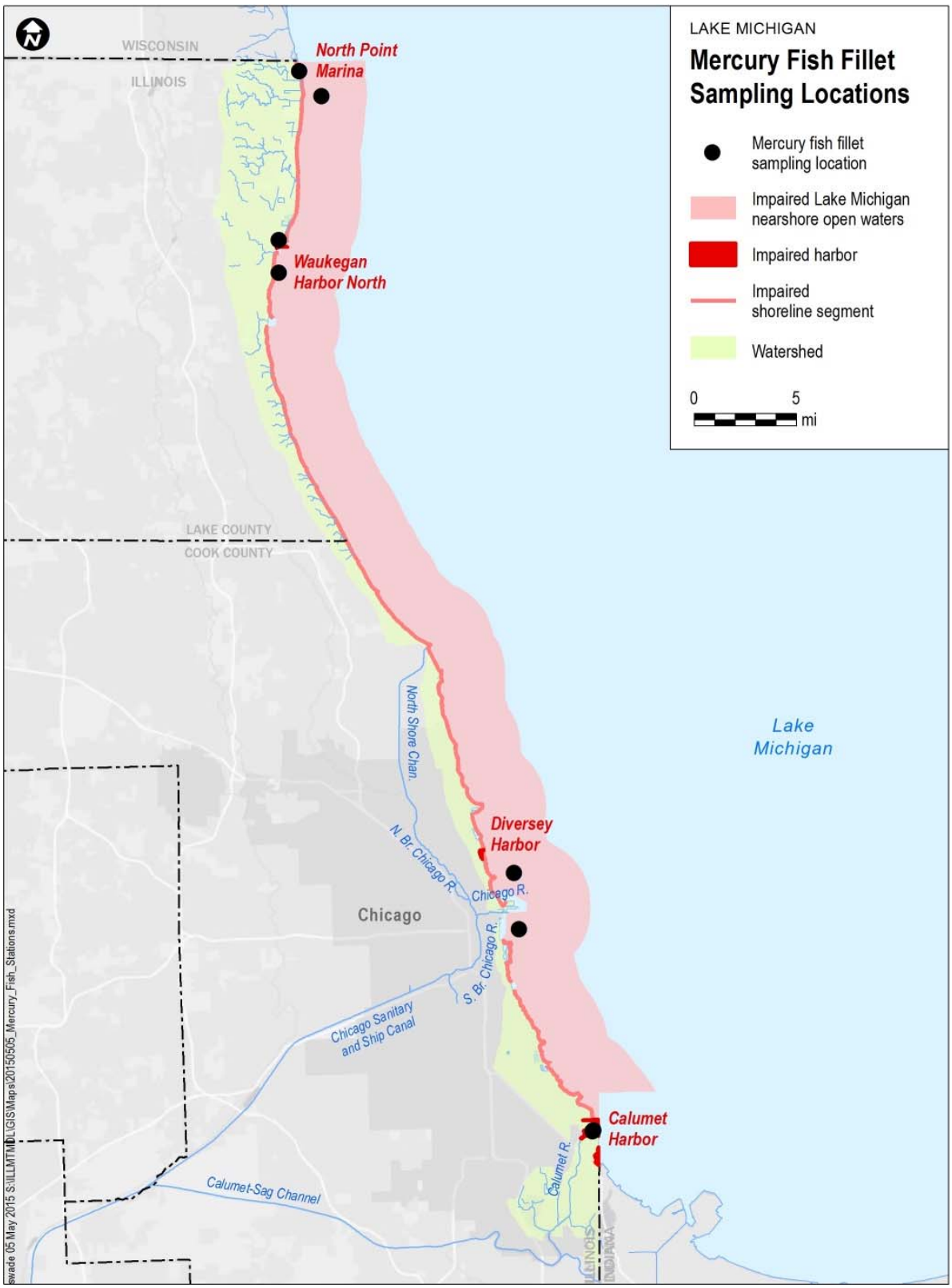

Figure 2-6. Sampling Locations for Mercury Fish Fillets

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3 Applicable Water Quality Standards and TMDL Targets

This section describes relevant WQS, designated use support, and numeric TMDL targets for mercury.

3.1 Water Quality Standards

The Clean Water Act Section 303(c)(2)(A) requires states to designate appropriate water uses for all waterbodies, and adopt 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. Some examples of designated uses are primary contact (such as swimming and water skiing), fish consumption, aquatic life, and aesthetic quality. Surface waters in Illinois fall into one of four categories: General Use, Public and Food Processing Water Supplies, Secondary Contact and Indigenous Life, and Lake Michigan Basin (IEPA, 2014). Each category has its own set of water quality standards. The standards for the Lake Michigan Basin are found in the Illinois Administrative Code (35 IAC 302.501-595 Subpart E). Some of the Lake Michigan Basin WQS apply to all waters within the basin, while others apply only to the open waters of the Lake or only to tributary waters of the Lake. WQS for the Lake Michigan Basin protect aquatic life, human health, wildlife, and recreational uses. Waters of the Lake Michigan Basin must be free from any substance or any combination of substances in concentrations toxic or harmful to human health, or to animal, plant, or aquatic life (35 IAC 302.540). Lake Michigan Basin waters include all tributaries of Lake Michigan, harbors, and open waters of the Illinois portion of the lake. Numeric water quality criteria are developed to protect the designated uses of surface waters, and the standards for mercury are described below.

The WQS for mercury in surface waters of the Lake Michigan basin are 0.0013 µg/L (or 1.3 ng/L) for the protection of wildlife, 0.0031 µg/L (or 3.1 ng/L) for the protection of human health, and 1.7 µg/L (1,700 ng/L) and 0.91 µg/L (910 ng/L) for the protection of aquatic life from adverse effects due to acute and chronic toxicity, respectively [35 IAC 302.504(e)]. These standards were adopted by the State of Illinois as part of the Great Lakes Water Quality Initiative and apply to all waters of the Lake Michigan Basin.

3.2 Designated Use Support

Every two years, the State of Illinois evaluates the extent to which waters of the state are attaining their designated uses. The degree of support of a designated use in a particular area (assessment unit) is determined by an analysis of biological, physicochemical, physical habitat, toxicity, and other data. When sufficient data are available, each applicable designated use in each assessment unit is assessed as *Fully Supporting* (good), *Not Supporting* (fair), or *Not Supporting* (poor). Waters in which at least one applicable use is not fully supported are considered impaired.

Fish consumption use is associated with all waterbodies in the state. The assessment of fish consumption use is based on (1) waterbody-specific fish-tissue data and (2) fish-consumption advisories issued by the multi-agency[4] Illinois FCMP, which consists of staff from the departments of Agriculture, Natural Resources, Public Health, the Illinois Emergency Management Agency, and IEPA. The FCMP uses a risk-based process developed in the Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory (Anderson et al., 1993). The Protocol requires the determination of a Health Protection Value (HPV) for a contaminant, which is then used to calculate the level of contaminant in fish tissue that will be protective of human health at several meal consumption frequencies (ranging from unlimited consumption to "do not eat"). This information is used to calculate the level of the contaminant in fish that will not result in exceeding the HPV at each meal consumption frequency.

For mercury, the HPV for fish consumption by sensitive populations (includes pregnant or nursing women, women of child-bearing age, and children under the age of 15) is 0.10 µg/kg/day. The HPV for women beyond child-bearing age and men over the age of 15 is 0.30 µg/kg/day. Based on the 0.10 µg/kg/day HPV, the lowest fish tissue concentration that would result in a fish consumption advisory is 0.06 mg/kg for all species; this is, therefore, the concentration used to assess support of the fish consumption use. The 0.06 mg/kg fish tissue concentration, which is a risk-based advisory concentration developed from an extensive database of studies of the health effects of methyl mercury, is used by the Fish Contaminant Monitoring Program as the starting point for issuing a "one meal per week" advisory. This concentration was derived by the Great Lakes Fish Advisory Task Force and accepted by the Great Lakes states for use in their sport fish advisory programs. It should be noted that this fish tissue assessment concentration was derived independently of the numeric water column criteria.

Although there is a statewide fish consumption advisory for mercury because of widespread contamination above criteria levels throughout the state, not all waterbodies have been sampled, and not all samples exceeded criteria levels. For mercury, fish consumption use is assessed as *Not Supporting* only for specific waters where at least one fish-tissue sample is available and where at least one fish species exceeds the 0.06 mg/kg criterion for mercury. Also, because the statewide advisory is for predator species, fish consumption use is only assessed as *Fully Supporting* in those waters where predator fish-tissue data from the most recent two years do not show mercury contamination above criteria levels. Waters where sufficient fish-tissue data are unavailable are considered *Not Assessed*.

Aquatic life uses are assessed using the three most recent years of available data. For Lake Michigan open waters and harbors, if two or more samples exceed the acute aquatic life criterion, the waters are considered impaired. If more than 10 percent of the samples exceed the chronic aquatic life criterion, the waters are considered impaired.

3.3 Numeric TMDL Targets

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

[4] From Illinois Department of Public Health website Factsheet "Fish Advisories in Illinois"

may be based on human health, aquatic life, or wildlife criteria. Where possible, the water quality criterion for the pollutant causing impairment is used as the numeric water quality target when developing the TMDL. Because all of the assessment units addressed in this TMDL are impaired for the fish consumption use, the HPV for fish consumption for sensitive populations was used to derive the TMDL target of 0.06 mg/kg for mercury.

This TMDL needs to demonstrate that compliance with the fish tissue TMDL target will also meet the water quality targets, including the human health and wildlife criteria described above (for all waters), and additionally for Waukegan Harbor, meet the aquatic life criteria. This has been accomplished via the application of published bioaccumulation factors (BAFs) for the Great Lakes, which provide a translator between pollutant concentration in the water column and resulting fish tissue contamination (USEPA, 1995). The water column concentration corresponding to the fish tissue TMDL target of 0.06 mg/kg mercury was calculated to equal 0.43 ng/L. This is lower (more stringent) than the most stringent WQS for mercury (1.3 ng/L) for wildlife, indicating that use of the fish tissue concentration as the TMDL target will result in water column concentrations that will comply with applicable water quality criteria to protect human health and wildlife. This apparent discrepancy in water column targets is due to the previously discussed fact that the fish tissue assessment concentration was derived independently of the numeric water column criteria.

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4 Source Assessment

The purpose of a source assessment is to consider all potential sources of the pollutant of concern, in order to quantify source reductions that are needed to attain designated uses. The sources that were investigated and their estimated load contributions are discussed in this section.

This TMDL was developed using a direct proportionality approach that allows data for the whole study area to be considered together to establish a TMDL that is appropriate for the entire study area. The approach is further described in Section 5.

A number of source categories were evaluated as potential sources of mercury to the study area:

- Hydrodynamic transport
- Atmospheric loading
- MS4 stormwater loading
- Flow reversals from the CAWS
- Other point source discharges

As described below, the most significant sources were found to be hydrodynamic transport of mercury from the open water of Lake Michigan and atmospheric loading.

4.1 Hydrodynamic Transport

The open water of Lake Michigan is a source of mercury to the project study area. As described below, the predominant flow patterns in Lake Michigan circulate counter-clockwise in the vicinity of the study area (Beletsky and Schwab, 2001; Beletsky et al., 1999). As such, mercury loads to the study area can be estimated using the flow into the study area and Lake Michigan mercury concentrations at the northern end of the study area.

Hydrodynamic transport between Lake Michigan and the nearshore open water segment was estimated for this project using the NOAA Great Lakes Coastal Forecasting System (GLCFS). The GLCFS is a set of models that simulate and predict the two- and three-dimensional structure of currents, temperatures, winds, waves, and ice in the Great Lakes using a 4-km^2 (2 km x 2 km) grid size. The GLCFS uses a modified Princeton Ocean Model, developed by NOAA's Great Lakes Environmental Research Laboratory and The Ohio State University, and is supported by the National Weather Service (NOAA, 2015).

Results from the GLCFS were used to estimate the transfer of mercury into the study area. This was first accomplished by estimating the annual average flow of Lake Michigan water into the study area. GLCFS modeling results were extracted for the northern edge of the study area, as the predominant lake current is in this direction. Figure 4-1 shows the mean circulation, adapted from Beletsky and Schwab (2001). The mean current speed from the north was 3.35 cm/s for 2014. The area of conveyance for this velocity is 54,000 m^2, which was calculated by multiplying the average depth of the first two GLCFS model grid cells (10 m and 17 m) by the width of each cell (2 km each). Multiplying the average speed by

the area determined an average flow into the study area of 1,810 m^3/s. Mercury concentrations from the main body of Lake Michigan (USGS, undated), measured outside the study area, averaged 0.18 ng/L. Multiplying this concentration by flow would equal 10.3 kg/yr of mercury entering the study area due to transport from Lake Michigan. It is important to note that atmospheric deposition is the dominant source of mercury into the main body of Lake Michigan, such that reductions attained through this TMDL to control atmospheric loads will also help control loading from Lake Michigan.

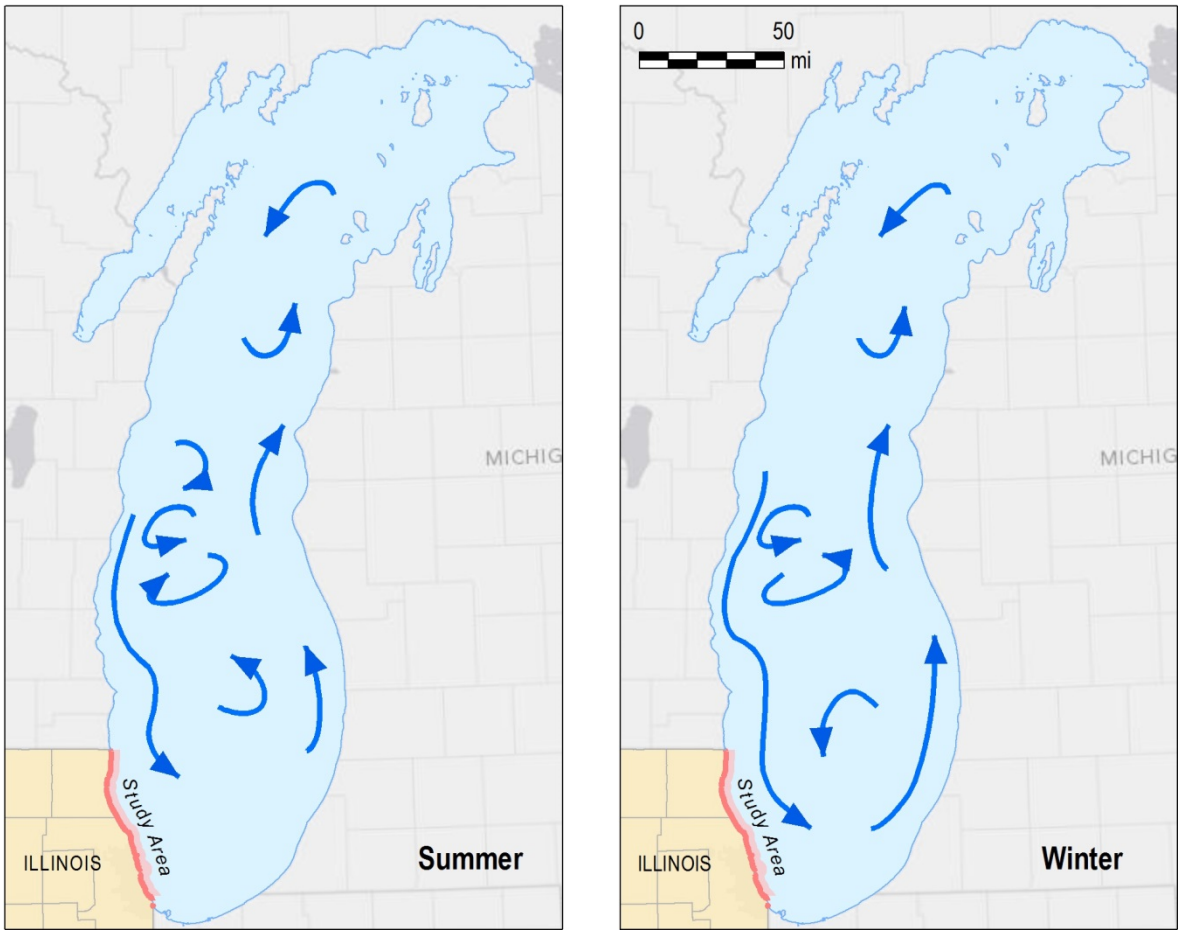

Figure 4-1. Observed Mean Circulation in Lake Michigan (Adapted from Beletsky et al., 1999 cited in Beletsky and Schwab, 2001)

4.2 Atmospheric Deposition

Atmospheric mercury loading to terrestrial and aquatic water surfaces occurs via wet and dry deposition. Sources of mercury that contribute to atmospheric loadings to the Illinois Lake Michigan nearshore are natural sources from geologic origins, re-emissions, and anthropogenic sources.

The total atmospheric mercury deposition across the nearshore open waters and harbors of the study area was obtained from USEPA's Regional Modeling System for Aerosols and Deposition (REMSAD; USEPA, 2008). 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" (USEPA, 2008). 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 becoming attached to water vapors or rain/snow. Dry deposition occurs when gas phase (i.e., absorption of reactive gaseous mercury) and particulate-bound mercury are deposited on terrestrial and aquatic surfaces. The Particle and Precursor Tagging Methodology feature of REMSAD allows the user to tag or track emissions from selected sources or groups of sources, and to quantify their contributions to mercury deposition throughout the modeling domain and simulation period. A coal-fired power plant operated by NRG/Midwest Generation, LLC in Waukegan is located within the study area. Mercury emissions from this power plant were included in the REMSAD simulations.

REMSAD estimated that in 2001[5], the mass of mercury deposited to the study area (i.e., Lake Michigan nearshore) through total atmospheric deposition was 23 kg/yr. Illinois sources contribute 37 percent of the atmospheric mercury deposition to the study area (Figure 4-2; Table 4-1). The contribution from the Waukegan power plant (0.82 kg) constitutes 9.4% of the modeled Illinois deposition. Regional sources, which include other U.S. states, Canada, and Mexico, contribute 12 percent of the mercury deposition. About 49 percent of the atmospheric mercury deposition to the project study area originated from background sources. *Background* refers to natural sources, as well as anthropogenic sources outside of North America. The remaining 2 percent of mercury deposition comes from re-emission, defined as previously deposited mercury that has been volatilized from water, land, or vegetation.

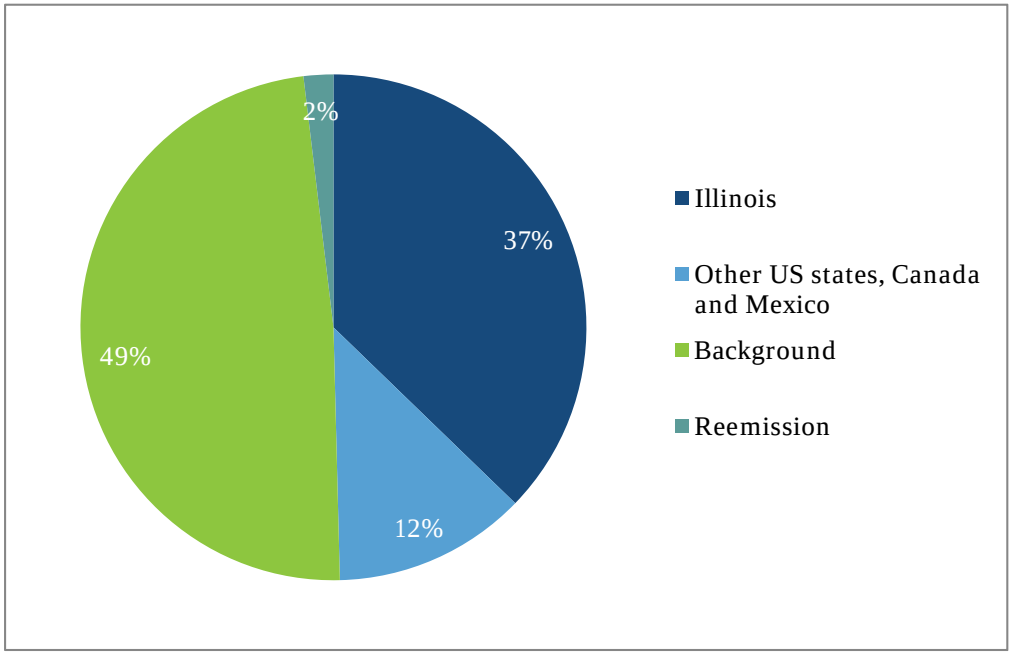

Figure 4-2. Distribution of Sources of Atmospheric Mercury Deposition to Illinois (Source: USEPA, 2015a)

[5] The REMSAD 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 USEPA used in the evaluation of the CAIR and the Clean Air Mercury Rule.

Table 4-1. Atmospheric Mercury Load by Source Category for Illinois, Surrounding States, Canada, and Mexico (Source: USEPA, 2015a)

Source Category of Atmospheric Mercury	Load (kg)	Load (lbs)	% Load
Background	11.27	24.86	49%
Re-emission	0.44	0.97	2%
Illinois	8.66	19.08	37%
Loading from other U.S. states, Canada, and Mexico	2.87	6.33	12%
Total	23.24	51.24	100%

4.2.1 Natural Sources

As explained in Section 2.1, natural sources of mercury include mercury emitted from geothermal sources, volcanic eruptions, and the weathering of mercury-containing rocks. There are no known natural sources of mercury in Illinois, unlike in other parts of the United States, such as California, where certain mountain ranges are rich in cinnabar deposits. Re-emission of previously deposited mercury can occur from vegetation, land, and water surfaces. Meteorological conditions and activities related to land use changes and biomass burning can enhance the re-emission process (Pirrone et al., 2010). Land use changes associated with deforestation and surface disturbances related to agricultural activities release soil mercury and contribute to re-emission.

4.2.2 Anthropogenic Sources

Anthropogenic sources of mercury are varied and widespread; most mercury emissions are attributed to a combustion source. In 1990, coal-fired power plants, municipal waste combustors, and medical waste incinerators were the three largest mercury emission source categories in the United States (Schmeltz et al., 2011; Evers et al., 2011). In the late 1990s, regulatory controls were imposed on municipal waste combustors and medical waste incinerators. As a result, mercury emissions from municipal waste combustors and medical waste incinerators declined by more than 90 percent in 2005, relative to 1990 levels. Between 1990 and 2005, anthropogenic mercury emissions in the United States declined by approximately 59 percent, largely due to controls on municipal and medical waste incinerators (Figure 4-3). Mercury emissions from power plants remained relatively unchanged during this time. Currently, coal-fired power plants are the single largest source of mercury emissions nationwide and in Great Lakes region (Evers et al., 2011; Schmeltz et al., 2011).

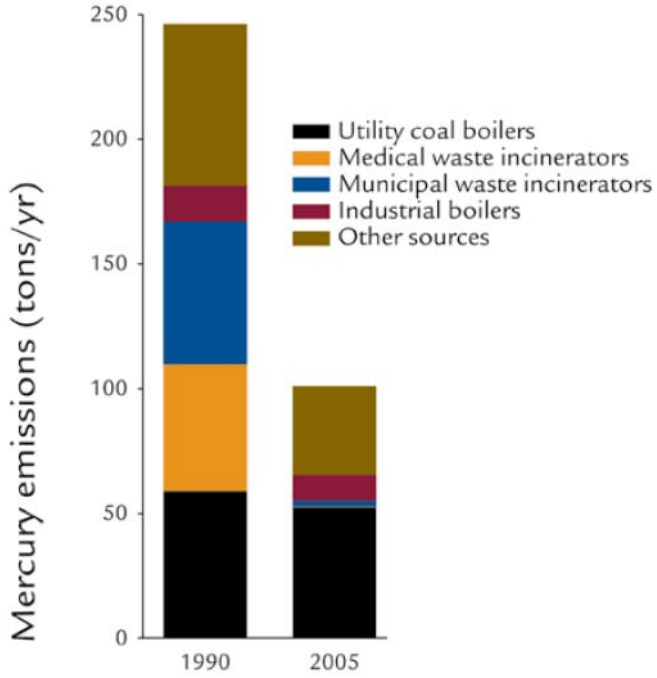

Figure 4-3. Total U.S. Anthropogenic Mercury Emissions 1990 vs. 2005 (Source: Evers et al., 2011)

In Illinois, the largest source category of anthropogenic mercury emissions is coal-fired electric utilities. Using 2002 data from the National Emissions Inventory (NEI), a period consistent with the REMSAD modeling period, the coal-fired electric utilities contributed over 70 percent of the total airborne mercury emissions in the state (Figure 4-4). Other notable source categories include mercury emissions from primary and secondary metal production; various industrial processes; fuel combustion for industrial, commercial, and residential purposes; waste incinerators including hazardous and medical waste combustors; and cement and lime manufacturing. In 2007, the State of Illinois promulgated the Illinois mercury rule targeted towards improving air quality by dramatically reducing mercury. Under the rule, mercury emission reductions began in 2009 and were required to be reduced by approximately 90% statewide by 2015. Mercury emissions from coal-fired power plants in Illinois were estimated at 7,700 pounds per year in 2006 and are currently estimated to be less than 600 pounds per year when also accounting for the retirement of 18 coal-fired units in Illinois since 2007. Mercury emissions from the Waukegan power plant have declined by about 90%; this facility currently is in compliance with the Illinois mercury rule. Additionally, mercury emissions will fall considerably further due to the expected retirement or conversion to natural gas of seven more units by the end of 2016, several of which are in the Great Lakes Basin area.

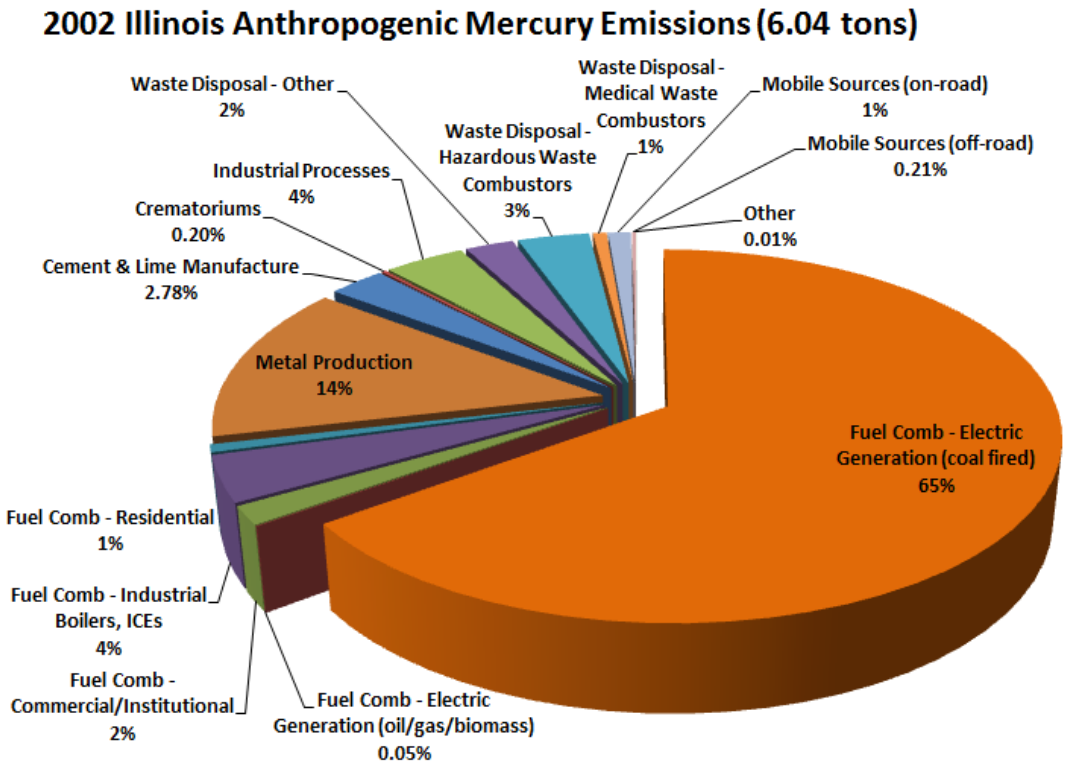

Figure 4-4. 2002 Total Anthropogenic Mercury Emissions to the Atmosphere from Illinois (Source: NEI, 2002)

4.3 MS4 Stormwater Mercury Loading

In addition to the fact that Lake County, Shields Township, Waukegan Township, Illinois Department of Transportation and the Cook County Highway Department have MS4 permits, 93.5 percent of the study area watershed lies within an MS4 city (including Chicago) or village. As a result, close to 100 percent of the study area is within an MS4 area. However, no site-specific data were available to quantify stormwater mercury loads for the study area watershed (MWRDGC, 2015). The magnitude of stormwater mercury loads was, therefore, estimated as the product of runoff, the study area drainage area, and an assumed mercury concentration, based on stormwater sampling outside the study area watershed. It was also conservatively assumed that all of the runoff generated within the study area watershed drains to Lake Michigan. The development of these inputs is described below.

Runoff quantity was calculated using the method developed by the Metropolitan Washington Council of Governments (Schueler, 1987) as: **R = P * Pj * Rv**

Where:

R = Annual runoff (inches),

P = Annual rainfall (inches) estimated as 36.1 inches, based on the average annual rainfall reported for Chicago Midway Airport 3 SW for the 1929-2013 period (http://www.crh.noaa.gov/lot/?n=111577_Midway)

Pj = Fraction of annual rainfall events that produce runoff (set to the default of 0.9)

Rv = Runoff coefficient. Rv is a function of impervious cover in the study area watershed. Impervious cover was calculated using Geographic Information System analysis for each major land use category: commercial (0.71), industrial (0.54), and residential (0.37). The following runoff coefficients resulted from these impervious cover values: commercial (0.69), industrial (0.54), and residential (0.38)

The area of the contributing watershed was calculated as 99.6 square miles, broken down as 3.82 square miles commercial, 4.05 square miles industrial, and 91.73 square miles residential.

The mercury concentration was based on USGS stormwater measurements for the Columbia River Basin, Washington, and Oregon (2009-2010) (Morace, 2012). The value used for load calculation was based on the average of reported values for total mercury, which equaled 37.17 ng/L. The estimated stormwater mercury load equaled 6.96 lbs/year (3.16 kg/yr).

4.4 Mercury Loading from Flow Reversals from the Chicago Area Waterway System (CAWS)

The CAWS is a 76.3-mile branching network of navigable waterways controlled by hydraulic structures. The CAWS flow is composed of treated sewage effluent, CSO, and stormwater runoff, and the dominant uses are for conveyance of treated municipal wastewater, commercial navigation, and flood control. Flows from the CAWS ultimately drain to the Mississippi River, but on occasion, flows are reversed and flow into Lake Michigan.

There are two types of reversals: gate reversals and lock reversals. Gate reversals occur adjacent to the lock structure and involve small volumes of water. Lock reversals occur when the locks are opened during severe storms. Lock reversals allow a much greater volume of water to flow into Lake Michigan. During particularly large storms, lock reversals allow flow from the CAWS to discharge to Lake Michigan through the control works shown in Figure 2-4 (O'Brien Lock, Chicago River Lock, and Wilmette Lock).

Limited site-specific data were available to quantify the magnitude of mercury loads from the CAWS flow reversals. The magnitude of loads entering the study area waters from periodic flow reversals of the CAWS was estimated based on measured flow and site-specific concentration data, as described below. Because this estimate was uncertain, a second load calculation is provided, using site-specific flow data and mercury measurements from another location.

The volume of flow is reported by the Metropolitan Water Reclamation District of Greater Chicago (MWRDGC) on their website http://www.mwrd.org/irj/go/km/docs/documents/MWRD/internet/protecting_the_environment/Combined_Sewer_Overflows/pdfs/Reversals.pdf. Until recently, the MWRDGC conducted water quality sampling in the CAWS during flow reversals, including measurements of mercury. Mercury loads to the study area from flow reversals were initially calculated based on mercury concentration data collected at approximately 30-minute intervals during the 2013 flow reversals at each of these three locations (Table 4-2), and the average 2010-2014 annual volume (4,021.4 million gallons). Because all mercury concentration measurements were lower than the detection limit of 0.2 ug/L, loads from this source could not be accurately characterized using site-specific concentration data.

Table 4-2. Measured CAWS Mercury Concentrations During Times of Flow Reversals

Location	Location of mercury sampling	Mercury results (4/18/13)
O'Brien Lock	Calumet Harbor, 95th St. Bridge: Calumet Harbor, Ewing Ave. Bridge	All 68 samples < 0.2 ug/L
Chicago River Lock	Chicago River Locks, Inner Harbor Sluice Gate; Chicago River Locks, Sluice Gate, DuSable Harbor	All 28 samples < 0.2 ug/L
Wilmette Lock	Wilmette Harbor, Wilmette Pump Station	All 12 samples < 0.2 ug/L

Instead, a range of mercury loads from flow reversals was roughly estimated to be between 0.099 kg/yr and 0.56 kg/yr, using two sources of information. The lower value was estimated based on low level mercury measurements collected in the Chicago River (average = 6.5 ng/L, when values < detection are set equal to the detection level of 0.5 or 10 ng/L depending on sample) and reported MWRDGC flow volumes. The higher value was estimated based on MWRDGC flow volumes and Columbia River stormwater concentrations (37.17 ng/L). The availability of mercury measurements for CSOs was investigated; however, mercury concentrations are not measured for CSOs in the study area (MWRDGC, 2015a).

4.5 Other Point Source Mercury Discharges to the Study Area

There is one individual NPDES permit in the watershed with mercury effluent limits and five additional individual permits with mercury monitoring requirements.

The permit for the NSWRD Waukegan Water Reclamation Facility (IL0030244) has gone through the public notice process and contains an average annual mercury concentration limit of 0.0000013 mg/L (1.3 ng/L) which is consistent with the most stringent water quality standards for the study area waterbodies. The annual average load for this facility equals the permitted load of 0.04 kg/yr. (0.00024 lbs/day at the design average flow)

Five individual NPDES permits contain mercury monitoring requirements (see Table 7-4). Two of the facilities have provided monitoring data, and the data shows that mercury levels have been below detection limits in both cases. The Permit Section will evaluate the monitoring data in future NPDES permit renewal cycles and will determine whether the discharge from the facility will be required to meet the mercury water quality standards.

4.6 Summary

Hydrodynamic transport of mercury from the main body of Lake Michigan and atmospheric loading are clearly important loading sources (

Table **4-3**). No determination could be made for stormwater loading, or flow reversals from the CAWS, because site-specific mercury concentration data were either below detection limits or not available. While literature-based estimates for these sources indicate that they are likely to be minor contributors to the study area as a whole, they have the potential to be significant contributors to individual harbors.

Table 4-3. Mercury Loads to the Study Area

Process	Data Sufficiency[a]	Estimated Magnitude
Hydrodynamic transport from main body of Lake Michigan	Acceptable	10.3 kg/yr
Atmospheric Loading	Acceptable	23.24 kg/yr
MS4 Stormwater Loading	Limited. Rough estimate made using literature-based concentrations	3.16 kg/yr
Flow Reversals from the Chicago Area Waterways	Limited. All available data are non-detectable; A range of rough estimates were made using Chicago River data and literature-based concentrations	0.099 kg/yr - 0.56 kg/yr
Other Point Source Discharges	Acceptable	0.04 kg/yr

[a] Site-specific data sufficiency is characterized as limited (indicating the use of literature values and/or measurements less than the detection level) for the majority of the processes of concern, with hydrodynamic transport and atmospheric loading being the only sources that can be quantified with existing data.

Figure 4-5 presents a map of mercury sources considered under this TMDL, which have been described in this section, with the exception of atmospheric loading because it cannot be easily mapped.

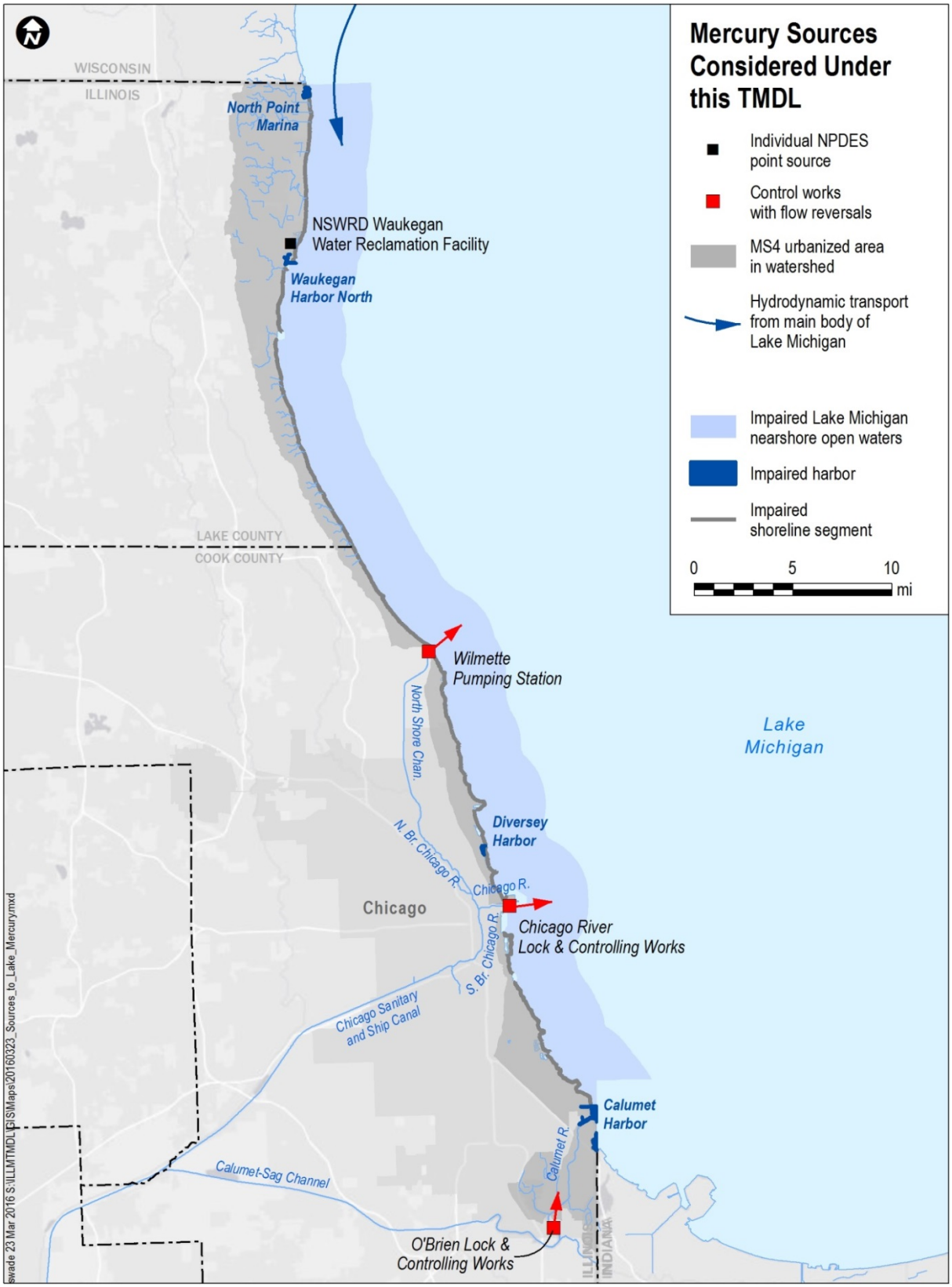

Figure 4-5. Mercury Sources Considered Under this TMDL, Excluding Atmospheric Loading, Which Can't Easily be Mapped.

5 Modeling Approach

A wide range of modeling frameworks exist that could potentially be used to support development of the Illinois Lake Michigan nearshore mercury TMDL. The TMDL Scoping Report (LimnoTech, 2015) reviewed the range of available frameworks and concluded that a zero-dimensional, steady state proportionality approach was most appropriate for this project, given the amount of data available to support TMDL development. This section describes the modeling approach for calculating the mercury TMDL. It consists of the following sections:

- Fish-tissue based approach
- Required reduction percentage

5.1 Fish Tissue-Based Approach

The approach for linking pollutant loads directly to fish tissue concentrations for this TMDL was patterned after the statewide mercury TMDL developed by the Minnesota Pollution Control Agency (MPCA, 2007) and statewide mercury TMDL report for Michigan (LimnoTech, 2013), which drew from the work of Jackson et al. (2000), a regional mercury TMDL for the Northeast United States (CDEP et al., 2007) .

This approach 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 waterbodies; and 3) ultimately, a proportional reduction in loading in waterbodies 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 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 shown in Equation 5-1 (USEPA, 2001; CDEP et al., 2007):

$$C_{fish_{t1}} = BAF * C_{water_{t1}} \quad (5\text{-}1)$$

Where:

$C_{fish_{t1}}$ and $C_{water_{t1}}$ represent mercury concentrations in fish (mg/kg) and water (mg/L) at time t_1, respectively. BAF represents the bioaccumulation factor, which is constant.

For a future time, t_2, when mercury concentrations have changed, but all other parameters remain constant, equation 5-2 applies:

$$C_{fish_{t2}} = BAF * C_{water_{t2}} \quad (5\text{-}2)$$

Where:

$C_{fish_{t2}}$ and $C_{water_{t2}}$ represent mercury concentrations in fish and water at that future time t_2, respectively, and $C_{fish_{t2}}$ is for a fish that is the same age, length, and species as for $C_{fish_{t1}}$.

Combining the two equations produces equation 5-3:

$$\frac{C_{fish_{t1}}}{C_{fish_{t2}}} = \frac{C_{water_{t1}}}{C_{water_{t2}}} \quad (5\text{-}3)$$

Because water column mercury concentrations are proportional to mercury air deposition load, the above equation can be expressed as shown in equation 5-4:

$$\frac{C_{fish_{t1}}}{C_{fish_{t2}}} = \frac{L_{air_{t1}}}{L_{air_{t2}}} \quad (5\text{-}4)$$

Where:

$L_{air_{t1}}$ and $L_{air_{t2}}$ are the air deposition mercury loads to the waterbody 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 a 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 (USEPA, 2001). 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 percent 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 percent of their long-term steady state response.

Application of the fish tissue-based approach requires the selection of a target concentration (Section 3.3), an appropriate fish species, and calculation of a reduction percentage, also referred to as a reduction factor.

5.1.1 Selection of a Target Fish Species

Fish tissue mercury concentrations have been sampled in a wide range of species across the study area, and they show varying degrees of bioaccumulation. The use of fish tissue samples from multiple species to form the basis for compliance with the fish consumption advisories incorporates these varying

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

degrees of bioaccumulation across the study area into the assessment for impairment of the fish consumption designated use.

The available fish tissue mercury concentration data for 33 samples across 8 species of fish, spanning the collection period of 2000 to 2012, were used in the evaluation. The distribution of concentrations suggests that largemouth bass have the highest mean mercury concentrations of these species (Table 5-1). All three largemouth bass tissue samples were collected in North Point Marina. Largemouth bass have a mean mercury concentration of 0.28 mg/kg. Largemouth bass was selected as the target species for this TMDL because it represents a top-predator species and has the highest mean mercury concentrations of the fish species evaluated.

Due to the lack of data from several harbors and the nearshore open water/shoreline zone, TMDL calculations require the extrapolation of fish data across sites to account for the absence/limited number of fish samples in certain TMDL zones. Although only three samples exist for largemouth bass (each are composites of 5 fish), and all from a single marina, their use as a target species is reasonable given the data available.

Table 5-1. Mean Fish Fillet Mercury Concentration (mg/kg) across Entire Study Area

Species	Count	Mean (mg/kg)
Largemouth Bass	3	0.2800
Smallmouth bass	7	0.1096
Rock Bass	9	0.1023
White sucker	4	0.0528
Sunfish	5	0.0328
Black bullhead	2	0.0550
Rainbow trout	2	0.0638
Brown Trout	1	0.1030

5.2 Required Reduction Percentage

The calculation of the reduction percentage, or reduction factor, is based on the load reductions necessary to achieve the target fish tissue mercury concentration, compared to the existing mean mercury concentration in fish tissue (Equation 5-5).

$$\%\ Reduction = {(C_{fish,current} - C_{fish,target})}/{C_{fish,current}} \quad (5\text{-}5)$$

Where:

$C_{fish,current}$ = Current mercury concentrations in fish (mg/kg)
$C_{fish,target}$ = Target mercury concentrations in fish (mg/kg)

Equation 5-5 was applied using the average mercury concentration of all largemouth bass (0.28 mg/kg) in conjunction with the fish tissue target of 0.06 mg/kg to calculate a required load reduction of 78.57 percent.

The year 2001 was used for calculating reductions, based on the availability of the atmospheric deposition modeling results from REMSAD (Section 4.2). A 2002 mercury emissions inventory baseline will be used to track reduction progress, because IEPA 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.

6 TMDL Development

A TMDL calculates the maximum amount of a pollutant allowed to enter a waterbody so that the waterbody will meet the WQS for that particular pollutant, in this case for 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 following equation:

$$TMDL = \sum LA + \sum WLA + MOS \quad (6\text{-}1)$$

Where:

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

$\sum LA$ = sum of all load allocation for nonpoint sources

$\sum WLA$ = 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 waterbody can assimilate and attain WQS)
2) Allocate this loading capacity among the three categories shown in Equation 6-1.

Equation 6-2 is used to calculate the TMDL using the existing combined load of mercury from point and nonpoint sources, defined as the "baseline load", and the reduction factor (RF):

$$TMDL = \text{Baseline Load} * (1\text{-}RF) \quad (6\text{-}2)$$

Where TMDL represents the assimilative capacity (LC) of the waterbody, expressed here as an annual load (kg/yr); baseline load 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 reduction percentage needed to achieve target fish mercury concentrations (see Equation 5-5 in Section 5.2). Determining an annual load is the most appropriate way to calculate this mercury TMDL, because the goal is to address long-term mercury bioaccumulation, rather than track short-term effects because there is a lag time between mercury entering the environment and bioaccumulating in fish. Nonetheless, TMDLs must be expressed in daily units whenever feasible. Consistent with the Michigan statewide mercury TMDL report (LimnoTech, 2013), a maximum allowable daily load can be estimated by dividing the annual load by 365 (MPCA, 2007, CDEP et al., 2007) (Equation 6-3).

$$\text{TMDL (kg/day)} = [\text{TMDL (kg/yr)}]/365 \quad (6\text{-}3)$$

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

- Baseline mercury load
- TMDL loading capacity
- Wasteload allocation
- Load allocation
- Margin of safety
- Critical conditions and seasonal variation

6.1 Baseline Mercury Load

The baseline load is the sum of the existing nonpoint and point source loads of mercury for the baseline year. As discussed in Section 5.2, the year 2001 was selected as a baseline year, based on the availability of atmospheric modeling results for 2001.

Point sources of mercury consist of regulated wastewater and stormwater discharges (including permitted municipal separate storm sewer system (MS4) discharges). Stormwater regulated under the NPDES stormwater program (i.e., Phase I and Phase II) is a point source. No detectable mercury concentrations were available for any of the NPDES discharges in the study area, and the source assessment conducted in Section 4 indicted that these sources are likely a small contributor (less than 10%) to existing mercury loads to the segment. As such, point sources are not included in the baseline mercury load. Point sources will receive a WLA, however, to ensure that these source loads do not lead to a WQS violation.

Diffuse, or nonpoint, sources of mercury to the study area consist almost entirely of atmospheric deposition, either directly to the study area via atmospheric deposition or indirectly to the main body of Lake Michigan, with subsequent transport into the study area.

Table 4-3 indicates that mercury loading due to hydrodynamic transport to the study area from the main body of Lake Michigan was 10.27 kg of mercury per year, while direct atmospheric deposition to the study area contributed 23.24 kg/yr. The sum of these numbers, 33.51 kg/yr, represents the nonpoint source load for the baseline year of 2001.

The nonpoint source load includes contributions from natural and anthropogenic sources of mercury deposition. The Minnesota Mercury TMDL (MPCA, 2007) assumed that mercury deposition is 30 percent natural and 70 percent anthropogenic in origin. These proportions were based on an inferred pre-industrial deposition rate of 3.7 μg/m^2 (from Swain et al., 1992), relative to the total atmospheric deposition of 12.5 μg/m^2 for Minnesota in 1990. The pre-anthropogenic deposition of 3.7 μg/m^2 used in the Minnesota TMDL was also consistent with the value of 3.1 μg/m^2 inferred from a Lake Michigan study showing consistency between different venues of research (Rossmann, 2010). The atmospheric deposition rate for the Lake Michigan nearshore study area in 2001 is 32.1 μg/m^2, based on REMSAD modeling results. The difference in atmospheric deposition rates between Minnesota (12.5 μg/m^2) and the Illinois Lake Michigan nearshore (32.1 μg/m^2) results in a higher anthropogenic percentage for the Illinois Lake Michigan nearshore than Minnesota. For the Illinois Lake Michigan nearshore TMDL, mercury deposition is assumed to be 12 percent natural and 88 percent anthropogenic (since 3.7 μg/m^2 is 12 percent of 32.1 μg/m^2). Applying these proportions to the total nonpoint source loads, the natural and anthropogenic contributions to mercury deposition are estimated as 4.02 kg/yr and 29.49 kg/yr, respectively.

The baseline total source load is the sum of the point source load and the nonpoint source load for 2001. Because the only significant source of mercury is from nonpoint sources, the baseline load for 2001 is equal to the nonpoint source load. The baseline load for 2001 is 33.51 kg/yr (Table 6-1).

Table 6-1. Baseline Mercury Load for 2001

Portion of Baseline Mercury Load	Load
Point Source Load	No detectable concentration*
Nonpoint Source Load	33.51 kg/yr
Total Baseline Load (2001)	33.51 kg/yr

*See discussion above for further explanation

6.2 TMDL Loading Capacity

The baseline load described in Section 6.1 and the RF described in Section 5.2 are used to define the TMDL loading capacity by applying the RF to the baseline load, as shown in Equation 6-4.

$$\text{TMDL}^* = \text{Baseline Load}^* \times (1\text{-RF})$$

$$7.18 \text{ kg/yr} = 33.51 \text{kg/yr} \times (1 - 0.7857) \qquad (6\text{-}4)$$

* Annual Numbers are then expressed as a "daily load"

$$7.18 \text{ kg/yr} / (365 \text{ days/year}) = \mathbf{0.020 \text{ kg/day}}$$

Inserting the baseline load (33.51 kg/yr) and RF (78.57 percent) into Equation 6-4 yields a TMDL of 7.2 kg/yr (16 lbs/yr). The daily equivalent load equals the annual load divided by 365, or **0.020 kg/day** (0.043 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 0.06 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, including MS4 stormwater. As described below, the total WLA equals 0.0004 kg/day for individual and MS4 NPDES permittees.

One individual NPDES permit with mercury limits has been identified in the watershed (Table 6-2). This is the NSWRD Waukegan Water Reclamation Facility (IL0030244). The WLA for this facility is set equal to its permitted mercury load of 0.04 kg/year, which translates to 0.0001 kg/day (0.00024 lbs/day) at design average flow.

MS4 permits in the project study area are shown in Table 6-2. Current data identifies MS4 point source mercury loads as being relatively small based on current monitoring methods, compared to current nonpoint source loads. Stormwater sources, whether contributed through air deposition or other sources, have the potential to contribute mercury loads. However, there is no assurance that these loads will remain a relatively minor contributor to the total load after reductions of nonpoint sources occur, or if more sensitive methods will provide additional information in the future. To ensure that MS4s do not cause or contribute to violation of the water quality standard of 1.3 ng/L, the TMDL assigns an aggregate wasteload allocation to entities with MS4 permits in the project study area.

The WLA associated with these stormwater discharges is determined by multiplying the magnitude of stormwater flow delivered to the study area from each of these sources (calculated in Section 4.3) by a concentration equal to the WQS in order to convert it to a load. This results in a stormwater MS4 WLA of 0.11 kg/yr (0.0003 kg/day; 0.00066 lbs/day). Permit processes will address reductions and loads for permitted entities. Best management practices for MS4 mercury reduction are discussed in Section 7.

Table 6-2. Study Area Entities with MS4 or Individual NPDES Permits

Type of Permit	Place Name (MS4 permit) or Facility Name (individual permit)	Permit Number
MS4	Beach Park	ILR400164
MS4	Chicago	ILR400173
MS4	Cook County Highway Department	ILR400485
MS4	Evanston	ILR400335
MS4	Glencoe	ILR400198
MS4	Highland Park	ILR400352
MS4	Highwood	ILR400353
MS4	Kenilworth	ILR400214
MS4	Lake Bluff	ILR400366

Type of Permit	Place Name (MS4 permit) or Facility Name (individual permit)	Permit Number
MS4	Lake County	ILR400517
MS4	Lake Forest	ILR400367
MS4	North Chicago	ILR400402
MS4	Shields Township	ILR400123
MS4	Waukegan	ILR400465
MS4	Waukegan Township	ILR400148
MS4	Wilmette	ILR400473
MS4	Winnetka	ILR400476
MS4	Winthrop Harbor	ILR400477
MS4	Zion	ILR400482
MS4	Illinois Department of Transportation	ILR400493
Individual	NSWRD Waukegan Water Reclamation Facility	IL0030244

6.4 Load Allocation

The LA for nonpoint sources, presented in

Table 6-3, is essentially[7] equal to the loading capacity of 0.02 kg/day calculated in Section 6.2. The nonpoint sources of mercury to the study area consist primarily of atmospheric deposition, either directly to the study area via atmospheric deposition or indirectly to the main body of Lake Michigan, with subsequent transport into the study area. The atmospheric deposition component of LA includes both natural and anthropogenic load allocations. Because natural sources of mercury cannot be controlled, the mercury load attributed to natural deposition (4.02 kg/yr, or 0.011 kg/day (0.024 lbs/day)) is expected to remain the same. Therefore, all necessary LA for atmospheric deposition is achieved by attributing reductions to anthropogenic mercury deposition.

[7] A portion of the loading capacity will be allocated to point sources, but this portion is within the round-off error of load allocation

Table 6-3. Mercury Load Allocation

Portion of Load Allocation	Result
Natural Load Allocation	
Transport from Lake Michigan	0.0076 kg/day
Atmospheric Deposition	0.0034 kg/day
Anthropogenic Load Allocation	
Transport from Lake Michigan	0.0060 kg/day
Atmospheric Deposition	0.0027 kg/day
Total Load Allocation	**0.020 kg/day**

This TMDL only has regulatory authority for mercury originating from within the State of Illinois. For that reason, it is necessary to divide the atmospheric mercury deposition to the study into separate components corresponding to (1) out-of-state sources and (2) within-state sources. As discussed in Section 4.2, the contribution of both in-state and out of state sources of mercury deposition in Illinois is provided by the Regional Modeling System for Aerosols and Deposition results. "In-state" represents mercury deposition load due to Illinois sources. The "out of state" load is the sum of the remaining categories: other U.S. states, Mexico, Canada, and background sources (including global and natural sources). In-state sources make up 37 percent of the atmospheric mercury load, while out-of-state sources make up the remaining 63 percent.

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. To calculate the required reductions from anthropogenic sources, the reduction factor of 78.57 percent (Section 5.2) is divided by the percentage of contribution from anthropogenic sources (88 percent). This results in a required reduction in anthropogenic deposition of 89.29 percent.

As stated above, the in-state contribution to total mercury deposition is 37 percent. Since Illinois' deposition sources are 12 percent natural and 88 percent anthropogenic, this translates to an in-state contribution of 42 percent of the anthropogenic deposition (37%÷ 88% = 42%). Therefore, the out-of-state share of anthropogenic deposition is 58 percent.

If the TMDL was designed solely to reduce in-state sources, the necessary reductions from these sources would be calculated using Equation 6-5:

$$\%\ \text{reduction in in-state deposition} = RF/(1 - \%\ \text{out-of-state anthropogenic contribution}) \quad (6\text{-}5)$$

Where:

RF = Required reduction factor in anthropogenic deposition (89.29%)

Given a required RF of 89.29 percent, and an out-of-state anthropogenic contribution of 58 percent, Equation 6-5 indicates that in-state sources would need to be reduced by 213 percent if no reductions were made to out-of-state sources. In-state reductions in mercury atmospheric deposition alone will not achieve the TMDL target. Therefore, this TMDL assumes that reductions from out-of-state sources will

be consistent with those required for in-state sources (i.e., an 89.29-percent reduction will be required for both in-state and out-of-state sources).

Atmospheric modeling results are available for the year 2001; however, the emissions inventory is for 2002. Although these years don't match exactly, this information is the best available and is sufficiently close for calculating the TMDL load reductions. The State's load reduction goal can be translated to emission reduction goals based on the 2002 mercury emissions inventory (Table 6-4). Because tracking in-state reductions will be based on 2002 estimated emissions, the reduction goal for Illinois is 89.29 percent of the 2002 mercury emissions, which is 587 kg/yr (1,291 lbs/yr; Table 6-4).

Table 6-4. Summary of Baseline and Target Mercury Emissions from Illinois In-State Anthropogenic Sources

Category	Result
2002 Estimated Emissions	5,479 kg/yr
Target Reduction Rate in Illinois' Anthropogenic Emissions	89.29%
Target Emissions [2002 emissions * (1- 0.8929 reduction)]	587 kg/yr

6.5 Margin of Safety

The MOS is a required part of the TMDL to account for technical uncertainties, such as model predictions, analysis of technical data, and the relationship between pollutant loading and receiving water quality. When calculating the TMDL, the MOS can be either explicit (e.g., stated as an additional percentage load reduction), implicit (e.g., conservative assumptions in the TMDL calculations or overall approach), or a combination of the two. For this mercury TMDL, the MOS is implicit through the conservative nature of the modeling approach being applied, which does not consider legacy effects. Although the most recent available largemouth bass data were selected for use in this TMDL, the fish tissue data likely reflect historically higher mercury loads to some extent, because the average life span of largemouth bass is 16 years (TPWD, 2015).

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, due to the extremely slow response time of water and fish concentrations to changes in atmospheric loads, essentially no variation in fish mercury concentrations occurs as a result of 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 in fish tissue mercury concentrations are more likely influenced by differences in size, diet, habitat, and other undefined factors that are expected to be greater in sum than seasonal variability (MPCA, 2007).

There are critical conditions in the sense that certain waterbodies 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.

6.7 TMDL Summary

The components of the mercury TMDL are summarized in Table 6-5.

Table 6-5. Summary of TMDL Components

TMDL Components	Result
Target Level and Reduction Factor	
Target Fish Mercury Concentration (Fish Tissue Residue Value)	0.06 mg/kg
Baseline Mercury Concentration for Largemouth Bass	0.28 mg/kg
Reduction Factor	78.57%
Mercury Load for Baseline Year 2001	
Point Source Load	No detectable concentration
Nonpoint Source Load	33.51 kg/year
Total Baseline Load	33.51 kg/year
Final TMDL	
Loading Capacity (LC)	0.02 kg/day
Margin of Safety (MOS)	Implicit
Wasteload Allocation (WLA)	0.0004 kg/day
Load Allocation (LA)	0.02 kg/day
Mercury Load Allocation for In-State and Out-of-State Deposition Sources	
In-State Contribution to LA[a]	0.0036 kg/day
Out-of-State Contribution to LA[b]	0.0160 kg/day
Necessary Reduction from Anthropogenic Emission Sources	89.29%

Note: numbers may not sum exactly due to rounding

[a] Anthropogenic sources only

[b] Anthropogenic and natural sources

7 Implementation Plan and Monitoring Recommendations

To achieve the mercury load allocations described in Section 6, mercury loads must be significantly reduced. Atmospheric deposition of mercury is the most significant source of mercury to the study area waterbodies (either through direct deposition to the study area or indirectly through transport from portions of Lake Michigan outside the study area), with point and other nonpoint sources contributing a much smaller proportion. TMDLs that call for reduction in sources for which a NPDES permit is not required should provide a reasonable assurance that the controls will be implemented and maintained. It is important to reduce all possible sources of mercury, as mercury cycles from atmosphere to surface water. Atmospheric mercury that is intercepted by impervious area can be removed before it continues to cycle through the natural and engineered systems by adjusting existing controls that remove other stormwater pollutants. Monitoring can identify areas likely to contain sinks of mercury. Focusing on a preventative, best management approach can provide a reasonable assurance that the controls needed to reduce mercury and other pollutants will be implemented and maintained.

Over the last several decades, atmospheric mercury emissions in the Great Lakes region have declined substantially (Section 2.1.1). Most of the decline can be attributed to decreases in mercury emissions from medical and municipal waste incinerators. In 2007, Illinois promulgated the Illinois mercury rule to reduce mercury emissions from coal-fired electric generating utilities. Under this rule, mercury emission reductions began in 2009 and were required to be reduced by approximately 90% statewide by 2015. In 2012, USEPA published the Mercury Air Toxics Standards (MATS) to reduce mercury emissions from power plants. Under the MATS rule, all power plants will have to limit their toxic emissions – ultimately preventing 90% of the mercury in coal burned at power plants from being emitted into the air. The implementation actions discussed in this section may accelerate this rate of decline by actively reducing sources of mercury that have been previously volatilizing and contributing to elevated atmospheric mercury concentrations.

This section identifies potential sources to target for mercury control and describes a suite of appropriate Best Management Practices (BMPs) for reducing mercury loads, including existing activities to reduce mercury, funding opportunities, reasonable assurances for making progress toward achieving the TMDL target, and monitoring. IEPA will work to identify appropriate BMP combinations to implement needed reductions to meet the TMDL goals.

7.1 Identifying Potential Sources to Target for Control

Atmospheric mercury loads can be reduced through the targeted reduction of mercury sources in Illinois. The identification of all mercury sources is a difficult, but important step.

7.1.1 Identification of Potential Mercury-Containing Products

Sznopek and Goonan (2000) compiled information regarding the past uses of mercury, which can be helpful in identifying controllable sources of mercury to the atmosphere. The most common uses until 1992 were the chlor-alkali process and batteries (Figure 7-1). Mercury use in both batteries and paint was banned in the 1990s, leading to an overall significant drop in mercury use (Sznopek and Goonan 2000). Other major sources of mercury are switches (in thermostats and automobiles), lightbulbs, and dental and laboratory instruments. Reductions in all of these uses have been implemented over time through various state and Federal regulations, but mercury use is still allowed in some applications. As mentioned in Section 4, mercury from these sources can be released into the atmosphere or transported in stormwater runoff. Thus, identifying and cleaning up existing sources is important to prevent future discharge.

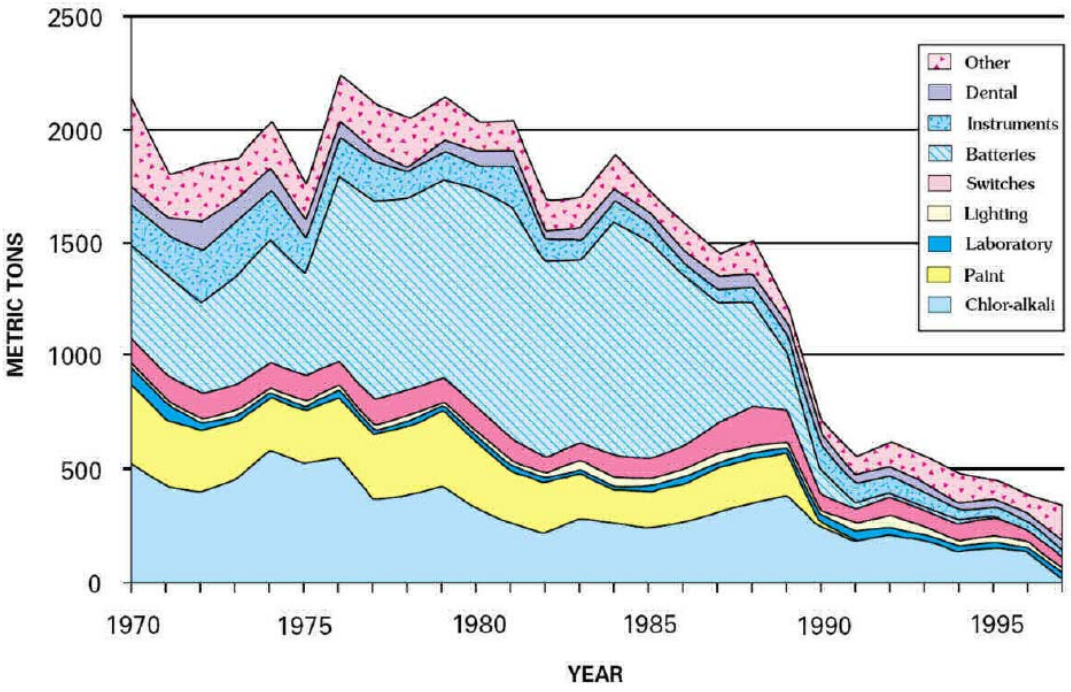

Figure 7-1. U.S. Industrial Consumption of Mercury, 1970-1997. (Source: Sznopek and Goonan, 2000)

7.1.2 Point Sources

NPDES-permitted point sources, including MS4 stormwater runoff, are not estimated to be a significant source of mercury. There is one individual NPDES permit with draft mercury effluent limits, and it is consistent with the TMDL. In order to ensure that future MS4 loads meet the TMDL, the MS4 permittees will be required to follow the implementation of BMPs as outlined in the TMDL.

There are several facilities that discharge to the study area, which have mercury monitoring requirements in their permits. If mercury is measured above detection levels, the permittee will be required to do mercury reduction and source analysis and meet mercury water quality standards. Any change in permit status would be addressed during the next permit renewal cycle.

7.2 Mercury BMPs

This section summarizes BMPs to reduce mercury loads and describes their appropriateness. Although the largest source of mercury is coal-fired electric utilities (discussed in Section 4.2.2), air sources cannot be controlled through a TMDL. However, air programs at the state and Federal level are working to reduce mercury emissions, and these programs are summarized in Section 7.4.

The BMPs described in this section are expected to reduce mercury from both nonpoint and point (i.e., MS4) sources, including atmospheric mercury that is deposited onto surface water or soil, which can be transported into Lake Michigan. Most of the BMPs discussed below can be implemented as part of local stormwater management plans or in MS4 permits. Table 7-1 provides information on the implementation points, sources, and pathways that are addressed for the range of BMPs. Table 7-2 summarizes the level of effectiveness that can be achieved in reducing contaminant loads to the storm sewer system for the range of BMPs described below.

7.2.1 Institutional BMPs

Institutional BMPs are focused on information sharing and governmental practices to help businesses and the general public avoid, or clean up and properly dispose of, products containing mercury. These BMPs require the least amount of infrastructure, engineering work, maintenance, and disturbance of existing land, because their purpose is to avoid the continued use or volatilization of mercury. A past program, the Chicago Clean Sweep Pilot program, was designed to educate Chicago-area businesses on the identification and proper management of mercury (and PCBs) and to set up a process under which certain businesses would be able to send certain mercury waste to a participating facility for recycling or disposal at a reduced cost. The Clean Sweep program has been discontinued, but could serve as a model for additional clean-up if communities are interested in pursuing funding to revitalize it.

The institutional BMPs listed below will help reduce mercury loads to the atmosphere through cleaning up existing sources and properly disposing of mercury-containing products and waste.

- Conduct public education and outreach campaigns to spread information about the potential sources of mercury, what to do with them if discovered, and safer alternatives. Information should be shared with buyers and suppliers of industrial equipment, consumers, and residents who fish for recreation or subsistence, to increase their awareness of fish advisories and the fish species that contain the highest concentrations of mercury.
- Promote wider/higher rate of recycling mercury-containing products to reduce the risk of mercury discharging from fluorescent light bulbs, thermometers, switches, instruments, etc. into Lake Michigan (can apply to homeowners and businesses).
- Help operators safely use drum top crushers according to regulation for volume reduction of spent fluorescent lamps.
- Innovatively reduce mercury use in hospitals.
- Continue to implement existing take-back programs (government- or non-profit-run programs to accept mercury-containing waste). The results of the statewide Mercury Product Stewardship Program for 2011-2013 are summarized in Figure 7-2. Legislation banning the sale/use of a large variety of mercury-containing products has been passed in Illinois (Section 7.4.3).
- Conduct targeted street sweeping to modify the frequency and/or the areas covered to target sources of mercury or, when more material is washing down streets, to prevent it from entering storm drains.

- Clean up illegally dumped waste.
- Review local/regional laws regulating waste disposal, and revise as necessary. This could include implementing fines for improperly disposing of mercury and sharing information on safer alternatives for lighting, instruments, switches, etc.
- Create a mercury dental amalgam management BMP brochure,
- Develop a fact sheet to show Illinois consumers what products contain mercury, what should be recycled, and where.

Mercury Product Stewardship Program

Activity and Outcome Measures

	Vehicle Recyclers, Crushers, and Scrap Metal Recyclers Participating	Mercury Switches Removed	Collection Locations Participating	Mercury-switch Thermostats Collected
2011	157	45,251	42	7,229[1]
2012	153	40,693	104	13,061[2]
2013	185	39,103	135	12,479[3]

[1]An additional 910 loose mercury switches or "bulbs" were collected in 2011.
[2]An additional 2,452 loose mercury switches or "bulbs" were collected in 2012.
[3]An additional 757 loose mercury switches or "bulbs" were collected in 2013.

Figure 7-2. Outcomes of Mercury Product Stewardship Program, 2011-2013 (Source: IEPA 2015a)

7.2.2 Contaminated Sites and Soil Remediation BMPs

These BMPs involve identifying and cleaning up soil that has been contaminated from past or continuing use of mercury. It is important to identify and remediate contaminated soil before it can be mobilized and transported into the storm drain system, especially during wet weather, to avoid further discharge and distribution into Lake Michigan and tributaries. In addition, remediation of mercury-contaminated soil and sites will also prevent further release to the atmosphere. Significantly more equipment use and land disturbance are required for these solutions than the institutional controls addressed previously. Examples of contaminated site and soil remediation BMPs include:

- Identification and elimination of storage or use of mercury: removal of old equipment containing mercury and proper disposal of it, in addition to soil remediation if mercury was spilled.
- Building remodeling or demolition: identification of older buildings that may contain mercury and replacement of fixtures with safer alternatives, or remove the buildings altogether. Common options include identifying and disposing of fluorescent lights, thermostats, surfaces painted with mercury-containing paint, etc.

7.2.3 Treatment Control BMPs (MS4 Stormwater BMPs)

Treatment control BMPs are engineered options to be installed or built within the existing storm sewer infrastructure to capture sediment containing mercury and prevent it from being discharged to Lake Michigan and can help meet the MS4 permit requirements. These BMPs can be implemented anywhere, but the limiting factor is access, since they require regular inspection and maintenance and specialized knowledge for installation. Due to the increased expense of this class of BMPs compared with institutional BMPs, it may be more cost effective to first conduct an illicit discharge investigation to

determine if and where a mercury source is located within the stormwater system (see Section 7.5.4 for a description of such an investigation). With that information, implementing treatment BMPs will be targeted and much more effective. These BMPs are effective at treating a range of contaminants and are not limited to controlling mercury loads. They are organized by the placement of the engineering practice relative to storm sewer pipes. More information on these BMPs can be found through the California Stormwater Quality Association (CASQA), 2003. These BMPs can be applied at three different locations within the stormwater system:

- Pipe entrance
    - Capture of mercury before it enters stormwater pipes
    - Includes infiltration trenches, basins, retention and reuse (rain barrels or underground tanks), ponds, detention basins, swales, buffer strips, bioretention
- Installed within MS4 pipes
    - Includes filters, screens, wet vault[8], hydrodynamic separators
    - Usually have high maintenance requirements and can sometimes back up flow when not maintained properly
- End of pipe
    - Includes sedimentation basins and constructed wetlands

[8] A wet vault is a BMP that consists of a permanent pool of water in a vault that rises and falls with storms and has a constricted opening to let runoff out. Its main treatment mechanism is settling of solids that are contaminated.

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Table 7-1. BMP Application for Controlling Mercury in Urban Areas Relative to Sources (Source: San Francisco Estuary Institute, 2010)

Best Management Practice (BMP) Category	Implementation Points: Dispersed: Private homes	Public lots, schools, hospitals, govt bldgs and research institutions	Private offices and businesses	Other private lots and industrial yards	On the street	Start of pipe	Within pipe	End of pipe	Applicable sources and pathways: Hg: Sources	Pathways
Institutional BMPs										
Education and outreach	√	√	√	√					IUP,ID,HW,BDR	
Volunteer cleanup efforts	√	√	√	√	√				IUP,ID,HW,BDR	
Recycling	√	√	√	√					IUP,ID,HW,BDR	
Amnesties	√	√	√	√					IUP,ID,HW,BDR	
Product Bans/product replacement	√	√	√	√					IUP,ID,HW,BDR	
Enforcement			√	√					OI,IUP,ID,HW,BDR	
Sweeping		√	√	√	√				A,OI,RF,RD,BDR	RI,VT,FT,W
Washing (streets/footpaths)		√	√	√	√				RD,BDR	RI,VT,FT,W
Illicit waste dumping cleanup					√	√	√	√	OI	RI
Stormwater conveyance maintenance				√		√	√	√	A,ID,RF	RI,VT,FT,W
Treatment BMPs										
Infiltration trench		√	√	√		√			A,OL,RF	RI,VT,FT,W
Infiltration basin		√	√	√		√			A,OL,RF	RI,VT,FT,W
Retention and reuse/irrigation	√	√	√			√		√	A,OL,RF	RI,VT,FT,W
Wet Pond		√	√	√		√			A,OL,RF	RI,VT,FT,W
Constructed wetland		√	√	√		√		√	A,OL,RF	RI,VT,FT,W
Extended detention basin		√	√	√		√		√	A,OL,RF	RI,VT,FT,W
Vegetated swale		√	√	√		√			A,OL,RF	RI,VT,FT,W
Vegetated buffer strip		√	√	√		√			A,OL,RF	RI,VT,FT,W
Bioretention (rain garden/green roof)	√	√	√	√		√			A,OL,RF	RI,VT,FT,W
Media filter		√	√	√			√		A,OL,RF	RI,VT,FT,W
Water quality inlet		√	√	√			√		A,OL,RF	RI,VT,FT,W
Wet vault		√	√	√			√		A,OL,RF	RI,VT,FT,W
Hydrodynamic separation		√	√	√			√		A,OL,RF	RI,VT,FT,W
Drain insert		√	√	√			√		A,OL,RF	RI,VT,FT,W
Flow diversion to wastewater treatment								√	All sources	All pathways

True sources: deposition= A

Source areas: Old industrial - OI, Hg products still in use = IUP, Illegal disposal - ID, Recycling facilities = RF, Road deposits = RD, Home and work place = HW

Building demolition and remodeling = BDR

Transport pathways: Runoff from impervious surfaces = RI, Vehicle tracking = VT, Foot tracking = FT, Wind = W

Table 7-2. Program Assessment Effectiveness for BMPs (Source: San Francisco Estuary Institute, 2010)

Best management practice (BMP) category	Most applicable effectiveness assessment outcome levels					
	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
	Documenting activities	Raising awareness	Changing behavior	Reducing loads from sources	Improving runoff quality	Protecting receiving water quality
Institutional BMPs						
Education and outreach	√	√	√			
Volunteer cleanup efforts	√			√		
Recycling	√			√		
Amnesties	√			√		
Product Bans / product replacement	√			√		
Enforcement	√	√	√	√		
Sweeping	√			√		
Washing (streets/footpaths)	√			√		
Illicit waste dumping cleanup	√			√		
Stormwater conveyance maintenance	√			√	√	
Treatment BMPs						
Infiltration trench	√			√	√	
Infiltration basin	√			√	√	
Retention and reuse / irrigation	√			√	√	
Wet Pond	√			√		
Constructed wetland	√			√		
Extended detention basin	√			√		
Vegetated swale	√			√	√	
Vegetated buffer strip	√			√	√	
Bioretention (Rain garden / green roof)	√			√	√	
Media filter	√			√		
Water quality inlet	√			√		
Wet vault	√			√		
Hydrodynamic separation	√			√		
Drain insert	√			√		
Flow diversion to wastewater treatment	√			√	√	√

7.3 Funding Opportunities

The most likely funding sources to implement the BMPs described in the previous section are the Great Lakes Restoration Initiative (http://greatlakesrestoration.us/index.html), the Illinois Green Infrastructure Program for Stormwater Management (www.epa.state.il.us/water/financial-assistance/igig.html), and Nonpoint Source Section 319 grants (http://www.epa.state.il.us/water/financial-assistance/nonpoint.html). However, multiple other programs can aid in funding measures to reduce mercury, as shown in Table 7-3.

Table 7-3. Funding Opportunities for Implementation of BMPs and Other Measures for Reducing Mercury

Funding Opportunity	Description
United States Environmental Protection Agency	
Great Lakes Restoration Initiative	Funds various projects, including a program area focused on Areas of Concern like Waukegan Harbor.
Environmental Education Local Grants Program	Support locally-focused environmental education projects that increase public awareness and knowledge about environmental issues and provide the skills that participants in its funded projects need to make informed environmental decisions and take responsible actions toward the environment.
National Institutes of Health	
Assessing and Addressing Community Exposures to Environmental Contaminants	Applicants should investigate the potential health risks of environmental exposures of concern to the community and implement an environmental public health action plan based on research findings
National Oceanic and Atmospheric Administration	
Coastal Services Center Cooperative Agreements	Provide technical assistance and project grants through a range of programs and partnering agreements, all focused on protecting and improving coastal environments.
Illinois Environmental Protection Agency	
Illinois Green Infrastructure Program for Stormwater Management	Grants are available to local units of government and other organizations to implement green infrastructure BMPs to control stormwater runoff for water quality protection in Illinois. Projects must be located within an MS4 or CSO area.
Nonpoint Source Section 319 Grants	Grants are available to local units of government and other organizations to protect water quality in Illinois. Projects must address issues relating to nonpoint source pollution (like stormwater runoff). Funds can be used to implement watershed management plans, including the development of information/education programs for the installation of BMPs.

7.4 Reasonable Assurance

This TMDL is based upon the assumption that in-state and out-of-state nonpoint source loads of mercury to the nearshore area of Lake Michigan will be reduced in the future. TMDLs that allow for reduction in sources for which an NPDES permit is not required should provide a reasonable assurance that the controls will be implemented and maintained. As discussed previously in this report, global anthropogenic emissions of mercury are the source of the vast majority of mercury deposition in the

watershed, and IEPA's achievement of the TMDL goal is dependent upon regional and global mercury emission reductions.

7.4.1 Water Programs-State

The point sources in this report only contribute a small portion of Illinois's mercury loading when compared with nonpoint sources or atmospheric deposition. However, NPDES permit holders will be required through their permit to determine if their facility adds to the mercury load, if the presence of mercury is due solely to facility pass-through, or because of stormwater conveyance. Facilities that do add to the mercury load will receive an effluent limit and will be required to meet the limit or develop and implement a cost-effective mercury waste minimization plan if one is not already in place to ensure mercury discharges from point sources does not exceed the WLA.

Currently the MS4 General Permit (ILR40) requires all regulated construction sites to have a stormwater pollution prevention plan that meets the requirements of Part IV of General NPDES Permit No. ILR10, including management practices, controls, and other provisions at least as protective as the requirements contained in the Illinois Urban Manual, 2014, or as amended including green infrastructure techniques where appropriate and practicable. In addition, there are requirements for meeting TMDL allocations:

"If a TMDL allocation or watershed management plan is approved for any waterbody into which you discharge, you must review your stormwater management program to determine whether the TMDL or watershed management plan includes requirements for control of stormwater discharges. If you are not meeting the TMDL allocations, you must modify your stormwater management program to implement the TMDL or watershed management plan within eighteen months of notification by IEPA of the TMDL or watershed management plan approval".

7.4.2 Waste Programs – Federal

Many efforts have been established to ensure that the quality of the Great Lakes is restored and maintained. In May 2004, a Presidential Executive Order was signed recognizing the Great Lakes as a national treasure and calling for the creation of a "Regional Collaboration of National Significance" and a cabinet-level Federal Great Lakes Interagency Task Force.

The U.S.-Canadian Great Lakes Binational Toxics Strategy marked its 10th anniversary with an annual report which identified that 12 of the 17 goals for source and emissions reductions set in 1997 have been met, and the rest are well advanced.

These programs, along with a host of others that can be found at http://www.epa.gov/greatlakes/index.html, ensure that the U.S. Federal Government, the governments of the individual states adjacent to the Great Lakes, and the government of Canada all are taking a variety of steps to address pollution in the Great Lakes system, including reducing sources of mercury.

A number of programs designed to reduce mercury loads to Lake Michigan are already in place. One example is the Great Lake Lakewide Management Plans (LaMPs). The Lake Michigan LaMP was written in 2000 to coordinate all the agencies working on protecting and restoring the lake. The plan tracks efforts like TMDLs and Area of Concern clean-ups, as well as overall ecosystem improvement projects that will contribute to mercury reductions in Lake Michigan.

7.4.2.a Coal Combustion Residuals

Coal Combustion Residuals (CCR), often referred to as coal ash, are residues from the combustion of coal in power plants and captured by pollution control technologies, like scrubbers. Coal ash contains contaminants like mercury, cadmium and arsenic. Without proper management, these contaminants can pollute waterways, groundwater, drinking water, and the air (USEPA, 2016). USEPA published a final rule on April 17, 2015 to regulate the disposal of CCRs as solid waste under the Resource Conservation and Recovery Act's subtitle D. The effective date of proposed rule was October 19, 2015[9]. It applies to both existing and new CCR units including lateral expansions of any existing unit.

This rule provides reasonable assurances that measures will be taken to prevent accidental catastrophic releases from potential sources of mercury to the study area. Provisions within the rules address: 1) the risks from structural failures of CCR surface impoundments, 2) groundwater contamination from the improper management of CCR in landfills and surface impoundments and 3) fugitive dust. Main features of the rule include:

- A requirement that any existing unlined CCR surface impoundment that is contaminating groundwater above a regulated constituent's groundwater protection standard must stop receiving CCR and either retrofit or close except in limited circumstances;
- The closure of any CCR landfill or CCR surface impoundment that cannot meet the applicable performance criteria for location restrictions or structural integrity.
- A requirement that CCR surface impoundments that do not receive CCR after the effective date of the rule, but still contain water and CCR be subject to all applicable regulatory requirements, unless the owner or operator of the facility dewaters and installs a final cover system on these inactive units no later than three years from publication of the rule.
- Operators of CCR units must maintain a publicly available website of compliance information for example, annual groundwater monitoring results, corrective action reports, fugitive dust control plans and closure completion notifications.

The rule is a "self-implementing rule" meaning that there is no direct federal oversight, and States and citizens are relied upon to monitor and report on rule implementation. Illinois rules ensure that facilities are currently implementing the requirements according to Federal and State rules and procedures. Owners or operators of regulated CCR units are required to notify the state of actions taken to comply with the requirements of the rule, and maintain a publicly accessible Internet site that will document the facility's compliance with the requirements of the rule. States will be able to access this site to monitor facility activities. The public information provisions are also intended to help ensure that power plant compliance with this rule is transparent to the communities that are potentially impacted by the disposal of CCRs.[10]

There are two coal combustion residual (CCR) surface impoundments located in the project study area. Midwest Generation, LLC reported that the CCR impoundment units (Waukegan (IL0002259, East Ash Pond and West Ash Pond) met inspection criteria.

[9] Corrected in Federal Register/Vol. 80. No. 127/Thursday July 2, p 37989
[10] https://www.gpo.gov/fdsys/pkg/FR-2015-04-17/pdf/2015-00257.pdf , accessed on 1/29/16

7.4.3 Waste Programs – State

Another example of waste-related efforts is state legislation enacted to ban particular mercury-containing goods. Several examples of Illinois state law and the date specific requirements became effective are included below:

- 2004: Thermometers (except those in health care facilities) and novelty products (Illinois Public Act 093-0165)
- 2005: All mercury-containing products for K-12 school purchasing (Illinois Public Act 093-0964)
- 2007: Electrical switches and relays (Illinois Public Act 093-0964)
- 2008-2012: Scientific instruments containing mercury (e.g., barometers, pressure transducers, pyrometers); cosmetics containing mercury (Mercury-added Product Prohibition Act 410 ILCS 46)
- 2008: Requires removal of automobile switches before the vehicles are crushed or otherwise processed (Illinois Public Act 094-0732). A non-profit organization, End-of-Life Vehicle Solutions (ELVS), helps facilities remove and collect mercury switches for recycling. This program includes the following:
  - Provides information on makes/models that contain mercury switches, the locations of the switches and how to remove them;
  - Supplies containers to store the removed mercury switches and pays for the cost of transporting the switches to a waste or recycling facility,
  - Pays a $2 bounty for each mercury switch processed and $6 for each anti-lock brake g-force sensor recycled to help offset removal costs.
- 2008: Sale and installation of mercury climate control thermostats (Public Act 95-452)
- 2009: Sale and distribution of cosmetics, toiletries, or fragrances containing mercury (Illinois Public Act 95-1019)
- 2011: Requires manufacturers to supply collection points for recycling mercury-containing thermostats (Illinois Public Act 096-1295). The goal is to collect 40,000 thermostats by 2020.
- 2012: Mercury wheel weights and balancers (Environmental Protection Act 415 ILCS 5/22.23c); Added zinc air button cell batteries to list of items banned from sale and distribution in the Mercury-added Product Prohibition Act (Illinois Public Act 97-1107)
- 2016: Requires all mercury thermostats to be removed from any commercial building prior to demolition. Also requires that the individual removing the thermostats to arrange in advance to have them delivered to an authorized mercury thermostat collection site. (Illinois Public Act 99-122/Senate Bill 679)

7.4.4 Air Programs – State

In 2006 and 2007 Illinois both promulgated the Illinois mercury rule (35 Ill. Adm. Code Part 225) and reached multi-pollutant reduction agreements with coal-fired owners and operators that resulted in substantial improvement to Illinois and regional air quality by dramatically reducing mercury, SO2, and NOx emissions. This rule was a critical milestone in reducing air pollution and one of the most important environmental and public health advances in Illinois history. At the time, the rule represented the largest reductions in air emissions ever agreed to by individual companies under any context, whether through an enforcement action or regulation. The rule is divided into two phases. As of July 1, 2009, coal-fired power plants must meet either a 0.0080 lbs mercury/GWh emission standard or

capture 90 percent of inlet mercury. Owners of multiple plants can average the limit across their fleet to meet the standard. Phase II, which began on January 1, 2013, applied on a single-plant basis, rather than being system-wide for those operating more than one plant. The final rule applies to coal- and oil-fired electric generating units (EGUs) with a capacity of 25 megawatts or greater.

The Illinois mercury rule is designed to achieve a high level of mercury control based on IEPA's finding that there exists mercury control technology that is both technically feasible and economically reasonable. Under the rule, mercury emission reductions began in 2009 and were required to be reduced by approximately 90% statewide by 2015. Mercury emissions from coal-fired power plants in Illinois were estimated at 7,700 pounds per year in 2006 and are currently estimated to be less than 600 pounds per year when also accounting for the retirement of 18 coal-fired units in Illinois since 2007. Additionally, mercury emissions will fall considerably further due to the expected retirement or conversion to natural gas of seven more units by the end of 2016, several of which are in the Great Lakes Basin area.

The power plant operated by NRG/Midwest Generation, LLC in Waukegan, Illinois is required to significantly reduce mercury emissions in accordance with the Illinois mercury rule which alone requires an approximate reduction in mercury emissions of 90%. The facility currently operates two coal-fired electric generating units (#'s 7 and 8) of 328 and 355 megawatt (MW) capacities, respectively. A third unit (#6) of 100 MW capacity was permanently shut down on December 21, 2007. Both units (#'s 7 and 8) are currently in compliance with all regulations and permit requirements regarding mercury emissions. Each unit at the Waukegan facility is equipped with a mercury control system consisting of activated carbon injection specifically designed for the control of mercury followed by an electrostatic precipitator to remove mercury and other particulates from the atmosphere. Both units have also recently installed dry sorbent injection systems which will further assist in mercury control. The mercury control system for unit 8 was demonstrated through testing in 2012 to have around 94% efficiency in reducing mercury emissions.[11]

7.4.5 Air Programs – Federal

The Clean Air Act (CAA) is the federal legislation governing the airborne release of mercury and other contaminants. Under the CAA, mercury is classified under the Act as a hazardous air pollutant and is thus subject to control under the National Emissions Standards for Hazardous Air Pollutants. Hazardous air pollutant emissions are controlled by establishing performance standards under a program known as maximum achievable control technology standards (MACT), designed to reduce hazardous air pollutant emissions as much as possible. MACT sets a standard that is at least as stringent as the emission reductions achieved by averaging the top 12% of the best controlled facilities in the same source category.

In 1990, three industry sectors made up approximately two-thirds of total U.S. mercury emissions: medical waste incinerators, municipal waste combustors, and coal-fired power plants. The first two of these sectors have been subject to MACT emissions standards. Power plants, however, were exempted from the MACT standards. As a result, mercury emissions from municipal waste combustors and medical waste incinerators have been reduced from these sources by more than 95% in 2005 relative to the 1990 levels (Table 7-4). Mercury emissions from power plants remained relatively unchanged

[11] Source of Waukegan plant information: Email from Jim Ross (IEPA) to Marcia Willhite (IEPA) on 2/10/2016.

during this time. The table below indicates the reductions achievable through MACT. Power plants are currently the dominant emitters of airborne mercury (50 %) in the United States.

Table 7-4. Sources of Mercury Emissions in the U.S.

Industrial Category	1990 Emissions tons per year (tpy)	2005 Emissions (tpy)	Percent Reduction
Power Plants	59	53	10%
Municipal Waste Combustors	57	2	96%
Medical Waste Incinerators	51	1	98%

Source: https://www3.epa.gov/airquality/powerplanttoxics/powerplants.html

7.4.5.a Mercury Air Toxics Standards

The majority of the mercury deposited via air deposition to the TMDL study area originates from sources outside of the TMDL study area and the State of Illinois (see Section 4.2). While Illinois has promulgated rules for Illinois air sources, air sources of mercury remain that are outside State of Illinois regulatory authority. On December 20, 2000, USEPA determined, pursuant to CAA section 112(n)(1)(A), that it is appropriate to regulate coal- and oil-fired EGUs, based on the determination that air toxic emissions, most notably mercury, pose hazards to public health and the environment and that there are available controls to reduce air toxic emissions from these units. On February 16, 2012, USEPA published the first ever national standard to reduce mercury and other toxic air pollutants from coal- and oil-fired EGUs also known as the Mercury Air Toxics Standards or "MATS".[12] Prior to the MATS, there were no national limits on emissions of mercury and other air toxics from power plants. Nationwide, there are about 1,400 coal and oil-fired electric generating units (EGUs) at 600 power plants covered by these standards. Approximately 40 percent of the current EGUs still do not have advanced pollution control equipment.[13] The MATS mercury standard compliance date was April 30, 2015.

MATS applies to EGUs larger than 25 MW that burn coal or oil for the purpose of generating electricity for sale and distribution through the national electric grid to the public. These include investor-owned units, as well as units owned by the Federal government, municipalities, and cooperatives that provide electricity for commercial, industrial, and residential uses. The regulatory framework for MATS was derived from the 1990 Clean Air Act Amendments. The CAA requires USEPA to set the emission standards for existing sources at a level that is at least as stringent as the emission reductions achieved by the average of the best performing 12% of sources in the category (i.e., MACT standards). All power plants will have to limit their toxic emissions – ultimately preventing 90% of the mercury in coal burned at power plants from being emitted into the air. Existing sources were given up to 4 years to comply with MATS. The MATS rule requires that installation of any needed treatment equipment be in operation and meeting emissions standards by the April 2015 deadline. The power plant operated by

[12] http://www3.epa.gov/mats/basic.html
[13] http://www3.epa.gov/airquality/powerplanttoxics/powerplants.html

NRG/Midwest Generation, LLC in Waukegan, Illinois is currently in compliance with MATS. USEPA estimates significant public health benefit due to the implementation of MATS. The MATS will help reduce mercury levels in fish and mercury exposure for pregnant women and children, reducing the risk of damage to children's developing nervous systems that can impair their ability to think and learn. The MATS standards are predicted to prevent up to 570 premature deaths in Illinois while creating up to $4.7 billion in health benefits in 2016.[14]

In summary, the state and national enforceable mechanisms for regulating and reducing the largest anthropogenic sources of mercury in the study area and nationally have been, and continue to be implemented reducing airborne sources of mercury to the environment. In addition to local and national sources, mercury emissions reductions from continental sources also needs to occur. Both the Illinois rule, promulgated in 2007, and a newer federal MATS rule require an approximate reduction in mercury emissions of 90%. It follows that air deposition that contributes to the mercury impairment of the fish consumption use in the TMDL study area and Lake Michigan will also be reduced. Based upon reductions realized from other regulated mercury air sources, and estimates that the MATS rule will prevent over 90% of the mercury in coal burned in power plants from being emitted to the air, IEPA believes that it is reasonable to assume the Illinois mercury rule and the MATS will contribute significantly to reductions in fish tissue concentrations called for in this TMDL thus providing reasonable assurance for the TMDL.

7.4.6 Support for Regional, National and International Mercury-reduction Policies and Initiatives

Because the TMDL identifies that over 90% of the mercury comes from sources outside of the state, it is recommended that IEPA follow the model of Minnesota from their statewide mercury TMDL implementation plan (MPCA, 2009) and work with neighboring states', environmental groups, USEPA, industries, the private/public sector, other interested parties and the general public as appropriate to establish policies and initiatives to achieve emission reductions from sources in the U.S. and other countries to meet Illinois' Mercury TMDL targets for deposition. The objectives of this work shall be to establish policies and programs that result in significant emission reductions and consistency of policies among states and countries.

These objectives can be achieved through technology and program transfer, after identifying model efforts globally. Initiatives with these objectives should be considered for support and involvement:

- Reduce or eliminate releases of mercury through pollution control or the use of alternative products and processes.
- Reduce or eliminate the intentional use of mercury in products and processes. This could include bans on the manufacture or sale of products with mercury.
- Maximize the proper end of life management of mercury products currently in use through outreach, readily accessible collection infrastructure and regulation.
- Eliminate the sale and export of mercury recovered from products and processes for uses that have a high likelihood of resulting in an environmental release.

[14] http://www3.epa.gov/mats/whereyoulive/il.html

7.5 Monitoring Recommendations to Track TMDL Effectiveness

Post-TMDL monitoring consists of collecting and analyzing data to evaluate progress towards attaining the TMDL target. Post-TMDL monitoring can assist in determining whether planned control actions are sufficient, or whether further measures need to be implemented. This section describes existing and recommended mercury monitoring for tracking trends and assessing TMDL effectiveness.

7.5.1 Fish Tissue Monitoring

Fish tissue monitoring is described in IEPA (2014a). Within the Great Lakes Basin, Illinois monitors fish tissue mercury in predator species collected every 3-5 years from four Lake Michigan harbors as part of its FCMP. Results are used to assess the status of existing fish consumption advisories or issue new advisories. Continued monitoring provides important information for the public from a health perspective. In the future, Illinois plans to measure mercury in yellow perch at two Lake Michigan open water stations. Fish tissue mercury concentrations from the FCMP can be used to assess progress towards the TMDL target. These data should be compiled as they become available and assessed to determine if mercury concentrations are decreasing.

The Illinois Water Quality Monitoring Program will conduct special samples monitoring as needed by special circumstances (e.g., investigations of spills, fish kills, and toxic chemical cleanup stations). The FCMP can also request specific numbers and sizes of selected fish or other aquatic species to be collected by field sampling teams or other personnel. Such samples may be designated as high priority for analysis by IEPA or another designated laboratory. Costs for collection and analysis of such samples shall be paid, to the extent possible, by the party or parties responsible for the special circumstance.

7.5.2 Atmospheric Mercury Monitoring

Total mercury in precipitation has been monitored weekly through the Mercury Deposition Network since 1996. The closest site to the study area watershed is at the Indiana Dunes National Lakeshore. Additional monitoring data for Lake Michigan atmospheric mercury deposition may also be available through the Canadian Atmospheric Mercury Measurement Network. Data collected through these programs should be compiled and analyzed to assess changes in mercury concentrations over time.

7.5.3 Air Emissions of Mercury

Air emissions of mercury from Illinois sources can be tracked over time using the NEI. The NEI, available by state, is a comprehensive and detailed estimate of air emissions of both criteria and hazardous air pollutants from all air emissions sources. The NEI is prepared every three years by the USEPA, based primarily on emission estimates and emission model inputs provided by state, local, and Tribal air agencies for sources in their jurisdictions, and is supplemented by data developed by the USEPA.

Under the Illinois Mercury Rule, 35 IAC Part 225, affected coal-fired sources are required to continuously monitor and record mercury emissions from each stack or common stack associated with an Electric Generating Unit (EGU). An affected source can show compliance using an output based limit in which mercury emission standards are based on the monthly gross electrical output. An affected source can alternatively show compliance with a minimum 90% reduction of input mercury in which the source measures and records mercury content of the coal burned versus mercury emissions from the stacks. Further, affected sources of an EGU must maintain records of the monthly emissions of mercury from the EGU, and monthly allowable emissions of mercury from the EGU if complying by the 90%

reduction based requirement. Quarterly and annual reports of the above as well as an annual compliance certification must be submitted to IEPA. Any deviation from an applicable requirement must be reported within 30 days of discovery of the deviation.

Under 40 CFR Part 63, Subpart UUUUU - National Emissions Standards for Hazardous Air Pollutants: Coal and Oil-Fired Electrical Utility Steam Generating Units, also known as MATS, affected coal-fired sources are also required to continuously monitor and record mercury emissions similar to the Illinois mercury rule. Under the MATS Rule, certain existing units also have the option to conduct periodic stack testing if the unit qualifies as a low emitting EGU (LEE). However, in Illinois, since an affected source is required to continuously monitor mercury to comply with the Illinois mercury rule, the added expense to qualify as a LEE unit would not justify this option. An affected source must maintain records of monthly mercury emissions, and submit quarterly reports and semi-annual compliance reports to IEPA. Any deviations from applicable 40 CFR Part 63, Subpart UUUUU requirements must be submitted with the semi-annual compliance reports.

Under both rules, the source is required to keep records and report any continuous monitoring system malfunctions or inoperative periods, and conduct annual Relative Accuracy Test Audits (RATA) of the continuous monitoring systems and report the results of the RATA to IEPA within 45 days.

7.5.4 Groundwater Monitoring

Groundwater monitoring data for mercury has been collected at the Waukegan Power Station since November, 2010. Groundwater is currently monitored on a quarterly basis from seven on-site monitoring wells. All of the monitoring results for mercury have been non-detect, with a reporting limit of 0.0002 mg/L. IEPA will continue to review groundwater monitoring data collected from these monitoring wells.

7.5.5 Illicit Discharge Survey

An illicit discharge survey should be conducted on storm sewers and surface waters discharging to Lake Michigan if it is suspected that there have been illicit discharges of mercury. Priority should be given to those discharges occurring within 500 meters of the beach or within the lake shoreline beach area. This survey is typically conducted by municipal public works personnel or a consultant. The survey involves a systematic screening of stormwater outfalls to determine the presence of an illicit discharge and is required by Illinois' Stormwater NPDES General Permit for Discharges from Small MS4s. The screening includes a physical inspection of the outfall, surrounding area and discharge, and sampling of the discharge for pollution indicators. Following the outfall survey, follow-up investigations are conducted in the stormwater conveyance system to narrow down and locate the source of the illicit discharge.

Suggested follow-up investigations/solutions:

- Conduct illicit discharge investigations for mercury sources in nearby storm sewers.
- Street Sweeping will reduce the amount of toxic pollutants that end up in the lakes/streams
- Separate Stormwater Collection System – use Jet-Vacuum for regular cleaning
- Mitigate stormwater flow from direct drainage areas by using green infrastructure measures such as retention basin, green roofs, bioswales or permeable pavements to eliminate ponding and drainage to the beach.

7.6 Schedule

This section presents the general BMP implementation schedule, which will depend on stakeholder engagement and active participation in the selection of BMPs and development of watershed based plans. IEPA strongly recommends establishing a watershed workgroup to work with the MS4 communities in the selection of BMPs and implementation plans. This is because practical and financial resources need to be considered, budgeted, and grants secured. IEPA will work with watershed workgroups and MS4 communities to provide guidance and to prioritize the recommended strategies to determine the most feasible BMP options and implementation plans. Please refer to the Guidance for Developing Watershed Action Plans in Illinois - May 2007 (CMAP/IEPA):

http://www.epa.state.il.us/water/watershed/publications/watershed-guidance.pdf .

Current NPDES permits (Table 7-5) will remain in effect until the permits are reissued, provided IEPA receives the NPDES permit renewal application prior to the expiration date of the existing NPDES permit. The WLAs will be incorporated into the permits upon reissuance.

The recently reissued MS4 General Permit became effective on March 1, 2016. The General Permit Part III- Special Condition (C) requires the MS4 Permittee to comply with the WLA when a TMDL is developed for that particular watershed within 18 months following notification by IEPA once the TMDL is approved. The BMPs contained in this section of the TMDL including the "menu of potential BMPs for MS4s" in Appendix B, can be adopted as appropriate, as minimum measures for permits to be consistent with the WLA contained in the TMDL and will be incorporated into the MS4 General Permit by reference.

Table 7-5. Schedule for Implementation

Stakeholder Engagement	
Working with stakeholders and workgroups to engage partners to prioritize recommended strategies	IEPA will reach out to other state agencies to share this TMDL and implementation plan. The majority of the TMDL study area lies within an MS4 service area. Therefore, stakeholder and watershed workgroups are encouraged to work with their respective MS4 permittees in the prioritization and selection of the BMPs and actively participate in the planning and design of the BMP projects to meet the recommendation of the TMDL target endpoints.

Permitting	
General NPDES Permit (No. ILR40) MS4 Stormwater Expires 02/28/21	Following notification by IEPA of the TMDL approval, the permittee must modify their stormwater management program to implement the TMDL recommendation, if the permittee determines they are not meeting the TMDL allocations within eighteen months of the notification date. Additional details are found in the General NPDES Permit ILR40, Part III Special Conditions, Subpart C.
NSWRD Waukegan Water Reclamation Facility (IL00030244) Permit expected to be issued in 2016 for a duration of 5 years.	Annual average mercury load of 0.04 kg/yr (0.00024 lbs/day) based on design average flow, which is consistent with the TMDL. This permit also includes a monitoring requirement of 1 day/month (composite sample), and calculation of a rolling annual monthly average mercury value.

Monitoring	
Fort Sheridan Landfills 6 and 7 (IL0072231) Expired 11/30/14	Report quarterly stormwater sampling for mercury on DMRs
Calumet Transload Railroad, LLC (IL0002593) Expires 01/31/2017	Report quarterly stormwater sampling for mercury on DMRs. If mercury is measured above detection levels, the permittee would have to do mercury reduction and source analysis to meet mercury water quality standards. Any change in permit status would be addressed during the next permit renewal cycle
Advanced Disposal Services Zion Landfill, Inc. (IL0067725) Expires 09/30/2020	Report quarterly stormwater sampling for mercury on DMRs. If mercury is measured above detection levels, the permittee would have to do mercury reduction and source analysis to meet mercury water quality standards. Any change in permit status would be addressed during the next permit renewal cycle
Midwest Generation, LLC Waukegan (IL0002259) Expires 03/31/2020	Report quarterly sampling for mercury on DMRs. If mercury is measured above detection levels, the permittee would have to do mercury reduction and source analysis to meet mercury water quality standards. Any change in permit status would be addressed during the next permit renewal cycle.
KCBX Terminals Company (IL0071625) Expires 04/30/2018	Quarterly mercury sampling (with limitations described in Special Condition 11 of the NPDES Permit). If mercury is measured above detection levels, the permittee would have to do mercury reduction and source analysis to meet mercury water quality standards. Any change in permit status would be addressed during the next permit renewal cycle
Illinois Fish Contaminant Monitoring Program	IEPA plans to start analyzing mercury in yellow perch collected from two Lake Michigan open water stations. In addition, every 3-5 years, predator fish samples are collected from four Lake Michigan harbor stations and analyzed for mercury. Harbors targeted for sampling include Calumet, Jackson, Waukegan North and North Shore Marina.
Groundwater monitoring	2010 – ongoing. Quarterly monitoring and IEPA review of data from seven on-site groundwater wells at the Waukegan Power Station.
Mercury Deposition Network	1996 – ongoing. Weekly monitoring of total mercury in precipitation occurs through the Mercury Deposition Network. The closest site to the study area watershed is at the Indiana Dunes National Lakeshore.
National Emissions Inventory	Every three years, USEPA prepares the NEI for every state, providing a comprehensive and detailed estimate of air emissions of both Criteria and Hazardous air pollutants from all air emissions sources. The NEI is based primarily on emission estimates and emission model inputs provided by state, local, and Tribal air agencies for sources in their jurisdictions, and is supplemented by data developed by the USEPA.

Rule Compliance and Monitoring	
Coal Combustion Residual Rule	October 2015 Effective date of proposed rule, applying to existing and new CCR units January 2016. CCR unit owner or operator must complete initial inspection requirements for CCR surface impoundments. Owners or operators of regulated CCR units are required to notify the state of actions taken to comply with the requirements of the rule, and maintain a publicly accessible Internet site that will document the facility's compliance with the requirements of the rule. January 2016 – January 2019. Among other things, additional requirements related to structural integrity, groundwater monitoring and corrective action, demonstration of meeting location restrictions, closure of inactive units.
MATS Rule 40 CFR Part 63, Subpart UUUUU - National Emissions Standards for Hazardous Air Pollutants: Coal and Oil-Fired Electrical Utility Steam Generating Units	MATS standard compliance date: April 30, 2015 Affected coal-fired sources[15] are required to continuously monitor and record mercury emissions. Under the MATS Rule, certain existing units also have the option to conduct periodic stack testing if the unit qualifies as a low emitting EGU. However, in Illinois, since an affected source is required to continuously monitor mercury to comply with the Illinois Mercury Rule, the added expense to qualify as a LEE unit would not justify this option. An affected source must maintain records of monthly mercury emissions, and submit quarterly reports and semi-annual compliance reports to IEPA. Any deviations from applicable 40 CFR Part 63, Subpart UUUUU requirements must be submitted with the semi-annual compliance reports. The source is required to keep records and report any continuous monitoring system malfunctions or inoperative periods, and conduct annual RATA of the continuous monitoring systems and report the results of the RATA to the IEPA within 45 days.
Illinois mercury rule, 35 IAC Part 225	2007 (Illinois mercury rule promulgated) 2009 Mercury emission reductions began 2015 90% statewide reduction Affected coal-fired sources are required to continuously monitor and record mercury emissions from each stack or common stack associated with an Electric Generating Unit. Affected sources of an EGU must maintain records of the monthly emissions of mercury from the EGU, and monthly allowable emissions of mercury from the EGU if complying by the 90% reduction based requirement. Quarterly and annual reports of the above as well as an annual compliance certification must be submitted to IEPA. Any deviation from an applicable requirement must be reported within 30 days of discovery of the deviation. The source is required to keep records and report any continuous monitoring system malfunctions or inoperative periods, and conduct annual RATA of the continuous monitoring systems and report the results of the RATA to IEPA within 45 days.

[15] MATS applies to EGUs larger than 25 MW that burn coal or oil for the purpose of generating electricity for sale and distribution through the national electric grid to the public.

8 Public Participation

Two public meetings were held on January 13, 2016 (6:00 pm) at Waukegan Public Library (Bradbury Room), Waukegan, Illinois, and on January 14, 2016 (10:00 am) at USEPA- Region 5 Office in Chicago, Illinois. The purpose of the meetings was to provide the public with an opportunity to comment on the final draft TMDL reports and to provide additional data that may be included in the TMDL development process.

IEPA announced the public notice by placing a display ad in the newspapers in the watershed (Chicago Tribune and Waukegan Lake County Sun). The public notice gave the date, time, location, and purpose of the meetings. It also provided references to obtain additional information about this specific watershed, the TMDL Program, and other related issues. The public notice was also mailed to NPDES & MS4 Permittees, environmental groups, and other organizations in the watershed by first class mail. The draft TMDL Report was available for review at the Waukegan Public Library Waukegan, Illinois and on IEPA's website at http://www.epa.illinois.gov/public-notices/index. Twenty two people in Waukegan and six people in Chicago attended the public meetings.

IEPA representatives, USEPA staff member along with the TMDL contractors conducted the public meetings and have answered several questions within the scope of the TMDL projects, and attendees were advised to send written questions/comments to IEPA by the end of the public comment period.

Contact information for IEPA staff and the TMDL consultant were provided to those interested to allow for follow-up questions. All attendees were asked to submit their comments and concerns to IEPA by midnight February 16, 2016.

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Appendix A:
303(d) List of Segments Impaired due to Mercury

Table A-1. Mercury-impaired segments in the project study area

TMDL Zone	HUC 10	Waterbody Name	Segment ID	Size	Size Units	Designated Use Impairment
Nearshore open water/shoreline	Lake Michigan Shoreline	North Point Beach	IL_QH-01	0.42	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	IL Beach State Park North	IL_QH-03	2.72	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	Waukegan North Beach	IL_QH-04	1.51	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	Waukegan South Beach	IL_QH-05	1.55	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	IL Beach State Park South	IL_QH-09	4.67	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	Lake Bluff Beach	IL_QI-06	5.5	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	Lake Forest Beach	IL_QI-10	3.79	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	Rosewood Beach	IL_QJ	2.19	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	Park Ave. Beach	IL_QJ-05	4.08	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	Glencoe Beach	IL_QK-04	2.15	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	Tower Beach	IL_QK-06	1.17	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	Lloyd Beach	IL_QK-07	0.32	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	Maple Beach	IL_QK-08	0.57	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	Elder Beach	IL_QK-09	0.92	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	Kenilworth Beach	IL_QL-03	0.76	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	Gilson Beach	IL_QL-06	2	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	Greenwood Beach	IL_QM-03	0.38	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	Lee Beach	IL_QM-04	0.43	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	Lighthouse Beach	IL_QM-05	0.64	Miles	Fish consumption

TMDL Zone	HUC 10	Waterbody Name	Segment ID	Size	Size Units	Designated Use Impairment
Nearshore open water/shoreline	Lake Michigan Shoreline	Northwestern University Beach	IL_QM-06	0.73	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	Clark Beach	IL_QM-07	0.94	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	South Boulevard Beach	IL_QM-08	0.98	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	Touhy (Leone) Beach	IL_QN-01	0.41	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	Loyola (Greenleaf) Beach	IL_QN-02	0.29	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	Hollywood/ Ostermann Beach	IL_QN-03	0.27	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	Foster Beach	IL_QN-04	0.65	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	Montrose Beach	IL_QN-05	1.45	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	Juneway Terrace	IL_QN-06	0.07	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	Rogers Beach	IL_QN-07	0.16	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	Howard Beach	IL_QN-08	0.16	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	Jarvis Beach	IL_QN-09	0.26	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	Pratt Beach	IL_QN-10	0.19	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	North Shore/Columbia	IL_QN-11	0.16	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	Albion Beach	IL_QN-12	0.53	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	Thorndale Beach	IL_QN-13	0.69	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	North Ave. Beach	IL_QO-01	0.55	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	Fullerton Beach	IL_QO-02	3.07	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	Webster Beach	IL_QO-03	0.29	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	Armitage Beach	IL_QO-04	0.27	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	Schiller Beach	IL_QO-05	0.57	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	Oak St. Beach	IL_QP-02	0.64	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	Ohio St. Beach	IL_QP-03	0.93	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	12th St. Beach	IL_QQ-01	1.93	Miles	Fish consumption

TMDL Zone	HUC 10	Waterbody Name	Segment ID	Size	Size Units	Designated Use Impairment
Nearshore open water/shoreline	Lake Michigan Shoreline	31st St. Beach	IL_QQ-02	3.32	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	49th St. Beach	IL_QR-01	1.43	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	Jackson Park/63rd Beach	IL_QS-02	0.73	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	Rainbow	IL_QS-03	3.34	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	57th St. Beach	IL_QS-04	0.33	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	67th St. Beach	IL_QS-05	0.71	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	South Shore Beach	IL_QS-06	0.43	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Shoreline	Calumet Beach	IL_QT-03	1.29	Miles	Fish consumption
Nearshore open water/shoreline	Lake Michigan Open Water	Open waters Lake Michigan Nearshore	IL_QLM-01	180	Square miles	Fish consumption
North Point Marina Harbor	North Point Marina Harbor	North Point Marina Harbor	IL_QH	0.121	Square miles	Fish consumption
Waukegan Harbor	Waukegan Harbor	Waukegan Harbor North	IL_QZO	0.0652	Square miles	Fish consumption, Aquatic life
Calumet Harbor	Calumet Harbor	Calumet Harbor	IL_3S	2.4	Square miles	Fish consumption
Diversey Harbor	Diversey Harbor	Diversey Harbor	IL_QZI	0.04563	Square miles	Fish consumption

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Appendix B: Menu of BMPs for MS4s and MS4 Communities

In the Illinois Lake Michigan Nearshore Mercury TMDL, IEPA is proposing a best management practices approach to controlling and reducing discharges of mercury. USEPA has proposed this approach to effectively reduce discharges of mercury from permitted sources, including MS4s. The authority to establish BMP conditions in NPDES permits is provided in 40CFR 122.44 (k).

IEPA proposes the following example language which can be incorporated into MS4 permits, as adapted from Appendix B 3.1 Specific Recommendations for Areas of Permitted MS4s Contributing to Surface Water Discharges to the Spokane River or Little Spokane River.

MS4-1. Evaluate levels of mercury in stormwater in areas of the MS4 to identify areas more likely to contribute mercury to surface waters based on any available information.

MS4-2. Evaluate levels of mercury in solids, at a quantitation level for total mercury appropriate for identifying these areas using an USEPA-approved test method.

MS4-3. Prioritize BMPs that are related to reducing or eliminating mercury in stormwater in areas of the MS4 more likely to contribute mercury to surface waters, based on any available information, including but not limited to the following:

Previous and ongoing mercury monitoring.

Includes monitoring for mercury in sediment traps, catch basins, and in stormwater suspended particulate matter (SSPM) at frequencies and locations adequate to assess and identify sources of mercury to municipal stormwater.

Nearby toxics cleanup sites with mercury as a known contaminant.

Business inspections and compliance records.

MS4-4. Remove accumulated solids from drain lines (including inlets, catch basins, sumps, conveyance lines, and oil/water separators) in priority areas of the MS4 at least once during the permit cycle.

MS4-5. Work with partners to remove of any identified legacy mercury sources within the MS4 as soon as practicable.

MS4-6. Purchase preferred products with the lowest practicable mercury concentrations for products that are likely to contact municipal stormwater.

MS4-7. Collaborative efforts are encouraged to comply with mercury source control requirements to achieve reductions sought in the TMDL

MS4-8. The permits should include the following requirements for new development and redevelopment disturbing one acre or more:

- Site design to minimize impervious areas, preserve vegetation, and preserve natural drainage systems.

- On-site stormwater management.

CCMS4-1. The permits should address possible contributions of mercury to the MS4 from businesses within the areas served by the MS4 as follows:

- The permits should require the establishment and maintenance of a database of inspections and status of compliance with applicable State and federal laws and local ordinance related to mercury in stormwater, for businesses within the area served by the MS4.
- Based on the information in the database and other available information, the permits should require the permittees to identify businesses that are likely to contribute mercury to the MS4 and to follow up with such businesses and appropriate regulatory agencies to develop and implement BMPs to reduce contributions of mercury to the MS4 from such businesses.

Appendix C: Information Resources for Education and Outreach

Recommendations for Distributing Information

(Adapted from the Waukegan Community Information Plan, USEPA, May 5, 2015, available at: https://www3.epa.gov/region5/cleanup/waukegan/pdfs/waukegan-cip-5-7-15.pdf)

One of IEPA's goals is to make sure that information about the TMDL and the BMPs recommended gets out to all community members, including different ethnic and age groups. IEPA strongly recommends for community members and organizations to promote a watershed workgroup or work closely with their respective municipalities to implement the BMPs outlined in Appendix B.

Listed below are some of the organizations and places that were suggested (from Waukegan Community Information Plan) and a similar approach is recommended for other communities in the watershed.

- Lilac Cottage in Bowen Park
- Lake County Forest Preserves
- Leave No Child Inside meetings
- Park Place
- Schools
- Churches
- Online calendar of events
- Quarterly magazine
- Scoop the Loop
- Dandelion Wine Fine Arts Festival
- Art Walks
- Waukegan Sports Park
- WaukeganMainStreet.org
- Black Chamber of Commerce of Lake County
- Minister's Alliance
- Polar Bear Plunge
- 4th of July parade
- Tour of homes
- Library calendar of events
- Belvidere Mall
- Illinois Refugee Rights (ISIRR.org)
- Monarch Festival

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Appendix D: Responsiveness Summary

This responsiveness summary responds to substantive questions and comments on the Illinois Lake Michigan mercury and PCBs final draft Total Maximum Daily Load (TMDL) received during the public comment period from January 15 through February 16, 2016 (determined by postmark). The summary includes questions and comments from the January 13, 2016 and January 14, 2016 public meetings as discussed below.

What is a TMDL?

A Total Maximum Daily Load (TMDL) is the sum of the allowable amount of a pollutant that a water body can receive from all contributing sources and still meet water quality standards or designated uses. The Illinois Lake Michigan (nearshore) mercury and PCB TMDL reports contain a plan detailing the actions necessary to reduce pollutant loads to the impaired water bodies and ensure compliance with applicable water quality standards. IEPA implements the TMDL program in accordance with Section 303(d) of the federal Clean Water Act and regulations thereunder.

Background Information

Illinois Environmental Protection Agency (IEPA) has identified 56 nearshore beach/shoreline, harbor and open water segments that are impaired due to concentrations of mercury and PCBs in fish tissue and the water column (IEPA, 2014). All of these waterbody segments are impaired for fish consumption use, and one segment (Waukegan Harbor North) is also impaired for aquatic life use. These impaired waters are included on the 2014 Draft Illinois Integrated Water Quality Report and Clean Water Act (CWA) Section 303(d) list (IEPA, 2014).

The CWA and USEPA regulations require that states develop TMDLs for waters that are placed on the CWA Section 303(d) list. IEPA is currently developing TMDLs for pollutants that have numeric water quality standards. Therefore, a TMDL was developed for mercury and PCBs for the watershed targeted for TMDL development within the Illinois Lake Michigan Watershed. IEPA coordinated with USEPA Region 5 and their TMDL contractors Michael Baker International/LimnoTech, Inc. to develop the TMDLs.

Public Meetings

Two public meetings were held on January 13, 2016 (6:00 pm) at Waukegan Public Library (Bradbury Room), Waukegan, Illinois, and on January 14, 2016 (10:00 am) at USEPA- Region 5 Office in Chicago, Illinois. The purpose of the meetings was to provide the public with an opportunity to comment on the final draft TMDL reports and to provide additional data that may be included in the TMDL development process. IEPA announced the public notice by placing a display ad in the newspapers in the watershed (Chicago Tribune and Waukegan Lake County Sun), and the draft TMDL reports were also public noticed on the Agency's Public Notice List webpage. The public notice gave the date, time, location, and purpose of the meetings. It also provided references to obtain additional information about this specific watershed, the TMDL Program, and other related issues. The public notice was also mailed to NPDES & MS4 Permittees, environmental groups, and other organizations in the watershed by first class mail. The draft TMDL Report was available for review at the Waukegan Public Library Waukegan, Illinois and on IEPA's website at http://www.epa.illinois.gov/public-notices/index. Twenty two people in Waukegan and six people in Chicago attended the public meetings.

Agency Responses to Questions, Concerns and Comments

1. The Draft TMDL Report explains that fish tissue concentrations were used to indicate mercury levels because the safe aquatic concentrations of mercury are at or below detectable levels. Fish tissue is not the only known method for concentrating mercury, and more direct methods for monitoring mercury, such as activated carbon, should be widely adopted, both for ambient monitoring, and for sampling of water exposed to coal and its combustion products.

   Response:

   IEPA will take this into consideration when developing future Water Quality Monitoring Plans.

2. The draft TMDL does not sufficiently address the largest source of mercury to nearshore Lake Michigan. It is critical that the IEPA fully address the mercury emissions from coal-fired power plants, especially NRG/Midwest Generation, LLC in Waukegan that is a significant contributor to the mercury pollution in Lake Michigan. While the Waukegan coal plant has installed activated carbon injection to reduce the amount of mercury it emits into the air, the mercury emissions are still significant and must be further addressed. According to USEPA's Toxics Release Inventory Program the plant emits 61 lbs of mercury annually. Since these emissions continue to contribute to the mercury impairment of Lake Michigan the plant should be required to make additional reductions through enhanced usage of the existing controls, and additional upgrades, such as a baghouse that can capture mercury and small particulates, should be installed.

Response:

The Waukegan Power Plant units owned by NRG Energy and operated by Midwest Generation currently comply with the federal Mercury and Air Toxics Standard (MATS) which requires the maximum degree of reduction in mercury emissions that, taking into consideration the cost of achieving such emission reduction, and any non-air quality health and environmental impacts and energy requirements, is achievable. These standards are commonly referred to as "Maximum Achievable Control Technology" or "MACT" standards.

Further, the facility is currently required to significantly reduce mercury emissions in accordance with 35 Ill. Adm. Code Part 225 which alone require an approximate reduction in mercury emissions of 90%. Both units are in compliance with all regulations and permit requirements regarding mercury emissions.

Each unit at the Waukegan facility is equipped with a mercury control system consisting of activated carbon injection specifically designed for the control of mercury followed by an electrostatic precipitator to remove mercury and other particulates from the atmosphere. Both units have also recently installed dry sorbent injection systems which will further assist in mercury control.

3. There should be interdepartmental cooperation between the Air Quality and Water Quality departments within the IEPA, particularly for a site area (Waukegan) containing multiple on-going Super Fund cleanups and nine brownfields with a waterfront coal burning plant operating without a legitimate operating license since 1995.

Response:

IEPA's Environmental Programs (Bureaus of Air, Land, & Water) work together to address multi-media environmental issues, and in this case the Bureaus have worked together to gather information that was necessary for the draft mercury and PCBs TMDL development process.

The Waukegan Power Plant owned by NRG Energy and operated by Midwest Generation is and has been operating under valid and legally effective State permits (both operating and construction). These permits were issued under Illinois' SIP authority in 35 IAC Part 201.

The application for such permit was submitted in 1995 and a Clean Air Act Permit Program (CAAPP) permit was issued in September 2005. However, the permit has not become effective due to an appeal filed before the Illinois Pollution Control Board who stayed the entire permit pending a settlement resolution.

The current status of this CAAPP permit is in the settlement stage of resolution. IEPA has developed a permit to resolve the appealed conditions in the permit and has sent that

draft permit to public notice for comment. IEPA is now finalizing responses to those comments and appropriate permit revisions as a result of those comments to submit to USEPA for their statutory right of review which is 45 days.

The NPDES Permit for the facility was reissued on March 25, 2015.

4. IEPA should develop a similar set of milestones and a longer-term goal for reductions from each source category to meet the TMDL targets. Minnesota's implementation plan includes a set of milestones spanning from 2009 to 2028 to ensure that their 2025 goal is met. For example, MPCA estimated that the annual mercury emission from coal-fired electric generation was 1,716 lbs/yr in 2005. They set a 2018 milestone of 294 lbs/yr and a 2025 goal of 235 lbs/yr. Their reduction strategy is to reduce emissions by 70-90% at all units greater than 5 lbs/yr by 2025 (mostly sooner) to achieve a 1,481 lbs/yr or 86% source reduction. The IEPA should develop a similar set of milestones and a longer-term goal for reductions from each source category to meet the TMDL targets.

   Response:

   In 2006 and 2007 Illinois both promulgated the Illinois mercury rule and reached multi-pollutant reduction agreements with coal-fired owners and operators that resulted in substantial improvement to Illinois and regional air quality by dramatically reducing mercury, SO_2, and NOx emissions. The rule and agreed to measures were a critical milestone in reducing air pollution and one of the most important environmental and public health advances in Illinois history. At the time, they represented the largest reductions in air emissions ever agreed to by individual companies under any context, whether through an enforcement action or regulation.

   The Illinois mercury rule is designed to achieve a high level of mercury control based on IEPA's finding that there exists mercury control technology that is both technically feasible and economically reasonable. Under the rule, mercury emission reductions began in 2009 and were required to be reduced by approximately 90% statewide by 2015. Mercury emissions from coal-fired power plants in Illinois were estimated at 7,700 lbs/yr in 2006 and are currently estimated to be less than 600 lbs/yr when also taking into account the retirement of 18 coal-fired units in Illinois since 2007. Additionally, mercury emissions will fall considerably further due to the expected retirement or conversion to natural gas of seven more units by the end of 2016, several of which are in the Great Lakes Basin area.

5. The coal ash ponds at the Waukegan plant are directly adjacent to Lake Michigan and are also exposed to weathering, and precipitation. The leachate is minimally treated, sampled, and reported prior to discharge into Lake Michigan. Monitoring of this leachate, exposed to a known source of mercury, should be made continuous and evaluated regularly. Additional test wells should be used to assure that mercury and other toxics are not carried toward the Lake by groundwater flow.

Response:

Groundwater monitoring data for mercury has been collected at NRG/Midwest Generation, LLC (Waukegan Power Plant) since November, 2010. Groundwater is currently monitored on a quarterly basis from seven on-site monitoring wells. All of the monitoring results for mercury have been non-detection, with a reporting limit of 0.0002 mg/L.

6. Take well samples around the plants and factories regularly, and make the companies accountable. Include a Monitoring Plan to conduct additional monitoring from wastewater and industrial sources. Track and maintain data where all the waste streams go (gas, liquid and solid waste) and make the data available to the public. Inform the citizens what they are breathing and drinking.

Response:

The municipal and industrial wastewater treatment facilities in the watershed including the Midwest Generation, LLC (Waukegan Power Plant) are required to monitor the effluent discharge for parameters that are in their respective NPDES permits and submit monthly discharge monitoring reports (DMRs). The DMR reports are available at: http://dataservices.epa.illinois.gov/dmrdata/dmrsearch.aspx.

In addition, IEPA's website http://www.epa.illinois.gov/citizens/index provides information regarding air quality, drinking water quality, and land pollution control programs.

Although the mercury Annual Emission Reports (AERs) are currently not available on any website they are readily available through the Freedom of Information Act (FOIA) process.

7. The coal pile at the Waukegan coal fired power plant is directly adjacent to Lake Michigan; coal in train cars is abraded and is also exposed to weathering and runoff release. The leachate from this pile should be collected, concentrated and measured prior to discharge into the Lake Michigan watershed. To reduce the exposure to rain and the airborne release of mercury from coal, it should be covered. In addition, additional test wells should be drilled, and dye tests used to determine whether past runoff from this source is being conveyed into the nearshore zone by groundwater flow.

Response:

The coal pile runoff is collected and treated prior to discharge in compliance with the NPDES permit. The coal pile is sprayed with water to control fugitive dust in compliance with air permit requirements. Sample results from groundwater monitoring from the coal pile area demonstrate no impact to groundwater associated with mercury. These groundwater monitoring results are submitted on a quarterly basis to IEPA, Division of Public Water Supplies.

8. Fixed equipment at the Waukegan Power Plant should be covered, and mercury in water exposed to the mobile equipment should be collected, concentrated and measured prior to discharge into the watershed.

Response:

According to NRG/Midwest Generation, LLC (Waukegan power Plant), the fixed conveyors are covered, stacker operations are monitored and optimized, and transfer points are under negative pressure to minimize fugitive dust during unloading and transport operations. Water coming into contact with transfer equipment is collected, treated, sampled and discharged in compliance with the NPDES permit for the facility.

9. The coal ash ponds at the Waukegan plant are open to precipitation, and the leachate is minimally treated prior to discharge into Lake Michigan. This leachate is then minimally sampled and reported. Monitoring of this leachate, exposed to a known source of mercury, should be made continuous and evaluated by a concentrating method as described above. Although they are lined, these coal ash ponds are next to the plant, and only 300 yards from Lake Michigan, and arsenic has been measured in test wells around them. They should be additionally tested for mercury using concentrating methods, and as requested above, additional test wells should be used to assure that mercury and other toxics are not carried toward the Lake by groundwater flow. To further reduce these risks we strongly encourage the IEPA to require that the plant handle its coal ash waste dry to prevent the leaching of contaminants into groundwater and Lake Michigan. As long as they contain mercury, the ash ponds should be covered to reduce the amount of leachate and the exposure of the nearshore zone to mercury that evaporates from the ponds.

Response:

The coal ash pond water from the lined impoundments is treated, sampled and discharged in accordance with the NPDES permit, and there is no indication of leachate discharge from the lined ash ponds. Sample results from groundwater monitoring from areas between the ash ponds and the Lake demonstrate no detection of mercury. Please also refer to response # 5.

10. While the Waukegan coal plant has installed activated carbon injection to reduce the amount of mercury it emits into the air, the mercury emissions are still significant and must be further addressed. According to the USEPA's Toxics Release Inventory Program the plant emits 61 lbs of mercury annually. Since these emissions continue to contribute to the mercury impairment of Lake Michigan the plant should be required to make additional reductions through enhanced usage of the existing controls, and additional upgrades, such as a baghouse that can capture mercury and small particulates, should be installed. If this is truly out of the jurisdiction of the IEPA's Bureau of Water should direct this critical action to the appropriate body such as the Bureau of Air.

    Response:

    The Bureau of Water has consulted with the Bureau of Air, and the air mercury emissions from NRG/Midwest Generation, LLC (Waukegan-Power Plant) are in compliance with both state and federal laws and regulations.

11. We are concerned that the toxic waste generated by the Waukegan coal plant's dry sorbent injection system, and coal ash the plant has created in the past, and continues to create, contains mercury and might be exposed to weathering in the Lake Michigan watershed. Mercury leaches readily from Portland cement containing coal ash, unless it is specially treated in advance. Coal ash disposal sites in the Lake Michigan watershed should be tested to see whether the stabilizing matrix used presently and in the past immobilizes mercury at the low levels that have polluted the Lake. Mercury that might evaporate from the RCRA sites that received these wastes and reenter the watershed should also be restricted. In addition, CERLCA sites throughout the watershed of this nearshore TMDL should be monitored.

    Response:

    Coal ash disposal sites are beyond the scope of this TMDL report. The NRG/Midwest Generation, LLC (Waukegan-Power Plant) manages coal ash in accordance with Federal and Illinois State requirements and does not own or operate any coal ash disposal sites in the Lake Michigan watershed.

12. The report should consider whether the Waukegan plant or plants near Racine are discharging mercury to Lake Michigan through stormwater runoff or through groundwater that is connected to the lake.

    Response:

    The Illinois Lake Michigan mercury and PCBs draft TMDL Watershed projects only address areas within the watershed and facilities outside the study area will be covered in future TMDL projects. The stormwater runoff at the Waukegan plant is collected in the station's collection system and treated using sedimentation and oil removal prior to discharge. Refer to comment # 5 for ground water monitoring results.

13. Do all potential sources of PCB and mercury loads to Lake Michigan have limits or monitoring requirements in their permits?

    Response:

    The wastewater treatment facilities in the Illinois Lake Michigan TMDL Watershed (refer to Table 6-2 in the TMDL reports) are not allowed to discharge PCBs as stated in their individual NPDES permits. The wastewater treatment facilities that have the potential to discharge mercury to Lake Michigan and its tributaries may have effluent limits or monitoring requirements in their respective NPDES permits. The General MS4 stormwater permit holders do not have limits or monitoring requirements at this time. However, the General Permit Part III- Special Condition (C) requires the MS4 Permittee to comply with the WLA when a TMDL is developed for that particular watershed within 18 months following notification by IEPA once the TMDL is approved.

    There are two coal combustion residual (CCR) surface impoundments in the study area. CCRs are covered by a final USEPA Rule effective October 19, 2015. Among other requirements, the Rule requires operators of CCR units to maintain a publicly available website of compliance information for example, annual groundwater monitoring results, corrective action reports, fugitive dust control plans and closure completion notifications.

14. According to the mercury draft TMDL report (refer to Section 7.5.2) the closest atmospheric mercury monitoring station is in the Indiana Dunes National Lakeshore. Monitoring for PCBs is conducted at the Chicago site (IIT Chicago) of the Integrated Atmospheric Deposition Network (IADN). The IEPA should work with USEPA to establish mercury monitoring at this site or another site within the study area watershed.

    Response:

    IEPA recognizes the value of mercury monitoring for the Great Lakes Basin area. The Lake Michigan Air Directors Consortium (LADCO), of which Illinois is a primary member, currently leads regional efforts on mercury monitoring.

15. Excessive ingress and impingement (I&I) of fish on the intake structures of the Waukegan coal plant generates a large discharge of fish tissue into the local aquatic food chain. The warmed discharge water is known to both attract fish into the nearshore zone and degrade their health. The elevated presence of mercury from the power plant, combined with these factors promotes more rapid uptake of mercury into the tissues of live fish that forage in the nearshore zone. This TMDL should call for reduced I&I both to reduce fish mortality and mercury uptake in the nearshore zone.

Response:

The question is beyond the scope of the TMDL report. The IEPA will look into your comment, however, the NRG/Midwest Generation, LLC (Waukegan power Plant) currently is meeting the requirements of its NPDES permit.

16. IEPA should request that LimnoTech perform plume modeling and develop a proper LA for the Waukegan plant and other prominent sources of mercury air emissions in the region.

Response:

Plume modeling is beyond the scope of this study. Mercury emissions from the coal fired power plant operated by NRG/Midwest Generation LLC are included in the REMSAD modeling that was used to calculate baseline mercury deposition loads to the study area. Reductions therefore consider contributions from that facility. REMSAD also considered mercury emissions from sources within the state of Illinois, regional sources including all other US states, Canada and Mexico, and global emissions. The proportionality approach selected for this project involves calculation of a reduction percentage that applies equally to all sources.

17. Review the Mercury Minimization Plan developed by Clean Water Services for the Tualatin River watershed in Oregon. Their plan includes educational outreach to reduce improper release of mercury to the environment.

Response:

IEPA has reviewed the Mercury Minimization Plan and a similar approach has already been included in the TMDL report.

18. Use monitoring data from the North Shore Sanitary District and emissions data from the Waukegan Generating Facility to estimate mercury loading.

Response:

The current NPDES Permit No. IL0030244 for North Shore Water Reclamation District - Waukegan Water Reclamation Facility does not have mercury limits or monitoring requirements. However, the draft NPDES permit for this facility does contain mercury limits for a discharge to Waukegan North Ditch (Outfall BO2), which is a tributary to Lake Michigan and the TMDL report was revised to include a wasteload allocation to be consistent with the TMDL study and the draft NPDES permit.

Mercury emissions from the coal fired power plant operated by NRG/Midwest Generation LLC (Waukegan power Plant) are included in the REMSAD simulations. Please also refer to response # 16.

19. Section 7.5 of the draft TMDL reports, titled "Monitoring Recommendations to Track TMDL Effectiveness," describes existing monitoring efforts but fails to recommend additional monitoring needed to accurately track TMDL effectiveness. For example, the Fish Contaminant Monitoring Program (FCMP) is given as the source of data on mercury and PCB levels in fish tissue. Given the limited amount of fish tissue data used to develop the TMDL targets, it appears that existing monitoring is insufficient and should be increased or expanded. Fish tissue sampling should be conducted more than once a year and should include a greater number and distribution of samples to accurately represent mercury and PCB contamination in all fish species and locations.

    Response:

    IEPA will continue to work with Illinois Department of Natural Resources (IDNR) to conduct more fish monitoring when additional resources become available.

20. The reports should include methods to address the main transport pathways for mercury and PCB loads to Lake Michigan, including runoff from impervious surfaces.

    Response:

    Section 7 describes best management practices for reducing mercury and PCBs load to Lake Michigan. This includes controls to reduce runoff from impervious surfaces.

21. IEPA should request consultation with USGS, the leading authority regarding environmental mercury.

    Response:

    Thank you for the suggestions. IEPA will contact USGS to follow up on the recent mercury study in the watershed.

22. IEPA should include maps showing the location of key point sources and nonpoint source areas.

    Response:

    A new map has been added to the report, which shows sources considered under each TMDL focusing on those that could easily be mapped.

23. In light of the finding that air deposition from sludge piles is a significant source of PCBs; the IEPA should investigate strategies to control air movement of PCBs from sludge piles.

    Response:

    As IEPA recently learned that a paper published by Shanahan et al. (2015) provides an inventory of PCBs in the watershed and estimates sewage sludge drying beds have the potential to contribute significantly to annual PCB emissions, IEPA will follow up with the

researchers and facilities that generate sludge in the watershed to understand and develop implementation plans to address the issue.

24. IEPA should calculate more specific reduction targets for each source category or facility and should outline the corresponding reduction strategies in an implementation strategy.

Response:

A wide range of modeling frameworks exist that could potentially be used to support the Illinois Lake Michigan nearshore mercury and PCB TMDLs. The TMDL Scoping Report (LimnoTech, 2015) reviewed the range of available frameworks and concluded that a zero-dimensional, steady state proportionality approach was most appropriate for this project (for both the mercury and PCB TMDLs), given the amount of data available to support TMDL development. This approach involves calculation of a reduction percentage that applies equally to all sources.

IEPA will reach out to watershed workgroups and other state agencies and share the TMDL and implementation plan. Interested stakeholders are encouraged to work closely with MS4 Permittees in their respective municipalities in developing BMP implementation strategies.

25. The reports should establish a process to ensure that all permits for new construction contain requirements to capture mercury and PCBs at the pipe entrance before they enter stormwater pipes using methods such as those included in the report (infiltration trenches, basins, retention and reuse, ponds, detention basins, swales, buffer strips, bioretention). The reports should also identify the MS4 pipes and end of pipes regulated by NPDES permits and establish a process for requiring treatment BMPs to control mercury and PCB loads leaving these pipes, such as those listed in the reports (filters, screens, wet vault, and hydrodynamic separators for MS4 pipes; sedimentation basins or constructed wetlands for end of pipe). New stormwater discharges should not be permitted under the MS4 General Permit until this permit is updated to require the BMPs needed to reach the TMDL targets. IEPA should require permits for new construction contain BMPs to capture mercury and PCBs at the pipe entrance before they enter stormwater pipes.

Response:

The MS4 General Permit IL40, Part IV- Section B(4) (a)(iv) - requires all regulated construction sites to have a stormwater pollution prevention plan that meets the requirements of Part IV of General NPDES Permit No. ILR10, including management practices, controls, and other provisions at least as protective as the requirements contained in the Illinois Urban Manual, 2014, or as amended including green infrastructure techniques where appropriate and practicable.

26. In order to meet water quality standards and attain all designated uses of the lake, the IEPA must develop a strong implementation plan to meet target reductions in mercury loads identified in the draft TMDL report. The implementation plans must include assurances that the most effective BMPs will be adopted and financed in order to make progress towards the needed reductions.

    Response:

    The draft TMDL reports include implementation and monitoring recommendations (refer to Section 7 in the report) and provides a reasonable assurance that the best management practices (BMPs) and controls outlined in the report will be implemented. IEPA can work with watershed workgroups and other organizations in the watershed to identify appropriate combinations of BMPs for both point and nonpoint sources to implement needed reductions in the study area to meet the TMDL target endpoint.

27. In order to ensure that the suggested BMPs are implemented, the IEPA should establish at least a general timeline that can be adapted as appropriate. This timeline should include a summary of the permit cycles for point sources and MS4s that identifies when BMP requirements will be incorporated. The reports should also include a description of the timeline and structure for the public engagement process to prioritize the recommended strategies to determine the most feasible options.

    Response:

    A schedule for implementation has been added to Section 7 of the PCB and mercury TMDL reports, which includes expiration dates for current individual NPDES permits and the MS4 Stormwater General Permit.

    The TMDL has identified that the existing wastewater treatment plants (WWTPs) are in compliance with their respective NPDES Permit effluent limits or monitoring requirements and must continue to be in compliance to be consistent with the TMDL target endpoint to meet water quality standards. The TMDL will be incorporated by reference into the MS4 General Permit No. ILR40 that became effective on March 1, 2016. The MS4 Permittees must comply with the TMDL recommendation within eighteen months following notification by IEPA upon approval of the final TMDL report by USEPA.

28. Require permits for new construction contain BMPs to capture mercury and PCBs at the pipe entrance before enter stormwater pipes. Identify the MS4 pipes and end of pipes regulated by NPDES permits and establish a process for requiring treatment BMPs to control mercury and PCB loads leaving these pipes. New stormwater discharges should not be permitted under the MS4 General Permit until this permit is updated to require the BMPs needed to reach the TMDL targets.

Response:

According to the MS4 General Permit IL40 – Part IV (B)(3)(b) – MS4 permittees are required to develop a storm sewer system map, showing the location of all outfalls and locations of all waters that receive discharges from those outfalls. In addition, the MS4 permit holders must comply with the requirements of the MS4 General Permit IL40 – Part IV (B)(4)-Construction Site Storm Water Runoff Control.

29. Illinois should specifically focus its Nonpoint Source Section 319 grants on implementing technologies that will directly lead to reductions in atmospheric deposition of mercury. Illinois should develop grants that encourage coal-fired power plants to phase out subbituminous coal and to clean bituminous coal to reduce its mercury content

Response:

IEPA administers the 319 cost share funding program for watershed based plans with the goal of improving water quality impacted by nonpoint source pollution. Grants are available to local units of government and other organizations to protect water quality in Illinois. Projects must address water quality issues relating directly to nonpoint source pollution. Funds can be used for the implementation of watershed based plans, including the development of information/ education programs and for the installation of best management practices (BMPs). Natural Resources Conservation Service (NRCS) and Soil Water Conservation District (SWCD) have Farm Bill funds and other grant possibilities including urban watershed projects that are addressing water quality issues in Illinois.

30. Form a Steering Committee consisting of concerned citizens, businesses, and government to have discussions and solutions to tackle environmental and progress issues. The IEPA should also follow Minnesota's process for stakeholder engagement in the oversight of the TMDL implementation. These stakeholders developed recommendations for source-specific reduction targets, strategies to meet the targets, and interim and final time frames for achieving reductions.

Response:

Thank you for the suggestions. IEPA's 319 cost-share funding program is available for developing best management practices (BMPs) that may be able to address nonpoint sources of mercury and PCBs impairments discussed in the report. Please refer to the link for the Guidance for Developing Watershed Action Plans in Illinois - May 2007 (Chicago Metropolitan Agency for Planning (CMAP)/Illinois EPA: http://www.epa.state.il.us/water/watershed/publications/watershed-guidance.pdf.

31. IEPA successfully implemented past programs such as the Cook County PCB and Mercury Clean Sweep Program. Intensive implementation of similar programs, programs to increase building and equipment recycling, and projects to clean up brownfields will be necessary to achieve the standards.

    Response:

    A past program, the Chicago Clean Sweep Pilot program was designed to educate Chicago-area businesses on the identification and proper management of mercury (and PCBs) and to set up a process under which certain businesses would be able to send certain mercury waste to a participating facility for recycling or disposal at a reduced cost. The Clean Sweep program has been discontinued, but could serve as a model for additional clean-ups if communities are interested in pursuing funding to revitalize it.

32. IEPA should do more community outreach for public meetings on the TMDL Draft Report, and its staff should be more responsive to community questions and public comments. The hearing should be given more widespread notification to local public. Were Waukegan City Officials and Lake County Board Members contacted directly inviting their attendance? We did not find the presenters to be particularly responsive to community questions and public comments

    Response:

    The public notice for the meeting was announced on IEPA's website and in a press release (Chicago Tribune and Waukegan Lake County Sun) to reach the general public in the watershed; environmental groups; municipal and county governments, and NPDES and MS4 permit holders were also notified by first class mail. The announcements provided details of meeting time and location and information on how to access the TMDL documents for review. Individuals who have participated in the earlier Scoping Report or previously expressed interest in the TMDL development process received an e-mail announcing the public notice. The draft TMDLs were available at IEPA website: http://www.epa.illinois.gov/Assets/iepa/public-notices/2015/lake-michigan-nearshore/public-notice.pdf.The public notice provides an opportunity for the public to read the TMDL and provide comments on the TMDL. The purpose of the public meeting is to provide an overview of the TMDL and to answer as many questions as possible at the meeting. As discussed at the meetings, the process also allows for IEPA to research any remaining unanswered questions and respond to them through this responsiveness summary. IEPA representatives, USEPA staff member along with the TMDL contractors conducted the public meetings and have answered several questions within the scope of the TMDL projects, and attendees were advised to send written questions/comments to IEPA by the end of the public comment period.