Ohio River Total Maximum Daily Load for PCBs

Ohio River Miles 40.0 to 317.1

Final Report

ORSANCO

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September 2002

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 TMDL BACKGROUND

Section 303(d) of the Clean Water Act requires states to develop Total Maximum Daily Loads (TMDLs) for waters not meeting designated uses after technology-based controls have been implemented. A TMDL establishes the allowable loadings of pollutants for a water body, quantifies the reductions necessary to meet all designated uses, and assigns load allocations. The eight minimum regulatory requirements for TMDLs are as follows:

1) TMDLs must be designed to meet applicable water quality standards.
2) TMDLs must include load allocations (LA) and wasteload allocations (WLA). A load allocation is an allowable pollutant load from non-point sources. A WLA is an allowable pollutant load from point sources. The combined LA and WLA must not result in violations of the applicable water quality standards.
3) TMDLs must consider the impacts of background (natural) pollutant contributions.
4) TMDLs must consider critical environmental conditions.
5) TMDLs must consider seasonal environmental variations.
6) TMDLs must include a margin of safety.
7) TMDLs must include public participation.
8) TMDLs must include reasonable assurance that the reduction goals set forth in the TMDL can be achieved and the applicable water quality standard can be met.

In 1997, the United States Environmental Protection Agency (USEPA), Region 3, entered into a Federal Consent Order to complete a TMDL for polychlorinated biphenyls (PCBs) for a section of the Ohio River listed on West Virginia’s 303(d) list. The entire length of the Ohio River is listed as impaired due to a long-standing fish consumption advisory resulting from elevated PCB levels in fish. This TMDL establishes the allowable loadings of PCBs for the Ohio River within the study area, and quantifies the reductions necessary to meet the applicable water quality standards.

The Ohio River Valley Water Sanitation Commission (ORSANCO) developed this TMDL report on behalf of USEPA, Region 3. ORSANCO is an interstate water pollution control agency for the Ohio River Basin.

1.2 POLYCHLORINATED BIPHENYLS

PCBs are manmade compounds that have been used commercially since 1929. These chemicals were manufactured as combinations of chlorinated biphenyls that differed according to the percentage of chlorine in the mixture. PCBs had a wide variety of industrial applications due to their chemical stability and flame resistance, however, these characteristics also enabled them to remain highly persistent in the environment. PCBs were commonly used as plasticizers, heat-transfer fluids, solvent extenders, hydraulic fluids, flame retardants, sealers, ink carriers, organic diluents and dielectric fluids.

Approximately 99 percent of commercial PCBs produced for U.S. industry were manufactured by Monsanto Chemical Company in Sauget, Illinois and sold under the trade name Aroclor® (USDHHS, 1995). The Aroclors are identified by a four-digit numbering code in which the first two digits denote the number of carbon atoms in the biphenyl group and the last two digits represent the approximate percentage of chlorine in the mixture. The most common PCBs manufactured include Aroclor® 1242, Aroclor® 1248, Aroclor® 1254 and Aroclor® 1260 (Cairns et al., 1986).

PCBs are not naturally occurring compounds so their presence in the environment is a result of anthropogenic activities. Approximately 1.25 billion pounds of PCBs were purchased by U.S. industry by the time production stopped in 1977 (USEPA, 1993). The USEPA estimates that 60 percent, or 750 million pounds, of PCBs produced are still in use in the United States in some 150,000 PCB transformers and 2.5 million mineral oil transformers (Graham, 1987). Another 36 percent (450 million pounds) of PCBs were either placed in landfills or dumps or were available to biota via air, water, soil and sediments. The remaining four percent (55 million pounds) were destroyed by incineration or were degraded in the environment (USEPA, 1993).

Although uses of PCBs now are limited to closed-system applications such as sealed capacitors and transformers, most contamination reflects a period when PCBs where used in open systems and losses to the environment were likely. Today, PCBs can be released into the environment from poorly maintained hazardous waste sites that contain PCBs, illegal or improper dumping of PCB wastes, and leaks or releases from electrical transformers containing PCBs. In addition, when PCBs are incinerated small amounts are released into the atmosphere as a result of incomplete combustion (USDHHS, 1995).

Main Pathways to Environment

- Municipal waste incinerators burning organic wastes.
- Industrial incinerators burning organic wastes.
- Poorly maintained hazardous waste sites that contain PCBs.
- Illegal or improper dumping of PCB wastes such as transformer fluids and leaks or releases from electrical transformers containing PCBs.
- Disposal of PCB-containing consumer products into municipal or other landfills not designed to handle hazardous waste.

The behavior of PCBs differs depending on the number of chlorine atoms present. In general, these compounds are liquids characterized as stable, relatively insoluble and having the ability to sorb strongly to organic matter. As the chlorine content increases, the solubility of the compound decreases and the mixture becomes more viscous. In addition, PCBs are highly lipophilic and bioaccumulation in fish tissue can result in concentrations that are considered unsafe for human consumption (USEPA, 1980).

PCBs exist in the atmosphere as vapors or adsorbed to airborne particulates. The gaseous form predominates, typically comprising over 90 percent of the total PCB concentration in air (Atlas et al., 1986). Once in the atmosphere, PCBs can be carried for long distances until they return to earth by wet or dry deposition (USDHHS, 1995).

The ultimate fate of PCBs in the environment is terrestrial or aquatic sediments. Once released into the environment, PCBs bind strongly to sediments where they remain in place or become transported by erosion. The adsorption of PCBs in soil is directly related to the degree of chlorination and the composition of the soil. Generally, adsorption increases as the chlorination of the compound and/or the organic carbon and clay content of the soil increase (USDHHS, 1995). In addition, experiments have shown that PCBs sorbed by soils remain relatively immobile against leaching with water or sanitary landfill leachate (Sawhney, 1986). However, in the presence of organic solvents, PCBs have been shown to leach significantly in soil thereby making it a concern at hazardous waste sites (Chou and Griffin, 1986). In surface waters, small amounts of PCBs remain dissolved but most settle in bottom sediments due to their high specific gravity and affinity for solids.

PCBs persist in the environment and may have an estimated half-life in terrestrial soil of several years (USDHHS, 1995). Sediments containing PCBs at the bottom of a large body of water such as a lake or river generally act as a reservoir from which PCBs may be released in small amounts over time. The breakdown of PCBs in water and soil occurs over several years, or even decades (USDHHS, 1995). The ability of PCBs to be degraded or transformed in the environment depends in part on the degree of chlorination of the biphenyl molecule. In general, the persistence of PCB congeners increases as the degree of chlorination increases.

PCBs are removed from the environment primarily by photochemical degradation or biodegradation. Photochemical degradation utilizes light energy to replace chlorine atoms with hydroxyls, ultimately dechlorinating PCBs. Generally, chlorobiphenyls with higher chlorine content undergo degradation faster than those with lower chlorine content. However, PCBs in bottom sediments not exposed to light will not degrade in this fashion. In biodegradation, both anaerobic and aerobic microorganisms present in soil and sediments decompose and metabolize PCBs. Biodegradation rates are highly variable because they depend on a number of factors including: the degree of chlorination, concentration of PCBs, types of microbial populations present, and the available nutrients and temperature in the subsurface (USDHHS, 1995). Generally, microbial degradation of the lower chlorinated biphenyls has been found to occur at a faster rate than the higher chlorinated biphenyls, but the process can be enhanced by the addition of pre-exposed microbial populations.

Humans can be exposed to PCBs by the ingestion of contaminated food, inhalation or dermal contact with contaminated media. Since 1985, when PCBs were restricted to sealed systems, ingestion has become the most significant route of exposure to the general population while inhalation and dermal contact are associated more with occupational exposure. Food can become contaminated with PCBs as a result of accidental spills, equipment malfunctions, and from contaminated food packaging. Currently, the primary source of PCB ingestion is through the consumption of contaminated fish (USDHHS, 1995).

Fish uptake PCBs in water through their gills and through the food chain by consumption of contaminated aquatic organisms. Once PCBs are absorbed into the bloodstream they accumulate primarily in fatty tissues where they have the ability to biomagnify, or increase in concentration, as the compound is transferred through the food chain. In humans and other mammals, PCBs accumulate in the gastrointestinal tract, adipose tissue and skin.

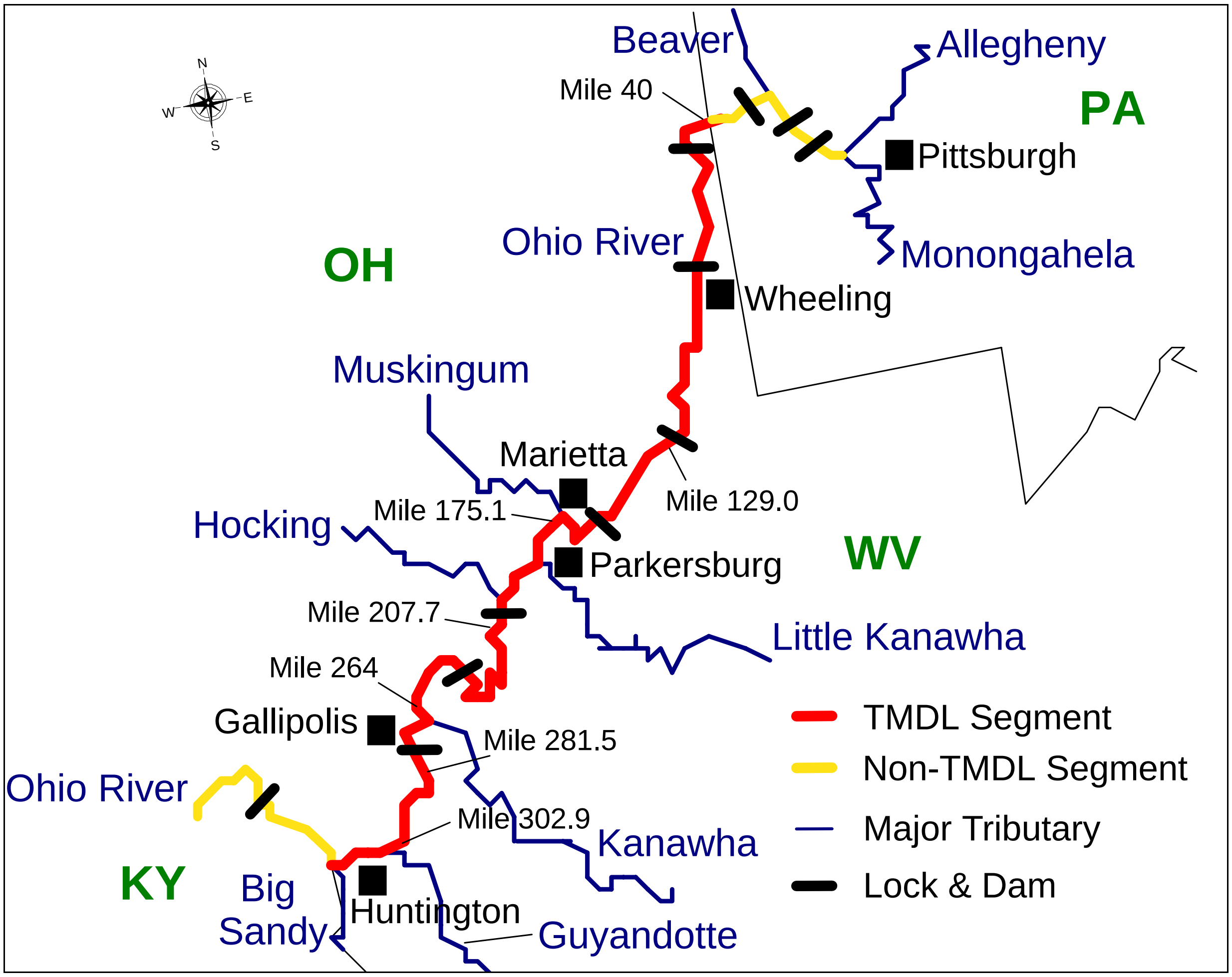
Opinions vary as to the precise health risks PCBs pose, however they are classified as *probable* human carcinogens and several studies suggest they can enhance the carcinogenicity of other chemicals. Most information regarding health effects of PCBs in humans is generated from occupational exposure studies. Currently, there is no conclusive evidence linking exposure of PCBs to cancer in humans. Individuals who have been exposed to PCBs have experienced symptoms such as chloracne, jaundice, numbness and swelling of limbs, spasms, hearing and vision problems, increased eye discharges, and gastrointestinal disorders (USEPA, 1980). Epidemiological studies indicate the major toxic effect in animals appears to be liver damage. Other effects include stomach, thyroid and kidney damage and immunosuppressive effects. Further laboratory testing has shown that PCBs cause miscarriages in rats, monkeys, minks and rabbits.

1.3 STUDY AREA DESCRIPTION

The Ohio River is 981 miles long, starting at the confluence of the Allegheny and Monongahela Rivers in Pittsburgh, PA and ending in Cairo, IL where the Ohio flows into the Mississippi River. There are 20 navigational lock and dam structures on the Ohio River, with seven of those located along the TMDL segment. The TMDL discussed in this report is for the portion of the Ohio River that begins at the Pennsylvania and West Virginia border near Chester, WV at Ohio River Mile (ORM) 40.0, and extends downstream for 277 river miles to the border between Kentucky and West Virginia near Kenova, WV at ORM 317.1 (Figure 1-1). Along this stretch, the Ohio River forms the border between Ohio and West Virginia.

The Ohio River Basin upstream of the TMDL segment drains approximately 23,300 square miles and includes three major tributary sub-basins (i.e., drainage area greater than 1,000 square miles) – the Allegheny, Monongahela, and Beaver Rivers. Within the TMDL segment, five major tributaries enter the Ohio River. These tributaries are the Muskingum, Little Kanawha, Hocking, Kanawha, and Guyandotte Rivers, and their confluences are at Ohio River mile points 172.2, 184.6, 199.3, 265.7, and 305.2, respectively. The Ohio River at the downstream end of the study area has a drainage area of approximately 56,000 square miles.

Figure 1-1. Map of the TMDL study area.



2.0 TMDL DEVELOPMENT

2.1 APPLICABLE WATER QUALITY STANDARDS

A TMDL must be designed to meet the applicable water quality standards. Water quality standards for both West Virginia and Ohio must be considered in the development of this TMDL since this portion of the Ohio River forms the boundary between the two states. The water quality criteria established in ORSANCO's Pollution Control Standards (2000) also apply to the Ohio River, and must be considered in the TMDL. Table 2-1 presents the applicable PCB water quality standards for the Ohio River in the TMDL segment.

Table 2-1. List of applicable human health water quality standard for PCBs

State	Human Health PCB nanograms/liter (ng/L)[1]	This value is applied at all times when the river flows are:	References & Comments
West Virginia	0.044	Equal to or greater than the minimum seven consecutive day drought flow with a ten year return frequency (7Q10)	(WV 46CSR1) (WV 46-1-7.2b)
Ohio	0.79	At one-tenth the harmonic mean flow	The new standard, which will go into effect in November 2002, is 1.7 ng/L.
ORSANCO's	0.17	At harmonic mean flow	

[1] This value is established at a cancer risk level (CRL) of 10^{-6} or one additional cancer case per 1,000,000 individuals. Except for Ohio's standard, which is established at a cancer risk level (CRL) of 10^{-5}.

The West Virginia water quality standard of 0.044 ng/L is more restrictive than that of Ohio and ORSANCO. The West Virginia standard, being more protective of human health, has therefore been used to establish the TMDL endpoints within the TMDL segment. This numeric endpoint identifies the in-stream concentration at which all designated uses of the Ohio River will be attained. The endpoint also provides the basis for calculating the allowable PCB loadings in the Ohio River, and determining the load reductions necessary to meet water quality standards.

2.2 CRITICAL CONDITION AND SEASONALITY

Concurrent with the selection of a numeric endpoint, the environmental conditions that will be used to calculate the allowable loads must be defined. TMDLs generally are designed around the concept of "critical condition." The critical condition is the set of environmental conditions, which if controls are designed to protect, that will ensure attainment of standards for all other conditions.

Because PCBs are considered carcinogenic and human health criteria for carcinogens are derived assuming a lifetime exposure, PCB human health criteria thus apply to ambient water concentrations averaged over a human lifetime (approximately 70 years). Harmonic mean flow is specifically identified as the appropriate flow condition to best represent the averaging of hydrologic conditions over a long period of time (EPA Guidance 1991). As a result, harmonic mean flow has been selected as the hydrologic condition that this TMDL will be based on. Table 2-2 presents the established harmonic mean flows for the Ohio River in the TMDL segment. For comparison purposes, the 7Q10 low flow values are also provided.

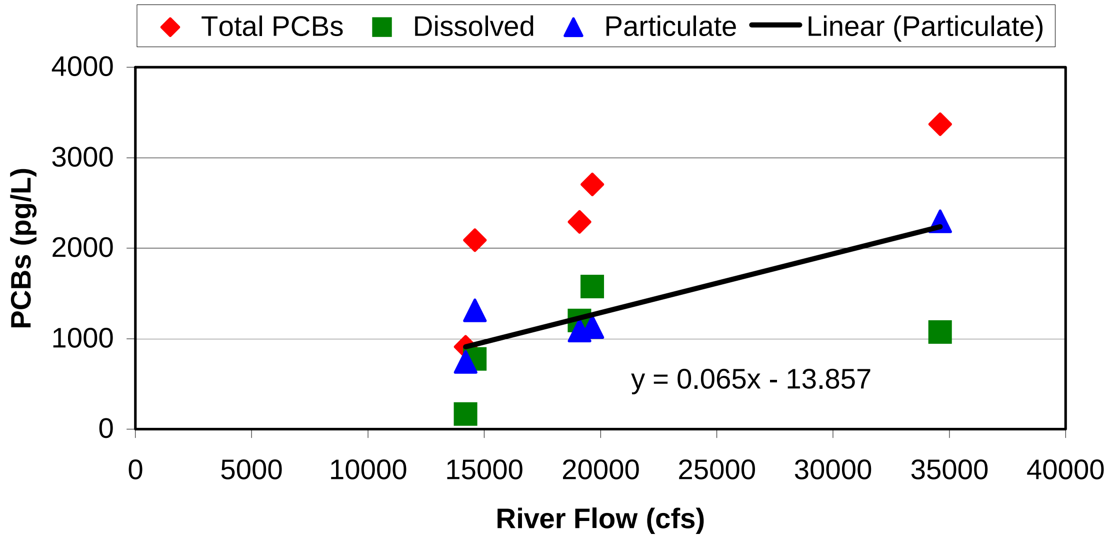
Table 2-2. Harmonic mean and 7Q10 flow values for the Ohio River within the TMDL study area (ORSANCO, 2000).

Ohio River Segment (river miles)	**7Q10 Low Flow ($feet^3$/second)**	**Harmonic Mean Flow ($feet^3$/second)**
40.0 – 161.7	5,880	20,500
161.7 – 237.5	6,560	24,500
237.5 – 279.2	6,700	26,000
279.2 – 305.2	9,120	34,500
305.2 – 317.1	9,300	35,900

Also, while the West Virginia water quality standard applies to the 7Q10 low flow condition, establishing the critical condition at the harmonic mean flow is considered protective of the WV standard. This is true because there is a positive correlation between stream flow and particulate phase PCB concentrations. An example of this relationship is provided in Figure 2-1. This relationship results in not only higher concentrations at greater flow conditions, but also larger loadings as flow increases.

By establishing the harmonic mean flow as the critical condition, the necessary load reductions to meet the water quality standard are significantly greater than if the TMDL was established at the 7Q10 flow. For example, the existing load at harmonic mean flow at Ohio River mile 175.1 is estimated to be 152.013 g/day (see Section 2.4 for discussion regarding estimation of loadings) with an allowable load of 2.637 g/day. A reduction of 149.376 g/day would be required to meet the water quality standard at harmonic mean flow. Conversely, if the TMDL was established at the 7Q10 flow, the existing load would be estimated at 21.988 g/day with an allowable load of 0.706 g/day. A reduction of only 21.282 g/day would be necessary to meet the water quality standard at the 7Q10 flow. Therefore, by establishing the critical condition at the harmonic mean flow, the reductions necessary to meet the water quality standard are sufficient to ensure the standard is met for all flows equal to or less than the harmonic mean flow.

Figure 2-1. Example of positive correlation between stream flow and particulate PCB concentrations at Ohio River Mile 175.1



In addition, if the TMDL were to be designed at the 7Q10 flow, the reductions called for would only ensure that the standard would be met at extreme low flow conditions. Because of the positive correlation between stream flow and PCB concentration, the standard would be exceeded at all flows above the 7Q10 flow. Considering that 1) human health criterion for carcinogens are based on a lifetime exposure, 2) harmonic mean flow is representative of average long-term hydrologic conditions, and 3) reductions based on loadings at harmonic mean flow would be protective of the water quality standard, the use of the harmonic mean flow as the critical condition is considered appropriate for this TMDL analysis.

Seasonality also must be considered in the TMDL development process. Simply stated, seasonality, in the context of a TMDL, refers to the natural variations of environmental conditions that affect pollutant concentrations. Stream flow is the most important environmental condition to consider for PCBs. On the Ohio River, periods of high flow conditions generally occur during the early spring months, while low flow seasonally occurs in late summer or early fall. In-stream concentrations of PCBs are directly affected by stream flow. In cases where point sources dominate, concentrations will be greatest during drought conditions due to less water for dilution. Conversely, PCB loads from non-point sources are greatest during rainy, high flow periods due to increased loadings from overland runoff of contaminated soils and resuspension of contaminated sediments from the river bottom.

While significant variations in concentrations of PCBs have been observed in the Ohio River, seasonality is inherently accounted for through use of the harmonic mean flow as the critical condition. Harmonic mean flow provides a representative long term average, that is consistent for use with a human health standard based on a lifetime exposure, as is the case for PCBs and all carcinogens.

2.3 TOTAL MAXIMUM DAILY LOAD CALCULATION

The total maximum daily load (TMDL) is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that amount to the sources of the pollutant. In order to develop the PCB TMDL for this Ohio River segment, the maximum pollutant loading was assessed at the critical flow condition. The allowable PCB loads for the Ohio River TMDL segment are presented in Table 2-3. These loads represent the applicable water quality standard of 0.044 ng/L applied at the harmonic mean flow condition.

Table 2-3. Total maximum daily PCB loads to meet WQS for segments of the Ohio River.

Ohio River Segment (river miles)	**Harmonic Mean Flow (feet^3/second)**	**PCB TMDL (grams/day)**
40.0 – 161.7	20,500	2.207
161.7 – 237.5	24,500	2.637
237.5 – 279.2	26,000	2.799
279.2 – 305.2	34,500	3.714
305.2 – 317.1	35,900	3.865

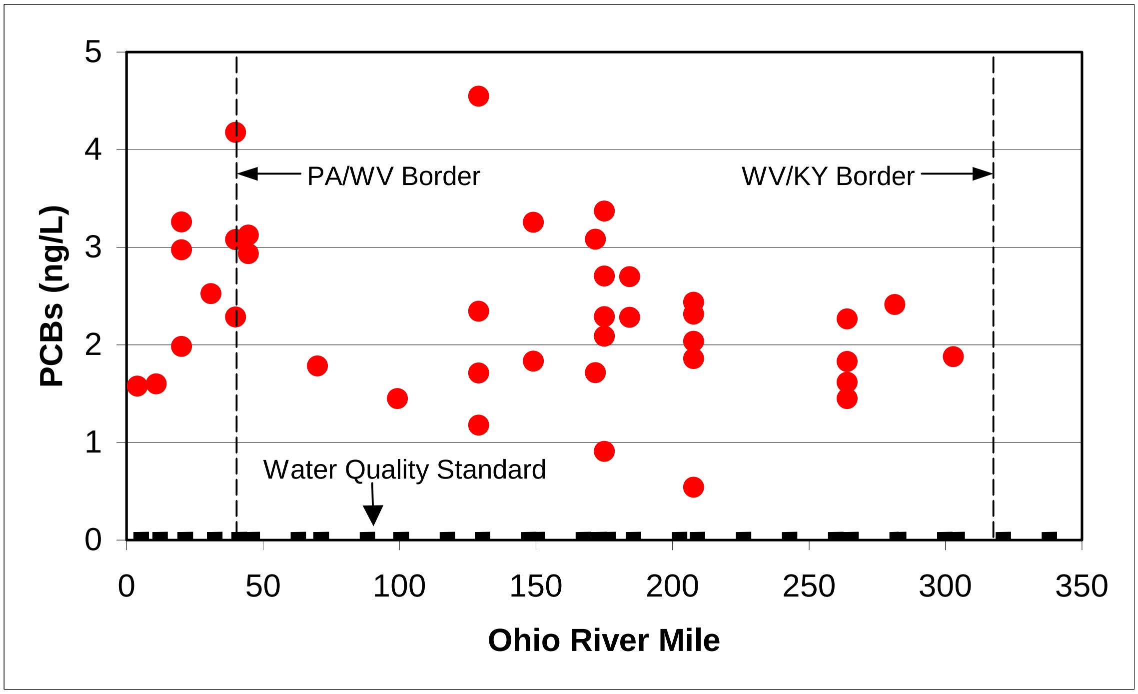
2.4 EXISTING OHIO RIVER PCB LOADS

ORSANCO utilized an innovative sampling technique referred to as high-volume water sampling to quantify ultra low-level concentrations of PCBs in the Ohio River, major tributaries and discharges. This sampling method involves filtering a large volume of water (1,000 liters) in order to collect a sufficient amount of PCBs, such that it can be detected by existing high-resolution analytical methods. This process is accomplished by first drawing the river water through glass fiber filters that separate and collect suspended solids. The filtered water then passes through stainless steel columns filled with a hydrophobic resin (XAD2) that extracts the PCBs present in the dissolved phase. The filters and columns then are analyzed separately to quantify PCB levels in both the particulate and dissolved phases. While this methodology is not yet approved by EPA, it is the only technique currently available for directly measuring ultra low levels of PCBs.

High-volume water samples were collected at nine Ohio River sampling locations within the TMDL segment, and at four sites on the Ohio River in Pennsylvania, upstream of the TMDL segment. Each site was sampled at least twice, with some targeted sites sampled up to five times. Sampling was conducted at different river flow conditions to evaluate the range of PCB concentrations present in the river. Samples were analyzed by USEPA Method 1668A for all 209 PCB congeners. Figure 2-2 graphically illustrates the Ohio River high-volume sampling results for total PCBs (sum of dissolved and particulate phases combined). In some cases only the dissolved or particulate portions of the samples were available for analysis. Data for these samples are not included in the graph;

however, these results are provided in the complete high-volume water sampling data summary in Appendix A.

Figure 2-2. Observed Ohio River PCB concentrations.



These results clearly indicate that current PCB levels in the Ohio River exceed West Virginia's water quality standard of 0.044 ng/L for all conditions sampled. The variability in the observed concentrations also indicates that loadings can fluctuate significantly with changes in stream flow. As mentioned earlier in this report, the allowable PCB loading calculations for this TMDL are based on a critical condition established at harmonic mean flow. To compare allowable loads to existing loads in the Ohio River, and to quantify necessary reductions to meet water quality standards, current in-stream concentrations and loadings at harmonic mean flow were predicted using the high-volume sampling data collected over a range of flow conditions.

In-stream PCB concentrations and loadings were calculated only for sites within the TMDL segment that were sampled on at least three occasions. Data for each site were evaluated separately to select the best method to predict the concentration at harmonic mean flow. Concentrations were estimated for the seven Ohio River sampling points included in Table 2-4. For all sites except ORM 207.7, a clear positive correlation between stream flow and PCBs in the particulate phase was observed. This type of correlation is expected since PCBs strongly bind to particulates in the water column, and suspended solids concentrations increase with stream flow due to an increase in soil erosion and resuspension of bottom sediments. Dissolved phase PCB results, in general, did not show a correlation with stream flow except at ORM 129. At this site, there was a positive correlation between dissolved PCB concentrations and flow.

Table 2-4. Predicted existing PCB concentrations at harmonic mean flow.

Sampling Location (Ohio River Mile)	**Harmonic Mean Flow (feet^3/second)**	**Predicted PCB Concentration (ng/L)**	**Method for Estimation of Total PCB Concentration**
ORM 40.0	20,500	4.57	Linear regression for particulate + average dissolved
ORM 129.0	20,500	2.96	Linear regression for total PCBs
ORM 175.1	24,500	2.54	Linear regression for particulate + average dissolved
ORM 207.7	24,500	2.44	Highest observed concentration at < harmonic mean flow
ORM 264.0	26,000	2.27	Linear regression for particulate + average dissolved
ORM 281.5	34,500	1.49	Linear regression for particulate + average dissolved
ORM 302.9	34,500	1.31	Linear regression for particulate + average dissolved

Based on the observed correlations mentioned above, total PCB concentrations at harmonic mean flow were calculated for each site except ORM 129.0 and ORM 207.7 based on the average dissolved concentration plus the estimated value generated from a linear regression between stream flow and observed particulate phase concentrations (see Table 2-4). At ORM 129.0, both the particulate and dissolved phase concentrations indicated a direct relationship with stream flow, therefore the total concentration at this site was determined by a linear regression between flow and total PCB concentration.

No relationship between flow and PCB levels was found for sampling data collected at ORM 207.7. Using a simple mean value for the total PCB concentration was considered for this site, however, the mean concentration value, which would be applied at harmonic mean flow, was less than the concentration observed at lower stream flows. It was deemed that a more conservative approach should be applied to ensure that the water quality standard will be attained provided that the reductions called for in this TMDL are met. Ultimately, the concentration used for ORM 207.7 was established at the single highest total PCB concentration measured at flows less than the harmonic mean flow. This value of 2.44 ng/L is more conservative, and therefore more protective of human health, than the mean concentration of 1.84 ng/L.

Using the predicted in-stream concentrations at harmonic mean flow, PCB loads were calculated for each sampling location (see Table 2-5). The greatest daily PCB load for the seven sampling locations (229.1 grams/day) occurred at the upstream TMDL boundary at the Pennsylvania/West Virginia border (ORM 40.0). This loading exceeds the allowable load by more than two orders of magnitude. The PCB load generally decreases as you move downstream, with the most significant decrease in load (approximately 35% decrease) occurring between ORM 40.0 and ORM 129.0. The one exception is between ORM 129.0 and ORM 175.1, which saw a slight increase in load from 148.6 grams/day to 152.0 grams/day (2% increase). Overall, the load at the most downstream site (ORM 302.9) is less than half of the existing load at the upstream boundary (ORM 40.0). This significant natural load reduction is likely the result of settling of contaminated particulate matter.

It should be pointed out that the existing load estimated in this report for ORM 40 is significantly less than that presented in the Ohio River PCB TMDL completed by Pennsylvania for the upper 40 miles of the Ohio River (PA DEP, 2001). At the time the Pennsylvania TMDL was completed, no high volume sampling data was available for the Ohio River and water column concentrations were extrapolated using fish tissue sampling results. This extrapolation resulted in an estimated water column concentration of 45.77 ng/L. The predicted concentration based on actual water column analytical data presented in this report is 4.57 ng/L. This represents an order of magnitude difference in predicted existing load values. Using the river data collected by ORSANCO provides a more accurate estimate of the existing PCB load at mile point 40 of 229.08g/day rather than the 2292 g/day prediction derived from extrapolation of fish tissue results.

2.5 NECESSARY OHIO RIVER PCB LOAD REDUCTIONS

Comparing existing loads to allowable loadings, the load reductions necessary to meet the applicable water quality standard of 0.044 ng/L were established. Necessary load reductions for the Ohio River ranged between 96.6 – 99.0 percent, with the greatest reductions needed at the upstream TMDL boundary (ORM 40.0). Table 2-5 presents the loading information, along with the necessary reductions to meet standards.

Table 2-5. Ohio River load reductions necessary to meet water quality standards.

Sampling Location (river mile)	Existing Load (g/day)	Maximum Allowable Load (g/day)	Load Reduction (g/day)	% Reduction Necessary
ORM 40.0	229.080	2.207	226.873	99.0
ORM 129.0	148.636	2.207	146.429	98.5
ORM 175.1	152.013	2.637	149.376	98.3
ORM 207.7	146.017	2.637	143.380	98.2
ORM 264.0	144.206	2.799	141.407	98.1
ORM 281.5	125.972	3.714	122.258	97.1
ORM 302.9	110.500	3.714	106.786	96.6

2.6 MARGIN OF SAFETY

To account for any uncertainties associated with the TMDL analysis, a margin of safety (MOS) must be incorporated into TMDL calculations. The MOS can either be implicit (e.g., use of conservative assumptions in the TMDL analysis) or explicit (e.g., expressed as a percentage of the total allowable loading held in reserve as a safety factor). For the TMDL discussed in this report, the MOS is implicitly incorporated through conservative assumptions. The two areas where conservative assumptions are applied to provide a MOS are 1) mass is assumed to be completely conserved as it passes through the study area, and 2) the existing Ohio River and tributary loadings, and therefore necessary load reductions, are estimated using a conservative approach to ensure that the applicable water quality standard is met.

For the Ohio River, the existing loads established in Sections 2.4 and 2.5 were estimated based on the either a linear regression between concentration and stream flow or the highest observed concentrations observed at stream flows less than the harmonic mean flow. The higher of the two values generated by these methods was used to establish the current Ohio River loads. Unlike the main stem Ohio River data, the tributary results did not show a clear correlation with stream flow. As a result, the linear regression method used to estimate Ohio River concentrations at harmonic mean flow could not be applied to the tributaries. Instead, a combination of two methods was used to provide estimates of the concentrations at harmonic mean flow that were both reasonable and conservative with respects to protecting human health. For each tributary, the average total concentration was compared to the highest concentration observed at stream flows less than the harmonic mean flow. The higher of the two values was selected as the estimated concentration at harmonic mean flow for loading calculations. This conservative method was applied to ensure that the water quality standard would be attained provided that the reductions called for in this TMDL are achieved.

3.0 INDUSTRIAL AND MUNICIPAL SOURCE ASSESSMENT

3.1 METHODS FOR SOURCE IDENTIFICATION

Sampling was conducted by ORSANCO as part of the Ohio River Watershed Pollutant Reduction Program to quantify current levels of PCBs in ambient air, water, sediment, and fish tissue within the TMDL study area. In addition to establishing the current concentrations present in the environment, the analytical results were reviewed to identify "hot spots" of contamination, and potentially identify PCB sources. The investigation of sites where PCB hot spots were detected is listed in the following section.

ORSANCO conducted an extensive search to identify potential sources within the upper portion of the Ohio River for PCB loadings. Industrial and municipal sources were identified using several different databases, agencies, and contacts. The National Priorities List (NPL) search was done using the Right to Know (RTK) Network database to identify all CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act) facilities in each state within the Ohio River Basin. The list of sites then was reduced to only those facilities on the final NPL or proposed for the final NPL. The sites in the watershed were then investigated on EPA's CERCLIS (Comprehensive Environmental Response, Compensation and Liability Information System) database website to identify chemicals of concern (COCs). COCs were taken from the official Record of Decision (ROD) when available or from the EPA region's superfund site descriptions. Since a large amount of information was returned from the search, the final NPL list contained in Appendix B contains only information on NPL sites listed for PCBs in Ohio River counties relating to Ohio River miles zero to 317. Counties in the watershed were queried to generate a list of facilities reporting releases of PCBs and the quantities released. This search was conducted by using USEPA's Toxic Release Inventory (TRI) and the RTK database. The years 1988 through 1998 for each state were queried.

State agencies for Pennsylvania, West Virginia, and Ohio were also contacted. State agencies ran queries within the Permit Compliance System (PCS) to yield returns on facilities that have National Pollutant Discharge Elimination System (NPDES) permits that require monitoring for PCBs. State contacts provided such information to ORSANCO through telephone conversations and documents via email. NPDES searches were conducted using USEPA's Envirofacts Warehouse database and onsite at ORSANCO, using the filed NPDES permits for Ohio River dischargers. A complete listing of all of sites identified through these searches is provided in Appendix B.

During the source assessment, weaknesses were found within the databases used for identification of possible sources of PCB loading. Insufficient data within TRI, such as pathways of releases and quantities released, provided problems in assessing the potential impacts of releases to the Ohio River. ORSANCO made every effort to obtain the best and most complete source information available, however, there are gaps in the data regarding the sources due to the limitations and incompleteness of the databases searched.

Databases and Agencies utilized in Source Investigation

- Toxic Release Inventory (USEPA)
- Right To Know Network
- Permit Compliance System (USEPA and States of Pennsylvania, West Virginia, and Ohio)
- USEPA's Envirofacts Warehouse database
- ORSANCO NPDES permit files cataloged onsite
- Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS)
- Individual federal and state agency personnel

3.2 SITE DISCUSSIONS

The information regarding sites discussed below is based on the multimedia sampling results collected by ORSANCO, and facility information found within the source assessment discussed in Section 3.1. The facilities named below are either those that have confirmed, past PCB contamination problems, or those facilities in which high-volume water sampling results revealed the presence of PCBs in their effluents. Further investigation is warranted prior to any recommended action at any of these locations. Appendix B includes a listing of sources identified through searches of the TRI, NPL, and PCS databases. Also provided in Appendix C, is an inventory of potential PCB sources identified based on general industry type. This list includes industries simply associated with the use of PCBs, and therefore, many of these facilities may not be actual PCB sources.

3.2.1 Ohio River Mile Point 3.3

Elevated levels of PCBs were detected in a sediment sample taken at Ohio River mile point 3.3. One high-volume water sampling event was conducted on ALCOSAN's effluent, which is a 200 million gallon per day (MGD) sewage treatment plant located at mile 3.1, in order to quantify potential PCB loadings from the plant. A total concentration of 6.4 ng/L was measured for the single sampling event. Applying this concentration to the plants design discharge capacity of 200 MGD, the potential PCB load from this facility is 4.9 g/day. The allowable PCB load for this section of the Ohio River at harmonic mean flow is 1.6 g/day. Based on this information, further sampling of the river and sediments in this area may be warranted, in addition to further upstream sampling, sampling of the ALCOSAN system, and public and industrial water supplies tributary to the ALCOSAN system. It is possible that the detection of PCBs in ALCOSAN effluent is simply due to pass through of upstream river concentrations from water supply systems tributary to the ALCOSAN system since river concentrations in this area were found to be between 1 and 5 ng/L.

The former Allis Chalmers site is located in Pittsburgh, Allegheny County, PA, on the north bank of the Ohio River across from Brunot Island. During the 1970s, USEPA conducted an investigation and documented that a 30,000-gallon vault of PCBs was at this site. The PCB TMDL report completed by Pennsylvania Department of Environmental Protection (PA DEP) for the Pennsylvania stretch of the Ohio River reported that, based on information provided by USEPA, the vault of PCB contaminated oil at this site has been removed. The report also indicated that there is no evidence to suggest this site is currently a source of PCB contamination in the Ohio River basin. However, some of the PCBs contaminating Ohio River sediments could be the result of past releases from the former Allis Chalmers facility.

3.2.2 Ohio River Mile Point 36.3

Elevated levels of PCBs were detected in a sediment sample taken at Ohio River mile point 36.3. Such results suggest potential sources within the vicinity. A steel manufacturing facility, power generating facility, and a petroleum terminal, are all located in close proximity to the site where the sample was collected. Unfortunately, no information was found through database searches that points to potential sources of the PCB contamination.

3.2.3 Ohio River Mile Point 71.4

Elevated levels of PCBs (highest levels found by ORSANCO) were detected within sediment collected at Ohio River mile point 71.4. These results suggest potential localized sources. The sample was collected at the downstream edge of a large barge mooring area adjacent to a large steel making facility in Steubenville, Ohio. While the location of the sampling point suggests this facility as a possible source, other nearby potential sources are located upstream of the contaminated sediment. Another large steel manufacturing facility is located 1.4 miles upstream and a wastewater treatment plant is 0.9 miles upstream of the site.

3.2.4 Ohio River Mile Point 122.9

Elevated levels of PCBs were detected within the sediment sample taken at Ohio River mile point 122.9. Such results suggest potential nearby sources. Data obtained from the NPL search and the CERCLIS database regarding Ormet Primary Aluminum Corporation (NPDES permit number OH0010855) indicate that this facility may potentially be the source of elevated PCB levels in the sediment sample taken at this site. The sample was collected directly in front of what once was a backwater drainage ditch for Outfall 004 at the facility. During Superfund cleanup, this area's sediment was sampled and showed the highest contamination at the facility. The facility was placed on the NPL with confirmed Aroclor® 1248 contamination. Since cleanup, the drainage/backwater area from former Outfall 004 has been bermed and closed off from public access from the river with fencing. Upstream of Ohio River mile point 122.9, other potential sources include industrial chemical and metal coating facilities. However, no information was found through database searches that points to other potential sources of PCB contamination.

3.2.5 Monongahela River Mile Point 2.6

Elevated levels of PCBs were detected in a sediment sample taken at Monongahela River mile point 2.6. Such results suggest potential sources within the vicinity. A large steel making facility and a petroleum company are both located upstream of the sample location, however, no conclusive data exists to determine the source of the PCB contamination.

3.2.6 Kanawha River Mile Point 44.0

High-volume water sampling was conducted on the effluent of the Nitro Wastewater Treatment Plant (WWTP) located on the Kanawha River at mile 44.0. The Kanawha River enters the Ohio River near Point Pleasant, West Virginia at Ohio River mile 265.7. The results for the single sampling event indicated a total PCB concentration of 4.6 ng/L. Applying this concentration to the plants design capacity of 1.25 MGD, the plants potential PCB load to the Kanawha River is 0.022 g/day.

3.3 POTENTIAL SOURCES IDENTIFIED IN PA OHIO RIVER PCB TMDL

In addition to the sites referred to above, several other sites along the Ohio River were identified in the Ohio River PCB TMDL completed by Pennsylvania DEP in 2001. These include the Breslube-Penn site, the former H. K. Porter site, the Texas Eastern Holbrook Compressor Station, and the Ohio River Park. The former Allis Chalmers site was also referred to in the PA PCB TMDL, which was previously discussed in Section 3.2.1, Ohio River Mile 3.3 discussion.

The Breslube-Penn site is located in Coraopolis, Allegheny County, PA. The site is situated along Montour Run, a tributary that enters the Ohio River at mile 9.7. The facility historically operated as a solvent recovery and oil recycling facility, and currently is inactive. The PA PCB TMDL stated that elevated levels of PCBs had been found in soil and groundwater at a soil staging area and filter cake area, where soil and filter cake wastes from previous remedial activities had been stockpiled on site. The report indicates that sampling of this area, revealed an average PCB concentration of 52 mg/kg. The site may be an existing source of PCBs to the Ohio River through continuous contaminated soil erosion; however, there is insufficient data to quantify any contributions.

The former H. K. Porter site is located in Hopewell Township, Beaver County, PA on Shouse Run. Shouse Run is a tributary to the Ohio River, entering the Ohio at river mile 14.8. PCB concentrations in the soil are documented to be as high as 130 mg/kg; however, no PCBs were detected in Shouse Run. This site is being addressed under Pennsylvania’s Hazardous Sites Cleanup Act (HSCA) program. The former H. K. Porter Drum Dump Site is located on approximately 17.5 acres of property situated 0.25 miles west of the Ohio River and adjacent to State Route 51 in Hopewell Township. Shouse Run transects the property and is located at the end of the disposal area, which contained between 1,500 and 2,000 rusted 55-gallon drums containing various hazardous wastes. Analytical results from soils and wastes collected from October 1990 through January 1993 revealed the presence of lead and PCBs at elevated concentrations. In 1991, H. K. Porter excavated approximately 7,875 tons of non-hazardous wastes and 4,260 tons of hazardous wastes from the disposal area. In the late 1990s, Pennsylvania Department of Environmental Protection (PA DEP) conducted additional cleanup activities under HSCA, including the excavation and off-site disposal of about 50,000 cubic yards of hazardous waste. A soil cover was then installed and the entire site was revegetated. The site does not represent a current source of contaminated soil erosion to the Ohio River; however, past releases may have contributed to the sediment contamination in the Ohio River.

The Texas Eastern Holbrook Compressor Station (NPDES permit number PA0216593) is located in Richmond Hill, Greene County, PA. This site was an historic non-point source of PCBs in the Ohio River watershed. A statewide Consent Order and Agreement (CO&A) required Texas Eastern to remove PCB contaminated soil, and to collect and treat contaminated groundwater. The facility currently discharges treated groundwater to Dunkard Fork Creek, a tributary of Wheeling Creek, which enters the Ohio River at mile 90.8. The NPDES permit allows for an average monthly concentration of 1.87 ng/L. Based on the plants design discharge capacity of 0.0489 MGD, the allowable daily load for this facility is 0.0003 grams.

The Ohio River Park site is located approximately ten miles downstream of Pittsburgh, PA on the western end of Neville Island, within the Ohio River. This site is on the final NPL. Remedial actions have been completed under CERCLA and a sports complex has been developed on the site, therefore, covering any remaining contaminated soil that could serve as a potential non-point source of PCB to the Ohio River.

3.4 GENERAL DISCUSSION ON PUBLICLY OWNED TREATMENT WORKS

ORSANCO sampled effluents at the ALCOSAN Wastewater Treatment Plant (WWTP) (Ohio River mile 3.1) and the Nitro, West Virginia WWTP (Kanawha River mile 44.0). Initially, sampling was conducted at these sites to evaluate the possibility that POTWs in general discharge dioxin. These sites were not targeted based on any known contamination. ALCOSAN was selected simply because it is the largest POTW on the Ohio River. The Nitro plant was sampled because the facility receives wastes from several potential and confirmed dioxin sources. Since dioxins were found in samples taken at both ALCOSAN and Nitro WWTPs, ORSANCO elected to analyze the samples for PCBs as well.

PCBs were detected in the high-volume water samples collected at both facilities. Similar results were found in a sample collected at another major POTW (Morris Foreman WWTP) downstream of the TMDL study area. These results, which are provided in Table A-3 in Appendix A, suggest that POTWs in general may be sources of PCBs to the Ohio River. It should be noted, however, that there is no information suggesting that POTWs create new PCBs. Potential sources of PCBs to these facilities include industrial sources, runoff from contaminated sites and other land-based runoff and the numerous water supply systems tributary to them which withdraw their water from the river representing pass through of existing PCB loads and resulting in no net increase in PCB levels in the river above those upstream of the discharges.

Using the average concentration observed at the three facilities mentioned above, a gross estimate of the potential loading from all 69 municipal wastewater treatment plants that directly discharge to the Ohio River within the TMDL study area was calculated. This estimate was based on the facilities design flow capacity, and an average concentration of 6.14 ng/L. Based on this calculation, 7.2 grams/day may potentially be entering the river from WWTPs between Ohio River miles 0.0 to 317.1. This loading represents 6.5 percent of the current Ohio River load measured at Ohio River mile 302.9. This load is also represents 186 percent of the allowable load at the downstream end of the TMDL segment.

4.0 ENVIRONMENTAL SOURCES

4.1 SEDIMENT

Samples of Ohio River and tributary bottom sediments were collected from the confluence of the Allegheny and Monongahela Rivers to Kenova, WV (ORM 317) during low flow conditions in August and September of 2001. Bottom sediment was collected approximately every five miles on the main stem (non-targeted sites), at 26 targeted sites, and from each major tributary of the study area. Targeted sites were selected based on past contamination problems and industry types that are potential sources of PCBs and dioxin. Ninety-two bottom sediment samples were collected in all, nine of those duplicates, at a total of 83 sites.

The purpose of the sediment survey was to characterize Ohio River bottom sediments from Pittsburgh through the TMDL study area. The survey was also intended to address water-column PCB loads resulting in part from resuspension of contaminated sediments. A secondary goal was to identify previously unknown “hot spots” or areas with significant PCB contamination.

4.1.1 Method

Ohio River and tributary sediments were collected using the ORSANCO Standard Operating Procedure for Collection of Bottom Sediments. Samples were collected from a boat using a Petite Ponar® clamshell-style sample dredge. Sediment samples were sieved in the field to remove particles larger than 2mm.

Twenty-six targeted sample sites were selected based on their proximity to sites listed on the final NPL, TRI, or state agency records of contaminated sites. These samples were taken below outfalls of industrial sites or at the mouths of creeks draining the properties of interest.

4.1.2 Sediment Data and Results

Eighty-three bottom sediment samples were collected in ten tributaries and 73 locations on the main stem of the Ohio River. In addition to PCBs, the samples were analyzed for dioxins and furans, chlordane, total organic carbon (TOC), and particle size composition. Results for total PCBs, TOC, and particle size are presented in a tabular format in Appendix D.

4.1.2.1 PCB Analysis

Total PCB data for the Ohio River sediment collected indicates widespread, low-level PCB contamination in the environment, as well as several areas of higher concentration zones of PCB contamination. Two locations not previously identified by the database investigation of sources were found to have significant PCB contamination in sediments, and Ohio River sediment contamination from several sites with documented PCB contamination was confirmed.

Laboratory analysis for all 209 polychlorinated biphenyl congeners was done using USEPA method 1668A for High Resolution Gas Chromatography/High Resolution Mass

Spectrometry (USEPA, 1999). Detection limits for this set of sediment samples ranged from $1x10^{-6}$ to $1x10^{-5}$ parts per million (ppm). For simplicity, all total PCB values reported in this text are in ppm.

4.1.2.1.1 Sediment Quality Criteria

Although specific sediment quality criteria for total PCBs have not been established for the Ohio River, *The Incidence and Severity of Sediment Contamination In Surface Waters of the United States* (EPA 823-R-97-006), also known as The National Sediment Inventory (NSI), includes multiple PCB screening levels for the protection of consumers. These values are based on the theoretical bioaccumulation potential (TBP) and cancer risk levels from the primary route of human exposure to contaminated sediment, consumption of fish. Screening levels are guidelines for analysis of sediment quality data; they have no applicability as regulatory criteria.

The NSI calculated a 0.0025 ppm total PCBs contaminated sediment screening level at a cancer risk of 10^{-5}. That criterion, for application nationally, was calculated using average sediment organic carbon (1%) and fish tissue lipid content (3%). This standard is exceeded by 85.6% of the sediment samples reviewed for the NSI, and it was exceeded by 99% of the sediment samples taken in the Ohio River TMDL study area.

A more appropriate screening level for this report is based on the Great Lakes Protocol Model Advisory Grouping level of one meal per week raw fish fillet with 0.06 – 0.2 ppm total PCBs. Both West Virginia and Ohio use this protocol for the issuance of fish consumption advisories. Using the TBP method, a site-specific screening level for total PCB concentrations in sediments was calculated using the following equation:

$$C_s = (TBP/(BSAF \text{ x } F_l) \text{ x } F_{oc}$$

Where:
C_s = Sediment Concentration Screening Level
TBP = Theoretical Bioaccumulation Potential (fish tissue concentration)
BSAF = Biota-Sediment Accumulation Factors
F_l = Fraction of lipids in fish tissue
F_{oc} = Fraction of organic carbon in sediment

A TBP value of 0.06 ppm was used which corresponds to the lowest fish tissue concentration in which a one meal per week consumption advisory would be issued. A default value of 1.85 was used for the BSAF as defined by the NSI. Based on ORSANCO data for the Ohio River, an average percent lipids value of 3.9% was applied, as well as a sediment organic carbon value of 3.7%. This calculation yields a site-specific screening level for total PCB concentrations in Ohio River sediments of 0.031 ppm. This screening level is exceeded by 89% of the sediment samples collected in the TMDL study area.

4.1.2.1.2 PCB Results

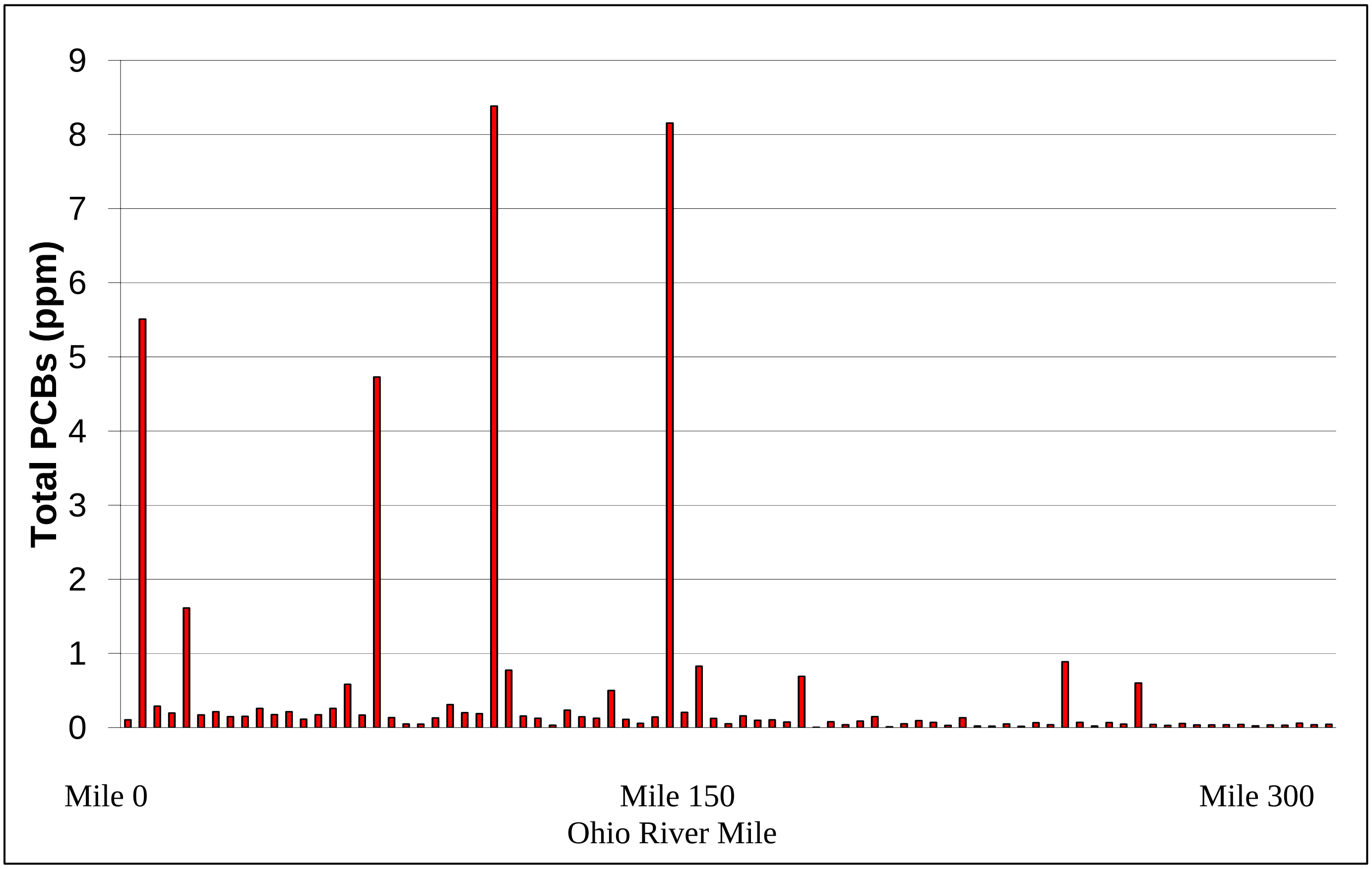
PCBs were detected in 100% of the sediment samples taken in the study area. Total PCB results for the 83 samples ranged from less than 0.01 ppm to more than 8 ppm. Four samples clearly indicated localized "hotspot" contamination. The two highest, samples with 8.4 and 8.2 ppm total PCB concentrations, were found on the main stem of the Ohio

River at targeted sites. The third highest result was found at the mouth of the Monongahela River at 5.5 ppm total PCBs in a non-targeted location. Sediment with 4.7 parts per million total PCBs was collected at Ohio River mile 36.3 in an industrialized section of the river without previous documentation of PCB contaminated sediments. Results for all samples excluding duplicates are presented in Figure 4-1.

The average PCB concentration among all samples is 0.5 ppm, an indicator of the significance of the “hotspots” identified above. The average PCB concentration of all targeted sites is 0.75 ppm while that of non-targeted sites is 0.3 ppm. These findings indicate both the ubiquitous nature of the pollutant in Ohio River sediments as well as the local impacts of industrialized areas on Ohio River sediment quality.

Ten samples had concentrations below the 0.031 ppm screening level calculated for the TMDL study area by the TBP method above. The lowest concentration of PCBs in Ohio River sediments was 0.016 ppm at mile 222.2 between Jackson County, West Virginia and Meigs County, Ohio. Duck Creek, the smallest tributary investigated, had the overall lowest concentration of PCBs discovered in the survey at 0.002 ppm. The Duck Creek sediment sample was collected to discover if DDT (1,1,1 trichloro-2,2-bis(p-chlorophenyl)ethane) contamination recently identified by Ohio Environmental Protection Agency (OEPA) included a PCB component. Values for all sediment samples collected are provided in Appendix D.

Figure 4.1 Sediment Survey Total PCB Results (ppm)



4.1.2.1.3 Duplicate Data

Comparative data for the duplicate samples shows reproducible results for PCBs in all but one case. A targeted sample collected on the Ohio River at mile 106.1 has a greater than 100% Relative Percent Difference (RPD) between the original sample and the duplicate. The sample in question, one of two duplicate sample locations with a greater than 0.5 ppm concentration, shows a significant loss of di- and tri-chlorinated biphenyls. The existence of the other 0.5 ppm duplicate sample and each of the seven other samples without loss of the low-chlorinated congeners indicates the loss may not have occurred due to the field sampling method but in a post-processing or laboratory analysis anomaly. A full comparison of duplicate sample data is presented in Appendix E.

4.1.2.2 TOC Analysis

All sediment samples were analyzed by USEPA method 415.1 for TOC. Results are given in percent organic carbon on a dry weight basis. The organic carbon content of sediment directly affects the bioavailability of polychlorinated biphenyls and other nonionic chemicals to organisms living in or in contact with the sediment. The TBP accounts for organic carbon by dividing the concentration of pollutant in the sediment by its percent organic carbon. Less organic carbon in whole sediment concentrates the pollutant in the most bioavailable location (sorbed to organic carbon particulates) and results in a greater potential for bioaccumulation of the pollutant.

Total organic carbon results for the 83 sediment samples collected in the study ranged from 0.6% to more than 8% TOC on a dry weight basis. The average of all samples collected was 3.7% TOC. Sediments with high percentage of organic carbon are likely to be oily, showing a sheen, or by their odor reveal the presence of decomposing organic matter.

The highest PCB concentrations were found in locations that also had high oil or organic matter content with the exception of the sample collected at ORM 36.3. Due to its low TOC content the theoretical bioaccumulation potential of the sediment collected at Ohio River mile 36.3 was nearly twice that of the sample with the highest PCB concentration collected in oily sediment at mile 71.4. Percentage of total organic carbon is central to the bioavailability of PCBs in sediment and through consumption of fish the human health risk from contaminated sediment.

4.1.2.3 Particle Size Analysis

Every sample collected was characterized by its percent by weight of sand (<2mm), silt (<53um), and clay (<2um). This testing was performed to increase understanding of the composition of Ohio River bottom sediments as well as better understand the location of PCBs in relation to sediment size. Sand content of the 83 samples ranged from a low of 2.8% to more than 80%. The silt fraction varied from 8 to 62% and clay from 4 to 42%. Average sand, silt, and clay content in Ohio River sediment samples was 48%/35%/16%, respectively.

No correlation was found between PCB concentration and the sand, silt or clay content of the samples.

4.1.3 Sediment Conclusion

All sediment samples collected on the Ohio River and tributaries in the TMDL study area had detectable levels of PCBs. Four samples are standout “hotspots” and require further study to determine the extent of contamination and necessity for follow-up action. No sample collected would trigger action under the Toxic Substances Control Act (40 CFR Part 761.20), a regulatory protection level of 50 ppm PCBs that requires remediation. The National Sediment Inventory reports that PCBs were detected in 3,842 (41%) of 9,401 stations where sediment was analyzed for PCB content (USEPA, 1997). PCBs were detected in 100% of the sediment samples collected in the TMDL study area.

4.1.4 Sediment as a Source: Resuspension Calculations

Sediment samples were collected to investigate in addition to “hotspots,” the potential of sediment resuspension to contribute to the water column PCB load. Due to the uncertainty of resuspension calculations, the sediment data has not been used for specific allocations in the TMDL calculation though it is considered a contributor to water column concentrations of PCBs. This TMDL study lacks all the information necessary to calculate load allocations for sediment. However, using conservative hypothetical numbers for the resuspension rate and areal extent of contaminated sites, a scenario of sediment contribution to water column PCB load has been explored for the four sediment samples with the highest total PCB concentration. The following calculations represent possible loadings from resuspension and do not attempt to quantify actual loadings for differing flow and settling conditions.

The sediment resuspension rate used in this analysis represents the highest value applied in the Columbia River Dioxin TMDL (LTI, 1992). Using this high-end resuspension rate of 3×10^{-4} meters/day provides a conservative, upper-limit estimate of the potential resuspension load. The Columbia River TMDL resuspension rate has been applied without refinement because this resuspension analysis is an exploratory exercise and did not warrant the study required to calibrate the value to the Ohio River.

Sediment concentrations have been converted to grams per cubic meter using the average dry soil bulk density of 1.5 g/cm^3 (USEPA, 1996). With a resuspension rate in meters per day, the PCB concentration in grams per cubic meter, and an area in square meters one can use the equation below to arrive at a PCB load due to resuspension of contaminated sediment in grams of PCBs per day.

$$\text{Resuspension Load (g/day)} = R \times C_s \times A_s$$

Where:
R = Resuspension rate in meters per day (m/d)
C_s = PCB Concentration in sediment in grams per cubic meter (g/m^3)
A_s = Area of sediment in square meters (m^2)

Most sediment samples collected in the survey show low concentrations of PCBs and represent only limited areas with no significant source potential for PCBs in the water column. When taken together, however, the nearly constant presence of sediments with 0.3 ppm total PCBs over 300 miles of the Ohio River bottom has the potential to contribute a significant load to the water column. Though no attempt to quantify the load from resuspension of low-level contaminated sediment has been made, it is apparent that the area involved would generate a substantial result to the resuspension equation above.

In contrast, the sites of most intense contamination can be shown to provide a significant load as discrete sources based on resuspension calculations. Calculated resuspension loads are compared in grams per day to the allowable load at harmonic mean flow using the West Virginia Water Quality Standard of 0.044 ng/L total PCBs.

4.1.4.1 Ohio River Mile 71.4

A sample from Ohio River Mile 71.4 represents the highest level of PCBs in sediment found in the 317-mile study area. The concentration of PCBs in the sediment at that location is 8.38 ppm. This sample was collected in a mooring area that extends nearly one mile along the Ohio shoreline. Qualitative description of the sediment is marked by a strong oil odor and black coloration topped by green and brown layers. The sampling crew reported a large area with similar bottom characteristics. From this information a conservative estimate of the areal extent of the contaminated sediment is 16,000ft^2 (800 ft x 20 ft). Using this area, the equation above results in a calculated resuspended sediment PCB load of 5.6 grams per day. At the established harmonic mean flow of 20,500 cubic feet per second for this segment of the Ohio River (31.7-161.7), the maximum load allowed by West Virginia water quality standard is 2.21 grams per day. The calculated resuspension load of 5.6 g/day is 253% of the maximum allowable load and 2.4% of the existing in-stream load of 229.1grams/day measured at ORM 40.0.

4.1.4.2 Ohio River Mile 122.9

A sample taken adjacent to the former Ormet site in Monroe County, Ohio had the second highest concentration of PCBs in sediment found on the survey at 8.16 ppm. The site has been listed on the final National Priorities List and has received superfund money for the cleanup of PCB Aroclor 1248, among other organic contaminants. Qualitative information for this sample describes black-brown sediment with significant leaf content. Areal extent of the sediment used for the resuspension calculation was 7,500 ft^2. The calculated resuspension load from this sediment is 2.6 grams total PCBs per day. This load can also be compared to the 2.21 grams per day allowable load for this segment at harmonic mean flow. The 4.5 grams per day is 118% of the allowable load and 1.7% of the existing in-stream load of 148.6 g/day measured at ORM 129.0.

4.1.4.3 Monongahela River Mile 2.6

An oily sample was collected in the Monongahela River 2.6 miles above its confluence with the Allegheny River. This sample contained 5.5 ppm total PCBs. The sediment was collected directly downstream of a concrete ice breaking structure, 45 feet from the left descending bank. The qualitative description of this sample indicates a black layer and rainbow sheen. From the field sampling notes, the areal extent of this sediment deposit is estimated to be 1,000 square feet. The resuspension calculation shows a 0.23-gram daily PCB load from this data. This calculated resuspension load represents 0.7% of the measured in-stream load of 33.5 g/day at river mile 2.3.

4.1.4.4 Ohio River Mile 36.3

The sediment sample collected at ORM 36.3 near Midland, PA was taken at the downstream end of the abandoned U.S. Army Corps of Engineers Lock Number 7. A sheen was noted in the sediment at this location. The estimated areal extent of the sediment deposit is 1,000 square feet. Analysis of this sample revealed a PCB concentration of 4.7 ppm total PCBs. The resuspension calculation estimates a 0.20-gram per day load from this data. This calculated resuspension load represents less than 0.1% of the existing in-stream load of 229.1g/day measured at ORM 40.0.

4.1.4.5 Sediment Resuspension Conclusion

A reasonable assumption is that Ohio River sediments are both a sink and a source for PCBs in the water column depending on flow conditions. During periods of high flow the resuspension of PCB contaminated sediments, likely provides a significant source of water column PCB contamination. The resuspension calculations made here are simply indicators of the potential for contaminated sediments, like those in some of the areas sampled, to contribute a PCB load to the water column. Load allocations have not been made with this data because further study would be necessary to better define the areal extent of contaminated sediment and a calibrated resuspension rate for the Ohio River.

4.2 PCBs IN AMBIENT AIR & ATMOSPHERIC DEPOSITION

ORSANCO conducted ambient air sampling events along the upper Ohio River as part of the Ohio River Watershed Pollutant Reduction Program in 2001 and 2002. Air monitoring was conducted in order to quantify ambient air concentrations of PCBs, identify possible hot spots of air contamination, and estimate the potential loadings to the Ohio River from atmospheric deposition. Sampling was conducted at six locations for PCBs. Four rounds of air monitoring were conducted at each site from July 2001 through April 2002 (approximately every three months).

4.2.1 Method

Ambient air samples were collected following USEPA Method TO-9A. The sample collection method involved filtering 325 – 400 cubic meters of air through a quartz filter and polyurethane foam plug (PUF) assembly over a 24-hour period. Two TE-1000 PUF samplers (the equivalent of a PS-1 sampler) were used to collect the samples. Air monitoring was limited to four rounds of sampling at six sites due to budgetary constraints. Site selection was based on several factors including 1) presence of nearby facilities reporting air releases of PCBs in TRI database, 2) targeting of urban and industrialized areas with likely PCB sources, and 3) selecting sites that provided adequate spatial coverage for the large area to be assessed. Other requirements for specific site selection included the presence of a large flat area to place the samplers with no nearby obstructions to air flow (e.g., tall buildings), access to power to run the equipment, secure location to avoid tampering with the equipment, and 24-hour access was needed by the samplers for periodic checks on the operation of the equipment.

The six locations chosen consisted of the following:

1. Pittsburgh, PA - near ORM 8
    - Pittsburgh is a major metropolitan area that is highly industrialized. Allegheny County's Department of Air Quality, identified several possible air monitoring stations that they currently operate, which ORSANCO could use. The Stowe Township site, situated above Neville Island on the upper ridge of the left descending bank of the Ohio River, was selected for PCB monitoring. This site is secure and is very close to a heavily industrialized area.

2. Weirton, WV – near ORM 66
    - Weirton is a highly industrialized area. Several steel manufacturing facilities and chemical companies reside in the area. Weirton Water Works was identified as a suitable place to sample. The site was secure, and the area in which the sampler was placed was on a large, flat, grassy plain, approximately 200-300 yards from the left descending bank of the Ohio River.

3. Moundsville, WV – near ORM 102
    - The Moundsville area was selected to due to its proximity to several large power plants. Power plants in general have been identified as potential sources of PCBs. The Moundsville Wastewater Treatment Plant was chosen as the specific sampling location because it is situated downwind of a power plant, the site was secure, and it offered 24-hour access as needed for the sampling. The PUF sampler was placed atop the roof of the staff commissary.

4. Marietta, OH – near ORM 172
    - Marietta was identified as a location for air sampling due to the significant amount of industry in the local area. This site was already established as an air monitoring site for ORSANCO's dioxin monitoring conducted in 2000. The sampler was placed atop the roof of the Chemical/Biology building at Marietta College. This location was approximately 50-60 feet above the ground.

5. Letart, WV – near ORM 238
    - Racine Lock and Dam was chosen as a sampling location in the area of Letart, WV. This area was chosen due to its close proximity to several power plants and large industrial facilities along the Ohio River. The sampler was placed atop the maintenance building, on the left descending bank of the river.

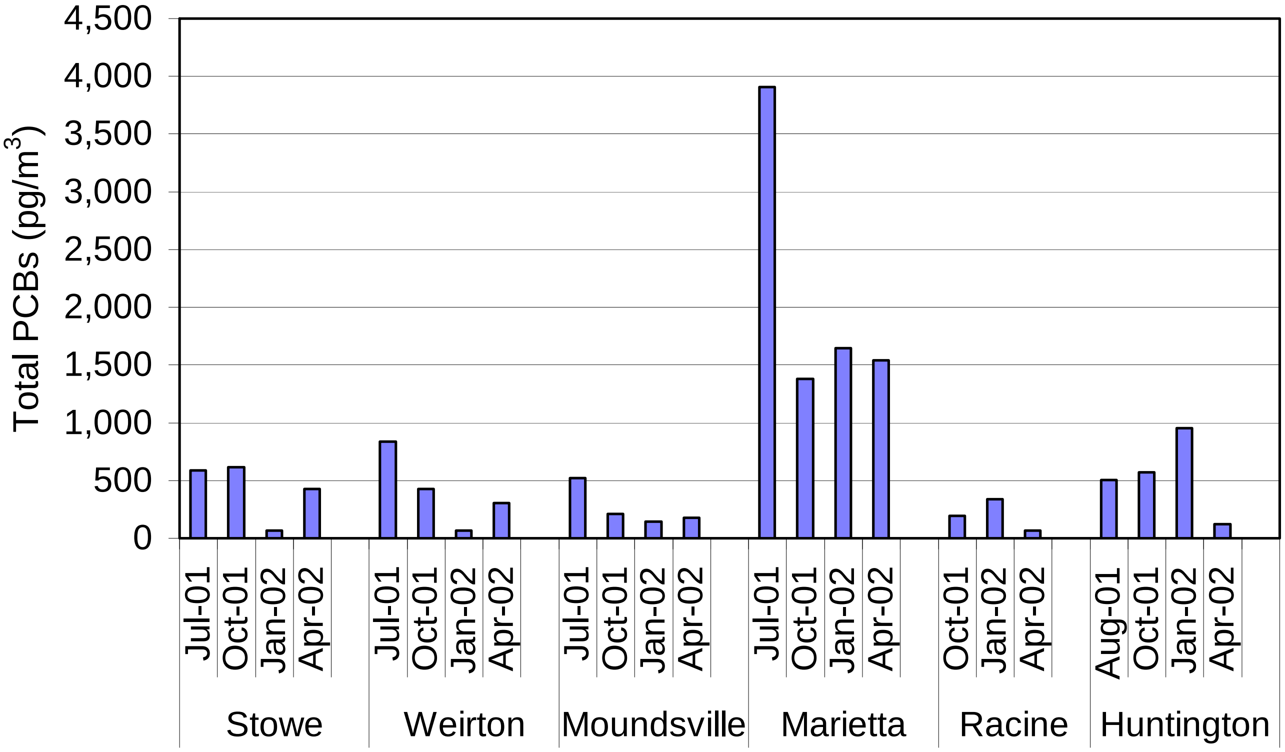
6. Huntington, WV – near ORM 307
    - The Huntington area was targeted because it is a large urban area with several large industrial facilities nearby along the Ohio River. The location chosen was at the West Virginia-American Water Plant on 24th Street. The sampler was placed atop the roof of the water intake structure.

4.2.2 Ambient Air Results

Four rounds of air sampling were conducted at the six locations identified above. One sample collected at the Racine Lock and Dam in July 2001, however, was not analyzed due to an equipment malfunction, thus leaving only 23 sample results. PCBs were detected in all samples. Total PCB concentrations in ambient air samples ranged from 68 pg/m^3 at Stowe Township, PA to more than 3,700 pg/m^3 at Marietta, OH. The results are illustrated in Figure 4-1, with the raw data provided in Appendix F.

In each round, Marietta was found to have the highest concentration of PCBs in ambient air. Marietta samples frequently were twice the concentration of the other locations. Racine, OH had the lowest average concentration, however, this average is based on only three samples instead of four due to above mentioned equipment malfunction that negated the July 2001 sample at this location. Seasonal variations were evident at some locations. For instance, levels found in the July samples collected at the Weirton, WV, Moundsville, WV, and Marietta, OH sites far exceeded the concentrations observed at these sites during other rounds of sampling. These seasonal fluctuations may be attributed to specific source types. Additional investigations are needed to identify specific sources and to quantify atmospheric sources loadings.

Figure 4-1. Ambient air sampling total PCB results (pg/m^3).



4.2.3 Estimation of Atmospheric Deposition of PCBs

Contaminants in the air enter the Ohio River by way of atmospheric deposition. There are three mechanisms by which ambient air concentrations of contaminants enter the river: wet deposition, dry deposition and net gas exchange. Wet deposition occurs when rain collects particulate contaminants from the air and transports them to the river through precipitation. Dry deposition is simple settling of particulates into the river. Net gas exchange is a balance of absorption (PCB source) into the river and volatilization from the river (PCB sink).

Gas exchange only occurs at the interface of the water surface and the atmosphere, and is dependent on several factors such as surface area, wind speed and temperature. Wet and dry deposition occurs directly to the water surface as well as to the land in the watershed. Some of the material deposited to the land would reach the water by overland runoff.

In the Great Lakes, atmospheric deposition directly to surface water is the dominant loading factor for the presence of PCBs in the water (Bandemehr, 1998). Because atmospheric deposition has been demonstrated to be a significant source for other aquatic systems, it is important to consider the potential atmospheric loading to the Ohio River. It is expected that the atmosphere will play a smaller part for the Ohio River than for the Great Lakes due to the significantly smaller surface area and the direct contribution of terrestrial sources of PCBs to the river. The science of estimating loading from the atmosphere is still fairly new, with more robust methods under development. The following estimates should be used to gain a gross understanding of the potential.

Based on a review of previous studies on net gas exchange, it was decided not to include this portion of the loading in the calculations. The Integrated Atmospheric Deposition Network (IADN) has completed a large body of work on net gas exchange for the Great Lakes. The data for 1990 to 1996 show annual net losses of PCBs for each of the lakes due to volatilization (Galarneau et al., 2000). While there are certain to be differences between the Great Lakes system and the Ohio River, it is assumed that the differences would be in the direction of a greater rate of volatilization. This assumption is based on several factors. First, volatilization is dependent on temperature. Because the Ohio River Basin has a higher annual mean temperature than the Great Lakes, volatilization would be higher. Second, mixing of the water column in the Ohio River due to its current would not allow the stratification that occurs in the Great Lakes. The lack of stratification in the river would allow a greater proportion of the PCBs to be exposed to the air/water interface where volatilization occurs. Third, turbulence due to dams also aerates the water column causing further volatilization. Therefore ORSANCO has decided that the vapor phase would not likely represent a load into the river, but would rather be a net loss that will be ignored and unquantified in this TMDL assessment.

The Ohio River PCB TMDL completed by PA DEP for the upper 40 miles of the river addresses atmospheric deposition by simply stating that based on studies in the Great Lakes, it was assumed that the load entering the Ohio River from atmospheric deposition was less than the loss due to volatilization. Atmospheric deposition was therefore eliminated in their study as a net source of PCBs to the Ohio River. ORSANCO, however, has attempted to estimate the load from deposition using ambient air monitoring data collected within the TMDL study area. It is recognized that there may be losses through volatilization; however, further study would be necessary to quantify these losses. ORSANCO's conservative approach, which assumes mass is completely conserved once in the river, provides for an additional margin of safety. ORSANCO considers this approach appropriate considering the potentially significant uncertainty associated with quantifying loadings from atmospheric deposition.

Due to budgetary constraints, PCB concentrations in rain have not been evaluated. However, a review of pertinent literature indicates that wet and dry deposition are typically within the same order of magnitude (see Table 4-1). Wet deposition has been found to occur mainly by washout of particles (Falconer, et. al. 1995). Because this calculation of atmospheric deposition is very rough, a 1:1 ratio of dry to wet deposition is used for this study.

Table 4-1. Comparison of PCB deposition rates for the Great Lakes.

Location	**Dry Deposition ($ng\ m^2\ d^{-1}$)**	**Wet Deposition ($ng\ m^2\ d^{-1}$)**
L. Superior	1.54	2.97
L. Michigan	1.26	4.13
L. Huron	-	7.13
L. Erie	2.10	3.23
L. Ontario	0.80	8.63

Bandemehr, et al., 1998

Air samples were collected using a quartz fiber filter/PUF combination. The filter acts to remove the particulates, while the PUF collects the contaminants in the vapor phase. Because particulates have been found to break through the filter in samples collected using this method, the results would be skewed towards greater vapor phase concentrations. To remedy this problem, the filter and PUF were combined and analyzed as one sample to provide a total (particulate + vapor) ambient air concentration of PCBs.

A comparison of ambient air concentrations of PCBs found in other studies was performed as a broad check on ORSANCO's sample results (Table 4-2). The concentrations labeled from the Great Lakes were from stations located in rural areas. The Chicago samples were collected near known PCB storage areas. This review showed ORSANCOs sample results correlated well with ranges found in rural and urban areas.

Dry deposition of PCBs, however, is only dependent on the contaminants in the particulate phase. Therefore, the amount of PCBs in the particulate phase was estimated by applying theoretical phase distribution values to the total ambient air concentration. Estimating the fraction of contaminant adsorbed to particles was done using the Junge-Pankow model as described by R. L. Falconer (Falconer et al., 1994). Particulate fraction was completed for 180 PCB congeners for which there were published values for vapor pressure. Deposition rates were calculated for these 180 PCBs with known vapor pressures, and then estimates for the remaining 29 congeners were made by calculating an average for each homologue group.

Table 4-2. Comparison of total PCB concentrations in ambient air.

Location	**Total PCBs (pg/m^3)**	**Mean of Range (pg/m^3)**
ORSANCO	68.38 – 3,907.00	779.8
L. Superior[a]	95.6 – 210.01	146.08
L. Michigan[a]	147.79 – 189.04	167.24
L. Huron[a]	45.33 – 56.93	51.13
L. Erie[a]	271.35 – 368.80	334.94
L. Ontario[a]	83.74 – 174.70	134.76
Chicago[b]	1,210.0 – 11,890.0	3,714.7

[a] Bandemehr, et.al., 1998

[b] Hsu, Y. K., 2000

Dry deposition is represented by the equation: $L_d=C_a\varphi_a v_a A$, where: C_a (kg/m^3) is the total atmospheric concentration of the contaminant; φ_a is the fraction of the contaminant in the particle phase; v_a (cm/s) is the deposition velocity of the particles and; and A (m^2) is the area of the river.

No direct measurement of particle deposition velocity has been made by ORSANCO. A review of methods to determine deposition velocity was performed by the International Atmospheric Deposition Network (IADN) (Hoff, et al., 1996). Using several published methods, it was found that deposition velocities ranged across two orders of magnitude (0.01 cm/s – 5.0 cm/s). This review concluded that a velocity of 0.2 cm/s was reasonable based on particle sizes found in sampling. In order to maintain consistency to other studies, this value was used for ORSANCO's assessment. It should be recognized that this range represents a potential for considerable imprecision in the final loading estimates.

The Ohio River surface area was calculated using the length and average width of each pool as provided in the Ohio River Fact Book (ORSANCO, 1994). Contaminant concentration was applied to the area by splitting the distance between each sample point and applying the concentration data over the ranges identified in Table 4-3. No attempt has been made to include the area of tributaries in the loading estimates.

The calculated deposition rates are shown in Table 4-4. These rates compared well with other published results presented in Table 4-1 above.

Table 4-3. Sample location and range each sample was applied to.

Location	Ohio River Mile	Range Data Applied To (River Miles)
Stowe Township	8	0-37.1
Weirton Water	66.2	37.1 - 84.3
Moundsville WWTP	102.4	84.3-137.1
Marietta College	171.8	137.1-204.65
Racine Lock & Dam	237.5	204.65-275.35
Huntington Water	306.9	275.35-302.9

Table 4-4. Estimated dry deposition rates at six Ohio River locations.

	Deposition Rates	
Location	**Range (ng m^2 d^{-1})**	**Mean (ng m^2 d^{-1})**
Stowe Township	0.403 – 1.763	1.098
Weirton Water	0.458 – 1.150	0.867
Moundsville WWTP	0.424 – 0.882	0.654
Marietta College	4.568 – 16.183	10.835
Racine Lock & Dam	0.478 – 1.126	0.899
Huntington Water	0.567 – 3.404	1.597

Using these dry deposition rates and assuming a 1:1 ratio of dry to wet deposition, the total PCB loadings that directly deposit to the river's surface were calculated for seven locations along the TMDL segment (see Table 4-5). The loadings are cumulative with the values reported at each Ohio River point representing the total load entering the river upstream of that point. These locations correspond to the high-volume water sampling sites where current in-stream PCB loads have been quantified.

Table 4-5. Cumulative atmospheric PCB loads directly deposited to the Ohio River.

Location	Wet & Dry Total Load (g/day)	% Allowable Load	% Actual Load
ORM 40.0	0.059	2.94	0.026
ORM 129.0	0.115	5.24	0.078
ORM 175.1	0.677	26.03	0.445
ORM207.7	1.097	42.17	0.751
ORM 264.0	1.157	41.32	0.802
ORM 281.5	1.180	31.88	0.936
ORM 302.9	1.217	32.89	1.101

Another potential route of atmospheric loading to the Ohio River is through deposition onto the watershed and then transport by runoff to the river and tributaries. One study provided a gross estimate of 10% of the material that is wet and dry deposited in the watershed would be transported through fluvial action to Lake Superior (Hoff et al., 1996). These estimates can be readily made, but may be grossly inaccurate due to limited air sampling data, which would have to be extrapolated for the entire watershed. However, water sampling from tributaries will give significantly more accurate measurements than watershed estimates for this potential source. Since ORSANCO is already performing water sampling of the major tributaries, no attempt has been made to determine atmospheric loading to the entire watershed, but rather has been limited to only direct deposition to the river's surface area. Additional monitoring within each tributary sub-basin would be necessary to quantify atmospheric loadings to the watershed.

4.3 TRIBUTARY LOADS

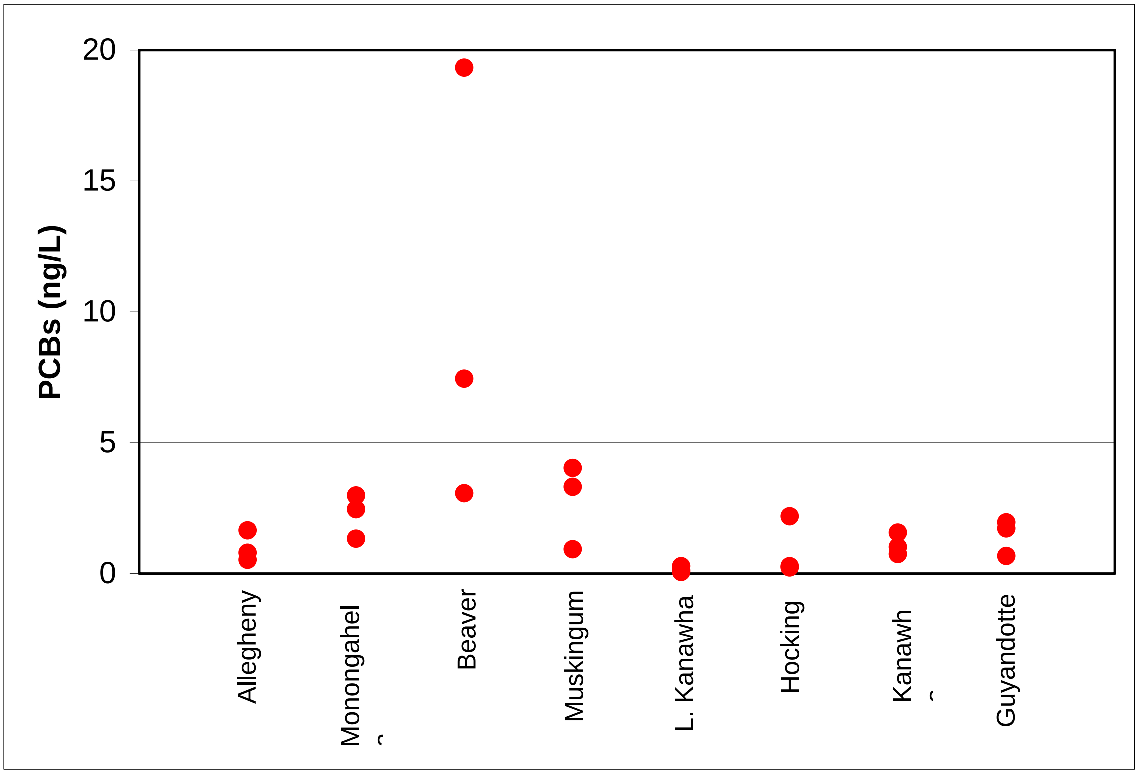
While this TMDL is limited to the main stem of Ohio River from mile points 40.0 – 317.1, there are several major tributary sub-basins (i.e., greater than 1,000 square miles) within the TMDL study area that contribute to the PCB loadings found in the Ohio River. For the purposes of this TMDL, the eight major tributaries within the study area have been treated as PCB sources to the Ohio River. The tributaries considered in this report include the Monongahela, Allegheny, Beaver, Muskingum, Little Kanawha, Hocking, Kanawha, and Guyandotte Rivers. It is realized that the PCBs present in these streams likely originate from a variety of sources potentially including both point and non-point sources. Further investigations would be necessary to determine the specific sources contributing to the PCB contamination found in the tributaries.

A minimum of three rounds of high-volume water sampling was conducted on each of the eight major tributaries in order to quantify existing concentrations of PCBs. An effort was made to collect samples at different hydrologic conditions to evaluate the range of concentrations present. Figure 4-1 graphically illustrates the tributary high-volume sampling results for total PCBs (sum of dissolved and particulate phases combined). In some cases only the dissolved or particulate portions of the samples were available for analysis. The data for these samples are not included in the graph; however, these results are provided in the complete high-volume water sampling data summary in Appendix A.

All tributary samples exceeded West Virginia's water quality standard of 0.044 ng/L. The lowest total PCB concentration observed was 0.06 ng/L on the Little Kanawha River, while the highest concentration measured was on the Beaver River at 19.33 ng/L.
In order to calculate the PCB loads entering the Ohio River from the tributaries, concentrations at harmonic mean flow had to be estimated for each stream based on the observed results. However, unlike the main stem Ohio River data, the tributary results for PCB concentrations did not show a clear correlation with stream flow. As a result, the linear regression method used to estimate Ohio River concentrations at harmonic mean flow could not be applied to the tributaries. Instead, a combination of two methods was used to provide estimates of the concentrations at harmonic mean flow that were both reasonable and conservative with respects to protecting human health. For each tributary, the average total concentration was compared to the highest concentration observed at stream flows less than the harmonic mean flow. The higher of the two values was selected as the estimated concentration at harmonic mean flow for loading calculations. This conservative method was applied to ensure that the water quality

standard would be attained provided that the reductions called for in this TMDL are achieved.

Figure 4-1. Observed PCB concentrations for major Ohio River tributaries.



Following the above mentioned method resulted in using three average concentrations (Beaver, Hocking, and Kanawha Rivers), and five single sample results (Allegheny, Monongahela, Muskingum, Little Kanawha, and Guyandotte Rivers) to establish the total PCB concentration to be used for each tributary loading calculation. These results are included in Table 4-6, along with the estimated tributary loads at harmonic mean flow. Also included in this table are the percentages of the allowable Ohio River loads that these tributaries contribute, as well as the percentages of the actual Ohio River loads that the tributary loads represent.

These results indicate that the five largest tributaries to the upper Ohio River (Allegheny, Monongahela, Beaver, Muskingum, and Kanawha) each contribute PCB loads that far exceed the allowable loadings for the Ohio River. Allowable loadings for the Ohio River range from 1.6 g/day in Pittsburgh, PA, to 3.86 g/day at the downstream border of the TMDL segment near Kenova, WV. Significant load reductions from the major tributaries will be necessary to meet water quality standards on the Ohio River. Recommended tributary load reductions are provided in the next section regarding TMDL allocations.

Table 4-6. Estimated tributary PCB concentrations and loads at harmonic mean flow.

Tributary	Harmonic Mean Flow (feet^3/second)	Predicted PCB Concentration (ng/L)	Existing PCB Load (g/day)	% Allowable Ohio River Load	% Actual Ohio River Load
Allegheny	9780	1.66	39.624	1793[a]	17.3[a]
Monongahela	5590	2.45	33.507	1516[a]	14.6[a]
Beaver	2000	9.95	48.687	2203[a]	21.3[a]
Muskingum	3800	4.03	37.504	1422[b]	24.7[b]
Little Kanawha	385	0.28	0.260	9.9[c]	0.18[c]
Hocking	340	0.90	0.749	28[c]	0.51[c]
Kanawha	8500	1.11	23.083	623[d]	18.3[d]
Guyandotte	690	1.72	2.904	78[e]	2.6[e]

a – Based on allowable and actual Ohio River loads established at Ohio River mile 40.0
b – Based on allowable and actual Ohio River loads established at Ohio River mile 175.1
c – Based on allowable and actual Ohio River loads established at Ohio River mile 207.7
d – Based on allowable and actual Ohio River loads established at Ohio River mile 281.5
e – Based on allowable and actual Ohio River loads established at Ohio River mile 302.9

5.0 TMDL ALLOCATIONS

The total maximum daily load (TMDL) represents the maximum amount of a contaminant that a stream can naturally assimilate and still meet the applicable water quality standards. The TMDL for a stream segment can be simply stated as the sum of all waste load allocations (WLAs) from point sources, load allocations (LAs) from non-point sources and natural background levels, plus a margin of safety (MOS). This can be expressed by the following equation:

$$\text{TMDL} = \sum \text{WLAs} + \sum \text{LAs} + \text{MOS}$$

5.1 WASTE LOAD ALLOCATIONS

Two facilities have been identified as point sources of PCBs within the TMDL segment (Ohio River mile 40 to 317.1). These include the Texas Eastern Holbrook Compressor Station in Greene County, PA, and the Nitro WWTP in Nitro, WV. Additional details regarding each of these facilities are presented in Section 3.2 of this report. Several other potential sources were also identified but insufficient data was available to make a positive determination.

In addition, a single high-volume water sample collected on the effluent from the ALCOSAN WWTP located at ORM 3.1, suggests PCBs may be present in the discharge either due to addition of PCBs to their collection system from an industrial source, runoff from contaminated soil and/or water supply systems withdrawing their water from the river upstream of the discharge. This facility discharges to the river above the present study’s boundaries and therefore is not being allocated a specific PCB loading in this study. The April 2001 Pennsylvania TMDL for the portion of the Ohio River in Pennsylvania addresses load allocations for this segment.

High-volume water sampling also suggests that the Nitro WWTP releases PCBs. This facility is located on the Kanawha River approximately 44 miles upstream of the confluence with the Ohio River. If it is confirmed that Nitro is a significant source of PCBs, then an allocation to Nitro would be considered in any future TMDL for the Kanawha River, and therefore, assigning a WLA for this facility is not necessary as part of this TMDL. The load allocation for the Kanawha River is 0.915 g/day, which leaves ample capacity to accommodate the estimated 0.022 g/day entering the river from the Nitro WWTP.

Pennsylvania’s 2001 PCB TMDL for the Ohio River identified Texas Eastern Holbrook Station (PA0216593) as contributing PCBs to the Ohio River through treatment of contaminated groundwater. Pennsylvania’s study did not include an allocation for this facility since the discharge eventually flows into the Ohio River in West Virginia, beyond the scope of their study. Therefore, an allocation will be assigned to this facility in this TMDL for the portion of the river below Pennsylvania. The NPDES permit for the Texas Eastern Holbrook allows for PCBs to be discharged at an average monthly concentration of 1.87 ng/L. The plants design discharge capacity is 0.0489 MGD. Based on the allowable PCB concentration and the plants discharge capacity, the waste load allocation for this facility is 0.0003 g/day. No high-volume water sampling was conducted at this site to quantify the current loading, however, the permit holder is required to collect two grab samples quarterly. The analytical results for these samples must be non-detects for PCBs at a minimum reporting level of 500 ng/L. Therefore, current PCB concentrations present in the plant's effluent can only be characterized as less than 500 ng/L, with a daily load less than 0.0926 g/day.

The existing PCBs loads and waste load allocation for Texas Eastern Holbrook is provided in Table 5-1. The Ohio River mile point at which this load enters the Ohio River and the necessary reduction are also included.

Table 5-1. Waste load allocations to point sources.

Facility	Ohio River Mile	Existing Load (g/day)	Allocated Load (g/day)	Necessary Reduction
Texas Eastern Holbrook	90.8	Less than 0.0926	0.0003	Unknown if any reduction is necessary

Other potential point sources of PCBs in the study area have been discussed in section 3.2 of this report. Insufficient effluent data is available to positively identify actual sources and their loads. Additional monitoring and source identification is required. However, this study recommends a general wasteload allocation for all point sources of PCBs in the study area such that the West Virginia water quality standards for PCBs are met in the effluent of any identified PCB point source.

5.2 LOAD ALLOCATIONS

Load allocations, in the context of a TMDL, refer to the allowable pollutant loadings established for non-point sources and background levels. Potential non-point sources include overland runoff, atmospheric deposition, groundwater contamination, and resuspension of contaminated sediments. These pollutant loadings either enter the Ohio River directly or enter through tributary inputs to the Ohio River. Allocations were established for the five major tributaries that enter the Ohio River within the TMDL segment by applying the applicable water quality standards at harmonic mean flow. The remaining portions of the allowable loadings after considering all other allocations to point sources, tributaries, and background levels, were assigned to the load allocation for unidentified sources that directly enter the Ohio River.

5.2.1 Background Conditions

Potential loadings due to background levels of a contaminant must be considered in the TMDL development process. PCBs, however, are not naturally occurring compounds.

They are created solely by anthropogenic activities, and therefore, the load allocation to background levels in the environment is set at zero g/day.

5.2.2 Tributary Load Allocations

The five major tributaries that enter the Ohio River along the TMDL segment include the Muskingum, Little Kanawha, Hocking, Kanawha, and Guyandotte Rivers. Existing PCB loads for these tributaries were discussed in section 4.3. The load allocations established for each tributary were calculated by applying the applicable water quality standards at the tributaries harmonic mean flows.

In Section 2.1, the applicable water quality standard for the Ohio River within the TMDL segment was established as 0.044 ng/L. Article VI of the Ohio River Valley Water Sanitation Compact states that "all sewage or industrial wastes discharged or permitted to flow into [Ohio River Basin tributaries of the Compact States] situated wholly within one State shall be treated to that extent, if any, which may be necessary to maintain such waters in a sanitary and satisfactory condition at least equal to the condition of the waters of the interstate stream immediately above the confluence" (ORSANCO, 1948). This implies that tributaries entering the Ohio River must possess water quality characteristics equal to or better than Ohio River water quality conditions at the point of confluence. Therefore, the applicable water quality standard for the Ohio River also applies to tributaries that directly enter the Ohio River. As such, the allocations for these five tributaries are based on the applicable Ohio River water quality standard of 0.044 ng/L. The tributary allocations and percent load reductions necessary are presented in Table 5-2.

Table 5-2. Tributary load allocations and necessary reductions.

Tributary	Enters Ohio River at Mile	Existing Load (g/day)	Allocated Load (g/day)	Percent Reduction
Muskingum	172.2	37.504	0.409	98.9
Little Kanawha	184.6	0.260	0.041	84.1
Hocking	199.3	0.749	0.037	95.1
Kanawha	265.7	23.083	0.915	96.0
Guyandotte	305.2	2.904	0.074	97.4

PCBs present in the tributaries may originate from a variety of non-point sources such as atmospheric deposition, overland runoff, and resuspension of contaminated sediments. There also may be point sources not yet been identified that contribute to the tributary PCB loads. The tributary allocations represent the sum of all source loadings allowed for those streams. This approach does not lend itself to identifying specific tributary sources for reductions; however, the overall load reductions needed for those sub-basins are quantified. Additional investigations would be necessary to pinpoint specific sources causing the tributary contamination.

5.2.3 Other Sources to the Ohio River

In addition to the point sources identified and the major tributary inputs, there also are other sources that contribute PCB loads directly to the Ohio River. These include atmospheric deposition to the river's surface, resuspension of contaminated sediments, overland runoff that enters the Ohio River directly or via other tributaries not specifically addressed in this report, inflow of contaminated groundwater, and possibly unidentified point sources. Due to the difficulties in quantifying these loads individually, the allocations to these sources have been combined into a single load allocation for "other sources." This allocation represents the remaining allowable load after considering allocations to point sources and major tributaries. These values are provided in Table 5-3.

5.3 ALLOCATION SUMMARY

A summary of the TMDL allocations is presented in Table 5-3. Allocations are provided for eight locations along the TMDL segment. These locations correspond to the seven monitoring stations where PCB loads were quantified, plus one site at the downstream boundary of the TMDL segment at Ohio River mile 317.1. The allocation to "Other Sources" represents the portion of the allowable load available after all other identified sources have been considered.

Table 5-3. Ohio River PCB allocation summary.

Ohio River Mile	Feature / Source Input	Ohio River Harmonic Mean Flow ft^3/s	Allowable Load g/day	Identified Point Sources (WLA) g/day	Major Tributaries (LA) g/day	All Other Sources (LA) g/day	MOS
40.0	PA/WV Border	20,500	2.207				Implicit
90.8	Texas Eastern Holbrook			0.0003			
129.0		20,500	2.207				Implicit
172.2	Muskingum				0.409		
175.1		24,500	2.637			0.021	Implicit
184.6	Little Kanawha				0.041		
199.3	Hocking				0.037		
264.0		26,000	2.799			0.084	Implicit
265.7	Kanawha				0.915		
281.5		34,500	3.714				Implicit
302.9		34,500	3.714				Implicit
305.2	Guyandotte				0.074		
317.1		35,900	3.865			0.077	Implicit

6.0 RECOMMENDED ACTIONS

6.1 TRIBUTARY SOURCE INVESTIGATIONS

The five major tributaries that enter the Ohio River along the TMDL segment contribute significant PCB loads to the Ohio River. Substantial reductions from tributary sources would be necessary to meet the water quality standard on the Ohio River. Loadings may come from unidentified point sources and a variety of non-point sources. While the total loadings from these inputs have been quantified collectively, individual sources have not been identified. Investigations of each major tributary sub-basin would be required to positively identify areas for load reductions. While reductions are needed for all five major tributaries, initial investigations should target the Muskingum and Kanawha Rivers. These two rivers account for nearly 94 percent of the total tributary PCB load entering the Ohio River within the TMDL segment.

6.2 ADDITIONAL MUNICIPAL WWTP MONITORING

Limited high-volume water sampling conducted on the effluent at two municipal wastewater treatment plants within the TMDL study area revealed the presence of PCBs. Similar results were found at another POTW downstream of the study area. These results are likely not unique to just these three treatment facilities. A gross estimate of the potential loading from the 69 municipal WWTPs that directly discharge to the Ohio River from miles 0 to 317.1 indicated that approximately 7 grams of PCBs may be directly discharged from these facilities to the Ohio River each day. Considering the large number of POTWs within the entire Ohio River Basin, the potential loadings from these facilities may be significant. Additional monitoring should be conducted to more accurately quantify the PCB loads discharged from POTWs and to determine the amount of PCBs attributable to source water loadings. Possible control strategies should also be evaluated.

6.3 CONTROL OF IN-PLACE SEDIMENTS

Sediment sampling revealed wide spread PCB contamination within the TMDL study area. Some localized hot spots were identified. Contaminated sediments get resuspended into the water column and contribute to violations of the in-stream water quality standard. Options for remediation include physical removal of contaminated sediments and natural attenuation.

Removal of sediments would involve dredging contaminated sediments, and then disposing of the material in an approved manner. Problems associated with this option include: 1) very expensive, 2) destruction of habitat for benthic organisms, and 3) possible resuspension of contaminants into the water column. Also, if sources are still present, the “clean” sediments will become recontaminated. Due to the wide spread contamination present in the Ohio River, the option to remediate through dredging is limited to only addressing hot spots of contamination. The overall effectiveness of this method is difficult to predict.

Natural attenuation refers to the removal of a contaminant through natural processes. Theses processes include burial by cleaner sediments, dispersion, volatilization, and biodegradation. While this is a low-cost method, these natural removal processes act very slowly on conservative pollutants such as PCBs.

Further evaluation of sediment controls is needed to identify the best option for sediment remediation on the Ohio River.

6.4 EVALUATION OF ATMOSPHERIC SOURCES

PCBs were detected in all ambient air samples collected at six locations within the TMDL study area. This data was used to provide gross estimates of PCB loads directly entering the Ohio River through atmospheric deposition. This analysis concluded that atmospheric deposition might contribute to the elevated PCB levels found in the Ohio River. Additional monitoring, however, is necessary to better quantify the impacts of atmospheric sources.

PCBs inadvertently enter the atmosphere through a variety of sources including incinerators, boilers, industrial furnaces, transformer fires, and other chemical processes. While potential atmospheric PCB sources were inventoried for the Ohio River Basin, no confirmed sources were identified. Specific atmospheric sources need to be identified and possible controls for air emissions of PCBs should be explored.

7.0 REASONABLE ASSURANCE

There must be reasonable assurance that the goals set forth in a TMDL can be achieved, and the applicable water quality standard can be met. Due to the widespread contamination of PCBs and their persistence in the environment, no proposed remedies will provide a quick solution to the problem on the Ohio River. However, actions can be taken to ensure that the objectives will ultimately be attained.

Initial actions need to be focused on addressing current point sources of PCBs. Limited sampling identified POTWs as possible point sources. Additional monitoring is necessary to better quantify the loadings from these facilities. Once loadings are established, possible control strategies can be considered.

Similarly, a gross estimate indicated that atmospheric deposition to the Ohio River may contribute more than 40 percent of the allowable load at some points along the TMDL segment. This value only estimates direct deposition to the river's surface area, and the actual contribution from atmospheric deposition may be significantly greater when depositional loadings to the tributary sub-basins are considered. While atmospheric deposition is a non-point source to the Ohio River, some of the contamination in the atmosphere originates from point source air emissions. The point sources to the atmosphere must be identified and possible control strategies need to be evaluated.

Once point sources controls are implemented, the existing contamination present in Ohio River sediments can be addressed. Options include natural attenuation and dredging of contaminated sediments. Further study is necessary before a recommended plan of action can be developed to address the sediment contamination.

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Appendix A – High-Volume Water Sampling Data

Table A-1. Ohio River PCB Concentrations

River Mile	Date Sampled	Flow ft^3/second	Total PCBs ng/L (ppt)		
			Dissolved	Particulate	Total
4	08/02/00	16852	----	3.71	
4	04/25/01	38706	0.43	1.15	1.58
10.9	08/03/00	17808	----	4.13	
10.9	04/26/01	35600	0.59	1.01	1.60
20.2	07/07/98	19500	1.24	2.02	3.26
20.2	09/15/98	7700	1.50	1.48	2.98
20.2	08/04/00	22484	----	6.44	
20.2	04/27/01	33770	0.55	1.43	1.99
30.9	08/05/00	29300	----	4.29	
30.9	04/30/01	24000	0.81	1.71	2.52
40	07/08/98	14700	1.46	2.71	4.18
40	09/16/98	7800	1.43	1.65	3.08
40	08/08/00	50098	----	11.74	
40	05/01/01	27700	0.79	1.49	2.29
44.6	07/09/98	21700	1.37	1.76	3.12
44.6	09/17/98	7100	1.52	1.42	2.93
69.9	08/09/00	37837	----	5.59	
69.9	05/02/01	23600	0.79	1.00	1.78
99.2	08/11/00	26439	2.91	----	
99.2	05/03/01	18828	0.77	0.68	1.45
129	07/14/98	17000	1.21	1.14	2.34
129	08/11/98	10500	1.40	----	
129	09/22/98	10100	0.27	0.91	1.18
129	08/12/00	28359	2.49	2.05	4.55
129	05/04/01	15700	0.82	0.89	1.71
149	08/13/00	15954	2.17	1.08	3.26
149	05/05/01	21500	0.85	0.98	1.83
171.8	08/14/00	19291	1.88	1.21	3.08
171.8	05/07/01	12000	0.78	0.93	1.71
175.1	07/15/98	34600	1.07	2.30	3.37
175.1	08/12/98	19100	1.20	1.09	2.29
175.1	09/23/98	14200	0.16	0.74	0.91
175.1	08/16/00	19644	1.58	1.13	2.70
175.1	05/09/01	14600	0.78	1.31	2.09
184.3	08/17/00	17313	1.62	1.08	2.70
184.3	05/10/01	25700	0.85	1.44	2.28
207.7	07/16/98	32500	1.23	0.80	2.04
207.7	08/13/98	20500	1.34	0.52	1.86
207.7	09/24/98	12000	0.26	0.28	0.54
207.7	08/18/00	17212	1.30	1.01	2.31
207.7	05/11/01	13100	0.88	1.56	2.44

Table A-1. Ohio River PCB Concentrations (cont.)

River Mile	Date Sampled	Flow ft^3/second	Total PCBs ng/L (ppt)		
			Dissolved	Particulate	Total
264	08/20/97	62700	0.82	0.80	1.62
264	09/24/97	14500	0.76	0.69	1.45
264	06/18/98	93700	----	4.16	
264	11/03/98	9100	----	0.25	
264	08/19/00	8700	1.17	0.66	1.83
264	05/12/01	22100	0.87	1.39	2.27
281.5	08/21/97	68800	0.70	1.72	2.41
281.5	09/25/97	17600	0.59	----	
281.5	06/19/98	175400	----	2.94	
281.5	11/04/98	15900	----	0.33	
302.9	08/22/97	61300	0.68	1.20	1.88
302.9	06/20/98	103900	----	2.86	
302.9	11/05/98	17600	----	0.24	

Table A-2. Tributary PCB Concentrations

River	River Mile	Ohio River Confluence Mile Point	Date Sampled	Flow ft^3/second	Total PCBs ng/L (ppt)		
					Dissolved	Particulate	Total
Allegheny	1.2	0	7/31/2000	6063		1.60	
Allegheny	1.2	0	4/23/2001	35500	0.21	0.59	0.79
Allegheny	1.2	0	10/24/2001	5100	0.37	1.29	1.66
Allegheny	1.2	0	3/21/2002	24000	0.20	0.33	0.53
Monongahela	2.3	0	8/1/2000	6911		6.45	
Monongahela	2.3	0	4/24/2001	13800	0.85	2.13	2.98
Monongahela	2.3	0	10/23/2001	2400	1.15	1.31	2.45
Monongahela	2.3	0	3/23/2002	23800	0.49	0.84	1.33
Beaver	1.5	25.4	8/7/2000	3811		15.47	
Beaver	1.5	25.4	4/28/2001	2399	2.09	5.36	7.45
Beaver	1.5	25.4	3/23/2002	3080	1.28	1.79	3.07
Beaver	1.5	25.4	3/27/2002	26500	1.32	18.01	19.33
Muskingum	0.8	172.2	8/15/2000	2159	1.42	1.90	3.32
Muskingum	0.8	172.2	5/8/2001	3950	0.96	3.07	4.03
Muskingum	0.8	172.2	3/27/2002	18450	0.19	0.73	0.93
Little Kanawha	1.7	184.6	11/7/2001	403	0.13	0.15	0.28
Little Kanawha	1.7	184.6	3/6/2002	1614	0.04	0.02	0.06
Little Kanawha	1.7	184.6	3/28/2002	11000	0.07	0.06	0.13
Hocking	2.3	199.3	11/6/2001	222	0.12	0.11	0.23
Hocking	2.3	199.3	1/25/2002	2543	0.28	1.91	2.19
Hocking	2.3	199.3	3/29/2002	3370	0.06	0.22	0.28
Kanawha	1.3	265.7	6/25/1997	7600		0.40	
Kanawha	1.3	265.7	8/19/1997	5000	0.58	0.44	1.02
Kanawha	1.3	265.7	9/23/1997	3700		0.00	
Kanawha	1.3	265.7	11/2/1998	3600		0.40	
Kanawha	1.3	265.7	1/29/2002	22445	0.24	0.50	0.74
Kanawha	1.3	265.7	4/3/2002	38500	0.27	1.30	1.56
Guyandotte	1.1	305.2	12/16/1998	823	0.21	1.51	1.72
Guyandotte	1.1	305.2	3/17/1999	8162	0.20	1.76	1.96
Guyandotte	1.1	305.2	4/4/2002	6500		3.51	
Guyandotte	1.1	305.2	4/16/2002	3042	0.22	0.45	0.67

Table A-3. POTW effluent sampling results for PCBs

				Total PCBs ng/L (ppt)		
Facility Name	**Location**	**Date Sampled**	**Design Flow (MGD)**	**Dissolved**	**Particulate**	**Total**
ALCOSAN	Pittsburgh, PA	11-1-00	200	2.02	4.41	6.43
Nitro WWTP	Nitro, WV	4-12-01	1.25	1.08	3.51	4.59
Morris Foreman	Louisville, KY	5-31-01	105	3.68	3.72	7.40

Figure A-1: Ohio River PCB concentrations plotted versus stream flow

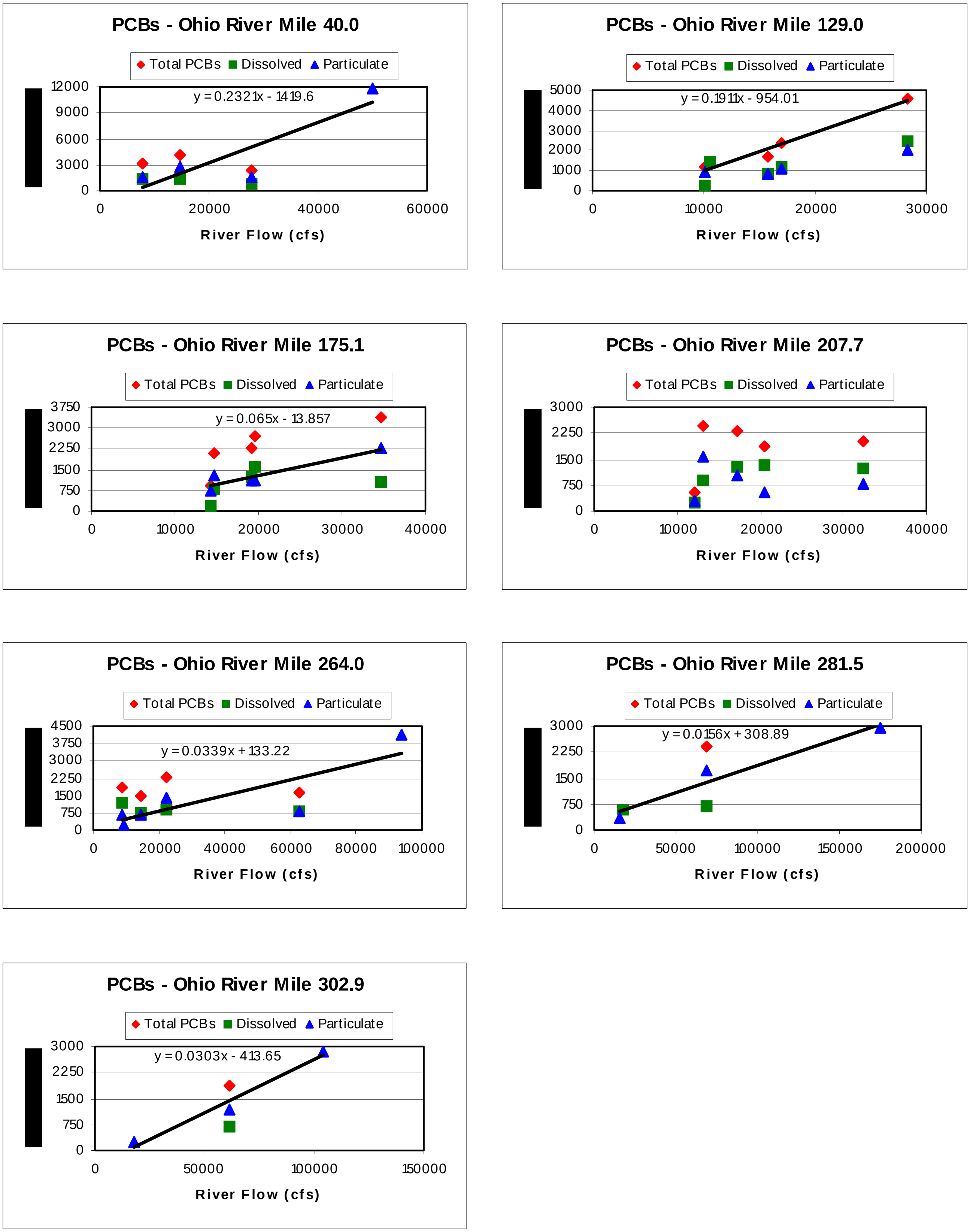
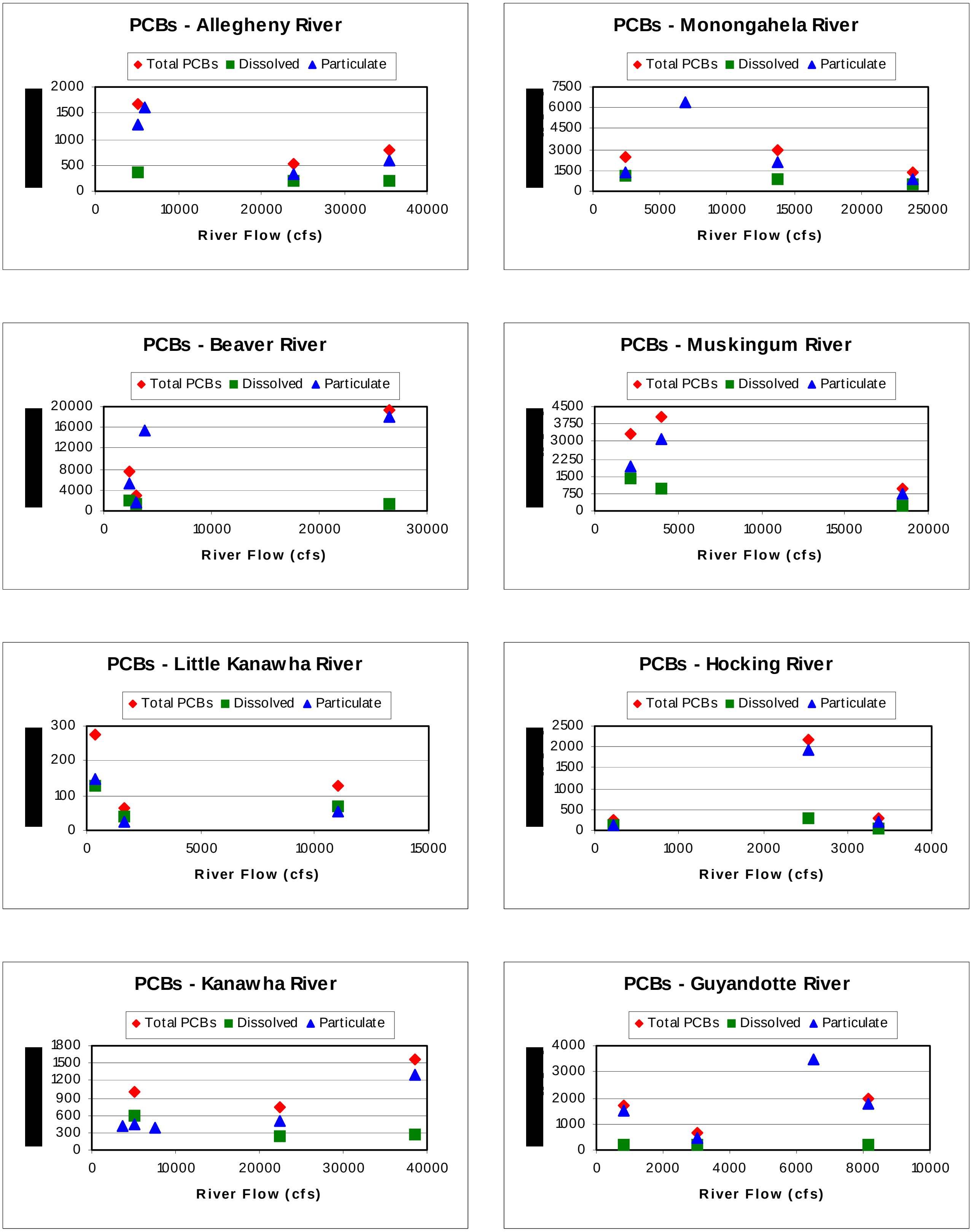


Figure A-2: Major tributary PCB concentrations plotted versus stream flow



Appendix B – Potential Sources Identified by Database Searches of CERCLIS, TRI, and PCS

Table B-1. National Priority List sites with PCBs as Chemicals of Concern in the Ohio River Basin in PA, WV, and OH.

Site Name	National Priority List Status	Ohio River Mile Point	State	County	Latitude	Longitude
Air Force Plant 85	Proposed for NPL	NA	OH	Franklin	39.987777	82.887221
ALSCO Anaconda	Currently on the Final NPL	NA	OH	Tuscarawas	40.361111	81.440831
Chem-Dyne	Currently on the Final NPL	NA	OH	Butler	39.4079	84.552
Miami County Incinerator	Currently on the Final NPL	NA	OH	Miami	40.074169	84.224169
North Sanitary Landfill	Currently on the Final NPL	NA	OH	Montgomery	39.78611	84.1525
Pristine, Inc.	Currently on the Final NPL	NA	OH	Hamilton	39.236111	84.437231
Summit National	Currently on the Final NPL	NA	OH	Portage	41.024	81.0971
TRW, Inc. (Minerva Plant)	Currently on the Final NPL	NA	OH	Stark	40.745	81.09
Breslube-Penn, Inc.	Currently on the Final NPL	9.3	PA	Allegheny	40.501389	80.146389
Ohio River Park	Currently on the Final NPL	10	PA	Allegheny	40.518611	80.1525
Osborne Landfill	Currently on the Final NPL	NA	PA	Mercer	41.161111	80.058331
River Road Landfill (Waste Management, Inc.)	Currently on the Final NPL	NA	PA	Mercer	41.266669	80.4875
Westinghouse Electric Corp. (Sharon Plant)	Currently on the Final NPL	NA	PA	Mercer	41.2434	80.5058
Fike Chemical, Inc.	Currently on the Final NPL	NA	WV	Putnam	38.426669	81.8425
Ordinance Works Disposal Areas	Currently on the Final NPL	NA	WV	Monongalia	39.603331	79.979719

Table B-2. TRI PCB release data for Ohio River counties in Pennsylvania, West Virginia, and Ohio

Facility Name	Primary Industry	River Mile	State	County	Total Release (lbs)	Years Reported	Latitude	Longitude
Zinc Corp. Of America,	Primary Smelting and Refining Of Zinc	29	PA	Beaver	2300	87-89	40.4021	80.2022
INCO Alloys International Inc.	Nonferrous Rolling and Drawing, NEC	310	WV	Cabell	5300	87	38.2504	82.2316
Weirton Steel Corp.	Blast Furnaces and Steel Mills	61.5	WV	Hancock	95574	88-99	40.2458	80.3523
Shell Chemical Co.,	Synthetic Rubber	188.7	OH	Washington	12360	87	39.1652	81.3817

Table B-3 Facilities required to monitor effluent for PCBs located in Ohio River counties from river mile 0 – 317 (PCS).

Facility Name	Facility type	River Mile	State	County	City	NPDES ID	Latitude	Longitude
City of East Liverpool	Sewerage Systems	44.6	OH	Columbiana	East Liverpool	OH0024970	40.621389	80.588611
M & G Polymers USA Corp.	Plastic materials and resins	231.6	WV	Mason	Apple Grove	WV0000132	38.665278	82.183056

Appendix C – Potential PCB Sources in the Ohio River Basin Identified by Industry Type (PCS, 1997 And OEPA, 1997)*

State	County	City	Facility Name	Activity
WV	Brooke	Beech Bottom	Wheeling Pittsburgh Steel Corp.	Manufacturing - Metals
WV	Brooke	Follansbee	Wheeling Pittsburgh Steel Corp.	Manufacturing - Steel
WV	Brooke	Follansbee	Koppers Industries, Inc	Manufacturing - Industrial Organic Chemicals
WV	Brooke	Follansbee	Wheeling-Nisshin Inc.	Manufacturing - Blast Furnaces & Steel Mills
WV	Brooke	Follansbee	Wheeling-Pittsburgh Steel Corp	Manufacturing - Blast Furnaces & Steel Mills
WV	Fayette	Alloy	ELKEM Metals Co.	Manufacturing - Electrometallurgical Products
WV	Hancock	Weirton	Weirton Steel Corporation	Manufacturing - Steel
WV	Harrison	Anmoore	UCAR Carbon, Inc.	Manufacturing - Carbon & Graphite Products
WV	Jackson	Ravenswood	Ravenswood Aluminum Corp.	Manufacturing - Primary Aluminum
WV	Kanawha	Belle	E.I.Du Pont De Nemours & Co.	Manufacturing - Nitrogenous Fertilizers
WV	Kanawha	Belle	Occidental Electrochemicals	Manufacturing - Industrial Organic Chemicals
WV	Kanawha	Institute	Rhone-Poulenc Ag Co.	Manufacturing - Industrial Organic Chemicals
WV	Kanawha	S. Charleston	CLEARON Corporation	Manufacturing - Industrial Inorganic Chemicals
WV	Kanawha	S. Charleston	FMC Corporation	Manufacturing - Industrial Inorganic Chemicals
WV	Kanawha	S. Charleston	Union Carbide Corporation	Manufacturing - Industrial Organic Chemicals
WV	Marion	Fairmont	Philips Lighting Co.	Manufacturing - Electric Lamps
WV	Marshall	Benwood	Wheeling Pittsburgh Steel Corp.	Manufacturing - Steel
WV	Marshall	Moundsville	Ohio Power Co.	Power Generator
WV	Marshall	Moundsville	Ohio Power Co.	Power Generator
WV	Marshall	Moundsville	Olin Corporation	Manufacturing - Chemicals
WV	Marshall	Moundsville	L.C.P. Chemicals - W.V., Inc.	Manufacturing - Alkalies & Chlorine
WV	Marshall	Natrium	P.P.G. Industries, Inc.	Manufacturing - Alkalies & Chlorine
WV	Marshall	New Martinsville	Bayer Corporation	Manufacturing - Cyclic Crudes & Intermediates
WV	Mason	New Haven	Central Operating Co.	Power Generator
WV	Mason	Apple Grove	Goodyear Tire & Rubber Co.	Manufacturing - Plastics Materials & Resins
WV	Mason	Gallipolis Ferry	AKZO Nobel Chemicals Inc.	Manufacturing - Industrial Organic Chemicals
WV	Mason	New Haven	Appalachian Power Co.	Power Generator
WV	Monongalia	Morgantown	GE Specialty Chemicals, Inc.	Manufacturing - Industrial Organic Chemicals
WV	Monongalia	Morgantown	GE Specialty Chemicals, Inc.	Manufacturing - Cyclic Crudes & Intermediates
WV	Ohio	Wheeling	Environmental Protection Svc.	PCB Storer
WV	Pleasants	Willow Island	Monongahela Power Co.	Power Generator

* Information compiled in this list includes industries associated with the use of PCBs; therefore, many facilities may not be actual PCB sources.

Appendix C – Potential PCB Sources in the Ohio River Basin Identified by Industry Type (PCS, 1997 And OEPA, 1997)*

State	County	City	Facility Name	Activity
WV	Pleasants	Willow Island	Cytec Industries	Manufacturing - Industrial Organic Chemicals
WV	Putnam	Nitro	Flexsys America, L.P.	Manufacturing - Industrial Organic Chemicals
WV	Putnam	Nitro	FMC Corporation	Manufacturing - Industrial Inorganic Chemicals
WV	Putnam	Nitro	Kincaid Enterprises	Manufacturing - Industrial Inorganic Chemicals
WV	Putnam	Scott Depot	Payne Engineering Co. Inc	Manufacturing - Relays & Industrial Controls
WV	Putnam	St. Albans	Appalachian Power Co.	Manufacturing - Motors & Generators
WV	Putnam	St. Albans	Tow Maintenance & Cleaning,Inc	Manufacturing - Industrial Organic Chemicals
WV	Tyler	Sistersville	OSI Specialties, Inc.	Manufacturing - Plastics Materials & Resins
WV	Wayne	Neal	Aristech Chemicals Corp.	Manufacturing - Plastics Materials & Resins
WV	Wood	Parkersburg	E.I.Du Pont De Nemours & Co.	Manufacturing - Chemicals
WV	Wood	Washington	E.I.Du Pont De Nemours & Co.	Manufacturing - Plastics Materials & Resins
WV	Wood	Washington	General Electric Co.	Manufacturing - Plastics Materials & Resins
PA	Allegheny	Brackenridge	Allegheny Ludlum Steel	Manufacturing - Blast Furnaces & Steel Mills
PA	Allegheny	Clairton City	USX Corp - Us Steel Group	Manufacturing - Blast Furnaces & Steel Mills
PA	Allegheny	Collier Twp	Universal Stainless & Alloy Pr	Manufacturing - Blast Furnaces & Steel Mills
PA	Allegheny	Coraopolis Boro	Pittsburgh Forgings Co.	Manufacturing - Metals
PA	Allegheny	Crescent Twp	Duquesne Light Co.	Power Generator
PA	Allegheny	Dravosburg Boro	USS Irvin Plant	Manufacturing - Blast Furnaces & Steel Mills
PA	Allegheny	Harmar Twp	Westinghouse Elec. Corp	Manufacturing - Motors & Generators
PA	Allegheny	Jefferson	Hercules Inc.	Manufacturing - Plastics Materials & Resins
PA	Allegheny	Leetsdale	Hussey Copper, Ltd	Manufacturing - Copper Rolling & Drawing
PA	Allegheny	Mckees Rock	United States Steel Corp.	Manufacturing - Steel
PA	Allegheny	Neville Island	Aristech Chemical Corporation	Manufacturing - Chemicals
PA	Allegheny	Neville Island	Shenango Inc-Neville Coke&Iron	Manufacturing - Blast Furnaces & Steel Mills
PA	Allegheny	Neville Twp	Neville Chemical Co.	Manufacturing - Plastics Materials & Resins
PA	Allegheny	North Braddock	USX Corp	Manufacturing - Blast Furnaces & Steel Mills
PA	Allegheny	Pittsburgh	Duquesne Light Co.	Power Generator
PA	Allegheny	Pittsburgh	Allis-Chalmers Corp Pgh	Manufacturing - Transformers
PA	Allegheny	Pittsburgh	Koppers Co	Manufacturing - Electrical Industrial Apparatus
PA	Allegheny	Pittsburgh	LTV Steel Co.	Manufacturing - Blast Furnaces & Steel Mills

* Information compiled in this list includes industries associated with the use of PCBs; therefore, many facilities may not be actual PCB sources.

Appendix C – Potential PCB Sources in the Ohio River Basin Identified by Industry Type (PCS, 1997 And OEPA, 1997)*

State	County	City	Facility Name	Activity
PA	Allegheny	Pittsburgh	Pittsburgh Flatroll Co.	Manufacturing - Blast Furnaces & Steel Mills
PA	Armstrong	Apollo	Babcock & Wilcox Co.	Manufacturing - Industrial Inorganic Chemicals
PA	Beaver	Ambridge Boro	Babcock & Wilcox Co.	Manufacturing - Steel Pipes
PA	Beaver	Ambridge Boro	H.H. Robertson Co.	Manufacturing - Metal Panels
PA	Beaver	Beaver Boro	Cutler-Hammer Inc.	Manufacturing - Switchgears & Switchboards
PA	Beaver	Beaver County	Koppel Steel Corp	Manufacturing - Steel Pipe & Tubes
PA	Beaver	Beaver Falls	Teledyne Industries Inc	Manufacturing - Cold Finishing Of Steel Shapes
PA	Beaver	Midland	J & L Specialty Steel, Inc.	Manufacturing - Blast Furnaces & Steel Mills
PA	Beaver	Midland Boro	LTV Steel Co., Inc.	Manufacturing - Steel
PA	Beaver	Monaca	Superior Drawn Steel Co.	Manufacturing - Steel
PA	Beaver	Monaca Boro	AMPCO Pittsburgh Corporation	Manufacturing - Steel
PA	Beaver	Potter Twp	ARCO Chemical Co.	Manufacturing - Plastics Materials & Resins
PA	Beaver	Potter Twp	BASF Corporation	Manufacturing - Synthetic Rubber
PA	Beaver	Potter Twp	Zinc Corp Of America	Manufacturing - Primary Nonferrous Metals
PA	Beaver	Shippingport Boro	Duquesne Light Co.	Power Generator
PA	Beaver	Shippingport Boro	Pennsylvania Power Co.	Power Generator
PA	Beaver	Vanport Twp	Westinghouse Electric Corp	Manufacturing - Switchgears & Switchboards
PA	Beaver		LTV Steel Co. Inc.	Manufacturing - Blast Furnaces & Steel Mills
PA	Butler	East Butler Boro	Magnetics Inc/Div Of Sprang In	Manufacturing - Relays & Industrial Controls
PA	Butler	East Butler Boro	Spang And Co.	Manufacturing - Electronic Components
PA	Butler	Mars Boro	James Austin Co.	Manufacturing - Household Vacuum Cleaners
PA	Butler	Petrolia Boro	Witco Corp - Petrolia Facility	Manufacturing - Surface Active Agents
PA	Cambria	Johnstown	SCM Metal Products Inc.	Manufacturing - Primary Metal Products
PA	Crawford	Saegertown	Spectrum Control	Manufacturing - Semiconductors
PA	Elk	Ridgway	Quality Components, Inc.	Manufacturing - Semiconductors
PA	Elk	Saint Marys	Keystone Thermometrics	Manufacturing - Electronic Resistors
PA	Elk	Saint Marys	St Marys Carbon Co. Inc	Manufacturing - Carbon & Graphite Products
PA	Elk	Saint Marys	Stackpole Carbon Co	Manufacturing - Carbon & Graphite Products
PA	Mckean	Bradford	Corning Glass Works	Manufacturing - Electronic Resistors
PA	Mckean	Kane	Stackpole Magnetic Systems Inc	Manufacturing - Relays & Industrial Controls

* Information compiled in this list includes industries associated with the use of PCBs; therefore, many facilities may not be actual PCB sources.

Appendix C – Potential PCB Sources in the Ohio River Basin Identified by Industry Type (PCS, 1997 And OEPA, 1997)*

State	County	City	Facility Name	Activity
PA	Mckean	Kane Authority	Houston Electronics	Manufacturing - Electron Tubes
PA	Mckean	Kane Authority	Semiconductor Specialties Corp	Manufacturing - Semiconductors
PA	Mckean	Mount Jewett	Keystone Thermometrics	Manufacturing - Electronic Resistors
PA	Mercer	Farrell	Caparo Steel Co. Inc	Manufacturing - Blast Furnaces & Steel Mills
PA	Mercer	Perry Twp	Component Intertechnologies	Manufacturing - Semiconductors
PA	Mercer	Sharon	ARMCO Inc.	Manufacturing - Steel Pipe & Tubes
PA	Mercer	Sharon	Westinghouse Electric Corp.	Manufacturing - Current-Carrying Wiring Devices
PA	Mercer	Wheatland	Wheatland Tube Co	Manufacturing - Steel Pipe & Tubes
PA	Somerset	Stonycreek Twp	Vanyo Inc	Manufacturing - Transformers
PA	Venango	Oil City	GTE Operations Support Inc	Manufacturing - Electronic Connectors
PA	Venango	Oil City	PFV Enterprises Inc	Manufacturing - Electronic Connectors
PA	Washington	Allenport	Wheeling-Pittsburgh Steel Corp.	Manufacturing - Blast Furnaces & Steel Mills
PA	Washington	Cannonsburg Boro	McGraw-Edison Power Sys Div	Manufacturing - Transformers
PA	Washington	Canton Twp	Jessop Steel/Washington	Manufacturing - Blast Furnaces & Steel Mills
PA	Washington	Chartiers Twp	RCA Corp-Meadow Lands	Manufacturing - Communication Equipment
PA	Westmoreland	Salem Twp	Talon Division Of Textron	Manufacturing - Wiring Devices
PA	Westmoreland	Vandergrift	Allegheny Ludlum Corp	Manufacturing - Blast Furnaces & Steel Mills
PA	Westmoreland	West Leechburg	Allegheny Ludlum Corp	Manufacturing - Cold Finishing Of Steel Shapes
PA	Westmoreland	Youngwood	Powerex, Inc	Manufacturing - Semiconductors
OH	Allen	Lima	BP Oil Lima Refinery	PCB Generator
OH	Allen	Lima	Ford Motor Company	PCB Generator
OH	Allen	Lima	National Lime & Stone Co.	PCB Generator
OH	Allen	Lima	Westinghouse Electric Corp.	PCB Generator
OH	Allen	Lima	Dana Corporation	PCB Generator
OH	Allen	Spencerville	Trim Trends Inc.	PCB Generator
OH	Ashland	Perrysville	CGST-Lucas Compressor Sta.	PCB Generator
OH	Athens	Albany	Compressor Station 204	PCB Generator
OH	Athens	Athens	Texas Eastern Gas	PCB Generator
OH	Auglaize	St Marys	City Of St. Marys	PCB Generator
OH	Belmont	Martins Ferry	Wheeling Pittsburgh Steel Corp.	Manufacturing - Steel

* Information compiled in this list includes industries associated with the use of PCBs; therefore, many facilities may not be actual PCB sources.

Appendix C – Potential PCB Sources in the Ohio River Basin Identified by Industry Type (PCS, 1997 And OEPA, 1997)*

State	County	City	Facility Name	Activity
OH	Belmont	Shadyside	Ohio Edison Co.	Power Generator
OH	Belmont	Shadyside	Ohio Edison Co.	PCB Generator
OH	Brown	Aberdeen	Dayton Power & Light Co.	PCB Generator
OH	Butler	Hamilton	Champion International	PCB Generator
OH	Butler	Hamilton	Electric Distribution Div Stor	PCB Generator
OH	Butler	Hamilton	Hamilton Cy Elec Dtrb Div Strg	PCB Generator
OH	Butler	Hamilton	Hamilton Municipal Garage	PCB Generator
OH	Butler	Middletown	Cincinnati Gas & Electric Co.	PCB Generator
OH	Butler	Middletown	AK Steel Corporation	Manufacturing - Blast Furnaces & Steel Mills
OH	Carroll	Carrollton	Carroll Elec Coop	PCB Generator
OH	Carroll	Carrollton	Tennessee Gas Pipeline Sta 214	PCB Generator
OH	Champaign	Urbana	Dayton Power & Light Co.	PCB Generator
OH	Clark	Springfield	DYNEX Industries Inc.	PCB Generator
OH	Clark	Springfield	Kelsey-Hayes Building	PCB Generator
OH	Clark	Springfield	Ohio Edison Co.	PCB Generator
OH	Clark	Springfield	Ohio Edison Co.	PCB Generator
OH	Clermont	Goshen	Goshen Local Schools	PCB Generator
OH	Clermont	Moscow	Cincinnati Gas & Electric Co.	Power Generator
OH	Clermont	New Richmond	Cincinnati Gas & Electric Co.	Power Generator
OH	Clinton	Wilmington	Dayton Power & Light Co.	PCB Generator
OH	Columbiania	Leetonia	TCO-Brinker Compressor Station	PCB Generator
OH	Columbiania	Salem	CGST	PCB Generator
OH	Coshocton	Coshocton	The Frontier Power Company	PCB Generator
OH	Coshocton	Coshocton	Armco Inc.	Manufacturing - Blast Furnaces & Steel Mills
OH	Crawford	Bucyrus	Bucyrus Plant	PCB Generator
OH	Crawford	Bucyrus	CGST	PCB Generator
OH	Crawford	Galion	Galion Light & Power	PCB Generator
OH	Darke	Arcanum	Arcanum Water And Lgt Plant	PCB Generator
OH	Darke	Greenville	Darke Rural Elec Coop Inc.	PCB Generator
OH	Darke	Greenville	Dayton Power & Light Co.	PCB Generator

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Appendix C – Potential PCB Sources in the Ohio River Basin Identified by Industry Type (PCS, 1997 And OEPA, 1997)*

State	County	City	Facility Name	Activity
OH	Delaware	Delaware	Delaware Rec Oxford Substa	PCB Generator
OH	Fairfield	Lancaster	S. Central Power Co.	PCB Generator
OH	Fayette	Washington Court	Dayton Power & Light Co.	PCB Generator
OH	Franklin	Columbus	CGST	PCB Generator
OH	Franklin	Columbus	CGST	PCB Generator
OH	Franklin	Columbus	City Of Columbus Div Of Electric	PCB Generator
OH	Franklin	Columbus	Columbus Southern Power	PCB Generator
OH	Franklin	Columbus	Defense Construction Supply Ctr	PCB Generator
OH	Franklin	Columbus	IBM Building	PCB Generator
OH	Franklin	Columbus	PCB Destruction Unit	PCB Generator
OH	Franklin	Columbus	USAF Plant 85	PCB Generator
OH	Franklin	Columbus	Battelle Memorial Institute	Manufacturing - Relays & Industrial Controls
OH	Franklin	Grove City	Robertshaw Controls Co.	Manufacturing - Relays & Industrial Controls
OH	Franklin	Hilliard	ARCA Ohio, Inc.	PCB Generator
OH	Franklin	Westerville	Westerville Electric Division	PCB Generator
OH	Gallia	Cheshire	Gavin Plant	PCB Generator
OH	Gallia	Cheshire	Ohio Power Co.	Power Generator
OH	Gallia	Cheshire	Ohio Valley Electric Corp.	Power Generator
OH	Gallia	Gallipolis	Buckeye Rural Electric	PCB Generator
OH	Greene	Cedarville	Columbia Gas Howell Regulator	PCB Generator
OH	Greene	Fairborn	Dayton Power & Light Co.	PCB Generator
OH	Greene	Fairborn	DYNEX Industries, Inc.	PCB Generator
OH	Greene	Fairborn	Wright Patterson AFB	PCB Generator
OH	Greene	Xenia	Dayton Power & Light Co.	PCB Generator
OH	Guernsey	Cambridge	CGST	PCB Generator
OH	Guernsey	Cambridge	TCO-Guernsey Compressor Sta	PCB Generator
OH	Guernsey	Cambridge	TTR, Inc.	PCB Generator
OH	Hamilton	Addyston	Monsanto Plastics & Resin Co.	Manufacturing - Plastics & Resins
OH	Hamilton	Cincinnati	A. B. Steel Mill	PCB Generator
OH	Hamilton	Cincinnati	CECOS International Inc.	PCB Generator & Storer

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Appendix C – Potential PCB Sources in the Ohio River Basin Identified by Industry Type (PCS, 1997 And OEPA, 1997)*

State	County	City	Facility Name	Activity
OH	Hamilton	Cincinnati	Cincinnati Gas & Electric Co.	PCB Generator
OH	Hamilton	Cincinnati	Cincy Recycle	PCB Generator
OH	Hamilton	Cincinnati	Environmental Enterprises Inc.	PCB Generator
OH	Hamilton	Cincinnati	GE Aircraft Engines	PCB Generator
OH	Hamilton	Cincinnati	General Electric Service Center	PCB Generator
OH	Hamilton	Cincinnati	USEPA Research Ctr	PCB Generator
OH	Hamilton	Cincinnati	USEPA Test Evaluation Fac	PCB Generator
OH	Hamilton	Cincinnati	Westinghouse Electric Corp.	PCB Generator
OH	Hamilton	Cincinnati	KDI Precision Products Inc.	PCB Generator
OH	Hamilton	Cincinnati	Spring Grove Resource Recovery	PCB Generator
OH	Hamilton	Cincinnati	The Electric Service Co., Inc.	PCB Generator
OH	Hamilton	Cincinnati	Westinghouse Electric Corp.	PCB Generator
OH	Hamilton	Cincinnati	City Of Hamilton	Manufacturing - Communication Equipment
OH	Hamilton	Fernald	US DOE Feed Materials Prod Ctr	PCB Generator
OH	Hamilton	Harrison	Hamilton Foundry & Machine Co.	PCB Generator
OH	Hamilton	North Bend	Cincinnati Gas & Electric Co.	Power Generator
OH	Hamilton	North Bend	Kaiser Aluminum & Chemical Co.	Manufacturing - Chemicals
OH	Hamilton		Electric Service Co, Inc.	PCB Generator
OH	Hardin	Kenton	Occidental Chem Corp.	PCB Generator
OH	Hardin	Kenton	United R Electric Inc.	PCB Generator
OH	Holmes	Millersburg	Holmes-Wayne Electric Coop Inc.	PCB Generator
OH	Jefferson	Brillant	Ohio Power Co.	Power Generator
OH	Jefferson	Brilliant	Tidd Power Plant	PCB Generator
OH	Jefferson	Mingo Junction	Wheeling Pittsburgh Steel Corp.	Manufacturing - Blast Furnaces & Steel Mills
OH	Jefferson	Steubenville	Weirton Steel Corporation	Manufacturing - Steel
OH	Jefferson	Steubenville	Wheeling-Pittsburgh Steel Corp.	Manufacturing - Blast Furnaces & Steel Mills
OH	Jefferson	Stratton	Ohio Edison Co.	Power Generator
OH	Jefferson	Stratton	Ohio Edison Co.	PCB Generator
OH	Jefferson	Sugar Grove	Columbia Gas	PCB Generator
OH	Jefferson	Sugar Grove	TCO-Crawford Compressor Sta	PCB Generator

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Appendix C – Potential PCB Sources in the Ohio River Basin Identified by Industry Type (PCS, 1997 And OEPA, 1997)*

State	County	City	Facility Name	Activity
OH	Jefferson	Toronto	Ohio Edison Co.	Power Generator
OH	Jefferson	Toronto	Ohio Edison Co.	PCB Generator
OH	Jefferson	Toronto	Titanium Metals Corp.	Manufacturing - Nonferrous Rolling & Drawing
OH	Jefferson	Yorkville	Wheeling Pittsburgh Steel Corp.	Manufacturing - Cold Finishing Of Steel Shapes
OH	Knox	Gambier	CGST	PCB Generator
OH	Knox	Mt Vernon	CGST	PCB Generator
OH	Lawrence	Ironton	Allied Signal	PCB Generator
OH	Lawrence	Ironton	Ironton Iron, Inc.	Manufacturing - Iron
OH	Lawrence	South Point	Ashland Oil Co., Inc.	Manufacturing - Chemicals
OH	Lawrence	South Point	Columbia Gas	PCB Generator
OH	Logan	Bellefontaine	Dayton Power & Light Co.	PCB Generator
OH	Logan	Bellefontaine	Logan County Coop	PCB Generator
OH	Logan	West Liberty	PMI Food- Equip Group (Hobart)	PCB Generator
OH	Madison	Plain City	RANCO Incorporated	Manufacturing - Relays & Industrial Controls
OH	Marion	Marion	Eaton-Forge Division	PCB Generator
OH	Marion	Marion	Ohio Edison Co.	PCB Generator
OH	Marion	Marion	Whirlpool Corp.	Manufacturing - Laundry Equipment
OH	Medina	Medina	CGST-Medina Compressor Sta.	PCB Generator
OH	Medina	Medina	CGST-York Compressor Station	PCB Generator
OH	Medina	Wadsworth	National Metal Abrasive, Inc.	PCB Generator
OH	Meigs	Pomeroy	CGST	PCB Generator
OH	Meigs	Racine	Ohio Power Co.	Power Generator
OH	Mercer	Celina	Celina Municipal Utilities	PCB Generator
OH	Mercer	Coldwater	Dayton Power & Light Co.	PCB Generator
OH	Miami	Piqua	Pioneer Rec	PCB Generator
OH	Miami	Tipp City	Tipp City Light Plant	PCB Generator
OH	Miami	Tipp City	A. O. Smith	Manufacturing - Motors & Generators
OH	Miami	Troy	Dayton Power & Light Co.	PCB Generator
OH	Miami	Troy	Hobart Corporation	PCB Generator
OH	Monroe	Hannibal	ORMET Corporation	PCB Generator

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Appendix C – Potential PCB Sources in the Ohio River Basin Identified by Industry Type (PCS, 1997 And OEPA, 1997)*

State	County	City	Facility Name	Activity
OH	Monroe	Lewisville	Texas Eastern Gas	PCB Generator
OH	Montgomery	Centerville	Dayton Power & Light Co.	PCB Generator
OH	Montgomery	Dayton	ACUSTAR Inc.	PCB Generator
OH	Montgomery	Dayton	Dayton Power & Light Co.	PCB Generator
OH	Montgomery	Dayton	Dayton Power & Light Co.	PCB Generator
OH	Montgomery	Dayton	Dayton Power & Light Co.	PCB Generator
OH	Montgomery	Dayton	Dayton PWR & Light Research Pk	PCB Generator
OH	Montgomery	Dayton	Dayton West Service Center	PCB Generator
OH	Montgomery	Dayton	Defense Electronics Supply Ctr	PCB Generator
OH	Montgomery	Dayton	Delco Moraine NDH	PCB Generator
OH	Montgomery	Dayton	General Motors Corp.	PCB Generator
OH	Montgomery	Dayton	General Motors Corp.	PCB Generator
OH	Montgomery	Dayton	High Voltage Maintenance Corp	PCB Generator
OH	Montgomery	Dayton	Mendelson Electronics	PCB Generator
OH	Montgomery	Dayton	Traffic Signal Shop	PCB Generator
OH	Montgomery	Dayton	Labinal Components, Inc.	Manufacturing - Motors & Generators
OH	Montgomery	Englewood	Dayton Power & Light Co.	PCB Generator
OH	Montgomery	Huber Heights	Dayton Power & Light Co.	PCB Generator
OH	Montgomery	Kettering	General Motors Corp.	PCB Generator
OH	Montgomery	Miamisburg	Dayton Power & Light Co.	PCB Generator
OH	Montgomery	Miamisburg	Dayton Power & Light Co.	PCB Generator
OH	Montgomery	Miamisburg	Hayden Environmental Group	PCB Generator
OH	Montgomery	Miamisburg	US DOE Mound	PCB Generator
OH	Montgomery	Moraine	General Motors Corp.	PCB Generator
OH	Montgomery	Moraine	General Motors Corp.	PCB Generator
OH	Muskingum	New Concord	Guernsey Muskingum Elec Coop	PCB Generator
OH	Muskingum	Zanesville	ARMCO Inc.	Manufacturing - Blast Furnaces & Steel Mills
OH	Muskingum	Zanesville	Burnham Corporation	Manufacturing - Iron Foundries
OH	Muskingum	Zanesville	McGraw-Edison Co.	Manufacturing - Transformers
OH	Perry	Somerset	Texas Eastern Gas	PCB Generator

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Appendix C – Potential PCB Sources in the Ohio River Basin Identified by Industry Type (PCS, 1997 And OEPA, 1997)*

State	County	City	Facility Name	Activity
OH	Pickaway	Circleville	P.P.G. Industries, Inc.	PCB Generator
OH	Pike	Piketon	USDOE Portsmouth Diffusion Plt	PCB Generator
OH	Preble	Eaton	Dayton Power & Light Co.	PCB Generator
OH	Richland	Lucas	CGST-Weaver Compressor Sta.	PCB Generator
OH	Richland	Lucas	Village Of Lucas Electric	PCB Generator
OH	Richland	Mansfield	CGST	PCB Generator
OH	Richland	Mansfield	Ohio Edison Co.	PCB Generator
OH	Richland	Mansfield	ARMCO Inc.	Manufacturing - Blast Furnaces & Steel Mills
OH	Richland	Mansfield	Ideal Electric Co.	Manufacturing - Motors & Generators
OH	Richland	Mansfield	Westinghouse Air Brake Co.	Manufacturing - Wiring Devices
OH	Richland	Shelby	Copperweld Corp	Manufacturing - Blast Furnaces & Steel Mills
OH	Scioto	Haverhill	Aristech Chemical Corporation	Manufacturing - Chemicals
OH	Scioto	Portsmouth	New Boston Coke Corp.	Manufacturing - Blast Furnaces & Steel Mills
OH	Scioto	Wheelersburg	Texas Eastern Gas	PCB Generator
OH	Shelby	Sidney	Dayton Power & Light Co.	PCB Generator
OH	Stark	Canton	Timken Co Harrison Steel Plnt	PCB Generator
OH	Stark	Canton	Buckhill Station	PCB Generator
OH	Stark	Canton	Ensr Corp.	PCB Generator
OH	Stark	Canton	Ford Motor Company	PCB Generator
OH	Stark	Canton	General Service Center	PCB Generator
OH	Stark	Canton	Wadsworth Alert Laboratories	PCB Generator
OH	Stark	Canton	Warren Cons Ind Metfab	PCB Generator
OH	Stark	Louisville	Magnetek Ohio Transformer	PCB Generator
OH	Stark	Louisville	J&L Speciality Steel, Inc.	Manufacturing - Cold Finishing Of Steel Shapes
OH	Stark	Massillon	Republic Engineered Steels	Manufacturing - Blast Furnaces & Steel Mills
OH	Stark	Massillon	National Feedscrew & Machining	PCB Generator
OH	Stark	Massillon	Ohio Edison Co.	PCB Generator
OH	Stark	Navarre	PSA Laboratory Services	PCB Generator
OH	Stark	North Canton	ENSECO-Wadsworth/Alert Lab	PCB Generator
OH	Stark		Mercury Stainless Inc	Manufacturing - Blast Furnaces & Steel Mills

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Appendix C – Potential PCB Sources in the Ohio River Basin Identified by Industry Type (PCS, 1997 And OEPA, 1997)*

State	**County**	**City**	**Facility Name**	**Activity**
OH	Summit	Akron	Loral Defense System	PCB Generator
OH	Summit	Akron	Ohio Edison Co.	PCB Generator
OH	Summit	Akron	Ohio Edison Co.	PCB Generator
OH	Summit	Akron	Ohio Edison Co.	PCB Generator
OH	Trumbull	Niles	Ohio Edison Co.	PCB Generator
OH	Trumbull	Niles	Warren Cons Industries	PCB Generator
OH	Trumbull	Niles	RMI Titanium Co.	Manufacturing - Nonferrous Rolling & Drawing
OH	Trumbull	Warren	Autumn Industries Inc.	PCB Generator
OH	Trumbull	Warren	Ohio Edison Co.	PCB Generator
OH	Trumbull	Warren	General Motors Corp.	PCB Generator
OH	Trumbull	Warren	CSC Industries Inc.	Manufacturing - Blast Furnaces & Steel Mills
OH	Trumbull	Warren	LTV Steel Co.	Manufacturing - Blast Furnaces & Steel Mills
OH	Trumbull	Warren	Thomas Steel Strip Corp.	Manufacturing - Cold Finishing Of Steel Shapes
OH	Trumbull	Warren	Warren Consolidated Industry	Manufacturing - Blast Furnaces & Steel Mills
OH	Tuscarawas	Dover	Armco Inc.	Manufacturing - Blast Furnaces & Steel Mills
OH	Union	Marysville	Dayton Power & Light Co.	PCB Generator
OH	Union	Marysville	Union Rural Elec Coop, Inc.	PCB Generator
OH	Vinton	Mcarthur	TCO-Mcarthur Compressor Sta	PCB Generator
OH	Washington	Belpre	Ohio Power Co.	Power Generator
OH	Washington	Belpre	Shell Chemical Co.	Manufacturing - Chemicals
OH	Washington	Beverly	Muskingum River Plant	PCB Generator
OH	Washington	Marietta	ELKEM Metals Co.	PCB Generator
OH	Washington	Marietta	American Municipal Pwr	PCB Generator
OH	Washington	Marietta	Marietta Polystyrene Plant	PCB Generator
OH	Washington	Marietta	Washington Elec Coop Whse	PCB Generator
OH	Wayne	Big Prairie	CGST Miley Compressor Station	PCB Generator
OH	Wayne	Orrville	Orrville Elec Util	PCB Generator
OH	Wayne	Wooster	CGST-Wooster Area Office	PCB Generator
OH	Wayne	Wooster	The Gerstenslager Company	PCB Generator
OH		Wells Twp	Ohio Power Co.	Power Generator

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Appendix C – Potential PCB Sources in the Ohio River Basin Identified by Industry Type (PCS, 1997 And OEPA, 1997)*

State	County	City	Facility Name	Activity
OH		Westville	CGST-Grove Regulating Station	PCB Generator
KY	Barren		Battery Properties Inc	Manufacturing - Primary Batteries
KY	Boone	Rabbit Hash	Cincinnati Gas & Electric Co.	Power Generator
KY	Boyd	Ashland	ARMCO Steel Co.	Manufacturing - Iron
KY	Boyd	Ashland	AK Steel Corp Coke Plant	Manufacturing - Blast Furnaces & Steel Mills
KY	Boyd	Catlettsburg	Ashland Oil Co., Inc.	Manufacturing - Chemicals
KY	Boyd	Catlettsburg	INCO Alloys International Inc	Manufacturing - Nonferrous Rolling & Drawing
KY	Boyd		AK Steel Corp West Works	Manufacturing - Blast Furnaces & Steel Mills
KY	Campbell	Wilders	Newport Steel Corp.	Manufacturing - Steel Pipe & Tubes
KY	Carroll	Carrollton	Kawneer Co., Inc.	Manufacturing - Metals
KY	Carroll	Ghent	Kentucky Utilities Co.	Power Generator
KY	Clark	Winchester	OSRAM Sylvania Inc	Manufacturing - Electric Lamps
KY	Daviess	Owensboro	Owensboro Municipal Utilities	Power Generator
KY	Daviess	Owensboro	W.R. Grace And Co.	Manufacturing - Plastics
KY	Daviess	Owensboro	Green River Steel Corp.	Manufacturing - Blast Furnaces & Steel Mills
KY	Greenup	Wurtland	E.I.Du Pont De Nemours & Co.	Manufacturing - Chemicals
KY	Hancock	Hawesville	Alumax Aluminum Corporation	Manufacturing - Aluminum
KY	Hancock	Hawesville	Big Rivers Electric Corp.	Power Generator
KY	Hancock	Hawesville	National Aluminum Corp.	Aluminum Casting
KY	Hancock	Hawesville	National Southwire Aluminum Co.	Manufacturing - Primary Aluminum
KY	Hancock	Lewisport	Commonwealth Aluminum	Manufacturing - Aluminum Rolling & Drawing
KY	Hardin	Elizabethtown	Superior Cable	Manufacturing - Telephone & Telegraph Apparatus
KY	Harlan	Dayhoit	Cooper Ind	Manufacturing - Motors & Generators
KY	Henderson	Henderson	Henderson Power & Light	Power Generator
KY	Henderson	Henderson	Unison Transformer Services	PCB Generator
KY	Henderson		ALCAN Ingot Sebree Aluminum	Manufacturing - Primary Aluminum
KY	Jefferson	Louisville	B.F. Goodrich Chemical Co.	Manufacturing - Resins & Rubber
KY	Jefferson	Louisville	Borden Chemical A&C	Manufacturing - Chemicals
KY	Jefferson	Louisville	Louisville Gas & Electric Co.	Power Generator
KY	Jefferson	Louisville	Louisville Gas & Electric Co.	Power Generator

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Appendix C – Potential PCB Sources in the Ohio River Basin Identified by Industry Type (PCS, 1997 And OEPA, 1997)*

State	County	City	Facility Name	Activity
KY	Jefferson	Louisville	Louisville Gas & Electric Co.	Power Generator
KY	Jefferson	Louisville	Louisville Gas & Electric Co.	Power Generator
KY	Jefferson	Louisville	Louisville Gas & Electric Co.	Power Generator
KY	Jefferson	Louisville	General Electric Co	Manufacturing - Electron Tubes
KY	Jefferson		Alpha Envir Services Inc	Manufacturing - Storage Batteries
KY	Jefferson		KY Assoc Of Electric Coop Inc	Manufacturing - Transformers
KY	Knox		Waitsboro Mfg	Manufacturing - Current-Carrying Wiring Devices
KY	Logan	Russellville	Btr Precision Die Casting Inc.	Manufacturing - Aluminum Foundries
KY	Madison		Yuasa-Exide Inc	Manufacturing - Storage Batteries
KY	Mason	Maysville	E. Kentucky Power Cooperative	Power Generator
KY	Mason	Maysville	Wald Manufacturing Co., Inc.	Electroplating Operation
KY	Mccracken	West Paduchah	Tennessee Valley Authority	Power Generator
KY	Meade	Bradenburg	Olin Corporation	Manufacturing - Chemicals
KY	Mercer	Burgin	Keystone Brush & Contact Co	Manufacturing - Carbon & Graphite Products
KY	Montgomery	Mount Sterling	A. O. Smith Electrical Prod	Manufacturing - Motors & Generators
KY	Russell		Superior Battery Mfg Co Inc	Manufacturing - Storage Batteries
KY	Woodford	Versailles	OSRAM Sylvania Inc	Manufacturing - Electric Lamps
IN	Clinton	Frankfort	Mallory Controls	Manufacturing - Relays & Industrial Controls
IN	Clinton	Frankfort	Mallory Controls, Emerson Elec	Manufacturing - Relays & Industrial Controls
IN	Dearborn	Lawrenceburg	Indiana & Michigan Power Co.	Power Generator
IN	Floyd	New Albany	PSI Energy	Power Generator
IN	Fountain	Attica	C & D Charter Power Systems	Manufacturing - Storage Batteries
IN	Gibson	Princeton	Hansen Manufacturing Co.	Manufacturing - Motors & Generators
IN	Grant	Marion	Thomson Consumer Electronics	Manufacturing - Electron Tubes
IN	Greene	Linton	General Electric Co.	Manufacturing - Motors & Generators
IN	Henry	New Castle	Allegheny Ludlum Steel	Manufacturing - Cold Finishing Of Steel Shapes
IN	Howard	Kokomo	Delco Electronics Corp.	Manufacturing - Semiconductors
IN	Jefferson	Madison	Indiana-Kentucky Electric Corp.	Power Generator
IN	Lawrence	Bedford	G.M. Corp., Powertrain Div.	Manufacturing - Aluminum Foundries
IN	Marion	Indianapolis	QUEMETCO (RSR Corporation)	Manufacturing - Secondary Nonferrous Metals

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State	County	City	Facility Name	Activity
IN	Monroe	Bloomington	ABB Power T & D Co., Inc.	Manufacturing - Electrical Apparatus
IN	Montgomery	Crawfordsville	Midstates Wire	Manufacturing - Steel Wire & Related Products
IN	Posey	Mt. Vernon	Babcock & Wilcox Co.	Manufacturing - Components
IN	Posey	Mt. Vernon	General Electric Co.	
IN	Spencer	Rockport	Indiana & Michigan Power Co.	Power Generator
IN	Tippecanoe	Lafayette	Aluminum Co. Of Am. (Alcoa)	Manufacturing - Secondary Metals
IN	Tippecanoe	West Lafayette	CTS Microelectronics, Inc.	Manufacturing - Semiconductors
IN	Vanderburgh	Evansville	Southern Indiana Gas & Electric Co.	Power Generator
IN	Vigo	Terre Haute	ALCAN Rolled Products Co.	Manufacturing - Aluminum
IN	Wabash	Wabash	Bulldog Battery Corporation	Manufacturing - Storage Batteries
IN	Warrick	Newburgh	Southern Indiana Gas & Electric Co.	Power Generator
IN	Warrick	Newburgh	Aluminum Co. Of Amer. (Alcoa)	Manufacturing - Primary Aluminum
IN	Wells	Bluffton	Indiana Acoustical Components	Manufacturing - Electron Tubes
IL	Massac	Joppa	Electric Energy, Inc.	Power Generator
IL	Vermilion	Danville Twp	Valmont Electric Inc.	Manufacturing - Transformers

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Appendix D - Sediment Data for Total PCBs, Total Organic Carbon and Sediment Particle Size

River	Mile Point	Date	Sample ID	Total PCBs (ppm)	TOC (%dry wt)	% sand (<2mm)	% silt (<53 um)	% clay (<2um)
Allegheny	2.1	8/13/2001	AL2.1-1-S	0.1028	5.4	76.8	16.3	6.9
Beaver	1.8	8/15/2001	BE1.8-1-S	0.2577	3.7	73.4	17.2	9.4
Big Sandy	1.8	9/5/2001	BS1.8-1-S	0.0445	5.7	14.3	59.9	25.8
Duck Creek	0.6	8/23/2001	DC0.6-1-ST	0.0022	1.9	2.8	54.6	42.6
Guyandotte	0.7	9/4/2001	GU0.7-1-S	0.0351	6.1	18.0	56.3	25.7
Hocking	2.1	8/28/2001	HK2.1-1-S	0.0288	1.4	32.2	47.1	20.7
Kanawha	3.1	8/30/2001	K3.1-1-S	0.0405	2.9	36.6	47.2	16.2
Little Kanawha	1.8	8/27/2001	LK1.8-1-S	0.0094	2.0	16.5	60.2	23.3
Monongahela	2.6	8/13/2001	MO2.6-1-S	5.5080	7.3	38.0	44.1	17.9
Muskingum	2.2	8/27/2001	MU2.2-1-S	0.0772	1.7	68.9	21.1	10.0
Ohio	1.0	8/13/2001	O1.0-1-ST	0.2893	6.2	66.0	22.9	11.1
Ohio	2.7	8/14/2001	O2.7-1-ST	0.1966	3.4	3.0	61.8	35.2
Ohio	3.3	8/14/2001	O3.3-1-ST	1.6118	5.3	64.8	23.0	12.2
Ohio	8.5	8/14/2001	O8.5-1-S	0.1713	4.9	60.6	25.8	13.6
Ohio	10.0	8/14/2001	O10.0-1-ST	0.2133	2.6	87.8	8.0	4.2
Ohio	12.8	8/14/2001	O12.8-1-S	0.1464	5.6	39.7	41.4	18.9
Ohio	12.8	8/14/2001	O12.8-1-SD	0.1733	5.1	41.9	38.6	19.5
Ohio	15.2	8/15/2001	O15.2-1-ST	0.1531	4.3	64.5	23.8	11.7
Ohio	16.1	8/15/2001	O16.1-1-ST	0.2570	5.2	31.2	46.4	22.4
Ohio	17.2	8/15/2001	O17.2-1-ST	0.1765	5.6	85.7	9.7	4.6
Ohio	22.2	8/15/2001	O22.2-1-ST	0.2138	6.7	53.0	32.3	14.7
Ohio	24.3	8/15/2001	O24.3-1-ST	0.1144	2.0	77.1	16.8	6.1
Ohio	24.6	8/15/2001	O24.6-1-ST	0.1722	5.4	56.7	31.2	12.1
Ohio	29.1	8/15/2001	O29.1-1-ST	0.5830	5.1	26.2	49.2	24.6
Ohio	29.1	8/15/2001	O29.1-1-STD	0.5617	5.3	27.7	47.9	24.4
Ohio	32.9	8/16/2001	O32.9-1-S	0.1682	5.0	21.8	49.4	28.8
Ohio	32.9	8/16/2001	O32.9-1-SD	0.1501	4.6	22.6	47.4	30.0
Ohio	36.3	8/16/2001	O36.3-1-S	4.7269	2.5	78.3	13.5	8.2
Ohio	42.3	8/16/2001	O42.3-1-S	0.1341	4.6	63.0	24.9	12.1

Appendix D - Sediment Data for Total PCBs, Total Organic Carbon and Sediment Particle Size

River	Mile Point	Date	Sample ID	Total PCBs (ppm)	TOC (%dry wt)	% sand (<2mm)	% silt (<53 um)	% clay (<2um)
Ohio	47.1	8/16/2001	O47.1-1-S	0.0480	4.4	38.3	43.9	17.8
Ohio	50.8	8/16/2001	O50.8-1-S	0.0457	3.2	39.0	43.2	17.8
Ohio	57.5	8/17/2001	O57.5-1-S	0.1293	3.9	22.6	53.2	24.2
Ohio	63.3	8/17/2001	O63.3-1-ST	0.3090	4.9	24.1	52.6	23.3
Ohio	69.6	8/17/2001	O69.6-1-ST	0.2007	5.7	63.1	24.5	12.4
Ohio	69.8	8/17/2001	O69.8-1-ST	0.1885	6.5	40.7	38.3	21.0
Ohio	71.4	8/17/2001	O71.4-1-ST	8.3838	7.1	40.0	49.0	11.0
Ohio	77.7	8/20/2001	O77.7-1-S	0.7727	4.8	60.2	26.0	13.8
Ohio	83.8	8/20/2001	O83.8-1-ST	0.1537	5.4	62.6	26.5	10.9
Ohio	88.1	8/20/2001	O88.1-1-S	0.1271	5.8	81.9	11.2	6.9
Ohio	90.8	8/20/2001	O90.8-1-ST	0.0319	3.1	20.5	52.4	27.1
Ohio	94.1	8/21/2001	O94.1-1-S	0.2348	7.8	40.0	41.7	18.3
Ohio	97.3	8/21/2001	O97.3-1-S	0.1447	5.7	57.3	27.9	14.8
Ohio	101.8	8/21/2001	O101.8-1-S	0.1270	4.8	64.8	24.3	10.9
Ohio	106.1	8/21/2001	O106.1-1-ST	0.4994	2.5	59.3	26.3	14.4
Ohio	106.1	8/21/2001	O106.1-1-STD	0.2014	3.2	59.8	25.8	14.4
Ohio	111.2	8/21/2001	O111.2-1-S	0.1114	4.7	53.9	31.0	15.1
Ohio	114.5	8/21/2001	O114.5-1-ST	0.0558	1.8	76.0	16.5	7.5
Ohio	119.8	8/21/2001	O119.8-1-S	0.1422	4.6	17.3	56.3	26.4
Ohio	122.9	8/21/2001	O122.9-1-ST	8.1547	8.2	29.3	51.1	19.6
Ohio	129.5	8/22/2001	O129.5-1-S	0.2034	4.0	58.8	28.2	13.0
Ohio	133.1	8/22/2001	O133.1-1-S	0.8276	4.5	45.7	37.5	16.8
Ohio	138.3	8/22/2001	O138.3-1-S	0.1225	5.3	44.8	43.7	11.5
Ohio	143.3	8/22/2001	O143.3-1-S	0.0525	2.2	74.8	18.3	6.9
Ohio	146.7	8/22/2001	O146.7-1-S	0.1567	4.6	30.3	48.4	21.3
Ohio	146.7	8/22/2001	O146.7-1-SD	0.1549	4.2	32.6	48.3	19.1
Ohio	152.2	8/23/2001	O152.2-1-S	0.0976	4.4	39.4	37.2	23.4
Ohio	158.1	8/23/2001	O158.1-1-S	0.1041	3.6	47.2	38.8	14.0
Ohio	164.0	8/23/2001	O164.0-1-ST	0.0744	3.0	42.0	42.9	15.1

Appendix D - Sediment Data for Total PCBs, Total Organic Carbon and Sediment Particle Size

River	Mile Point	Date	Sample ID	Total PCBs (ppm)	TOC (%dry wt)	% sand (<2mm)	% silt (<53 um)	% clay (<2um)
Ohio	164.0	8/23/2001	O164.0-1-STD	0.0654	2.8	41.0	43.9	15.1
Ohio	167.7	8/23/2001	O167.7-1-S	0.6901	5.1	46.8	37.3	15.9
Ohio	173.0	8/27/2001	O173.0-1-S	0.0376	1.9	31.4	49.1	19.5
Ohio	177.1	8/27/2001	O177.1-1-ST	0.0873	2.0	27.4	55.6	17.0
Ohio	182.2	8/27/2001	O182.2-1-ST	0.1473	1.5	51.5	34.5	14.0
Ohio	188.7	8/28/2001	O188.7-1-ST	0.0506	2.7	34.2	47.7	18.1
Ohio	188.7	8/28/2001	O188.7-1-STD	0.0446	2.3	46.5	39.9	13.6
Ohio	192.4	8/28/2001	O192.4-1-S	0.0916	3.0	35.1	46.4	18.5
Ohio	197.3	8/28/2001	O197.3-1-S	0.0692	2.4	28.8	46.4	24.8
Ohio	202.1	8/28/2001	O202.1-1-S	0.1313	2.1	50.1	36.0	13.9
Ohio	207.9	8/28/2001	O207.9-1-S	0.0195	1.0	83.5	9.9	6.6
Ohio	212.0	8/28/2001	O212.0-1-S	0.0190	0.6	86.3	9.1	4.6
Ohio	217.0	8/29/2001	O217.0-1-S	0.0497	1.4	62.1	24.2	13.7
Ohio	222.2	8/29/2001	O222.2-1-S	0.0161	1.1	56.2	29.3	14.5
Ohio	227.0	8/29/2001	O227.0-1-S	0.0656	2.7	44.9	35.3	19.8
Ohio	232.3	8/29/2001	O232.3-1-S	0.0385	1.1	69.6	20.6	9.8
Ohio	236.8	8/29/2001	O236.8-1-S	0.8864	3.1	33.4	44.4	22.2
Ohio	242.2	8/29/2001	O242.2-1-S	0.0688	2.0	58.4	28.9	12.7
Ohio	247.7	8/29/2001	O247.7-1-S	0.0211	2.3	28.1	46.9	25.0
Ohio	252.5	8/30/2001	O252.5-1-S	0.0659	2.6	55.4	29.2	15.4
Ohio	258.8	8/30/2001	O258.8-1-ST	0.0459	1.8	58.5	30.6	10.9
Ohio	258.8	8/30/2001	O258.8-1-STD	0.0380	1.8	56.9	33.0	10.1
Ohio	262.4	8/30/2001	O262.4-1-S	0.6013	2.2	43.5	39.3	17.2
Ohio	267.1	8/30/2001	O267.1-1-S	0.0282	3.8	31.0	48.0	21.0
Ohio	274.0	8/30/2001	O274.0-1-S	0.0537	2.3	42.6	42.5	14.9
Ohio	282.5	8/31/2001	O282.5-1-S	0.0368	2.6	45.4	42.4	12.2
Ohio	287.3	8/31/2001	O287.3-1-S	0.0358	3.0	40.6	43.7	15.7

Appendix D - Sediment Data for Total PCBs, Total Organic Carbon and Sediment Particle Size

River	Mile Point	Date	Sample ID	Total PCBs (ppm)	TOC (%dry wt)	% sand (<2mm)	% silt (<53 um)	% clay (<2um)
Ohio	292.2	8/31/2001	O292.2-1-S	0.0382	1.6	50.2	34.1	15.7
Ohio	298.1	8/31/2001	O298.1-1-S	0.0400	2.8	49.6	38.4	12.0
Ohio	301.0	9/4/2001	O301.0-1-S	0.0223	2.5	22.9	51.0	26.1
Ohio	301.0	9/4/2001	O301.0-1-SD	0.0217	2.4	23.8	52.3	23.9
Ohio	306.5	9/4/2001	O306.5-1-S	0.0301	5.5	57.7	27.2	15.1
Ohio	310.5	9/5/2001	O310.5-1-S	0.0585	2.5	69.5	21.6	8.9
Ohio	316.6	9/5/2001	O316.6-1-S	0.0377	2.9	35.2	37.7	27.1

Appendix E - Sediment Survey Duplicate Sample Data

River	Mile Point	Date	Sample ID	Total PCBs (ppm)	TOC (%dry wt)	% sand (<2mm)	% silt (<53 um)	% clay (<2um)
Ohio	12.8	8/14/2001	O12.8-1-S	0.146	5.61	39.7	41.4	18.9
Ohio	12.8	8/14/2001	O12.8-1-SD	0.173	5.07	41.9	38.6	19.5
Ohio	29.1	8/15/2001	O29.1-1-ST	0.583	5.14	26.2	49.2	24.6
Ohio	29.1	8/15/2001	O29.1-1-STD	0.562	5.31	27.7	47.9	24.4
Ohio	32.9	8/16/2001	O32.9-1-S	0.168	5.03	21.8	49.4	28.8
Ohio	32.9	8/16/2001	O32.9-1-SD	0.155	4.60	22.6	47.4	30.0
Ohio	106.1	8/21/2001	O106.1-1-ST	0.500	2.50	59.3	26.3	14.4
Ohio	106.1	8/21/2001	O106.1-1-STD	0.201	3.19	59.8	25.8	14.4
Ohio	146.7	8/22/2001	O146.7-1-S	0.157	4.56	30.3	48.4	21.3
Ohio	146.7	8/22/2001	O146.7-1-SD	0.155	4.15	32.6	48.3	19.1
Ohio	164.0	8/23/2001	O164.0-1-ST	0.074	2.97	42.0	42.9	15.1
Ohio	164.0	8/23/2001	O164.0-1-STD	0.065	2.82	41.0	43.9	15.1
Ohio	188.7	8/28/2001	O188.7-1-ST	0.051	2.71	34.2	47.7	18.1
Ohio	188.7	8/28/2001	O188.7-1-STD	0.045	2.33	46.5	39.9	13.6
Ohio	258.8	8/30/2001	O258.8-1-ST	0.046	1.83	58.5	30.6	10.9
Ohio	258.8	8/30/2001	O258.8-1-STD	0.038	1.82	56.9	33.0	10.1
Ohio	301.0	9/4/2001	O301.0-1-S	0.022	2.50	22.9	51.0	26.1
Ohio	301.0	9/4/2001	O301.0-1-SD	0.022	2.40	23.8	52.3	23.9

Appendix F – PCB Concentrations in Ambient Air

Location	**Date**	**Total PCBs**	**Units**
Stowe, PA	July-01	586	pg/m^3
Stowe, PA	October-01	616	pg/m^3
Stowe, PA	January-02	68	pg/m^3
Stowe, PA	April-02	426	pg/m^3
Weirton, WV	July-01	837	pg/m^3
Weirton, WV	October-01	428	pg/m^3
Weirton, WV	January-02	69	pg/m^3
Weirton, WV	April-02	303	pg/m^3
Moundsville, WV	July-01	520	pg/m^3
Moundsville, WV	October-01	209	pg/m^3
Moundsville, WV	January-02	145	pg/m^3
Moundsville, WV	April-02	175	pg/m^3
Marietta, OH	July-01	3,907	pg/m^3
Marietta, OH	October-01	1,380	pg/m^3
Marietta, OH	January-02	1,645	pg/m^3
Marietta, OH	April-02	1,540	pg/m^3
Racine, OH	October-01	194	pg/m^3
Racine, OH	January-02	337	pg/m^3
Racine, OH	April-02	69	pg/m^3
Huntington, WV	August-01	503	pg/m^3
Huntington, WV	October-01	569	pg/m^3
Huntington, WV	January-02	950	pg/m^3
Huntington, WV	April-02	120	pg/m^3