Section

E

Evaluating Beneficial Use: Human Health (Fish Contaminants)

E1. Background

The State of Ohio has operated a formal Fish Consumption Advisory (FCA) Program since 1993. Since July 2002, the program's technical and decision making expertise has been housed at the Ohio Environmental Protection Agency. The risk assessment protocols used were developed in the early 1990s under the auspices of the Great Lakes Governors Association.

Ohio has adopted human health water quality standards (WQS) criteria to protect the public from adverse impacts, both carcinogenic and non-carcinogenic, due to exposure via drinking water (applicable at public water supply intakes) and to exposure from the contaminated flesh of sport fish (applicable in all surface waters). The latter criterion is called the non-drinking water human health criterion. The purpose of that criterion is to ensure levels of a chemical in water do not bioaccumulate in fish to levels harmful to people who catch and eat the fish. The relationship of the non-drinking water human health criterion to the FCA risk assessment protocols is explained below.

E2. Rationale and Evaluation Method

U.S. EPA's guidance for preparing 2006 Integrated Report states:

> "Although the CWA does not explicitly direct the use of fish and shellfish consumption advisories or NSSP [National Shellfish Sanitation Program] classifications to determine attainment of water quality standards, states are required to consider all existing and readily available data and information to identify impaired segments on their section 303(d) lists. For purposes of determining whether a segment is impaired and should be included on a section 303(d) list, EPA considers a fish or shellfish consumption advisory, a NSSP classification, and the supporting data to be existing and readily available data and information that demonstrates non-attainment of a section 101(a) "fishable" use when:
>
> ✓ the advisory is based on fish and shellfish tissue data,
> ✓ a lower than "Approved" NSSP classification is based on water column and shellfish tissue data (and this is not a precautionary "Prohibited" classification or the state water quality standard does not identify lower than "Approved" as attainment of the standard),
> ✓ the data are collected from the specific segment in question, and
> ✓ the risk assessment parameters (e.g., toxicity, risk level, exposure duration and consumption rate) of the advisory or classification are cumulatively equal to, or less protective than those in the State's WQS" (U.S. EPA, 2005).

Ohio's WQS regulations do not describe human consumption of sport fish as an explicit element of aquatic life protection. However, the WQS do include human health criteria that are applicable to all surface waters of the State. Certain of these criteria are derived using assumptions about the bioaccumulation of chemicals in the food chain, and the criteria are intended to protect people from adverse health impacts that could arise from consuming fish caught in Ohio's waters. To determine when and how waters should be listed as impaired because of FCAs, the risk assessment parameters on which the human health WQS criteria are based were compared with those used in the Ohio FCA program. If the State has issued an advisory for a specific waterbody and that advisory is equal to or less protective than the State's WQS, then one can assume there is an exceedance of the WQS. On the other hand, if the

advisory is more protective than the WQS, one cannot assume that the issuance of the advisory indicates an exceedance of the WQS. Figure E-1 illustrates this point.

Figure E-1. Illustration of the relationship among the WQS values, the values that trigger issuance of FCAs and the resulting decision regarding waterbody impairment associated with an FCA.

A fish consumption advisory is determined based on the quantity of a chemical in fish, such as micrograms of chemical per kilogram of fish tissue (µg/kg). WQS, on the other hand, are expressed as the quantity of chemical in water, such as micrograms of chemical per liter of water (µg/l). The information used to calculate the human health non-drinking WQS criterion can be used to calculate a maximum safe fish concentration. The fish concentration value can then be directly compared to the FCA program values to determine whether the advisory is less or more protective than the WQS criterion. The values in Table E-1 make this comparison for chemicals for which there are both an FCA and an Ohio human health non-drinking water criterion. Because Ohio human health criteria differ between the Lake Erie and Ohio River basins, separate comparisons are presented.

Table E-1. Comparison between fish concentration values and FCA program values.

Basin / Parameter	Fish concentration on which the WQS is based [1]	Range of fish concentrations triggering an "eat no more than one meal per week" advisory	Range of fish concentrations triggering an "eat no more than one meal per month" advisory
Lake Erie / PCB	23 µg/kg	50 - 220 µg/kg	221 - 1,000 µg/kg
Ohio River / PCB	54 µg/kg	50 - 220 µg/kg	221 - 1,000 µg/kg
Lake Erie / mercury	350 µg/kg	110 - 220 µg/kg	221 - 1,000 µg/kg
Ohio River / mercury	1,000 µg/kg	110 - 220 µg/kg	221 - 1,000 µg/kg
Lake Erie / DDT	140 µg/kg	500 - 2,188 µg/kg	2,189 – 9,459 µg/kg
Ohio River / DDT	320 µg/kg	500 - 2,188 µg/kg	2,189 – 9,459 µg/kg
Lake Erie / Chlordane	130 µg/kg	500 - 2,188 µg/kg	2,189 – 9,459 µg/kg
Ohio River / Chlordane	310 µg/kg	500 - 2,188 µg/kg	2,189 – 9,459 µg/kg
Lake Erie / Hexachlorobenzene	29 µg/kg	800 - 3,499 µg/kg	3,500 - 15,099 µg/kg
Ohio River / hexachlorobenzene	67 µg/kg	800 - 3,499 µg/kg	3,500 - 15,099 µg/kg
Lake Erie/ mirex	88 µg/kg	200 - 874 µg/kg	875 - 3,783 µg/kg
Ohio River/ mirex	200 µg/kg	200 - 874 µg/kg	875 - 3,783 µg/kg

Values	Advisory is less protective than the WQS criterion, WQS exceeded, waterbody impaired
Values	Advisory is more protective than WQS criterion, WQS not exceeded, no impairment from FCA
Values	Advisory may be more, or less, protective than WQS criterion

[1] See Section E4 for an explanation of how these concentrations were calculated.

These constituents were chosen based on U.S. EPA's recommendations on page 53 of its 2006 Integrated Report Guidance (http://www.epa.gov/owow/tmdl/2006IRG/report/2006irg-sec5.pdf; U.S. EPA, 2006a). Hexachlorobenzene and mirex were added because of historic fish tissue contamination with those contaminants.

The table demonstrates that the levels of fish tissue contaminants that trigger a fish advisory have little obvious relation to the levels of fish tissue contaminants on which the WQS criteria are based. This discrepancy exists because different assumptions about fish consumption rates are made in calculating water quality standards than in issuing fish advisories. For example, the fish consumption rate used to calculate the Ohio River Basin WQS criteria is 17.5 grams per day. The fish consumption rate used to calculate a "one meal per week" advisory recommendation is 32.6 grams per day. These values are not the same because the WQS criteria fish consumption rates are based on nutritional studies that attempt to capture approximately how much sport caught fish people are eating, whereas the fish consumption advisory rates are meant to advise people how much fish they can safely consume.

U.S. EPA stipulates that the risk assessment parameters used to categorize fish tissue contaminant data must be at least as protective as those used in the WQS-based fish concentrations. Fish advisory contaminant levels are not directly related to the WQS criteria

contaminant levels, and in some cases are not as protective. Therefore, Ohio EPA has elected to directly compare fish tissue data with the WQS criteria calculations shown in the above table, instead of using advisory-based categorizations.

The following steps were utilized to determine a 303(d) list category for waters based on fish tissue contaminant data:

Step 1: Determine available data

All data in the fish tissue database were evaluated for the 2012 Integrated Report. The most recent 10 years of data collections, 2001-2010, were used for making category 1 and category 5 determinations. In cases where multiple years of data were available in that 10 year window, all data were weighted equally. In cases where the only data available were older than 2001, the category determined by those data became historical (i.e., impaired-historical, unimpaired-historical or insufficient data-historical).

Ohio's Credible Data Law states that all data greater than five years in age will be considered historical, and that it can be used as long as the Director has identified compelling reasons as to why the data are credible. In the case of fish tissue, the use of data older than five but ten or fewer years old is necessary.

The use of historical data is necessary because not enough fish tissue samples are gathered from enough locations each year to conduct a thorough assessment of contaminant levels in fish tissue across the state. Frequently, multiple sampling years are needed to make a determination about issuing or rescinding an advisory. Owing to limited staff time and budget resources, it sometimes takes over five years to revisit a location and collect more fish tissue samples. A more complete picture of contaminants in fish tissue is presented when data are utilized that reach back 10 years.

Step 2: Determine fish tissue contaminant concentrations

For streams in each assessment unit (AU)[1], a weighted average based on species and trophic level was calculated for each contaminant. One year of data was considered adequate to categorize the fish as impaired or unimpaired. Inland lakes are considered a component of the assessment unit(s) in which they are geographically located, so sample results may affect the assessment status of the AU(s) and the index scores for the AU(s). Inland lakes are also analyzed individually; results are displayed in Table E-10.

Step 3: Determine adequate species data

In order to assess an AU as category 1 or 5, at least four samples from that AU are needed, with at least two samples from each of trophic levels three and four. An exception was made for AUs with 10 or more samples from one trophic level and only one sample from the other trophic level.

A geometric mean was calculated for each species, and then a weighted average was calculated for each trophic level. A weighted average for each AU was then calculated using the consumption rates found in the water quality criteria calculations. That weighted average

[1] Assessment units include both watershed assessment units (12-digit hydrologic units) and large river assessment units (generally rivers that drain more than 500 square miles).

was then compared against the contaminant levels listed in Table E-2 and categorized as category 1 or 5.

In cases where those data requirements were not met, an AU was classified as category 3i. In cases where no data were available, an AU was classified as category 3.

This calculation methodology is derived from the methodology described in Section 4.3.2 of the document Guidance for Implementing the January 2001 Methylmercury Water Quality Criterion, Final, U.S. EPA Office of Science and Technology, EPA-823-R-09-002, January 2009 (http://www.epa.gov/waterscience/criteria/methylmercury/pdf/guidance-final.pdf).

Table E-2. Example data for calculating a weighted average fish tissue value.

Species	Trophic Level	Number of Samples	Geometric mean mercury concentration (mg/kg)
Black Crappie	3	1	0.085
Bluegill Sunfish	3	2	0.098
Channel Catfish	3	2	0.145
Common Carp	3	3	0.120
Largemouth Bass	4	3	0.212
Smallmouth Bass	4	1	0.421
Spotted Bass	4	1	0.347

For the Lake Erie Basin:

$$C_{avgLEB} = \frac{3.6 * C_3 + 11.4 * C_4}{15} = 0.27\ mg/kg$$

For the Ohio River Basin:

$$C_{avgORB} = \frac{11.8 * C_3 + 5.7 * C_4}{17.5} = 0.18\ mg/kg$$

Where:

C_3 = average concentration for trophic level 3
C_4 = average concentration for trophic level 4

Step 4: Determine appropriate assessment unit divisions

It should be recognized that in determining impairment status based on AUs instead of individual waterbodies, extrapolations to waterbodies without data are made. In some cases, waterbodies within an AU that have no data will be categorized as impaired.

Inland lakes are treated as individual waterbodies for impairment purposes regardless of whether they are entirely contained within an AU or straddle more than one AU and results for individual lakes are shown in Table E-10. In addition, any AU containing all or part of an impaired inland lake was considered to be not supporting the beneficial use (see Step 2 above for further explanation).

Step 5: Categorize waterbodies within assessment units

Category 5 – Impaired

Any AU meeting the data requirements in step 3 with a weighted average fish tissue concentration of PCBs, mercury, DDT, chlordane, or hexachlorobenzene above the WQS-based fish tissue concentration is placed into category 5. When the data indicating impairment are older than 10 years, the AU remains impaired but is considered impaired-historical, category 5h[2].

Category 1 – Not Impaired

To be categorized as category 1, not impaired, an AU must meet the data requirements in step 3, and the weighted average concentration of a contaminant must be below the threshold that would trigger an impairment. AUs that had previously been considered category 1, but with no data since 2001, were reclassified as Category 1h[2].

Category 3 – Insufficient or No Data

Any AU in which current data are available but those data are insufficient according to step 3 (to categorize the AU as category 1 or 5), the AU was listed as category 3i. If no data were available for an AU, the category was listed as 3. If an AU had previously been classified as category 3 or 3i, and there were no data in the AU since 2001, the AU was classified as category 3.

Please see Figure E-2 for a summary of the procedure detailed previously.

[2] An "h" subcategory could indicate one of two possibilities. In previous IRs, when Ohio reported on the larger assessment units, categories were assigned based on data collected anywhere in that unit. For the 2010 analysis, the 2008 category was assigned to each of the new, smaller units. If the original data were collected before 1999, a re-analysis of the data could not be completed for the 2010 report, so the smaller units retained the category of the larger unit. In some cases the data were collected within the smaller assessment unit and in other cases they were not. For the older data, a distinction between the two could not be made for this report. In addition, data collected in 1999 and 2000 are considered historical in the 2012 analysis.

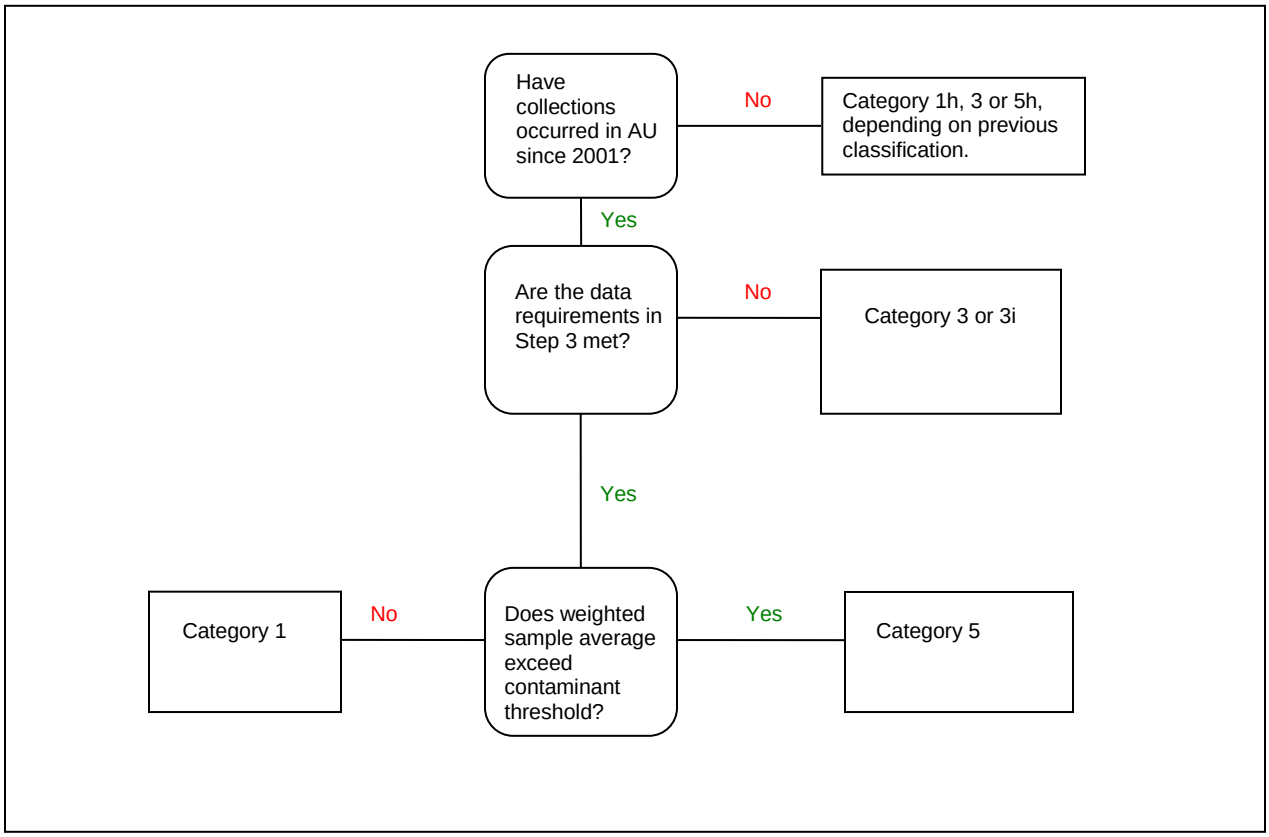


Figure E-2. Flow chart for the categorization of fish tissue data for the Integrated Report.

E3. Results

Fish tissue data for six contaminants were reviewed to determine an Integrated Report category. The methodology for selecting, reviewing, and categorizing fish tissue data is given in Section E2. The six contaminants reviewed were mercury, PCBs, chlordane, DDT, mirex and hexachlorobenzene. These contaminants were chosen for review based on current and recent fish consumption advisories in Ohio caused by these contaminants, as well as existing human health WQS criteria for the six contaminants.

Results are presented in Tables E-3 through E-10 and summarized in more detail by assessment unit at http://www.epa.ohio.gov/dsw/tmdl/2012IntReport/index.aspx. Detailed information on specific fish consumption advisories including geographic extent of the advisory, type and size of fish affected, and consumption advice can be found at http://www.epa.ohio.gov/dsw/fishadvisory/index.aspx.

For a statewide perspective, Table E-3 depicts aggregate state statistics for fish contaminant data compared to human health criteria. The stream and river information include both principal stream (50 to 500 square mile drainage) and large rivers (greater than 500 square miles drainage). The lake acres are the total based on publicly owned lakes greater than 5 acres.

Table E-3. Aggregate state statistics for fish contaminant data compared to human health criteria.

	Principal Wadeable Streams and Large Rivers (Miles)	Inland Lakes and Reservoirs (Acres)
All Ohio Miles/Acres	5,761	118,963
Miles/Acres Monitored	3,506	84,700
Miles/Acres Full Support	1,020 (29%)	52,472 (62%)
Miles/Acres Impaired	1,692 (48%)	19,594 (23%)
Miles/Acres Insufficient data	794 (23%)	12,634 (15%)

Table E-4 lists waters impaired because fish tissue levels of PCBs or mercury exceed the threshold level upon which the WQS criterion is based, while Table E-5 includes those not impaired. Table E-6 lists water bodies identified as impaired for this use on a previous 303(d) list that are no longer considered impaired, either because of new data or the updated methodology described in Section E1. There are ten WAUs in Ohio with significant pollution resulting in 303(d) listings from other contaminants that affect fish tissue, as shown in Table E-7. Remediation activities on most of these waterbodies are underway. In Table E-8, the data for all these locations have become historical and new data would need to be collected before a current impairment status can be determined. Since age of data alone is not a reason for delisting, the waterbodies remain on the 303(d) list. Table E-9 lists waters with current fish tissue data where inadequate samples exist to determine level of impairment. Table E-10 lists inland lake impairment status.

Table E-4. Waters not supporting the human health use because levels of PCBs or mercury in fish tissue exceed the threshold level upon which the WQS criterion is based.

Water Body	Assessment Unit	Pollutant
Baldwin Creek-East Branch Rocky River	04110001 02 02	PCBs
Beals Run-Indian Creek	05080002 08 03	PCBs
Beaver Creek to Maumee Bay-Maumee River	04100009 90 02	PCBs
Bell Creek-Muskingum River	05040004 08 08	PCBs
Bieler Run-Little Beaver Creek	05030101 06 10	PCBs
Big Darby Creek to Paint Creek-Scioto River	05060002 90 01	PCBs
Black River	04110001 06 02	PCBs
Blackwater Creek-Scioto River	05060002 04 06	PCBs
Blount Run-Muskingum River	05040004 03 05	PCBs
Blue Ridge Run-Tuscarawas River	05040001 18 04	PCBs
Boston Run-Cuyahoga River	04110002 04 05	PCBs
Boswell Run-Scioto River	05060002 13 04	PCBs
Brandywine Creek to mouth-Cuyahoga River	04110002 90 01	PCBs
Burgess Run-Yellow Creek	05030103 08 06	PCBs
Caesar Creek to O'Bannon Creek-Little Miami River	05090202 90 01	PCBs
Carroll Run-Scioto River	05060002 16 05	PCBs
Cat Creek-Muskingum River	05040004 12 03	PCBs
Charley Run Creek-Mahoning River	05030103 03 06	PCBs
Chippewa Creek to Sandy Creek-Tuscarawas River	05040001 90 01	PCBs
City of Canton-Middle Branch Nimishillen Creek	05040001 05 04	PCBs
City of Chillicothe-Paint Creek	05060003 10 03	PCBs
City of Cleveland-Cuyahoga River	04110002 06 05	PCBs
City of Dayton-Mad River	05080001 19 04	PCBs
City of Massillon-Tuscarawas River	05040001 12 02	PCBs
City of Warren-Mahoning River	05030103 06 03	PCBs
Clear Fork-East Branch St Joseph River	04100003 01 06	PCBs, Mercury
Cliff Creek-Paint Creek	05060003 06 03	PCBs
Coates Run-Hocking River	05030204 08 04	PCBs
Congress Run-Muskingum River	05040004 11 05	PCBs
Creager Cemetery-Maumee River	04100009 02 07	PCBs
Crooked Creek-Maumee River	04100009 09 03	PCBs
Crooked Creek-Walhonding River	05040003 09 08	PCBs
Cuyahoga Heights-Cuyahoga River	04110002 06 04	PCBs
Deer Creek	05030103 02 01	PCBs
Delaware Creek-Maumee River	04100009 09 04	PCBs
Devol Run-Muskingum River	05040004 12 04	PCBs
Dicks Creek	05080002 07 04	PCBs
Donnels Creek to mouth-Mad River	05080001 90 03	PCBs
Dorr Run-Hocking River	05030204 06 06	PCBs
Dry Run-Mahoning River	05030103 08 07	PCBs

Water Body	Assessment Unit	Pollutant
Dukes Run to mouth-Blanchard River	04100008 90 01	PCBs
Duncan Run-Muskingum River	05040004 08 03	PCBs
Dutch Run-Walhonding River	05040003 09 02	PCBs
Eagle Creek to Pennsylvania Border-Mahoning River	05030103 90 01	PCBs
East Branch Portage River	04100010 02 02	PCBs
Elk Creek-West Branch Black River	04110001 05 06	PCBs
Elk Run-Middle Fork Little Beaver Creek	05030101 04 05	PCBs
Fish Creek-Cuyahoga River	04110002 03 05	PCBs
Fish Creek-Mahoning River	05030103 01 03	PCBs
Flat Run-Mohican River	05040002 08 06	PCBs
Frost Run-Hocking River	05030204 10 04	PCBs
Gay Run-Big Darby Creek	05060001 22 02	PCBs
Grand Lake-St Marys	05120101 02 04	PCBs
Grant Run-Scioto River	05060001 23 03	PCBs
Griswold Creek-Chagrin River	04110003 04 02	PCBs
Grove Run-Scioto River	05060001 23 04	PCBs
Hamley Run-Hocking River	05030204 08 01	PCBs
Haskins Road Ditch-Maumee River	04100009 06 03	PCBs, Mercury
Headwaters Clear Fork Mohican River	05040002 03 01	PCBs
Headwaters Middle Fork Little Beaver Creek	05030101 04 02	PCBs
Headwaters Middle Sandusky River	04100011 04 03	PCBs
Heilman Ditch-Swan Creek	04100009 08 04	PCBs
Hollow Rock Run-Yellow Creek	05030101 08 04	PCBs
Howard Run-Blanchard River	04100008 03 04	PCBs
Huffman Dam-Mad River	05080001 19 03	PCBs
Indian Creek-Sandusky River	04100011 13 02	PCBs
Indiana Border to Tiffin River-Maumee River	04100005 90 01	PCBs
Island Creek-Mahoning River	05030103 02 04	PCBs
Jackson Ditch-East Branch Black River	04110001 04 04	PCBs
Jameson Creek-Whitewater River	05080003 08 10	PCBs
Ladue Reservoir-Bridge Creek	04110002 01 04	PCBs
Lake Rockwell-Cuyahoga River	04110002 02 03	PCBs
Lick Run-Scioto River	04110002 02 03	PCBs
Lick Run-Scioto River	05060002 05 03	PCBs
Licking River to Meigs Creek-Muskingum River	05040004 90 02	PCBs
L. Scioto River to Olentangy River-Scioto River	05060001 90 01	PCBs
Little Squaw Creek-Mahoning River	05030103 07 05	PCBs
Lizard Run-Big Darby Creek	05060001 22 04	PCBs
Long Run-Yellow Creek	05030101 07 04	PCBs
Lower Ashtabula River	04110003 01 05	PCBs
Lower Cross Creek	05030101 10 05	PCBs

Water Body	Assessment Unit	Pollutant
Lower Toussaint Creek	04100010 06 03	PCBs
Mad River to Fourmile Creek-Great Miami River	05080002 90 01	PCBs
Margaret Creek to mouth-Hocking River	05030204 90 02	PCBs
Meadow Run-Scioto River	05060002 11 05	PCBs
Meigs Creek to mouth-Muskingum River	05040004 90 03	PCBs
Mill Creek to mouth-Grand River	04110004 90 01	PCBs
Mohican River	05040002 90 01	PCBs
Moors Run-Scioto River	05060001 07 04	PCBs
Morgan Run-Tuscarawas River	05040001 19 04	PCBs
Mud Run-Tuscarawas River	05040001 18 02	PCBs
Mud Run-Walnut Creek	05060001 18 06	PCBs
Newman Run-Little Miami River	05090202 05 04	PCBs
North Branch Portage River	04100010 03 01	PCBs
O'Bannon Creek to mouth-Little Miami River	05090202 90 02	PCBs
Olentangy River to Big Darby Creek-Scioto River	05060001 90 02	PCBs
Olney Run-Muskingum River	05040004 08 09	PCBs
Opossum Creek-Great Miami River	05080002 01 06	PCBs
Ottawa Creek-Scioto River	05060001 05 05	PCBs
Paint Creek to Sunfish Creek-Scioto River	05060002 90 02	PCBs
Pancake Creek-Tuscarawas River	05040001 03 01	PCBs
Pike Run-Blanchard River	04100008 06 02	PCBs
Plumb Creek-Grand River	04110004 03 05	Mercury
Poe Run-Salt Creek	05060002 09 06	PCBs
Pone Run-Tuscarawas River	05040001 17 04	PCBs
Poplar Creek-Great Miami River	05080001 20 05	PCBs
Portage Lakes-Tuscarawas River	05040001 01 05	PCBs
Portage River	04100010 05 02	PCBs
Prairie Creek-St Marys River	04100004 02 05	PCBs
Preston Run-Maumee River	04100009 02 01	PCBs
Reasoners Run-Olive Green Creek	05040004 11 04	PCBs
Red Creek-Grand River	04110004 06 07	PCBs
Robinson Run-Muskingum River	05040004 03 01	PCBs
Rocky Fork	05040006 05 03	PCBs
Rocky Fork to mouth-Paint Creek	05060003 90 01	PCBs
Rough Run-Little Beaver Creek	05030101 06 09	PCBs
Salt Run-Little Miami River	05090202 09 03	PCBs
Sandy Creek to Stillwater Creek-Tuscarawas River	05040001 90 02	PCBs
Sawyer Brook-Cuyahoga River	04110002 01 06	PCBs
Scippo Creek	05060002 04 05	PCBs
Scott Creek to Margaret Creek-Hocking River	05030204 90 01	PCBs
Sibley Creek-Ottawa River	04100001 03 08	PCBs

Water Body	Assessment Unit	Pollutant
Silver Creek-Chippewa Creek	05040001 02 07	PCBs
Soldiers Run-Ohio Brush Creek	05090201 05 06	PCBs
Sour Run-Little Salt Creek	05060002 08 05	PCBs
Stillwater Creek to mouth-Tuscarawas River	05040001 90 03	PCBs
Stone Mill Run-Middle Fork Little Beaver Creek	05030101 04 03	PCBs
Stony Creek-Scioto River	05060002 10 05	PCBs
Sugar Creek-Duck Creek	05030201 09 04	PCBs
Sunfish Creek to mouth-Scioto River	05060002 90 03	PCBs
Switzer Creek-Clear Fork Mohican River	05040002 04 05	PCBs
Tarhe Run-Hocking River	05030204 04 04	PCBs
Tawawa Creek to Mad River-Great Miami River	05080001 90 01	PCBs
Tiffin River to Beaver Creek-Maumee River	04100009 90 01	PCBs
Town of Canal Fulton-Tuscarawas River	05040001 03 05	PCBs
Town of Jefferson-Mill Creek	04110004 04 03	Mercury
Town of New Miami-Great Miami River	05080002 07 06	PCBs
Town of Oakwood-Great Miami River	05080002 01 05	PCBs
Town of Upper Sandusky-Sandusky River	04100011 07 02	PCBs
Tusc./Wal. Confluence to Licking River-Muskingum River	05040004 90 01	PCBs
Tussing Ditch-Walnut Creek	05060001 18 02	PCBs
Village of Buckland-Auglaize River	04100007 02 02	PCBs
Village of Gilboa-Blanchard River	04100008 05 06	PCBs
Village of Mechanicsville-Grand River	04110004 06 03	PCBs
Wade Creek-Maumee River	04100009 02 03	PCBs
Walhonding River	05040003 90 01	PCBs
Whitewater River	05080003 90 01	PCBs
Willow Creek-Hocking River	05030204 10 01	PCBs
Willow Lake-Cuyahoga River	04110002 05 05	PCBs
Wingfoot Lake outlet-Little Cuyahoga River	04110002 03 03	PCBs
Wolf Creek-Tuscarawas River	05040001 12 03	PCBs
Wolf Creek to Sandusky Bay-Sandusky River	04100011 90 02	PCBs
Wolf Run-Tuscarawas River	05040001 12 04	PCBs
Yankee Run-St Marys River	04100004 03 03	PCBs

Table E-5. Waters fully supporting the human health use because fish tissue levels of PCBs or mercury are below the threshold level upon which the WQS criterion is based.

Water Body	Assessment Unit
Acton Lake Dam-Four Mile Creek	05080002 06 04
Alum Creek Dam-Alum Creek	05060001 14 04
Big Run	05040006 06 02
Big Run-Alum Creek	05060001 14 03
Booth Run-Pymatuning Creek	05030102 03 04
Brush Run-Kokosing River	05040003 04 03
Buckeye Lake	05040006 04 03
Bundle Run-Ohio Brush Creek	05090201 05 03
Canyon Run-Stillwater River	05080001 13 03
Center Branch	05030204 01 01
Charlemont Creek	04110001 05 01
City of Findlay Riverside Park-Blanchard River	04100008 02 05
Clarence J Brown Lake-Buck Creek	05080001 17 05
Cotton Run-Four Mile Creek	05080002 06 05
Deer Creek Lake-Deer Creek	05060002 02 05
Deer Creek-Blanchard River	04100008 06 05
Dillon Lake-Licking River	05040006 06 03
East Branch Kokosing River	05040003 01 02
East Branch Sunday Creek	05030204 07 01
East Fork Four Mile Creek-Four Mile Creek*	05080002 06 03
Forked Run-Ohio River	05030202 04 04
Franklin Branch-Rocky Fork*	05060003 05 05
Garbry Creek-Great Miami River	05080001 07 05
Green Creek	04100011 12 03
Greenville Creek to mouth-Stillwater River	05080001 90 02
Hayden Run-Scioto River	05060001 12 04
Headwaters Little Raccoon Creek	05090101 04 01
Headwaters North Branch Kokosing River	05040003 01 01
Headwaters Rocky Fork*	05060003 05 03
Hoover Reservoir-Big Walnut Creek	05060001 13 08
Indian Lake-Great Miami River	05080001 01 03
Jones Run-Stillwater River	05080001 14 04
Little Beaver Creek-Big Beaver Creek	05060002 13 03
Little East Fork-Ohio Brush Creek	05090201 05 01
Little Jelloway Creek	05040003 04 01
Little Yellow Creek	05030101 11 02
Lost Creek	04100007 03 05
Lower Bad Creek	04100009 03 02
Lower Caesar Creek	05090202 04 06
Lower Meander Creek	05030103 07 03

Water Body	Assessment Unit
Lower Town Creek	04100007 08 04
Lytle Creek*	05090202 06 03
Mile Run-Sandusky River	04100011 09 05
Mill Creek-Stillwater River	05080001 14 05
Mosquito Creek	05080001 07 02
Mouth Tymochtee Creek	04100011 06 05
Mud Creek	04100006 06 02
Mud Run-North Fork Paint Creek	05060003 08 05
Nimisila Reservoir-Nimisila Creek	05040001 03 02
Ninemile Creek-Sevenmile Creek	05080002 05 05
Norwalk Creek	04100012 06 03
O'Shaughnessy Dam-Scioto River	05060001 12 02
Peters Creek-Mill Creek	04110004 04 02
Rocky Fork Lake-Rocky Fork	05060003 05 04
Rush Run-Sevenmile Creek	05080002 05 04
Todd Run-East Fork Little Miami River	05090202 11 03
Town of Beamsville-Stillwater River	05080001 09 06
Town of Covington-Stillwater River	05080001 12 05
Town of Zaleski-Raccoon Creek	05090101 02 05
Turkey Run-Rush Creek	05030204 02 04
Tymochtee Creek to Wolf Creek-Sandusky River	04100011 90 01
Upper Little Stillwater Creek	05040001 15 03
Willow Creek-Sandusky River	04100011 11 03
Wills Creek Dam-Wills Creek	05040005 06 04
Wilson Creek-Cowan Creek	05090202 06 05

* based on historical data
Yellow text indicates WAUs that would be impaired if the U.S. EPA mercury criterion of 0.3 mg/kg were effective.

Table E-6. Waters fully supporting the human health use because fish tissue levels of PCBs or mercury are below the threshold level upon which the WQS criterion is based, and which were categorized as impaired in the 2010 Integrated Report.

Water Body	Assessment Unit	Reason for Delisting
Baker Creek-West Branch Rocky River	04110001 01 08	Methodology
Barron Creek-Little Darby Creek	05060001 20 05	Methodology
Beaver Run-Olentangy River	05060001 10 03	Methodology
Big Run-Auglaize River	04100007 09 04	Methodology
Big Run-Walnut Creek	05060001 18 05	New data
Blue Creek-Salt Creek	05060002 06 05	New data
Brandige Run-Olentangy River	05060001 10 05	Methodology
Bronson Creek-Grand River	04110004 05 02	Methodology
Claypool Run-Whetstone Creek	05060001 09 03	Methodology
Clear Fork	05030204 06 01	Methodology
Coon Creek-East Branch Black River	04110001 03 03	Methodology

Water Body	Assessment Unit	Reason for Delisting
Cossett Creek-West Branch Rocky River	04110001 01 06	Methodology
Deep Run-Olentangy River	05060001 11 01	Methodology
Delaware Run-Olentangy River	05060001 10 07	Methodology
Dry Run-Auglaize River	04100007 01 05	Methodology
Gander Run-Scioto River	05060001 04 01	Methodology
Greenbrier Creek-Big Darby Creek	05060001 22 03	Methodology
Harper Run-Hocking River	05030204 06 05	Methodology
Headwaters Hocking River	05030204 04 01	Methodology
Headwaters Olentangy River	05060001 08 01	Methodology
Headwaters Walnut Creek	05060001 17 02	Methodology
Headwaters West Fork Duck Creek	05030201 09 01	Methodology
Headwaters Whetstone Creek	05060001 09 02	Methodology
Hellbranch Run	05060001 22 01	Methodology
Indian Run-Olentangy River	05060001 10 06	Methodology
Jug Run-Wakatomika Creek	05040004 01 04	Methodology
Kirwin Reservoir-West Branch Mahoning River	05030103 03 04	New data
Lesley Run-Twin Creek	05080002 02 05	Methodology
Lima Reservoir-Ottawa River	04100007 03 06	Methodology
Little Sandusky River	04100011 07 01	Methodology
Middle Ashtabula River	04110003 01 04	Methodology
Middle Rock Creek	04110004 02 02	Methodology
Mogadore Reservoir-Little Cuyahoga River	04110002 03 02	New data
Mouth Olentangy River	05060001 11 03	Methodology
Mud Brook	04110002 04 01	Methodology
Nettle Creek	04100003 03 01	Methodology
Pymatuning Reservoir	05030102 01 05	New data
Rush Run-Olentangy River	05060001 11 02	Methodology
Seymour Run-Black Fork	05040002 02 02	Methodology
Silver Ditch-Big Darby Creek	05060001 21 02	Methodology
Sims Run-Auglaize River	04100007 02 03	Methodology
Sixmile Creek-Auglaize River	04100007 02 04	Methodology
Thomas Ditch-Little Darby Creek	05060001 20 06	Methodology
Town of Frazeysburg-Wakatomika Creek	05040004 02 04	Methodology
Town of Germantown-Twin Creek	05080002 03 06	Methodology
Town of Gratis-Twin Creek	05080002 03 04	Methodology
Town of La Rue-Scioto River	05060001 04 05	Methodology
Town of Washington Court House-Paint Creek	05060003 01 03	Methodology
Town of Willshire-St Marys River	04100004 03 05	Methodology
West Branch St Joseph River	04100003 02 04	Methodology
Worthington Ditch-Big Darby Creek	05060001 21 01	Methodology

Yellow text indicates WAUs that would be impaired if the U.S. EPA mercury criterion of 0.3 mg/kg were effective.

Table E-7. Waters with contaminants that affect fish tissue, not included in Table E-2 for these pollutants (included on the 303(d) list).

Water Body	Assessment Unit	Pollutant
Blue Ridge Run-Tuscarawas River	05040001 18 04	Hexachlorobenzene
City of Massillon-Tuscarawas River	05040001 12 02	Hexachlorobenzene
Headwaters Middle Fork Little Beaver Creek	05030101 04 02	Mirex
Morgan Run-Tuscarawas River	05040001 19 04	Hexachlorobenzene
Mud Run-Tuscarawas River	05040001 18 02	Hexachlorobenzene
Pone Run-Tuscarawas River	05040001 17 04	Hexachlorobenzene
Stone Mill Run-Middle Fork Little Beaver Creek	05030101 04 03	Mirex
Sugar Creek-Duck Creek	05030201 09 04	DDTs
Wolf Creek-Tuscarawas River	05040001 12 03	Hexachlorobenzene
Wolf Run-Tuscarawas River	05040001 12 04	Hexachlorobenzene

Table E-8. Waters for which the existing impaired status cannot be confirmed because data have become historical and not enough new data are available.
Note: The waters remain on the 303(d) list.

Water Body	Assessment Unit
Black Run-Wakatomika Creek	05040004 02 01
Bogles Run-Mad River	05080001 16 07
Brandywine Creek-Great Miami River	05080001 03 06
Brush Creek	04100006 05 02
Camp Creek-Eagle Creek	05030103 04 03
Chocolate Run-Mahoning River	05030103 04 06
City of Medina-West Branch Rocky River	04110001 01 05
Dilworth Run-North Fork Little Beaver Creek	05030101 06 07
Dry Run-Wolf Creek	05080002 01 03
East Creek-West Branch Black River	04110001 05 02
Farmers Run-Paint Creek	05060003 06 02
Findlay Upground Reservoirs-Blanchard River	04100008 02 03
Fourmile Creek-St Marys River	04100004 01 06
French Creek	04110001 06 01
Glade Run-Scioto River	05060001 04 06
Glady Creek-Mad River	05080001 15 04
Headwaters East Branch Rocky River	04110001 02 01
Headwaters Grand River	04110004 01 02
Headwaters Lower Sandusky River	04100011 04 05
Headwaters Tuscarawas River	05040001 01 01
Indian Creek-Paint Creek	05060003 06 01
Kings Creek	05080001 15 03
Little Wakatomika Creek	05040004 02 03
McIntyre Creek	05030101 10 04
Middle Cross Creek	05030101 10 03

Water Body	Assessment Unit
Mill Creek-Grand River	04110004 03 03
Mouth Eagle Creek	05030103 04 05
Mouth Vermilion River	04100012 02 04
New London Upground Reservoir-Vermilion River	04100012 01 04
New Years Creek-Duck Creek	05030201 09 03
Outlet Rocky Fork	05040002 02 04
Pondy Creek-Mad River	05080001 18 02
Queer Creek	05060002 09 02
Rennick Creek-Great Miami River	05080001 03 02
Ripley Run-Blanchard River	04100008 01 05
Robinson Run-Big Darby Creek	05060001 19 05
Rock Run-Mad River	05080001 18 05
Rocky River	04110001 02 03
Salt Creek-East Branch Black River	04110001 04 02
Sherrick Run-Nimishillen Creek	05040001 05 05
Spain Creek-Big Darby Creek	05060001 19 02
Spruce Creek-Shade River	05030202 03 04
Stoney Creek	05080001 04 03
Sugar Creek	04100007 05 01
Sugar Run-Sandusky River	04100011 07 05
Tommy Run-Chippewa Creek	05040001 02 05
Town Fork	05030101 08 01
Town of Caledonia-Olentangy River	05060001 08 04
Town of Carroll-Walnut Creek	05060001 17 05
Town of Litchfield-East Branch Black River	04110001 04 01
Town of Newton Falls-West Branch Mahoning River	05030103 03 05
Town of Oakwood-Auglaize River	04100007 09 07
Turkeyfoot Creek-Great Miami River	05080001 04 06
Upper Ashtabula River	04110003 01 03
Upper Tousant Creek	04100010 06 01
Village of Eagle Mills-Salt Creek	05060002 09 05
Wellington Creek	04110001 05 03
West Branch Nimishillen Creek	05040001 05 03
West Fork Mill Creek	05090203 01 02
West Sippo Creek-Tuscarawas River	05040001 03 09
Wolf Creek-Scioto River	05060001 04 03

Table E-9. Waters with current fish tissue data where inadequate samples exist to determine impairment status.

Water Body	Assessment Unit
Barren Creek-Raccoon Creek	05090101 06 02
Baughman Run-Tymochtee Creek	04100011 06 02
Beach City Reservoir-Sugar Creek	05040001 11 03
Biers Run-North Fork Paint Creek	05060003 09 04
Big Creek	04110004 06 06
Big Run-Black Fork Mohican River	05040002 08 03
Big Run-Federal Creek	05030204 09 05
Big Run-Flatrock Creek	04100007 12 06
Big Run-Scioto River	05060002 16 02
Black Fork	05090101 08 02
Buckeye Creek	05060002 08 02
Calico Creek-Muchinippi Creek	05080001 02 04
Cessna Ditch-Middle Branch Portage River	04100010 02 05
City of Marion-Little Scioto River	05060001 03 03
City of Springfield-Buck Creek	05080001 17 06
Clough Creek-Little Miami River	05090202 14 06
Coffee Run-Mahoning River	05030103 08 09
Crane Run-Buffalo Fork	05040005 02 05
Darling Run-Walhonding River	05040003 09 05
Davids Run-Scioto River	05060001 05 02
Delano Run-Kokosing River	05040003 03 04
Depue Run-Seneca Fork	05040005 01 04
Dry Run-Little Miami River	05090202 14 05
Dudley Run-Rush Creek	05060001 02 03
Enoch Creek-Tymochtee Creek	04100011 05 09
Factory Creek-Margaret Creek	05030204 08 03
Flat Run-Muskingum River	05040004 08 02
Frink Run	04100012 05 03
Granny Creek-Kokosing River	05040003 02 03
Grassy Creek	04100009 09 02
Greasy Run-Sycamore Creek	04100011 09 03
Hardin Creek-Beaver Creek	05120101 03 02
Headwaters Black Fork Mohican River	05040002 01 02
Headwaters Collins Fork	05040005 02 02
Headwaters Little Hocking River	05030202 01 03
Headwaters Little Rush Creek	05030204 02 01
Headwaters Little Scioto River	05060001 03 02
Headwaters Margaret Creek	05030204 08 02
Headwaters Rush Creek	05030204 01 02
Headwaters Wabash River	05120101 01 01

Water Body	Assessment Unit
Headwaters Yellow Creek	05030103 08 05
Horner Run-Little Miami River	05090202 14 03
Horse Creek-Little Salt Creek	05060002 08 03
Indian Creek-Little Rush Creek	05030204 02 02
Indianfield Run-Kokosing River	05040003 03 07
Jerome Fork-Mohican River	05040002 06 05
Job Run-North Branch Kokosing River	05040003 01 03
Kian Run-Scioto River	05060001 23 02
Lapp Ditch-Auglaize River	04100007 09 05
Lee Creek-Ohio River	05090201 08 04
Lick Creek-Maumee River	04100009 05 10
Lick Fork	05090201 05 02
Little Lost Creek-Lost Creek	05080001 08 04
Lower Moxahala Creek	05040004 05 04
Lower Muddy Fork Mohican River	05040002 05 03
Lower South Fork Sugar Creek	05040001 10 05
Manns Fork Salt Creek	05040004 06 05
Marsh Run-Conneaut Creek	04120101 06 05
Middle East Fork Duck Creek	05030201 08 03
Middle Fork Salt Creek	05060002 07 02
Middle Mosquito Creek	05030103 05 02
Middle Muddy Fork Mohican River	05040002 05 02
Mouth Clear Creek	05030204 03 02
Negro Run-Mohican River	05040002 08 05
North Chaney Ditch-Maumee River	04100005 02 02
O'Bannon Creek	05090202 09 02
Otter Creek-Frontal Lake Erie	04100010 07 06
Patterson Creek-West Fork Little Beaver Creek	05030101 05 04
Peters Creek-Crooked Creek	05040005 05 03
Piper Run-Hocking River	05030204 10 02
Pleasant Run-Honey Creek	05080001 20 04
Raccoon Creek	04100011 02 04
Rader Creek	04100010 01 01
Rhodes Ditch-South Branch Portage River	04100010 02 04
Rocky Ford	04100010 01 03
Sigafoos Run-Mohican River	05040002 08 04
Snooks Run-Maumee River	04100005 02 08
South Fork Captina Creek	05030106 09 02
Squaw Creek	05030103 07 04
Sterling Run	05090201 10 01
Talcott Creek-Grand River	04110004 06 05

Water Body	Assessment Unit
Thorn Run-Sandusky River	04100011 09 04
Town of Bloomdale-South Branch Portage River	04100010 02 03
Town of Irvington-Stillwater River	05080001 14 06
Town of Perrysville-Black Fork Mohican River	05040002 08 02
Town of Rudolph-Middle Branch Portage River	04100010 01 04
Town of Willoughby-Chagrin River	04110003 04 03
Turkey Run-Deer Creek	05060002 01 06
Upper McMahon Creek	05030106 07 02
Village of Napoleon-Maumee River	04100009 02 06
Walnut Creek-West Branch Huron River	04100012 04 03

Table E-10. Inland lakes and their impairment status.

Water Body	Impairment Status (cause)
Acton Lake	Not Impaired
Adams Lake	Insufficient data
Alum Creek Reservoir	Not Impaired
Amick Reservoir	Insufficient data
Apple Valley Lake	Not Impaired
Archbold Reservoir #2	Insufficient data
Barnesville Reservoir #3	Insufficient data
Beach City Reservoir	Insufficient data
Beaver Creek Reservoir	Not Impaired
Bellevue Reservoir #5	Insufficient data
Belmont Lake	Insufficient data
Berlin Reservoir	**Impaired (PCBs)**
Buckeye Lake	Not Impaired
Bucyrus Reservoir #2	Not Impaired
Burr Oak Reservoir	Not Impaired
CJ Brown Reservoir	Not Impaired
Caesar Creek Lake	Not Impaired
Caldwell Lake	Insufficient data
Charles Mill Reservoir	Not Impaired
Clark Lake	Insufficient data
Clear Fork Reservoir	**Impaired (PCBs)**
Cowan Lake	Not Impaired
Cutler Lake	Insufficient data
Dale Walborn Reservoir	Not Impaired
Daugherty Lake	Insufficient data
Deer Creek Reservoir (Scioto basin)	Not Impaired
Deer Creek Reservoir (Mahoning basin)	**Impaired (PCBs)**
Delaware Reservoir	Not Impaired

Water Body	Impairment Status (cause)
Delta Reservoir #1	Insufficient data
Delta Reservoir #2	Insufficient data
Dillon Lake	Not Impaired
Dow Lake	Not Impaired
East Fork Lake	Not Impaired
East Reservoir	Insufficient data
Eastwood Lake	Insufficient data
Findlay Reservoir #1	Insufficient data
Findlay Reservoir #2	Insufficient data
Findley Lake State Park	Insufficient data
Forked Run Lake	Not Impaired
Fostoria #3	Insufficient data
Fox Lake	Insufficient data
Friendship Park Lake	Insufficient data
Grand Lake St. Marys	**Impaired (PCBs)**
Grant Lake	Insufficient data
Greenfield Lake	Not Impaired
Griggs Reservoir	Not Impaired
Hammertown Lake	Insufficient data
Hargus Lake	Insufficient data
Highlandtown Lake	Not Impaired
Hinckley Lake	Insufficient data
Hoover Reservoir	Not Impaired
Indian Lake	Not Impaired
Jackson Lake	Insufficient data
Jefferson Lake	Insufficient data
Killdeer Pond #30	Not Impaired
Killdeer Reservoir	Insufficient data
Kiser Lake	Not Impaired
Knox Lake	Not Impaired
Kokosing Lake	Insufficient data
LaDue Reservoir	**Impaired (PCBs)**
Lake Alma	Not Impaired
Lake Ann	Insufficient data
Lake Girard	Insufficient data
Lake Hamilton	Impaired
Lake Hope	Not Impaired
Lake Jisco	Insufficient data
Lake Katherine	Insufficient data
Lake LaSuAn	Insufficient data
Lake LaComte	Insufficient data

Water Body	Impairment Status (cause)
Lake Lavere	Insufficient data
Lake Logan	Not Impaired
Lake Mel	Insufficient data
Lake Milton	**Impaired (PCBs)**
Lake Rupert	Not Impaired
Lake Snowden	Insufficient data
Lake Sue	Insufficient data
Lake Wood Duck	Insufficient data
Lamberjack Lake	Insufficient data
Lima Lake	Insufficient data
Long Lake	Insufficient data
Lost Creek Reservoir	Not Impaired
Madison Lake	Insufficient data
McComb Reservoir #1	Insufficient data
McComb Reservoir #2	Insufficient data
Meadowbrook Lake	Not Impaired
Meander Creek Reservoir	Not Impaired
Metzger Reservoir	Insufficient data
Mogadore Reservoir	Not Impaired
Mosier Lake	Insufficient data
Mosquito Lake	Insufficient data
North Fork Kokosing Reservoir	Not Impaired
Nesmith Lake	**Impaired (PCBs)**
Nettle Lake	Not Impaired
New Lexington Reservoir	Insufficient data
New London Reservoir	Insufficient data
New Lyme Lake	Not Impaired
Nimisila Reservoir	Not Impaired
North Baltimore	Insufficient data
Norwalk Reservoir #3	Not Impaired
Oakthorpe Lake	Insufficient data
O'Shaughnessy Reservoir	Insufficient data
Oxbow Lake	Not Impaired
PJ Outhwaite Reservoir	Insufficient data
Paint Creek Lake	Not Impaired
Paulding Reservoir	Insufficient data
Pike Lake	Not Impaired
Pine Lake	Insufficient data
Pleasant Hill Reservoir	Not Impaired
Powers Reservoir	Insufficient data
Punderson Lake	Not Impaired

Water Body	Impairment Status (cause)
Pymatuning Reservoir	Not Impaired
Raccoon Creek Reservoir	Insufficient data
Rock Mill Reservoir	Insufficient data
Rocky Fork Lake	Not Impaired
Rose Lake	Insufficient data
Ross Lake	Not Impaired
Rush Creek Lake	Insufficient data
Schoonover Reservoir	**Impaired (Mercury)**
Seneca Lake	Insufficient data
Shelby Reservoir #3	Insufficient data
St. Joseph Lake	Not Impaired
Summit Lake	Not Impaired
Tappan Reservoir	Not Impaired
Tycoon Lake	Insufficient data
Upper Sandusky Reservoir	Insufficient data
Van Wert Reservoir #1	Insufficient data
Van Wert Reservoir #2	Insufficient data
Veteran's Memorial (Portage basin)	Not Impaired
Veteran's Memorial (Maumee basin)	Not Impaired
Veto Lake	Insufficient data
Wabash Reservoir	Insufficient data
Wellington Upground Reservoir	Not Impaired
West Branch Reservoir	Not Impaired
Westville Lake	**Impaired (PCBs)**
Willard Reservoir	Insufficient data
Wills Creek Reservoir	Not Impaired
Wingfoot Lake	Not Impaired
Wolf Run Lake	Insufficient data

Yellow text indicates WAUs that would be impaired if the U.S. EPA mercury criterion of 0.3 mg/kg were effective.
Bold text indicates impaired lakes.

E4. Supplemental Information

E4.1 Calculation of Fish Concentrations from Water Quality Standards Inputs

For carcinogens:

$$Fish\ Concentration\left(mg/kg\right)=\frac{\left[\frac{Cancer\ Risk\ Level}{q1^{*}\left(mg/kg/d\right)^{-1}}\right]\times Body\ Weight\left(kg\right)}{Fish\ Consumption\left(kg/d\right)}$$

For noncarcinogens:

$$\text{Fish Concentration}\left(mg/kg\right)=\frac{\text{RfD}\left(mg/kg/d\right)\times\text{Body Weight}\left(kg\right)\times\text{RSC}}{\text{Fish Consumption}\left(kg/d\right)}$$

For wildlife:

$$\text{Fish Concentration}\left(mg/kg\right)=\text{Wildlife WQC}\left(mg/L\right)\times BAF\,TL_{n}\left(L/kg\right)$$

Lake Erie Drainage Basin

	Mercury	Chlordane	DDT	PCBs	Hexachloro-benzene	Mirex
HHWQC	3.1 ng/L	2.4 µg/L	0.15 ng/L	0.026 ng/L	0.45 ng/L	0.074 ng/L
Wildlife Criteria	1.3 ng/L	N/A	0.011 ng/L	0.12 ng/L	N/A	N/A
The following inputs on which the WQS are based are used to calculate fish concentrations:						
Reference Dose (RfD)	1E-04 mg/kg/d	N/A	N/A	N/A	N/A	N/A
Slope Factor (q1*)	N/A	0.35 $(mg/kg/d)^{-1}$	0.34 $(mg/kg/d)^{-1}$	2.0 $(mg/kg/d)^{-1}$	1.6 $(mg/kg/d)^{-1}$	0.53 $(mg/kg/d)^{-1}$
Cancer Risk Level	N/A	1E-05	1E-05	1E-05	1E-05	1E-05
Body Weight	65 kg	70 kg	70 kg	70 kg	70 kg	70 kg
Trophic Level Three Bioaccumulation Factor (BAF TL^3)	27,900	116,600	376,400	520,900	43,690	353,000
Trophic Level Four Bioaccumulation Factor (BAF TL^4)	140,000	154,200	1,114,000	1,871,000	71,080	1,461,000
Fish Consumption	0.015 kg/d	0.015 kg/d	0.015 kg/d	0.015 kg/d	0.015 kg/d	0.015 kg/d
Relative Source Contribution Factor (RSC)	0.8	N/A	N/A	N/A	N/A	N/A

Source: U.S. EPA. 1995. Great Lakes Water Quality Initiative Criteria Documents for the Protection of Human Health. EPA-820-B-95-006. March 1995.

Derivation of Concentrations

Lake Erie Drainage Basin Mercury Human Health Fish Concentration

$$\frac{1E-04\,(mg/kg/d) \times 65\,(kg) \times 0.8}{0.015\,(kg/d)} = 0.35\,(mg/kg) = 350\,(\mu g/kg)$$

Lake Erie Drainage Basin Mercury Wildlife Fish Concentration

Trophic Level 3:

$$1.3E-06\,(mg/L) \times 27{,}900\,(L/kg) = 0.036\,(mg/kg) = 36\,(\mu g/kg)$$

Trophic Level 4:

$$1.3E-06\,(mg/L) \times 140{,}000\,(L/kg) = 0.18\,(mg/kg) = 180\,(\mu g/kg)$$

Lake Erie Drainage Basin Chlordane Human Health Fish Concentration

$$\frac{\left[\frac{1E-05}{0.35\,(mg/kg/d)}\right] \times 70\,(kg)}{0.015\,(kg/d)} = 0.13\,(mg/kg) = 130\,(\mu g/kg)$$

Lake Erie Drainage Basin DDT Human Health Fish Concentration

$$\frac{\left[\frac{1E-05}{0.34\,(mg/kg/d)}\right] \times 70\,(kg)}{0.015\,(kg/d)} = 0.14\,(mg/kg) = 140\,(\mu g/kg)$$

Lake Erie Drainage Basin DDT Wildlife Fish Concentration

Trophic Level 3:

$$1.1E-08\,(mg/L) \times 376{,}400\,(L/kg) = 0.0041\,(mg/kg) = 4.1\,(\mu g/kg)$$

Trophic Level 4:

$$1.1E-08\,(mg/L) \times 1{,}140{,}000\,(L/kg) = 0.012\,(mg/kg) = 12\,(\mu g/kg)$$

Lake Erie Drainage Basin PCB Human Health Fish Concentration

$$\frac{\left[\frac{1E-05}{2.0\,(mg/kg/d)}\right] \times 70\,(kg)}{0.015\,(kg/d)} = 0.023\,(mg/kg) = 23\,(\mu g/kg)$$

Lake Erie Drainage Basin PCB Wildlife Fish Concentration

Trophic Level 3:

$$1.2E-07\left(\frac{mg}{L}\right)\times 520{,}900\left(\frac{L}{kg}\right)=0.062\left(\frac{mg}{kg}\right)=62\left(\frac{\mu g}{kg}\right)$$

Trophic Level 4:

$$1.2E-07\left(\frac{mg}{L}\right)\times 1{,}871{,}000\left(\frac{L}{kg}\right)=0.22\left(\frac{mg}{kg}\right)=220\left(\frac{\mu g}{kg}\right)$$

Lake Erie Drainage Basin Hexachlorobenzene Human Health Fish Concentration

$$\frac{\left[\frac{1E-05}{1.6\left(\frac{mg}{kg/d}\right)}\right]\times 70(kg)}{0.015\left(\frac{kg}{d}\right)}=0.029\left(\frac{mg}{kg}\right)=29\left(\frac{\mu g}{kg}\right)$$

Lake Erie Drainage Basin Mirex Human Health Fish Concentration

$$\frac{\left[\frac{1E-05}{0.53\left(\frac{mg}{kg/d}\right)}\right]\times 70(kg)}{0.015\left(\frac{kg}{d}\right)}=0.088\left(\frac{mg}{kg}\right)=88\left(\frac{\mu g}{kg}\right)$$

Ohio River Drainage Basin

	Mercury	Chlordane	DDT	PCBs	Hexachloro-benzene	Mirex
HHWQC	12 ng/L*	21 ng/L	5.9 ng/L	1.7 ng/L	7.5 ng/L	0.11 ng/L
The following inputs on which the WQS are based are used to calculate fish concentrations:						
Reference Dose (RfD)	N/A	N/A	N/A	N/A	N/A	N/A
Slope Factor (q1*)	N/A	0.35 $(mg/kg/d)^{-1}$	0.34 $(mg/kg/d)^{-1}$	2.0 $(mg/kg/d)^{-1}$	1.6 $(mg/kg/d)^{-1}$	0.53 $(mg/kg/d)^{-1}$
Cancer Risk Level	N/A	1E-05	1E-05	1E-05	1E-05	1E-05
Body Weight	N/A	70 kg	70 kg	70 kg	70 kg	70 kg
Fish Consumption	N/A	0.0065 kg/d	0.0065 kg/d	0.0065 kg/d	0.0065 kg/d	0.0065 kg/d
Relative Source Contribution Factor (RSC)	N/A	N/A	N/A	N/A	N/A	N/A

* Based on the FDA action level of 1 mg/kg divided by the BCF of 83,333 L/kg.

Ohio River Drainage Basin Mercury Fish Concentration

1 mg/kg based on FDA action level

Ohio River Drainage Basin Chlordane Fish Concentration

$$\frac{\left[\frac{1E-05}{0.35\left(mg/kg/d\right)^{-1}}\right]\times 70\left(kg\right)}{0.0065\left(kg/d\right)}=0.31\left(mg/kg\right)=310\left(\mu g/kg\right)$$

Ohio River Drainage Basin DDT Fish Concentration

$$\frac{\left[\frac{1E-05}{0.34\left(mg/kg/d\right)^{-1}}\right]\times 70\left(kg\right)}{0.0065\left(kg/d\right)}=0.32\left(mg/kg\right)=320\left(\mu g/kg\right)$$

Ohio River Drainage Basin PCB Fish Concentration

$$\frac{\left[\frac{1E-05}{2.0\left(mg/kg/d\right)^{-1}}\right]\times 70\left(kg\right)}{0.0065\left(kg/d\right)}=0.054\left(mg/kg\right)=54\left(\mu g/kg\right)$$

Ohio River Drainage Basin Hexachlorobenzene Fish Concentration

$$\frac{\left[\frac{1E-05}{1.6\left(mg/kg/d\right)^{-1}}\right]\times 70\left(kg\right)}{0.0065\left(kg/d\right)}=0.067\left(mg/kg\right)=67\left(\mu g/kg\right)$$

Ohio River Drainage Basin Mirex Fish Concentration

$$\frac{\left[\frac{1E-05}{0.53\left(mg/kg/d\right)^{-1}}\right]\times 70\left(kg\right)}{0.0065\left(kg/d\right)}=0.20\left(mg/kg\right)=200\left(\mu g/kg\right)$$

Fish Tissue Concentrations for Determining Impairment for the 2012 IR (µg/kg)

	Lake Erie HH	Lake Erie – wildlife TL3	Lake Erie – wildlife TL4	Ohio River
Mercury	350	36	180	1000
Chlordane	130	N/A	N/A	310
DDT	140	4.1	12	320
PCBs	23	62	220	54
Hexachlorobenzene	29	N/A	N/A	67
Mirex	88	N/A	N/A	200

E4.2 What's the Difference between the Fish Consumption Advisory Decision and the Impairment Decision?

Some question may arise as to how the methodology for determining impairment status for the 2012 IR for fish tissue relates to the fish advisories issued by the State of Ohio. Rather than building on fish consumption advisory decisions, the revised methodology draws directly from the fish tissue contaminant database. This change was possible because of better accessibility to the raw data.

In short, the basis for determining impairment for the IR for fish tissue is similar but unrelated to the basis for determining advisories. The WQS calculations assume a certain amount of fish consumption and ensure that level of consumption is safe. The advisory calculations determine what level of fish consumption is safe. Therefore, both are protective of human health. However, advisories and Integrated Report impairment status are not directly related.

Advisory thresholds are given as one meal per week, one meal per month, one meal every other month, and do not eat. Each threshold is associated with a particular contaminant concentration that is based on consuming an 8 ounce meal. For both PCBs and mercury, those thresholds are 50 parts per billion (ppb) for one meal per week, 220 ppb for one meal per month, 1,000 ppb for one meal every other month and 2,000 ppb for do not eat.

The thresholds used for determining IR categories are based on water quality standards for human health. The water quality standards assume that people are eating a certain quantity of different types of fish over time. The Lake Erie basin WQS calculations for mercury and PCBs assume that people are eating 15 grams of fish per day. The Ohio River basin calculations for PCBs and mercury assume that people are eating 6.5 grams of fish per day.

Advisory thresholds are prescriptive, indicating to people how much fish is safe to eat given a certain level of fish contamination. Water quality standard-based thresholds are descriptive, indicating how much contamination is acceptable in fish given that people are eating a certain amount of certain types of fish. In other words, the advisories tell people how much fish they can safely eat, and the water quality standards assume how much fish people are eating and use that information to calculate a "safe" level of contamination in fish.

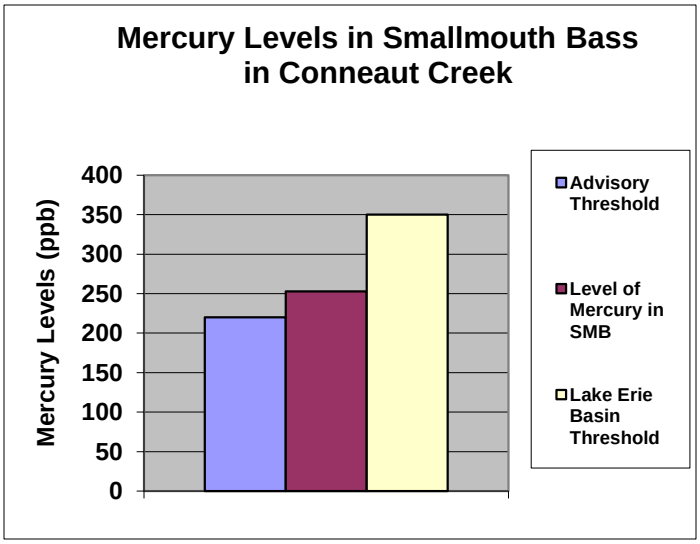
U.S. EPA, in its guidance on developing the IR, indicates that water quality standards are to be used as the basis for determining impairment categories for fish tissue. Because the assumptions used to calculate the advisories are different than the assumptions used to calculate the WQS, this results in cases where some water bodies have advisories against fish consumption but are not listed as impaired, and some water bodies are listed as impaired but no fish advisory is in place. This situation is demonstrated in the following table:

Parameter	Lake Erie Basin	Ohio River Basin	1 meal per week advisory	1 meal per month advisory
Fish Consumed	15 grams/day	6.5* grams/day	32.6 grams/day	7.6 grams/day
Maximum Allowable Fish Concentration				
PCB Threshold	23 ppb	54 ppb	50 ppb	220 ppb
Mercury Threshold	350 ppb	1000 ppb	50 ppb	220 ppb

* This value is under review in the current proposed WQS rule update for 3745-1. The proposed value of 17.5 g/day was used in calculating the proportion of trophic level 3 and 4 fish consumed in the Ohio River basin, but was not used in developing the thresholds for determining impairment status.

The reason the thresholds are different between the two basins is that the assumed fish consumption levels are different. The reason the water quality standard thresholds are different from the advisory thresholds is both because the fish consumption levels are different, and because for PCBs, a cancer slope factor is used to calculate the water quality standard criteria, which is stricter than the health protection value used to calculate the advisory threshold.

Data for smallmouth bass in Conneaut Creek provide an example where there is an advisory but the waterbody is not impaired.



Channel catfish in Pymatuning Reservoir show a case where there is no advisory but the water is listed as impaired.