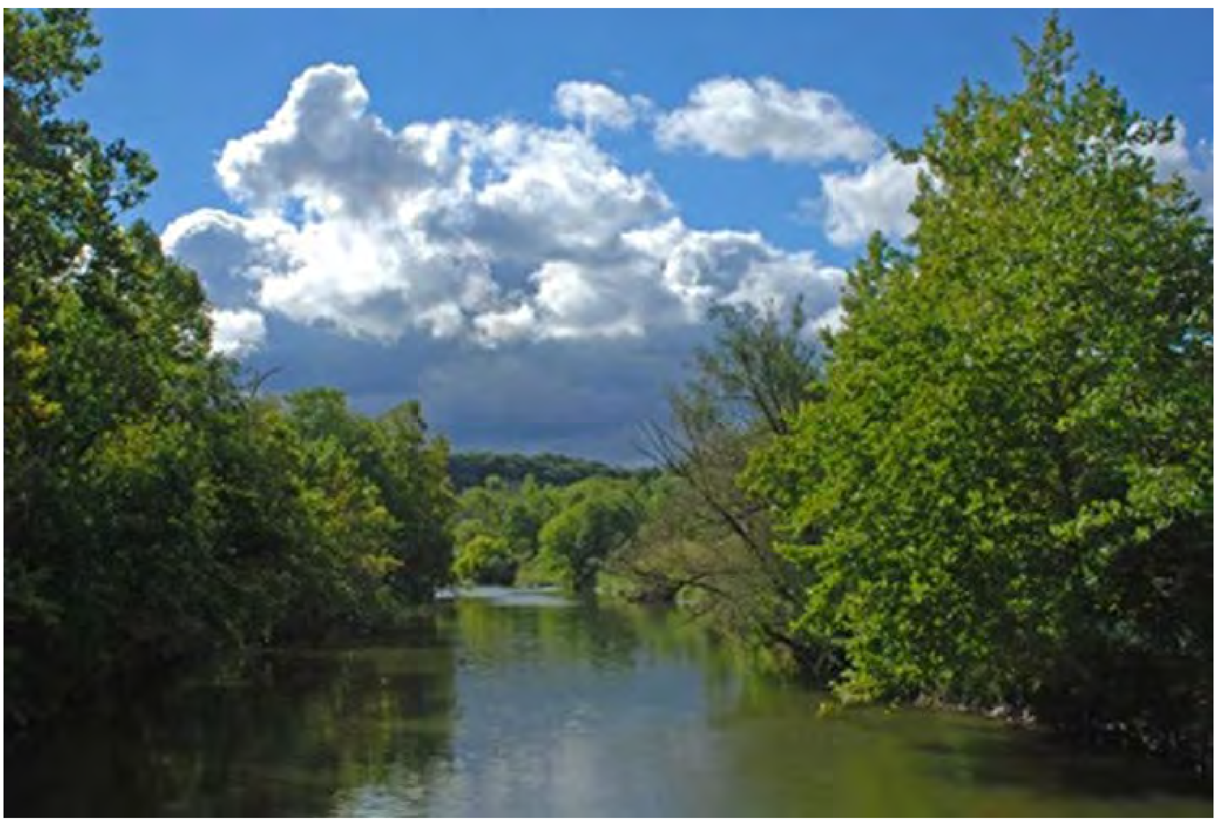
Ohio Environmental Protection Agency

Ohio 2020 Integrated Water Quality Monitoring and Assessment Report



Cuyahoga River

Division of Surface Water
Draft Report

February 2020

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List of Acronyms and Abbreviations

AmphIBI	amphibian index of biotic integrity
AMP	Atrazine monitoring program
AOC	Area of Concern (as identified under the Great Lakes Water Quality Agreement)
ARRA	American Recovery and Reinvestment Act of 2009
ATTAINS	Assessment, Total Maximum Daily Load (TMDL) Tracking and Implementation System
AU	assessment unit
BAV	beach action value
BEACH	Beaches Environmental Assessment and Coastal Health (Act)
BMP	best management practice
BNR	biological nutrient removal
BUI	Beneficial Use Impairment (as described in the Great Lakes Water Quality Agreement)
CABB	Center for Applied Bioassessment and Biocriteria
CAFO	Concentrated Animal Feeding Operations
CDBG	Community Development Block Grant
CDC	Center for Disease Control
cfu	colony forming unit
Corps	U.S. Army Corps of Engineers
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
CSO	combined sewer overflow
CSP	Conservation Stewardship Program
CWH	coldwater habitat
CWA	Clean Water Act
DDAGW	Division of Drinking and Ground Waters
DDT	dichlorodiphenyltrichloroethane
DEFA	Division of Environmental and Financial Assistance
DES	Division of Environmental Services
DLG	digital line graph
DRG	digital raster graphic
DSW	Division of Surface Water
EAG	External Advisory Group
EPA	Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
EWH	exceptional warmwater habitat
FCA	fish consumption advisory
FFY	federal fiscal year
FSA	Farm Service Agency
FWPCA	Federal Water Pollution Control Act
GIS	Geographic Information System
GLLA	Great Lakes Legacy Act
GLRC	Great Lakes Regional Collaboration
GLRI	Great Lakes Restoration Initiative
GLSM	Grand Lake St. Marys
GLWQA	Great Lakes Water Quality Agreement
GRP	Grassland Reserve Program
GRTS	Generalized Random Tessellation Stratified (survey design)
HAB	harmful algal bloom
HSD	honest significant difference

HUC	hydrologic unit code
IBI	index of biotic integrity
ICI	invertebrate community index
IDP	indirect discharge permit
IR	Integrated Report
kg	kilogram
L	liter
LA	load allocation
LAMP	lakewide action and management plan
LCI	Lake Condition Index
LDI	Landscape Development Intensity
LEAU	Lake Erie assessment unit
LEC	(Ohio) Lake Erie Commission
LENT	Lake Erie nutrient targets
LEPF	(Ohio) Lake Erie Protection Fund
LH	lake habitat
LHD	local health district
LRAU	large river assessment unit
LRW	limited resource water
LTCP	long-term control plan
MBI	Midwest Biodiversity Institute
MF	membrane filter
mg	milligram
mi^2	square miles
mL	milliliter
MIwb	modified index of well-being
MOR	monthly operating data
MPN	most probable number
MRBI	Mississippi River Basin Initiative
MS4	municipal separate storm sewer systems
MWH	modified warmwater habitat
NARS	National Aquatic Resource Survey
NCCA	National Coastal Condition Assessment
NCWQR	National Center for Water Quality Research
NEORSD	Northeast Ohio Regional Sewer District
ng	nanogram
NHD	National Hydrography Dataset
NLCD	National Land Cover Dataset
NOAA	National Oceanic and Atmospheric Administration
NOI	notice of intent
NPDES	National Pollutant Discharge Elimination System
NPS	nonpoint source
NRCS	Natural Resources Conservation Service
NSMP	Nonpoint Source Management Plan
NSSP	National Shellfish Sanitation Program
NWI	National Wetland Inventory
NWQI	National Water Quality Initiative
OAC	Ohio Administrative Code
ODH	Ohio Department of Health
ODNR	Ohio Department of Natural Resources

OMZA	outside mixing zone average
ORC	Ohio Revised Code
ORSANCO	Ohio River Valley Water Sanitation Commission
OSIP	Ohio Statewide Imagery Program
OTMP	Ohio Tributary Monitoring Program
OWDA	Ohio Water Development Authority
OWRC	Ohio Water Resources Council
PAHs	polyaromatic hydrocarbons
PHA	public health advisory
ppb	parts per billion
PCB	polychlorinated biphenyls
PCR	primary contact recreation
PDWS	public drinking water supply
POTW	publicly owned treatment works
PS	point source
PTI	permit to install
PTO	permit to operate
PWS	public water supply
QA	quality assurance
QC	quality control
QDC	qualified data collector
QSC	Quicksilver Caucus
RAP	Remedial Action Plan
RAS	return activated sludge
RF3	Reach File Version 3
RM	river mile
SDWA	Safe Drinking Water Act
SDWIS	Safe Drinking Water Information System
SFY	state fiscal year (July 1 to June 30)
SIU	significant industrial user
sq mi	square miles
SSM	single-sample maximum
STORET	STOrage and RETtrieval (a U.S. EPA water quality database)
STV	statistical threshold value
SWIF	Surface Water Improvement Fund
SWIMS	Surface Water Information Management System
TDS	total dissolve solids
TMDL	total maximum daily load
TNTC	too numerous to count
TOC	total organic carbon
µg	microgram
USDA	United States Department of Agriculture
U.S. EPA	United States Environmental Protection Agency
USC	United States Code
USGS	U.S. Geological Survey
UV	ultraviolet
VIBI	vegetation index of biotic integrity
VIBI-FQ	VIBI – floristic quality
WAS	waste activated sludge
WAUs	watershed assessment unit

WBLE	western basin of Lake Erie
WEG	(Ohio EPA's) wetland ecology group
WHIP	Wildlife Habitat Incentives Program
WHO	World Health Organization
WLA	wasteload allocation
WPCLF	Water Pollution Control Loan Fund
WQ	water quality
WQC	Water Quality Certification (Section 401)
WQM	Water Quality Management (plan)
WQPSD	Water Quality Permit Support Document
WQS	water quality standards
WRP	Wetlands Reserve Program
WRRSP	Water Resource Restoration Sponsor Program
WSRLA	Water Supply Revolving Loan Account
WWH	warmwater habitat
WWTP	wastewater treatment plant

Executive Summary

The *Ohio Integrated Water Quality Monitoring and Assessment Report* (IR) summarizes water quality conditions in the State of Ohio. This report satisfies Ohio's water quality reporting requirements under Sections 303(d), 305(b) and 314 of the federal Clean Water Act. This report was last updated in 2018. Analysis and listing changes are based on data collected during 2017 and 2018 for aquatic life and human health (fish tissue) uses and 2018 and 2019 for drinking water supply and recreation uses.

Using methods devised to determine the suitability of waters for four specific uses—aquatic life (fish and aquatic insects), recreation (such as boating and swimming), human health (related to fish tissue contamination) and public drinking water supplies—available data were compared with water quality goals. The results indicate which waters are meeting goals and which are not. Waters not meeting the goals for one or more of the four types of uses are referred to as *impaired.* The waters found to be impaired are prioritized and scheduled for further study and restoration.

This report describes the methods used to judge impairment of each type of use and have evolved in each reporting cycle as the Agency gains access to more data and develops better ways to interpret them. Results are reported for 1,538 watershed units, 38 large river units (in Ohio's 23 rivers that drain more than 500 square miles) and seven Lake Erie units.

The 2020 (IR) is one of transition. The 2020 IR will likely be the final report of the current style. The 2020 IR, however, is the first report utilizing U.S. EPA's Assessment, Total Maximum Daily Load (TMDL) Tracking and Implementation System (ATTAINS) database for report preparation and submittal. The style of the IR, contents, and methods to present water quality data and analyze trends will likely be revised in the 2022 IR as we continue to adapt to the ATTAINS database and U.S. EPA's How's My Waterway app (coming soon at ***epa.gov/waterdata/hows-my-waterway***).

Highlights of Beneficial Use Sections

For the human health use (fish tissue), polychlorinated biphenyl (PCB) contamination in fish is the cause of most of the human health impairments in Ohio. Mercury is the second leading cause.

The recreation (bacteria) use analysis focuses on the number of bacteria in the water. For Lake Erie public beaches, the frequency of swimming advisories varies widely, ranging from 0.4 percent to 44.3 percent. Generally, beaches located near population centers have the most problems. Results are also reported for streams and inland lakes.

The recreation use has also been assessed for algae impacts in Lake Erie. The western basin shoreline, the islands shoreline and the western basin open water assessment units are all listed as impaired by algae. The Sandusky basin and central basin open water units and central basin shoreline are in attainment. There is currently insufficient information to determine the attainment status of Sandusky basin shoreline (including Sandusky Bay).

The top reasons for aquatic life impairment continue to be habitat modification, nutrient enrichment, hydromodification, sedimentation/siltation and organic enrichment for large rivers and watersheds.

The chemicals of concern causing impairment of the public drinking water supply use include nitrate, atrazine and cyanotoxin (due to certain algae). The primary source of the chemicals is nonpoint source runoff from agricultural land use. Additional sources of nitrate include home and commercial fertilizer application, failing septic systems, unsewered areas and wastewater treatment plant discharges. Of the 118 public drinking water supply assessment units, 39 are now listed as impaired by algae, with another 25 on the watch list for algae.

Major Changes since the 2018 Integrated Report

Changes made between the 2018 Integrated Report and the 2020 Integrated Report are as follows:

- This is the first report prepared and submitted using U.S. EPA's new database system called ATTAINS. Once final, Ohio EPA's data will now be available to the public through U.S. EPA's application called "How's My Waterway".
- Ohio EPA is assigning a high priority to Lake Erie's western shoreline, western open water, and islands shoreline assessment units for impairments of public drinking water supply (algae) and recreation (algae), and committing to develop a TMDL over the next two to three years.
- New assessment methodologies and results are included for recreation (algae) for Lake Erie's Sandusky Bay shoreline and open water and central basin shoreline and open water units.
- Ohio EPA removed or delisted a total of 146 parameters (or causes of impairment) out of a total of 343 delistings because water quality standards are now in attainment based upon new sampling data or restoration activities.
- Ohio EPA was able to close out two plans (Category 4Bs) to address water quality impairments from the Georgetown and Pickerington wastewater treatment plants because implemented controls have resulted in improved water quality for the parameters of concern in Town Run and Sycamore Creek, respectively.

Section

A

An Overview of Water Quality in Ohio

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A1. Introduction

Clean water is important to Ohio's economy and standard of living.

Ohio is an economically important and diverse state with strong agriculture, manufacturing and service industries. Ohio is also a water-rich state bounded by Lake Erie on the north, the Ohio River on the south and more than 25,000 miles of named and designated streams and rivers within its borders. The suitability of these waters to support society's needs is critical to sustaining Ohio's economy and the standard of living of its citizens. Surface waters such as rivers, streams and lakes provide most of the water used for public drinking, for recreation such as swimming, boating and fishing, and for industrial uses including manufacturing, power generation, irrigation and mining.

Ohio EPA monitors water quality in Ohio and reports its findings.

Monitoring the quality of Ohio's valuable water resources is an important function of the Ohio Environmental Protection Agency (Ohio EPA). Since the early 1970s, Ohio EPA has measured the quality of Ohio's water resources and worked with industries, local governments and citizens to restore the quality of substandard waters. This report, updated every two years, is required by the federal Clean Water Act to fulfill two purposes: 1) to provide a summary of the status of the State's surface waters; and 2) to develop a list of waters that do not meet established goals—the impaired waters.

Under the Clean Water Act, once impaired waters are identified, the state must act to improve them. Typically, the actions include developing restoration plans [total maximum daily loads (TMDLs)]; water quality-based permits; and nonpoint source pollution control measures. As such, this report is an important document that provides information and direction to much of the State's work in water quality planning, monitoring, financial/technical assistance, permitting and nonpoint source programs.

Ohio EPA has developed innovative monitoring methods that directly measure progress toward the goals of the Clean Water Act. Generally recognized as a leader in water quality monitoring, Ohio uses the fish and aquatic insects that live in streams to assess the health of Ohio's flowing waters. Aquatic animals are generally the most sensitive indicators of pollution because they inhabit the water all the time. A healthy stream community is also associated with high quality recreational opportunities (for example, fishing and boating). Stream assessments are based on the experience gained through the collection of more than 28,000 fish population samples and nearly 14,500 aquatic insect community samples, depicted in Figure A-1.

Figure A-1 — Ohio EPA's Biological Sampling Locations 1978 - 2018

In addition to biological data, Ohio EPA collects information on the chemical quality of the water (nearly 250,000 water chemistry samples), sediment and wastewater discharges; data on the contaminants in fish flesh; and physical habitat information about streams. Taken together, this information identifies the factors that limit the health of aquatic life and that constitute threats to human health.

Reporting results

Ohio EPA currently reports out on three types of water bodies, called assessment units (AUs), as defined below. Section D1 of this report contains additional details and maps of the AUs. Information on Ohio's inland lakes is currently reported through the watershed unit in which it is located. Specific information on inland lakes can be found in the individual beneficial use sections (Sections F through H) in this report.

- Watersheds or watershed assessment units (WAUs) are delineated by the 12-digit hydrological unit code (HUC) system.
- Large rivers or large river assessment units (LRAUs) are segments of the 23 rivers that drain more than 500 square miles.
- Lake Erie or Lake Erie assessment units (LEAUs) consist of open water and shoreline units.

Transition to ATTAINS

The 2020 Integrated Water Quality Monitoring and Assessment Report (IR) marks the transition of Ohio EPA's report into U.S. EPA's Assessment, Total Maximum Daily Load (TMDL) Tracking and Implementation System (ATTAINS). As such, this report is a mix of old and new. Portions of the report have been modified to fit this new system. Ohio EPA's data in ATTAINS will be available to the public through U.S. EPA's How's My Waterway mobile app and a spreadsheet posted on Ohio EPA's website. Data presented in this 2020 IR will be available in How's My Waterway when Ohio EPA submits the final report to U.S. EPA for review and approval. In addition to data from ATTAINS, How's My Waterway will pull information from U.S. EPA's other databases, allowing users to query data from one place. The app is expected to be available in winter 2020 at: ***epa.gov/waterdata/hows-my-waterway***.

Overall water quality

Ohio EPA developed methods to determine how well Ohio's waters support four specific water uses:

1) human health impacts related to sport fish tissue contamination;
2) recreation;
3) human health impacts related to drinking water; and
4) aquatic life (fish and aquatic insects).

Available data are compared with established water quality goals and the results of the comparison indicate which waters are meeting goals and which are not. The results for each use are discussed in the next few pages. Additional details on the four uses is available in Section D of this report.

When the results of the assessments of the four beneficial uses for each AU are combined, a high-level picture of Ohio's water quality can be drawn. See Figure A-2.

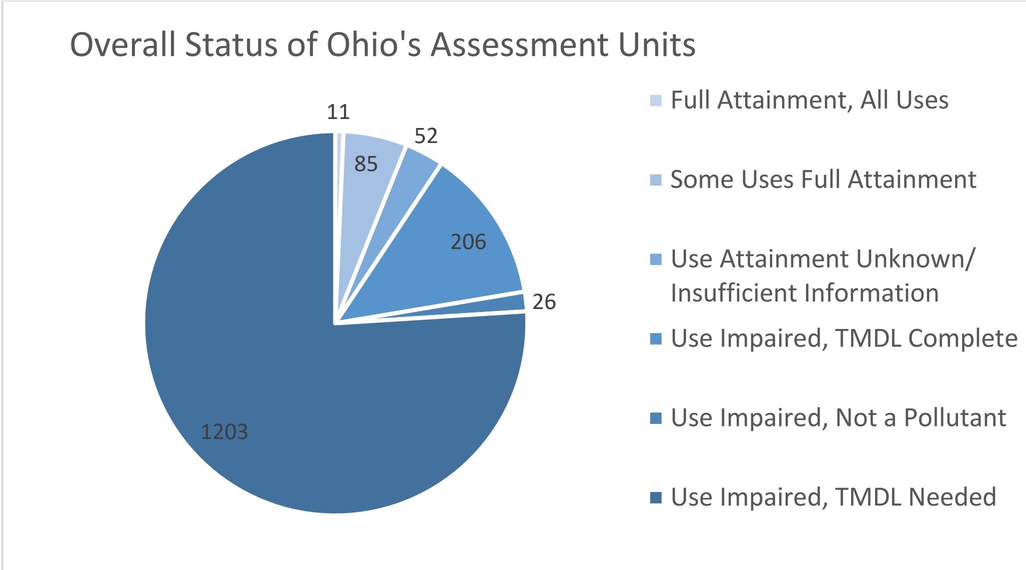

Figure A-2 — Overall summary of Ohio's combined assessment units. Output from ATTAINS.

To assess the **human health impacts related to fish tissue contamination**, Ohio EPA uses the same data that are used to generate Ohio's sport fish consumption advisory. Although the data are the same, the analyses are different. Ohio EPA urges Ohio's anglers to consult the sport fish consumption advisory regarding which and how much fish to eat. A link to the fish consumption advisory website is available at the end of this section.

For analysis in this report, data on the six fish tissue contaminants [mercury, polychlorinated biphenyls (PCBs), chlordane, mirex, hexachlorobenzene and dichlorodiphenyltrichloroethane (DDT)] are used to assign waters into the different reporting categories. See the results in Table A-1 below.

Are fish safe to eat?

While most Ohio sport fish are safe to eat, low levels of chemicals like PCBs and mercury have been found in some fish from certain waters.

To help protect the health of Ohioans, Ohio EPA in conjunction with the Ohio Department of Health offers an advisory for how often these fish can be safely eaten. An advisory is advice and should not be viewed as law or regulation. It is intended to help anglers and their families make educated choices about where to fish, what types of fish to eat, how to determine the amount and frequency of fish consumed and how to prepare fish for cooking.

By following these advisories, citizens can gain the health benefits of eating fish while reducing their exposure to unwanted contaminants.

Table A-1 — Summary of Human Health Fish Tissue Results

Water Type	Full Attainment	Not Supporting	Insufficient Information	Not Assessed
Watershed Assessment Units	242	430	56	810
Large Rivers	6	32	-	-
Lake Erie	-	7	-	-
Inland Lakes	54	8	37	-

The most common contaminant is PCBs, followed by mercury. A few waters contain fish whose flesh is contaminated by dichlorodiphenyltrichloroethane (DDT), mirex or hexachlorobenzene; data show no streams or lakes with fish contaminated by lead. PCB contamination is widespread, usually because of historical sources. Areas with traceable contamination and areas of special concern are being addressed through programs such as the Great Lakes Legacy Act, Superfund or the Resource Conservation and Recovery Act.

Mercury contamination is ubiquitous because of aerial deposition from local, regional and global sources. Thus, solving the problem of mercury contamination requires solutions on a broader scale than at a watershed level. For example, Ohio targeted mercury from consumer products such as switches and thermometers through legislation banning the sale of such products. Ultimately, increases in renewable energy sources and clean coal technology usage will lessen Ohio's mercury burden.

Fish populations contaminated by hexachlorobenzene, DDT or mirex are already in the process of being restored through various initiatives in state and federal waste remediation programs.

Much of the **recreation** analysis focuses on the amount of **bacteria** in the water. For Lake Erie public beaches, the frequency with which individual beaches were recommended for a swimming advisory based on elevated bacteria levels above the state water quality standards for the entire five-year reporting period (2015-2019) ranged from near zero at Battery Park, Catawba Island State Park, Conneaut Township Park, East Harbor State Park, Geneva State Park, Lakeside and South Bass Island State Park to more than a third of the season on average at six beaches: Bay View West, Edson Creek, Lakeview, Maumee Bay State Park (Erie and inland) and Villa Angela State Park.

Considerable variation in the frequency of advisories was observed between beaches and from season-to-season at many beaches. However, several beaches stand out as consistently good performers over the past several recreation seasons, including Battery Park, Catawba Island, Cedar Point, Conneaut, East Harbor State Park, Geneva State Park, Kelleys Island, Lakeside and South Bass Island State Park, which all had a cumulative exceedance frequency of less than 10 percent on a seasonal basis. These beaches rarely exceeded 10 days per season under advisement.

There were also several beaches that consistently performed poorly with three beaches, including Bay View West, Edson Creek and Lakeview under advisement nearly 40 percent of the time or more during the past five recreation seasons on a cumulative basis.

For inland streams, of the 196 assessment units having sufficient data available to determine the RU assessment status, 8 percent fully supported the use while 92 percent did not support the use. These results are comparable to the results from previous cycles that consistently show only a relatively small proportion of the state's watersheds demonstrate full support of the recreation use. In addition, all six of the large river units evaluated in this cycle failed to support the recreation use.

Is it safe to swim or wade?

For the most part, water in Ohio is safe for swimming or wading. Water activities are more dangerous after heavy rains due to the obvious physical dangers of being swept into the faster flows, but also because chemicals and bacteria wash into the streams along with the water that runs over the land. In some communities, sewage systems cannot handle the extra volume of water and release untreated sewage during and after heavy rains.

There are some areas where the waters and/or sediments have high levels of contaminants, including PCBs and polyaromatic hydrocarbons (PAHs), so swimming or wading in these areas is not recommended.

As for inland lakes, the frequency of exceedances during the five-year reporting period was 11.9 percent, slightly lower than the 13.8 percent rate reported in the previous cycle. There were 29 inland lake beaches where the aggregated exceedance frequency was more than 10 percent with the highest being 42 percent at the Dillon Reservoir followed by Madison Lake at 36 percent and Buckeye Lake's Crystal Beach at 32 percent.

Table A-2 — Summary of Recreation (Bacteria) Use Results

Water Type	Full Attainment	Not Supporting	Insufficient Information	Not Assessed
Watershed Assessment Units	159	1171	38	170
Large Rivers	3	32	1	2
Lake Erie	-	4	-	3
Inland Lakes	54	8	37	-

Lake Erie has also been assessed for **recreation** use impacted by significant **algae** biomass present during the recreation season. As a result, Ohio is listing the shorelines and open water in the western basin as impaired for recreation use. Additional details on the assessment and results for Lake Erie can be found in Section F.4 of this report.

Human health impacts related to drinking water focus on nitrate, pesticides and cyanotoxins (due to certain algae). In Ohio, 103 public water systems use surface water (excluding Ohio River intakes, purchased water systems, and multiple facilities at a water system) in 118 separate AUs.

Sufficient data were available to complete nitrate evaluations for half (53 percent) of the AUs of which 7 percent were identified as impaired and 46 percent were in full support. There was one new WAUs listed as impaired due to nitrates. Of the large rivers, three Maumee River, one Sandusky River AU, and one Scioto River AU remain impaired. Most of the 33 waters placed on the nitrate watch list are in northwestern Ohio.

Is water safe to drink?

Ohio EPA and public water systems around the state work hard to ensure that drinking water meets safe drinking water standards and that users have important information available about the sources and quality of the water. However, drinking water advisories do occur from time to time due to treatment plant malfunctions, water line breaks, and the rare case when source water contaminant levels exceed the plant's capacity to remove them.

It is important to remember that only a relatively small number of water systems have situations that warrant advisories. In 2010, 99 percent of all public water systems met all chemical standards. To get information about your local drinking water you can read the Consumer Confidence Report (CCR) provided annually by your community water system.

In this report, several waters are identified as impaired due to elevated nitrate or pesticides. Water systems in these areas and others with source water contaminants will issue public notice advisories or use additional treatment and water management strategies to ensure that safe water is delivered to their customers.

Pesticides were evaluated for 35 AUs. Five of the AUs were impaired while the remaining 30 were in full support. There were no new assessment units identified as impaired due to pesticides. A total of 24 AUs were placed on the pesticide watch list because of elevated atrazine. These areas of elevated atrazine coincide with the predominantly agricultural land use in western and northwestern Ohio.

During this reporting cycle the numeric cyanotoxin drinking water thresholds were aligned with the current threshold values in the 2019 State of Ohio Public Water System Harmful Algal Bloom Response Strategy, which affected impairment determination for two WAU based on saxitoxin concentrations in raw water. The monitoring of microcystins and cyanobacteria by Ohio public water systems greatly increased the data available to assess the algae indicator. Sufficient data were available to list 33 percent of the AUs as impaired due to algae, including three new AUs identified as impaired this reporting cycle. The impairment listing includes all AUs in Lake Erie with drinking water intakes. In addition, 30 WAUs and three LRAUs are assessed as impaired. An additional 24 AUs were placed on the algae watch list. WAUs that are impaired or on the watch list for cyanotoxins were found distributed across Ohio virtually in every geographic region.

Table A-3 — Summary of Public Water Supply Use Results

Water Type	Full Attainment	Not Supporting	Insufficient Information	Not Assessed
Watershed Assessment Units	32	36	35	-
Large Rivers	0	5	4	-
Lake Erie	0	6	-	-

The bulk of the new data evaluated for the **aquatic life use** is in areas Ohio EPA sampled during 2017 and 2018. Watersheds intensively monitored during 2017 and 2018 included the Tuscarawas River basin, Sugar Creek basin, Whitewater River basin, Swan River basin, Toussaint River basin, lower Maumee River basin, and Western Lake Erie tributaries and Cuyahoga River basin. The only large rivers comprehensively reassessed were the Tuscarawas River, Whitewater River, and Cuyahoga River. Detailed watershed survey reports for many of the basins mentioned above are or will be available from Ohio EPA's Division of Surface Water (see Biological and Water Quality Report Index, ***epa.ohio.gov/dsw/document_index/psdindx.aspx***).

Ohio's large rivers (the 23 rivers that drain more than 500 square miles) remained essentially unchanged in percent of monitored miles in full attainment compared to the same statistic reported in the 2018 IR. Based on monitoring through 2018, the full attainment statistic now stands at 88.2 percent (1,097 of 1,243 assessed LRAU miles), up 0.7 percent from the 2018 IR. Significant large rivers assessed for the 2020 IR included the Tuscarawas River (2017), Whitewater River (2017), and Cuyahoga River (2017). Attainment statistics for these three rivers (five LRAUs) are as follows.

- Tuscarawas River: 88.8 percent full attainment over 103.2 miles
- Whitewater River: 100 percent full attainment over 8.3 miles
- Cuyahoga River: 77.9 percent full attainment over 24.2 miles

Progress toward the 100 percent by 2020 aquatic life use goal for Ohio's large rivers is depicted in Figure A-3. Between the 2002 and 2020 reporting cycles, the percentage of large river miles in full attainment has increased from 62.5 percent to 88.2 percent and nearly 100 percent of total miles have been assessed. While the 100 percent full attainment by 2020 goal for large rivers was not reached, Ohio EPA is committed to continued support of this effort. In 2020, the Agency will complete a statewide large river survey covering every LRAU, the results of which will be reported in the 2022 IR. This statewide survey is planned to occur every 10 years thereafter to continue monitoring long-term trends.

For Ohio's 1,538 12-digit HUCs, the score remained essentially unchanged from the corresponding score reported in the 2018 IR, the average HUC12 WAU score stands at 64.3, a 0.1-point increase from the 2018 IR and a 7.6-point increase from the HUC12 baseline year of 2010. The WAU score is roughly equivalent to the percentage of monitored sites with full aquatic life use attainment in WAUs assessed for this IR cycle. Figure A-4 depicts the corresponding average score based on the old HUC11 WAUs, which were tracked from 2002 through 2010 and were used to gauge the progress of the 80 percent by 2010 aquatic life use goal as reported in the 2010 IR.

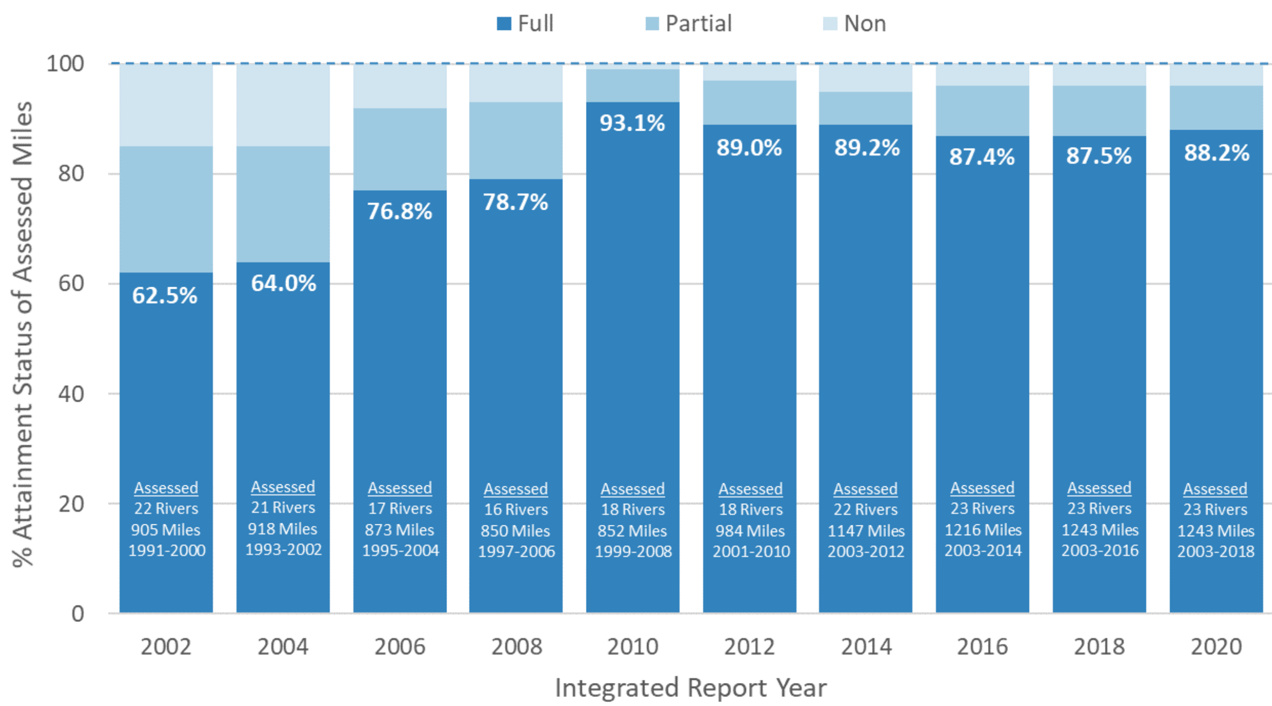

Figure A-3 — Percent attainment status and goal progress (100% by 2020) for monitored miles of Ohio's large river assessment units (23 rivers/38 AUs/1247.54 miles total).

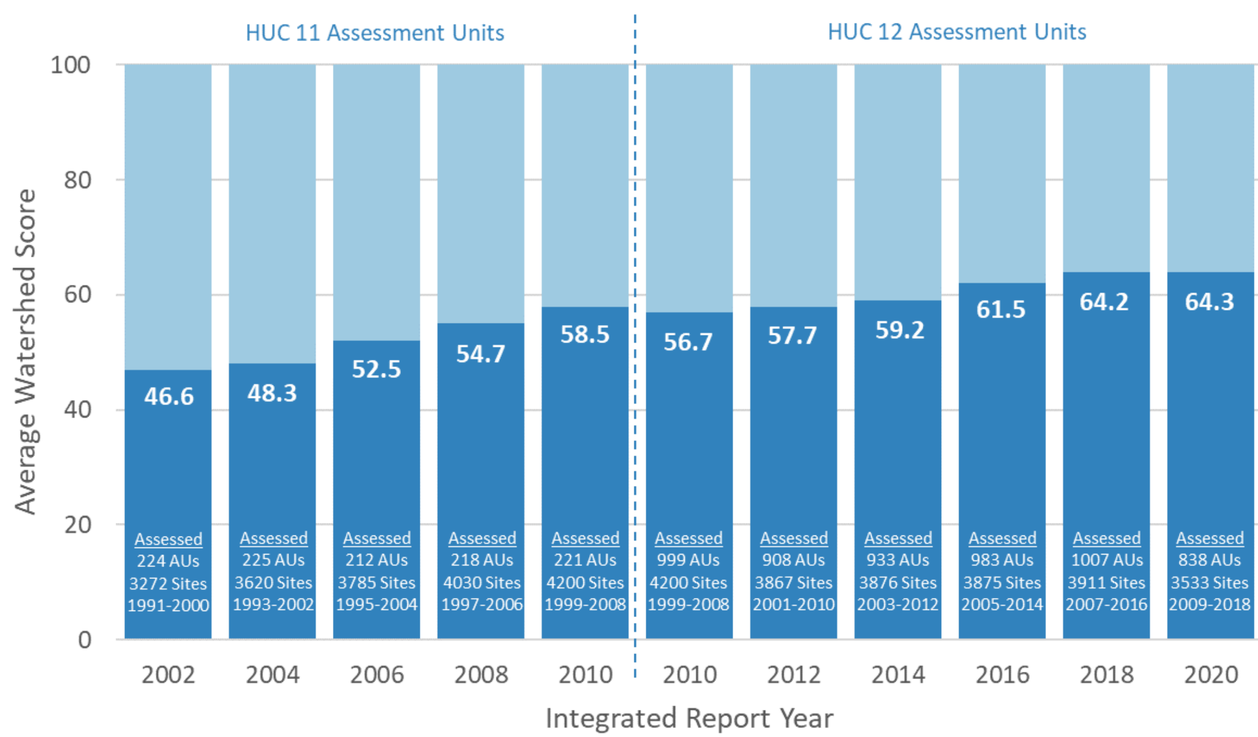

Figure A-4 — Average full attainment watershed score for monitored Ohio HUC11 watershed assessment units (IR cycles 2002-2010) and HUC12 watershed assessment units (IR cycles 2010-2018).

Progress toward the 80 percent by 2020 aquatic life use goal for Ohio's wading and principal stream and river sites (those monitored sites draining watersheds between 20 and 500 square miles) is depicted in Figure A-5. Contrasted with the 2010 IR statistic, when the 2020 goal benchmark was established, the percentage of qualifying sites in full attainment has increased more than seven percentage points with an increase from 61.4 percent to 68.7 percent.

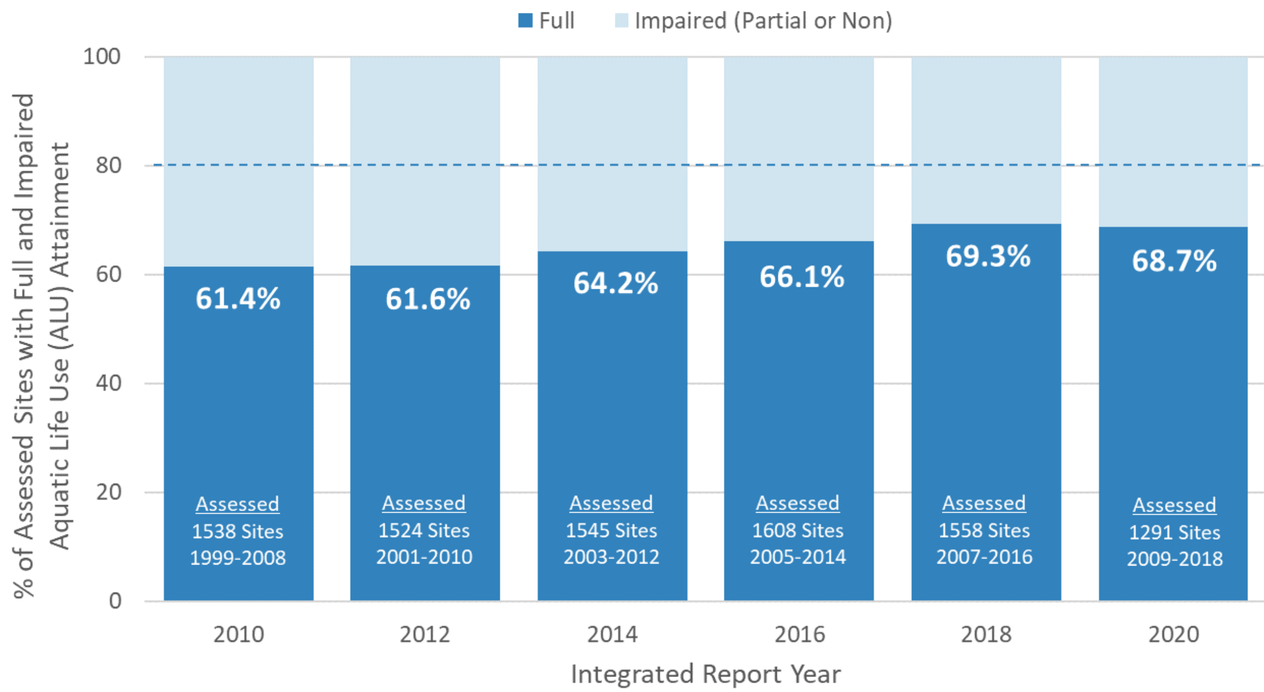

Figure A-5 — Status and trend of aquatic life use 80 percent by 2020 goal for wading and principal stream and river sites in Ohio based on the last six IR cycles.

The collection of more biological data along the shore of Lake Erie through the Great Lakes Restoration Initiative allows a more current analysis of shoreline conditions. The aquatic life use of the Lake Erie shoreline is impaired due primarily to tributary loadings of nutrients and sediment, aggravated by the proliferation of exotic species, algal blooms and shoreline habitat modifications.

Most common causes of aquatic life impairment

The top five most common causes of aquatic life impairment in LRAUs across the state are depicted in Figure A-6. Principal causes for LRAU impairments are commonly linked back to impoundments, whether that be directly through habitat/hydromodification or with sediment/nutrient/organic loading that is exacerbated by the impounded sections.

The top five most common causes of aquatic life impairment in WAUs across the state are depicted in Figure A-7. Principal causes for HUC12 WAU impairments were those primarily related to landscape modification issues involving agricultural land use and urban development. These types of impairments would be most manifest in smaller streams. Over half of the impaired WAUs had at least one monitored site impaired by one of these individual causes and many WAUs had several sites affected by three or more of the five causes listed as responsible for the aquatic life use impairment. This would not be an unusual situation given the frequently close association between these impairment causes (for example, nutrients, sedimentation/siltation, habitat modifications and hydromodifications in rural/agricultural landscapes relying on channelization and field tiles for drainage).

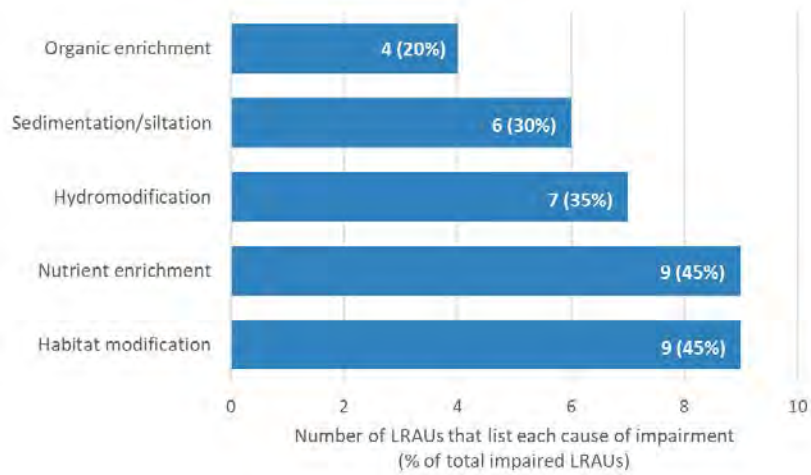

Figure A-6 — Top five causes of impairment in LRAUs.

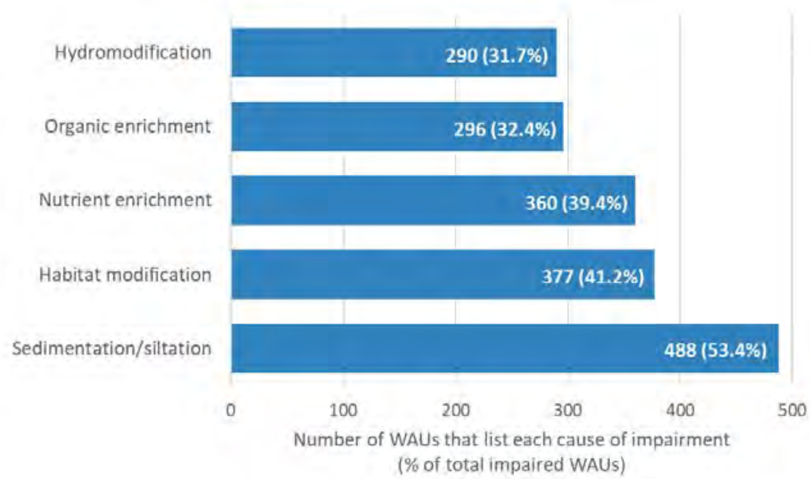

Figure A-7 — Top five causes of impairment in WAUs.

The major causes and sources of water quality problems are described below.

Organic enrichment is the addition of carbon-based materials from living organisms beyond natural rates and amounts. Natural decomposition of these materials can deplete oxygen supplies in surface waters. Dissolved oxygen is vital to fish and other aquatic life and for the prevention of odors associated with the decomposition process.

Siltation/sedimentation describes the deposition of fine soil particles on the bottom of stream and river channels. Deposition typically follows high-flow events that erode and pick up soil particles from the land. Soil particles also transport other pollutants. As the flow decreases, the soil particles fall to the stream bottom. This reduces the diversity of stream habitat available to aquatic organisms.

Habitat modification is the straightening, widening or deepening of a stream's natural channel. Habitat modification can also include the degrading or complete removal of vegetation from stream banks; such vegetation is essential to a healthy stream.

These activities can effectively transform a stream from a functioning ecosystem to a simple drainage conveyance. Some aquatic life will not be protected from predators and stressful flows and temperatures. The stream also often loses its ability to naturally process water pollutants.

Hydromodification, or flow alteration, describes any disruption to the natural hydrology of a stream system. Flow alteration includes stream impoundment, increased peak flows associated with the urbanization of watersheds and water-table regulation through sub-surface drainage. Such changes can cause extended periods without stream flow, more extreme or frequent floods and loss of fast current habitat in dam pool areas.

Contamination by pathogens occurs when human or animal waste reaches the stream. Pathogenic organisms include bacteria, viruses and protozoa.

Contamination by pathogens is a human health issue, as skin contact or accidental ingestion can lead to various conditions such as skin irritation, gastroenteritis or other more serious illnesses.

Nutrient enrichment describes the excess contribution of materials such as nitrogen and phosphorus used for plant growth. Excess nutrients are not toxic to aquatic life but can have an indirect effect because algae flourish where excess nutrients exist. The algae die, and their decay uses up the dissolved oxygen that other organisms need to live. The aquatic community is stressed on both a daily basis and over the long term.

The same nutrients that cause impairment of the aquatic life beneficial use also are a major contributing factor to the recent extensive HABs that have been observed in Lake Erie, the Ohio River and many inland Ohio water bodies. Grand Lake St. Marys in western Ohio has been particularly affected. HABs, a visually identified concentration of cyanobacteria, can occur almost anywhere there is water: lakes, ponds, storm water retention basins, rivers, streams or reservoirs.

Many HAB-forming organisms are native to Ohio, but only cause problems when environmental conditions favor them. HABs can cause taste and odor problems in drinking waters; pollute beaches with scums; reduce oxygen levels for fish and other animals; cause processing problems for public water supplies; and may generate toxic chemicals. Knowing what triggers HABs is key to reducing their occurrence and impacts. HABs may be minimized, and some completely avoided, by reducing the nutrients and pollutants added to the water.

Understanding how various land uses impact water quality can lead to more effective prevention and restoration.

Ohio has embraced a wide variety of economic enterprises over the years, so it is not surprising that there is a large variety of causes and sources of impairment some of which are described below.

Row crop cultivation is a common land use in Ohio. Frequently, cultivated cropland involves tile drainage. The challenge is to carry out actions that improve water quality while maintaining adequate drainage for profitable agriculture. The land application of manure, especially during winter months, is often a large source of both bacteria and nutrients entering streams and subsurface drainage tiles. Many cropland practices involve the channelization of streams, which creates deeply incised and straight ditches or streams.

This disconnects waterways from floodplains, which has damaging impacts on the quality of the system. The regularity of the stream channel and lack of in-stream cover reduces biological diversity.

Land development is the conversion of natural areas or agriculture to residential, industrial or commercial uses. Numerous scientific studies show that increasing impervious cover (for example, hard surfaces such as roads, parking lots, and rooftops) harms water quality. More water runs off the hard surfaces and more quickly. The rate of erosion increases, and streams become unstable. The resulting channel is less able to assimilate nutrients and other pollution. Higher runoff volume increases the amount of pollutants (for example, nutrients, metals, sediment, salts and pesticides).

Another problem is that stream temperatures can be raised when water runs over hot pavement and rooftops or sits in detention basins. When this heated water enters a stream, the higher temperatures reduce dissolved oxygen concentrations that aquatic life need to survive. With proper planning of development, many of these problems can be mitigated or avoided entirely.

Agricultural livestock operations can vary widely in how they are managed. Pasture land and animal feeding operations can be sources of nutrients and pathogens. Frequently livestock are permitted direct access to streams. Direct access not only allows the input of nutrients and pathogens, but also erodes the stream bank, causing excess sediments to enter the stream and habitat degradation. The most critical aspect of minimizing water quality impacts from any size animal feeding operation is the proper management of manure in terms of application and storage.

Industrial and municipal point sources include wastewater treatment plants and factories. Wastewater treatment plants can contribute to bacteria, nutrient enrichment, siltation and flow alteration problems. Industrial point sources, such as factories, sometimes discharge water that is excessively warm or cold, changing the temperature of the stream. Point sources may contain other pollutants such as chemicals, metals and solids.

Acid mine drainage impacts streams with high levels of acidity (low pH); high metal concentrations; elevated sulfate levels; and/or excessive dissolved and suspended solids and/or siltation. Acid mine drainage often has toxic effects on stream organisms and degrades habitat quality when deposited metals form a crust on the stream bed and susceptible soils erode from areas disturbed from mining. Ultimately it reduces biological diversity, eliminates sensitive aquatic life, and lowers ecosystem productivity.

Solving Ohio's water quality problems will require collaboration and creativity.

Most of Ohio's water quality problems will not be solved by issuing a permit or building a new wastewater treatment system to treat point sources of pollution. Improving Ohio's surface water quality will require effectively managing land use changes to ensure that polluted runoff is either captured and treated or allowed to infiltrate through the soil before running off into a stream.

Restoring and protecting natural stream functions so that pollutants may be more effectively assimilated by streams is also critical. These actions will require various programs and people working collaboratively on local water quality issues and concerns. Local educational efforts and enhanced water quality monitoring will also play important roles if we are to see significant water quality improvements throughout Ohio.

Many areas of the state are benefitting by the participation of individuals and organizations in local watershed organizations. Some of these organizations have been active for quite some time and are successfully influencing local land use decision making and implementing projects designed to improve water quality in their watershed. In recent years, the emphasis for section 319(h) grant funding has shifted from hiring local watershed coordinators and developing plans to implementing water quality improvement projects such as stream restoration, dam removals, agricultural best management practices and others. Ohio EPA is measuring improvements resulting from these projects; however, there remain challenges associated with changing land use decisions and finding cooperative partners. Ohio EPA encourages interested individuals and groups to register for the TMDL program listserv to be notified of opportunities to get involved in the TMDL development process.

Ohio EPA is also actively working with ODNR and the Ohio Department of Health (ODH) to protect people from toxins produced by cyanobacteria that may be in recreational waters at concentrations that can affect human health. The state strategy outlines thresholds for identified algal toxins, establishes monitoring protocols and identifies the process for posting and removing recreation use advisories. Furthermore, a website was established to provide background information about HABs; tips for staying safe when visiting public lakes; links to sampling information and current advisories; and contact information for reporting suspected HABs. A link to this website is at the end of this section.

The report provides more detail, including Ohio's Section 303(d) list of impaired waters, as required by the Clean Water Act.

This overview is intended to provide a summary of water quality conditions, progress and challenges in Ohio; it is only the first section of the much larger and more detailed 2020 Integrated Report.

The opening sections of the report describe the universe of water quality in Ohio—the size and scope of Ohio's water resources, programs that are used to evaluate and improve water quality and funding sources for water quality improvement.

The middle sections are more technical and explain the beneficial uses assigned to Ohio's waters; the assessment methodologies used for the analyses of those uses; the data used to determine whether those uses are being supported; and the conclusions drawn about water quality conditions in each AU.

The closing sections describe how waters found to be impaired will be scheduled for further study. The report concludes with summary tables of various types. Additional tables, including the impaired waters (303(d)) list, are available on Ohio EPA's website at ***epa.ohio.gov/dsw/tmdl/OhioIntegratedReport.aspx.*** Summaries of the condition of each AU are available through the Interactive Maps link on that webpage as well.

More Information

Many water quality reports on specific watersheds are mentioned in this overview. Find these reports at ***epa.ohio.gov/dsw/document_index/psdindx.aspx***

- Watershed restoration reports (TMDLs) — ***epa.ohio.gov/dsw/tmdl/index.aspx***
- Integrated Water Quality Monitoring and Assessment Report — ***epa.ohio.gov/dsw/tmdl/OhioIntegratedReport.aspx***
- Ohio EPA Division of Surface Water — ***epa.ohio.gov/dsw/SurfaceWater.aspx***
- Ohio EPA Division of Drinking and Ground Waters — ***epa.ohio.gov/ddagw/DrinkingandGroundWaters.aspx***
- Ohio EPA district office contact info — ***epa.ohio.gov/directions.aspx***
- Fish consumption advisory — ***epa.ohio.gov/dsw/fishadvisory/index.aspx***
- Harmful algal blooms — ***ohioalgaeinfo.com***
- Ohio Department of Health Beachguard (bacteria and algae) — ***publicapps.odh.ohio.gov/beachguardpublic/***
- List of Ohio watershed groups — ***ohiowatersheds.osu.edu/watershed-groups***
- Ohio Department of Agriculture, Soil, and Water Conservation — ***agri.ohio.gov/wps/portal/gov/oda/divisions/soil-and-water-conservation***
- U.S. Environmental Protection Agency water program — ***epa.gov/environmental-topics/water-topics***

Section

B

Ohio's Water Resources

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B1. Facts and Figures

Ohio is a water-rich state, bounded on the south by the Ohio River and the north by Lake Erie. These water bodies, as well as thousands of miles of inland streams and rivers and thousands of acres of lakes and wetlands, contribute to the quality of life of Ohio's citizens. The size and scope of Ohio's water resources are outlined in Table B-1.

Table B-1— Ohio's water resource statistics.

Metric	Value	Source	Scale
State population	11,536,504	2010 Census[1]	
Land area (square miles)	40,861	2010 Census[2]	
Rivers and streams			
Miles of named and designated streams	>23,000	ODNR[3]	1:24K
Total miles	58,343	NHD[4]	1:24K
Miles of perennial streams	29,412	NHD[4]	1:24K
Miles of intermittent streams	28,931	NHD[4]	1:24K
Miles of primary headwater streams	>115,000	Ohio EPA[5]	
Miles of large rivers (draining more than 500 square miles)	1,248	NHD[4]	1:24K
Miles of principal streams (draining 50 to 500 square miles)	4,453	NHD[4]	1:24K
Border miles: Ohio River	451	USGS $7^{1/2}$' Maps	1:24K
Lakes/Reservoirs			
Number of significant publicly owned lakes	447	ODNR[6]	1:24K
Total acreage of significant publicly owned lakes	118,963	ODNR[6]	1:24K
Border miles: Lake Erie shoreline	290	USGS $7^{1/2}$' Maps	1:24K
Total acreage of Ohio's Lake Erie waters	2,283,680	NHD[4]	1:24K
Wetlands			
Acreage	507,057	Ohio EPA[7]	1:24K
Percent of original wetlands	10 percent	Dahl[8]	

1 Source: ***factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml***
2 Source: ***census.gov/geo/reference/state-area.html***
3 Mileage for waters listed by Ohio Department of Natural Resources in *Gazetteer of Ohio Streams, 2nd edition* (ODNR 2001).
4 An estimate prepared from a computer-digitized map of U.S. streams and rivers produced by the U.S. Geological Survey (USGS) known as the National Hydrography Dataset (NHD). The NHD is based upon the content of USGS Digital Line Graph (DLG) hydrography data integrated with reach-related information from the U.S. EPA Reach File Version 3 (RF3). ***nhd.usgs.gov/index.html***
5 An estimate prepared by Ohio State University for Ohio EPA and reported in *Field Evaluation Manual for Ohio's Primary Headwater Habitat Streams* (Ohio EPA 2009).
6 Acreage for significant publicly owned lakes (> 5 acres) listed by Ohio Department of Natural Resources in *Inventory of Ohio's Lakes* (ODNR 1980).
7 Acreage for wetlands listed by Ohio EPA in *Intensification of the National Wetland Condition Assessment for Ohio: Final* Report (Ohio EPA 2015).
8 Loss of historic wetlands in Ohio estimated to be 90 percent (Dahl, 1990).

The larger water bodies included in Table B-1 comprise the major aquatic resources that are used and enjoyed by Ohioans for water supplies, recreation and other purposes. The quality of these perennial streams and other larger water bodies is strongly influenced by the condition and quality of the small feeder streams, often called the headwaters.

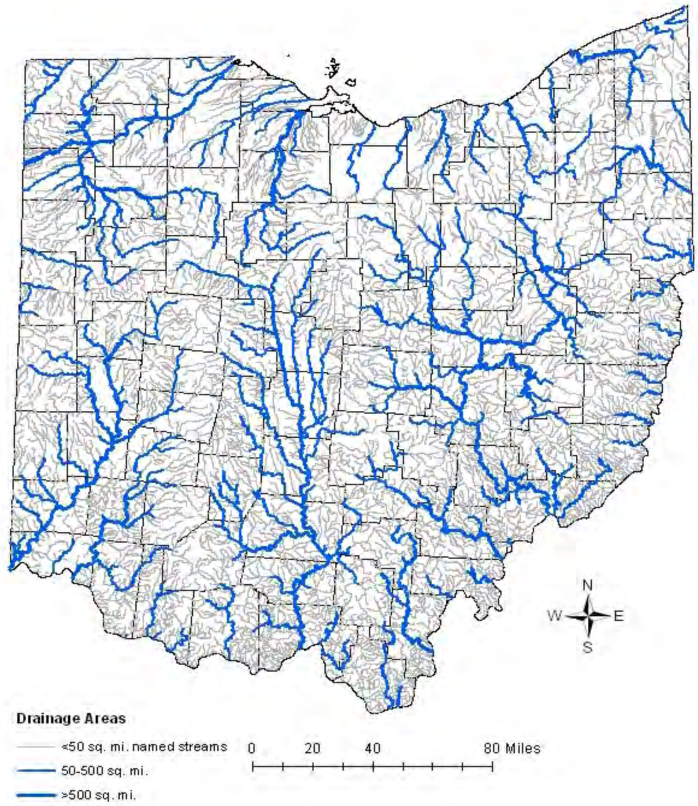


Figure B-1— Map of Ohio's principal streams and large rivers.

Approximately 28,900 miles of the more than 58,000 miles of stream channels digitally mapped in Ohio are headwater streams. However, the digital maps currently available for Ohio do not include the smallest of headwater channels. Results of a special study of primary headwater streams (drainage areas less than one square mile) place the estimate of primary headwaters between 146,000 to almost 250,000 miles (Ohio EPA 2009). Some of these primary headwater streams are, in fact, perennial habitats for aquatic life that supply base flow in larger streams. This illustrates the importance of taking a holistic watershed perspective in water resource management.

The named streams and rivers that are readily recognized by the public are mostly those that drain more than 50 mi^2. These 254 principal streams and large rivers in Ohio (comprising 5,679 linear stream miles) are listed by major Ohio watershed in Table B-2. Figure B-1 graphically depicts the extent of these stream and river miles within Ohio.

Ohio is an economically important and diverse state with strong manufacturing and agricultural industries. Many of the historical patterns of environmental impact in Ohio are related to the geographical distribution of basic industries, land use, mineral resources and population centers. Equally important, however, is an understanding of Ohio's geology, landform, land use and other natural features as these determine the basic characteristics and ecological potential of streams and rivers.

Ohio EPA bases the selection, development and calibration of ecological, toxicological and chemical/physical indicators on these factors. These indicators are then used via systematic ambient monitoring to provide information about existing environmental problems; threats to existing high-quality waters; and successes in abating water pollution problems in Ohio's surface waters.

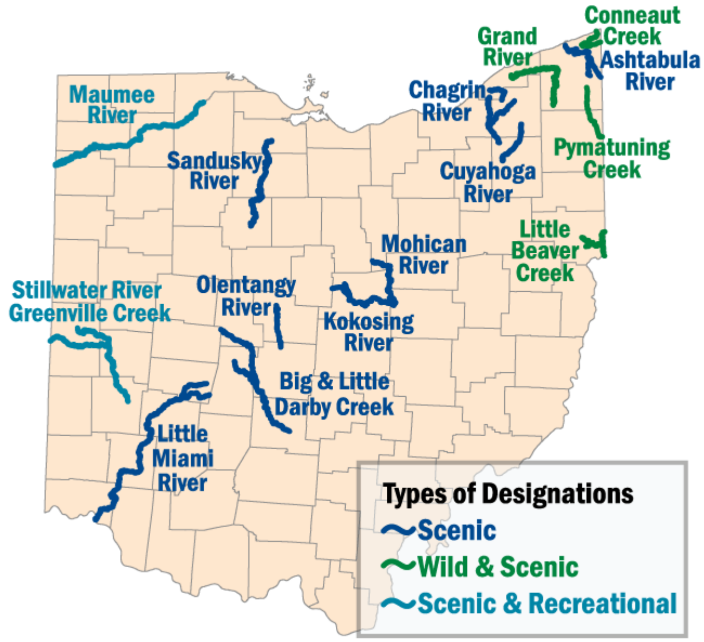
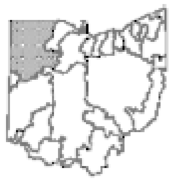
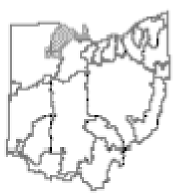
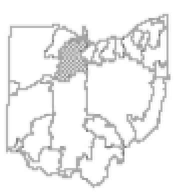
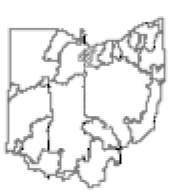
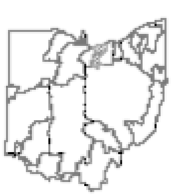


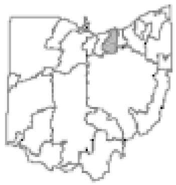
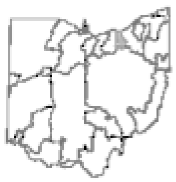
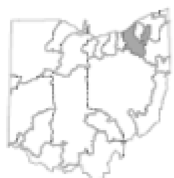
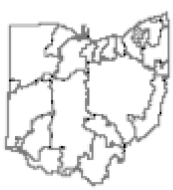
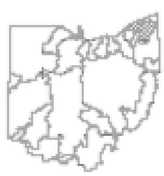
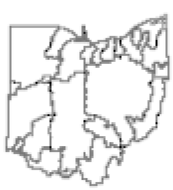
Figure B-2— Ohio Scenic River System.

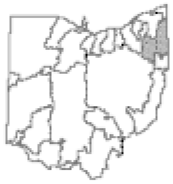
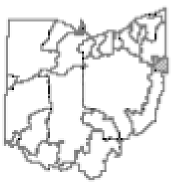
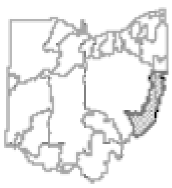
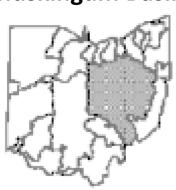
Source: **watercraft.ohiodnr.gov/scenicriversmap**

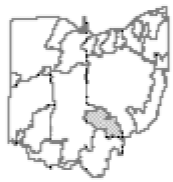
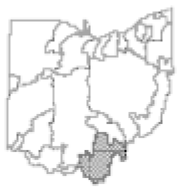
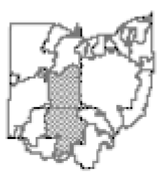
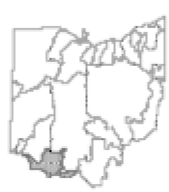
In Ohio, 15 river systems are included in the State Scenic Rivers Program, administered by the Ohio Department of Natural Resources (see Figure B-2). Between 1970 and 2018, a little more than 676 miles were designated Scenic; 102 miles in four systems were designated Wild; and 79 miles in two systems were designated Recreational. Portions of three stream systems—the Little Miami, Little Beaver Creek and Big and Little Darby Creek—are also included in the National Wild and Scenic System. The total Ohio stream miles included in the national designation is 207 miles. More information on Ohio's scenic rivers can be found at ***watercraft.ohiodnr.gov/scenicrivers***.

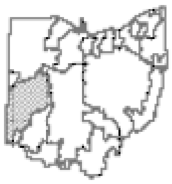
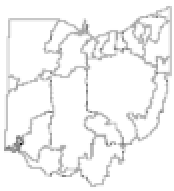
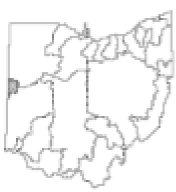
Table B-2 — List of Ohio's principal streams and large rivers.

Basin	Large Rivers (draining > 500 mi²)	Principal Streams (draining > 50 mi² but less than 500 mi²)	
Areas Draining to Lake Erie			
Maumee Basin 	Maumee River Auglaize River Blanchard River Tiffin River	Swan Creek Beaver Creek Bad Creek South Turkeyfoot Creek North Turkeyfoot Creek Flatrock Creek Powell Creek North Powell Creek Blue Creek Little Auglaize River Prairie Creek West Branch Prairie Creek Dog Creek Riley Creek Ottawa Creek Eagle Creek Ottawa River	Sugar Creek Hog Creek Jennings Creek Ottawa River Tenmile Creek St. Joseph River Fish Creek Nettle Creek West Branch St. Joseph River East Branch St. Joseph River St. Marys River Black Creek Mud Creek Lick Creek Brush Creek Bean Creek
Portage Basin 		Portage River Sugar Creek North Branch Portage River Toussaint Creek	South Branch Portage River Middle Branch Portage River Rocky Ford
Sandusky Basin 	Sandusky River	Wolf Creek East Branch Wolf Creek Sycamore Creek Broken Sword Creek	Green Creek Honey Creek Muddy Creek Tymochtee Creek
Huron Basin 		Huron River East Branch Huron River West Branch Huron River	
Vermilion Basin 		Vermilion River	

Basin	Large Rivers (draining > 500 mi²)	Principal Streams (draining > 50 mi² but less than 500 mi²)
Black Basin 		Black River East Branch Black River West Branch Black River
Rocky Basin 		Rocky River East Branch Rocky River West Branch Rocky River
Cuyahoga Basin 	Cuyahoga River	Tinkers Creek Breakneck Creek Little Cuyahoga River
Chagrin Basin 		Chagrin River Aurora Branch
Grand Basin 	Grand River	Mill Creek Rock Creek
Ashtabula Basin 		Ashtabula River Conneaut Creek

Basin	Large Rivers (draining > 500 mi^2)	Principal Streams (draining > 50 mi^2 but less than 500 mi^2)	
Areas Draining to the Ohio River			
Mahoning Basin 	Mahoning River	Meander Creek Mill Creek Mosquito Creek	Eagle Creek West Branch Mahoning River Pymatuning Creek
Little Beaver Basin 		Little Beaver Creek Bull Creek	North Fork Little Beaver Creek Middle Fork Little Beaver Creek West Fork Little Beaver Creek
Central Ohio Tributaries 		Captina Creek Cross Creek Duck Creek East Fork Duck Creek West Fork Duck Creek Little Muskingum River	McMahon Creek Short Creek Sunfish Creek Wheeling Creek Yellow Creek North Fork
Muskingum Basin 	Muskingum River Licking River Tuscarawas River Walhonding River Mohican River Wills Creek	Wolf Creek South Branch Wolf Creek West Branch Wolf Creek Olive Green Creek Conotton Creek Indian Fork Killbuck Creek Doughty Creek Apple Creek Rocky Fork Licking River South Fork Licking River Raccoon Creek North Fork Licking River Moxahala Creek Jonathan Creek Stillwater Creek Little Stillwater Creek Brushy Fork Sugar Creek South Fork Sugar Creek Sandy Creek Nimishillen Creek Still Fork White Eyes Creek	Wolf Creek Chippewa Creek Mill Creek Kokosing River Jelloway Creek North Branch Kokosing River Lake Fork Mohican River Muddy Fork Mohican River Jerome Fork Mohican River Black Fork Mohican River Rocky Fork Mohican River Clear Fork Mohican River Salt Fork Wills Creek Sugartree Fork Crooked Creek Leatherwood Creek Seneca Fork Buffalo Fork Little Hocking River Meigs Creek Salt Creek Wakatomika Creek Little Wakatomika Creek

Basin	Large Rivers (draining > 500 mi^2)	Principal Streams (draining > 50 mi^2 but less than 500 mi^2)	
Hocking Basin 	Hocking River	Margaret Creek Federal Creek Sunday Creek Monday Creek	Clear Creek Rush Creek Little Rush Creek
Southeast Ohio Tributaries 	Raccoon Creek	Indian Guyan Creek Leading Creek Little Scioto River Rocky Fork Little Scioto River Pine Creek Little Raccoon Creek	Elk Fork Shade River East Branch Shade River Middle Branch Shade River West Branch Shade River Symmes Creek Black Fork
Scioto Basin 	Scioto River Paint Creek	Big Beaver Creek Peepee Creek Walnut Creek Scippo Creek Walnut Creek Big Walnut Creek Mill Creek Alum Creek Blacklick Creek Bokes Creek Little Scioto River Rush Creek Big Darby Creek Little Darby Creek Deer Creek Sugar Run Olentangy River	Whetstone Creek North Fork Paint Creek Compton Creek Rocky Fork Paint Creek Rattlesnake Creek Lees Creek West Branch Rattlesnake Creek Sugar Creek East Fork Paint Creek Salt Creek Salt Lick Creek Middle Fork Salt Creek Laurel Run Scioto Brush Creek South Fork Scioto Brush Creek Sunfish Creek
Southwest Ohio Tributaries 		Bullskin Creek Eagle Creek West Fork Eagle Creek Ohio Brush Creek Baker Fork	West Fork Ohio Brush Creek Straight Creek White Oak Creek East Fork White Oak Creek North Fork White Oak Creek
Little Miami Basin 	Little Miami River	O'Bannon Creek Turtle Creek East Fork Little Miami River Stonelick Creek Todd Fork	Cowan Creek Caesar Creek Anderson Fork Massies Creek

Basin	Large Rivers (draining > 500 mi^2)	Principal Streams (draining > 50 mi^2 but less than 500 mi^2)	
Great Miami Basin 	Great Miami River Mad River Stillwater River Whitewater River	Indian Creek Clear Creek Bear Creek Wolf Creek Honey Creek Lost Creek Tawawa Creek Stony Creek Buck Creek Ludlow Creek	Greenville Creek Swamp Creek Dry Fork Fourmile Creek Sevenmile Creek Twin Creek Loramie Creek Muchinippi Creek South Fork Great Miami River
Mill Basin 		Mill Creek	
Wabash Basin 		Wabash River Beaver Creek	

Section

C

Managing Water Quality

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Figures

Tables

The Ohio General Assembly directs Ohio EPA and other state government departments to manage Ohio's water resources. The U.S. Environmental Protection Agency (U.S. EPA) has also delegated to Ohio EPA the responsibility to administer certain federal programs in Ohio.

The functions of various water quality management programs are explained in this section, along with a description of some funding expenditures for water quality activities in Ohio. Some federal government programs are included. Local government programs and decisions (for example, ordinances, planning and zoning) can have major impacts on water quality, but are not described here.

C1. Program Summary – Surface Water

The goal of Ohio EPA's Division of Surface Water (DSW) is to restore and maintain Ohio's water resources. This goal reflects the national water quality objective as contained in the federal Clean Water Act (CWA), which is "... to restore and maintain the chemical, physical and biological integrity of the Nation's waters"—often referred to as the fishable/swimmable goal. Fishable/swimmable waters are resources that support stable, balanced populations of aquatic organisms that are ecologically healthy and provide safe water to the people of Ohio for public and industrial water supplies and recreation.

DSW has a full-time staff of approximately 175 located in Columbus and the five Ohio EPA district offices. The division also employs approximately 30 interns during the summer to assist with biological and chemical water quality surveys. Funding for the division is comprised of federal monies, environmental protection funds generated through solid waste disposal fees and annual discharge fees.

A watershed-based approach to assessments and delivery of services has been a program management objective within DSW for nearly three decades. The rotating basin approach and the core work of the biological and water quality monitoring program have gradually become the division's assessment component within the Total Maximum Daily Load (TMDL) program. Ohio's TMDL program has been designed to be watershed-focused and to promote integration of other ongoing water program elements on a watershed basis. For additional information on Ohio EPA's water quality monitoring strategy and proposed revisions, see Section I of this report.

Biological and Water Quality Surveys

Ohio EPA routinely conducts biological and water quality surveys on a systematic basis throughout the state. A biological and water quality survey is an interdisciplinary monitoring effort coordinated on a reach-specific or watershed scale. Such efforts may involve a relatively simple setting, focusing on one or two small streams, one or two principal stressors and a handful of sampling sites or a much more complex effort including entire drainage basins, multiple and overlapping stressors and tens of sites.

Biological, chemical and physical habitat monitoring and assessment techniques are employed in surveys to meet four major objectives:

- provide a current and thorough re-assessment of water quality conditions in watersheds for pollutants identified as impairing beneficial uses based on data collected during prior surveys;
- determine the extent to which use designations assigned in the Ohio WQS are either attained or not attained;
- determine if use designations assigned to a given water body are appropriate and attainable and recommend designations or changes where needed; and
- determine if any changes in key ambient biological, chemical or physical indicators have taken place over time, particularly before and after the implementation of point source pollution controls or best management practices (BMPs).

The gathered data is processed, evaluated and synthesized in a biological and water quality report. The findings and conclusions of each biological and water quality survey may factor into regulatory actions taken by Ohio EPA and are incorporated into the Ohio WQS (Ohio Administrative Code (OAC) 3745-1), Water Quality Permit Support Documents, State Water Quality Management Plans, the Ohio Nonpoint Source (NPS) Assessment and the aquatic life beneficial use analysis in the Ohio Integrated Water Quality Monitoring and Assessment Report (IR) [this report, prepared to meet the requirements of CWA Sections 305(b) and 303(d)] and TMDLs.

More information about DSW's water quality monitoring and assessment program is available at ***epa.ohio.gov/dsw/bioassess/ohstrat.aspx***. An index with links to available biological and water quality reports can be found at ***epa.ohio.gov/dsw/document_index/psdindx.aspx***.

Biosolids

Sewage sludge is the solid, semi-solid or liquid residue generated during the treatment of domestic sewage in a treatment works. When treated and processed for beneficial use, sewage sludge becomes biosolids—nutrient-rich organic materials that can be safely recycled and applied as fertilizer. Only biosolids that meet the standards spelled out in Federal and state rules can be approved for use as a fertilizer. Publicly Owned Treatment Works (POTWs) make the decision whether to recycle the biosolids as a fertilizer, incinerate them or bury them in a landfill.

Ohio EPA received delegation to administer the biosolids program (CWA Section 503 Program) in 2005. In March 2000, the Ohio General Assembly passed House Bill (HB) 197 to provide the statutory authority for the director of Ohio EPA to seek delegation of the program. HB 197 modified the Ohio Revised Code (ORC) to provide the director of Ohio EPA the authority to adopt, enforce, modify and rescind rules necessary to implement the biosolids program. HB 197 also modified the ORC to include an annual sewage sludge fee to fund the program. Each dry ton of sewage sludge treated or disposed in the State of Ohio is assessed a fee, with a cap of $600,000 per year on all monies collected.

Shortly after the passage of HB 197, Ohio EPA began drafting rules that became effective in April 2002, as Ohio's Sewage Sludge Rules: Chapter 3745-40 of the OAC. The purpose of Chapter 3745-40 of the OAC is to "establish standards applicable to the treatment, storage, transfer or disposal of sewage sludge or biosolids, establish standards applicable to the beneficial use of biosolids, reasonably protect public health and the environment, encourage the beneficial use of biosolids, and minimize the creation of nuisance odors." The most recent version of OAC 3745-40 became effective in December 2018.

Funded by annual sludge fees, Ohio EPA employees complete sewage sludge management duties in the field and office. These employees perform compliance evaluation inspections at POTWs that beneficially use biosolids. They review annual data submitted by POTWs to ensure compliance with pollutant limits, monitoring and reporting requirements and perform authorization reviews for proposed land application sites. Employees track authorized biosolids application sites and associated data in a Geographic Information System, (GIS) program. As needed, field reconnaissance inspections are conducted at land application sites to verify compliance with site restrictions and management practices. These employees also review the NPDES permits that regulate sewage sludge generators and provide technical assistance to biosolids generators to ensure compliance with the OAC 3745-40.

Combined Sewer Overflow Control Program

Combined sewers were built to collect sanitary and industrial wastewater, as well as storm water runoff, and transport these combined waters to a wastewater treatment plant (WWTP). During dry weather, they are designed to transport all flow to the WWTP. When it rains, the volume of storm water and wastewater may exceed the capacity of the combined sewers or of the WWTP. When this happens, the combined sewers are designed to allow a portion of the combined wastewater to overflow into the nearest stream, river or lake. This is a combined sewer overflow (CSO). Ohio has approximately 1,112 known CSOs in 89 CSO communities (June 2019), ranging from small, rural villages to large metropolitan areas.

In 1994, U.S. EPA published the national CSO Control Policy. Working from the national policy, Ohio EPA issued its CSO Control Strategy in 1995. The primary goals of Ohio's strategy are to control CSOs so that they do not significantly contribute to violations of water quality standards or the impairment of designated uses and to minimize the total loading of pollutants discharged during wet weather. Ohio’s strategy addresses several issues that aren’t covered by the national policy (for example, sanitary sewer extensions that occur up pipe of CSOs).

In 2000, Congress passed the Wet Weather Water Quality Act, which did two important things: it codified the 1994 national policy by making it part of the CWA and required that all actions taken to implement CSO controls be consistent with the provisions of the national policy.

Ohio EPA continues to implement CSO controls through provisions included in National Pollutant Discharge Elimination System (NPDES) permits and using orders and consent agreements when appropriate. The NPDES permits for Ohio’s CSO communities require them to implement the nine minimum control measures. Requirements to develop and implement Long-Term Control Plans (LTCPs) are also included where appropriate. In 2007, U.S. EPA adopted a new definition for the Water Safe for Swimming Measure, which sets goals to address the water quality and human health impacts of CSOs. The new definition sets a goal of incorporating an implementation schedule of approved projects into an appropriate enforceable mechanism, including a permit or enforcement order, with specific dates and milestones for 91 percent of the nation’s CSO communities by September 2015. As of June 2019, 83 of Ohio’s 89 CSO communities met this definition (93 percent), meeting the U.S. EPA’s Safe for Swimming Measure goal.

Compliance Program

DSW staff works closely with the regulated community and local health departments to ensure that surface waters of the state are free of pollution. The regulated community with which DSW staff works includes wastewater facilities, both municipal and industrial; and small, unsewered communities experiencing problems with unsanitary conditions.

DSW staff provides technical assistance, conducts inspections of WWTPs, reviews operation reports, oversees land application of biosolids and manure from certain large concentrated animal feeding operations and investigates complaints regarding malfunctioning WWTPs and violations of Ohio's Water Quality Standards. DSW strives to ensure that permitted facilities comply with their NPDES permits.

Concentrated Animal Feeding Operations

On Dec. 14, 2000, Governor Taft signed a bill that started the process of transferring authority to regulate concentrated animal feeding operations (CAFOs) to the Ohio Department of Agriculture (ODA), which now regulates construction and operation of large concentrated animal feeding facilities under their Permit-to-Install (PTI) and Permit-to-Operate (PTO) programs. However, PTI authority for sewage treatment and disposal systems at animal feeding facilities and for animal feeding facilities that discharge to POTWs remains with Ohio EPA.

Ohio EPA also retains authority for implementing the NPDES permit program for animal feeding operations until the revised delegation agreement with U.S. EPA that has been submitted by Ohio is approved by U.S. EPA. Because of federal rule revisions and court decisions, only facilities that meet the definition of a CAFO and that are discharging or proposing to discharge are required to apply to Ohio EPA for an NPDES permit.

The CAFO program at Ohio EPA uses a watershed perspective to prioritize work to some degree. The changes in the federal rule resulting in CAFO NPDES permits being required only when a facility discharges limits our need and ability to prioritize permitting by watersheds. However, the status of the watershed is considered in making decisions about enforcement and compliance activities (for example, supplemental environmental projects may be preferred over penalties; more technical assistance may be focused on TMDL watersheds).

Credible Data – Citizen Monitoring Program

The program's authorizing legislation was passed and signed by the governor in 2003. Ohio EPA adopted rules in 2006 (OAC Chapter 3745-4) for the program's operation and revised those rules in 2011 and 2018. The legislation and the rules are explicit in the desire to not only encourage the collection of water quality data by citizens, but also to ensure that the data are valid and useful for their intended purpose. In other words, the data should be credible. The rule package bears the name credible data because of this important feature and because the enabling legislation was referred to as the credible data bill. Thus, the words credible data appear in the terminology applied to citizen monitoring programs that choose to participate.

As envisioned by the legislation, any person with an interest in water quality should have a means to collect certain types of data useful for various inquiries about the quality of the water resource. Ohio EPA's role is to foster and broadly oversee the collection, analysis and use of data collected by such volunteer individuals and organizations. To promote scientific validity, Ohio EPA has established specific requirements to participate in the program and to collect data using approved study plans.

The law and the administrative regulations are the basis for establishing three broad categories or levels of data that will be deemed credible for distinctly different purposes. The overall premise is that there must be an increasing level of scientific rigor behind the sampling and analytical work as we progress from Level 1 to Level 2 to Level 3.

Level 1's purpose is primarily to promote public awareness and education about surface waters of the state. Level 1 may be appropriate for educators from soil and water conservation districts (SWCDs), park districts, health departments, schools or anyone with an interest in Ohio water quality.

Level 2 was designed with watershed groups in mind and may also be appropriate for SWCDs and health departments. Level 2 data can be used to evaluate the effectiveness of pollution controls, to conduct initial screening of water quality conditions and to promote public awareness and education about surface waters of the state. Level 2 groups are often in the position to perform the valuable function of monitoring long-term surface water quality trends in a watershed (where Ohio EPA may not have the resources to frequently revisit an area).

Level 3 provides the highest level of scientific rigor, and methods are equivalent to those used by Ohio EPA personnel. The law limits the director to using only Level 3 data collected under the credible data program for certain regulatory applications (for example, setting water quality standards and evaluating attainment of those standards). In other words, data submitted under this program as Level 1 and Level 2 data cannot be used for those regulatory purposes.

As of October 2019, the Agency currently has 936 Level 1, 113 Level 2 and 86 Level 3 qualified data collectors and has approved 230 study plans since the program's inception in 2006. Ohio EPA has created a web-based portal for data entry and data access (Credible Data Online Application, ***epa.ohio.gov/dsw/credibledata/submission_of_data.aspx***), available through Ohio EPA's eBusiness Center.

Enforcement Program

Ohio EPA strives to ensure that individuals, permitted facilities and unpermitted facilities comply with applicable permits, rules and laws. In cases in which Ohio EPA is unable to resolve continuing water quality or other violations, DSW may recommend that enforcement action be taken. An enforcement action could be Director's Final Findings and Orders completed within Ohio EPA or a court action through the Attorney General's Office. DSW enforcement staff work with Ohio EPA attorneys, as well as the Attorney General's Office, to resolve these cases. Where possible, an added emphasis and priority is given to actions in sensitive watersheds. All final enforcement orders are posted on the DSW webpage.

Inland Lakes Program

Ohio EPA initiated a renewed monitoring effort for inland lakes in 2008. This report assesses three of the four beneficial uses that apply to inland lakes: recreation; public drinking water supply; and human health (via fish tissue). Ohio EPA plans to update the water quality standards rules for lakes. Once these rule updates are complete, Ohio EPA expects to include an assessment of the aquatic life use for lakes as a factor in listing watershed or large river assessment units in future CWA Section 303(d) lists. More information about Ohio EPA's Inland Lakes Program may be found in Section I of this report.

Isolated Wetlands Permitting

Ohio Revised Code (ORC) 6111 requires anyone who wishes to discharge fill material into an isolated wetland within Ohio, regardless of whether on private or public property, to obtain an Isolated Wetland Permit (IWP) from Ohio EPA. Isolated wetlands are not connected to other surface waters and are not considered waters of the United States by the U.S. Army Corps of Engineers and, therefore, are not subject to CWA Sections 404 and 401.

Ohio EPA's regulatory authority regarding isolated wetlands is provided in ORC 6111.02 through 6111.028. There are three different levels of IWPs, depending on the quality of the wetland and the acreage of wetland proposed for impact. Level one IWPs are considered a general permit and reissued by Ohio EPA every five years. The current level one IWP was issued on April 10, 2017. Applicants must submit a pre-activity notice for authorization under the level one IWP. Level two and level three IWPs are considered individual permits and involve a public notice and comment period.

Level two IWP applications require the submittal of everything required with a level one IWP application along with an analysis of practicable on-site alternatives. Level three IWP applications require the submittal of everything required with a level one IWP application and must undergo a full antidegradation review in accordance with OAC 3745-1-05 (antidegradation) and OAC 3745-1- 54 (wetland antidegradation). Under Ohio's antidegradation review, the director may authorize the lowering of wetland quality resulting from the discharge of dredged or fill material only after determining that the lowering of wetland quality will not result in the violation of state water quality standards. This is achieved through: 1) conducting an alternatives analysis; 2) intergovernmental coordination with other state and federal resource agencies; and 3) a public involvement process. The alternatives analysis is intended to walk applicants through a deliberate procedure to avoid and minimize impacts to wetlands while still achieving the project's purpose and need.

Ohio EPA strongly encourages applicants to engage in pre-application coordination early in the development phase to help identify high-quality resources, discuss potential alternatives and identify mitigation obligations. Applicants must provide compensatory mitigation for any unavoidable impacts to isolated wetlands in accordance with ORC 6111.022 through 6111.024 and 6111.027. Under state law, each IWP application must contain specific items for the permit to be issued. Ohio EPA has 30 days from the date of receipt of a level one IWP to authorize the project under the general permit or require the applicant to apply for an individual IWP. When a level two IWP application is formally considered complete, Ohio EPA has 90 days to either issue or deny the permit. When a level three IWP application is formally considered complete, Ohio EPA has 180 days to either issue or deny the permit.

IWP staff are assigned a region of the state based on Ohio EPA districts. In addition, Ohio EPA has staff dedicated specifically to the review of coal mining and Ohio Department of Transportation (ODOT) projects, as well as the review of wetland mitigation project compliance. Additional staff is dedicated to wetland research in support of the IWP program.

Lake Erie Program

DSW participates in many Lake Erie- and Great Lakes-related issues and efforts. The key program areas are implementation of Remedial Action Plans (RAPs) under the Areas of Concern (AOC) Program and implementation of the binational Lake Erie Lakewide Action and Management Plan (LAMP). Restoration of AOCs and implementation of the Lake Erie LAMP are focused on reducing the loadings of pollutants and restoring all beneficial uses to these waterbodies. Both programs are described in the Great Lakes Water Quality Agreement (GLWQA) between Canada and the United States and are mandated under the Great Lakes Critical Programs Act amendment to the CWA. The GLWQA was most recently revised in 2012 and the Agency is directly involved in implementing the new goals and requirements contained in the agreement.

Ohio EPA also conducts routine monitoring of Lake Erie (within Ohio's jurisdiction) and is responsible for reporting the Lake's condition and identifying impaired waters under the CWA. Ohio EPA initiated a *Comprehensive Lake Erie Nearshore Monitoring Program* in 2011 with the assistance of a Great Lakes Restoration Initiative (GLRI) grant to develop and implement a comprehensive monitoring program. Ohio's long-term monitoring program includes an assessment of water and sediment quality in the western and central basins at fixed ambient stations located in shoreline (bays) and nearshore areas. Biological monitoring includes tracking of burrowing mayfly[1] populations and calculation of fish index scores at select shoreline locations. The hypoxia/anoxia phenomenon in the Central Basin is also monitored with a series of transects that connect fixed ambient stations to the open waters. Periodic intensive surveys in bays, harbors and estuaries are also done.

[1] As an indicator organism, the status of mayfly populations can be used to evaluate long-term changes in water and sediment quality (Krieger et al, 2004).

This monitoring effort supports Annex 2 in the GLWQA, which calls for development of nearshore monitoring to support an integrated nearshore framework. Annex 4 of the GLWQA addresses nutrients and Ohio EPA's monitoring may also support assessment of the lake ecosystem objectives identified in the agreement. Monitoring will directly support the Agency's CWA evaluation of the Lake Erie Assessment Units in the IR. Additionally, long-term monitoring will provide the data needed to evaluate water quality trends, assess the effectiveness of remedial and nutrient reduction programs, measure compliance with jurisdictional regulatory programs, identify emerging problems and support AOC delisting.

Areas of Concern and Remedial Action Plans

AOCs were initially identified in the early 1980s as the most environmentally degraded areas along the Great Lakes shoreline, including Ohio's Lake Erie coast. Annex 1 of the GLWQA calls for restoration of beneficial uses that have become impaired at the local level through development and implementation of Remedial Action Plans and more recently Management Actions. In many ways, these beneficial use impairments (BUIs) reflect similar goals as Ohio WQS but may have targets that differ slightly and are aimed for baseline benchmarks of restoration and recovery. BUIs in Ohio include: restrictions on fish and wildlife consumption; degradation of fish and wildlife populations; fish tumors or other deformities; degradation of benthos; restrictions on dredging; eutrophication or undesirable algae; beach closings; degradation of aesthetics; added costs to agriculture and industry; degradation of phytoplankton and zooplankton populations; and loss of fish and wildlife habitat.

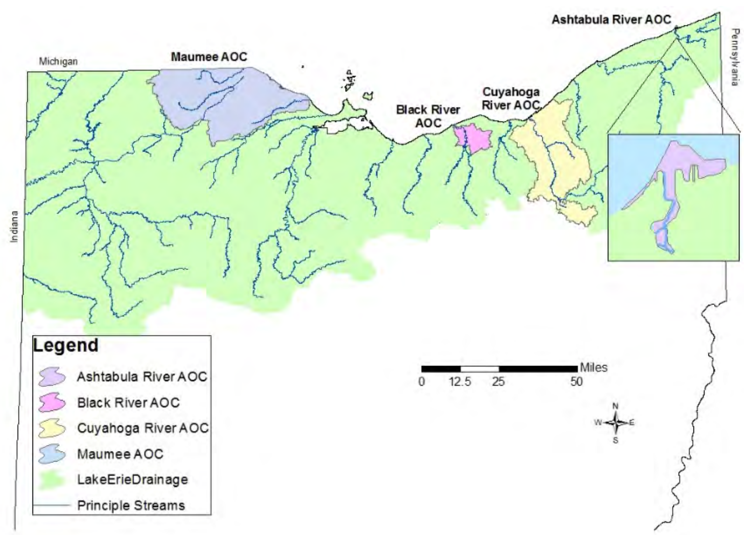


Figure C-1 — Ohio Lake Erie AOCs and major Lake Erie tributaries.

One way to track progress in AOCs is to measure how close the areas are to achieving restoration (delisting) targets. Restoration targets have been determined for each of the beneficial uses (aquatic life, human health, recreation and public drinking water supply) and monitoring programs to evaluate measures of progress to targets are being designed and implemented. Delisting Guidance and Restoration Targets for Ohio's Areas of Concern has been established and was updated as of 2017. In 2014, Ohio EPA developed a new AOC program framework. In 2018, the framework was updated to realize additional programmatic efficiencies when AOC Program coordination was shifted to the Ohio Lake Erie Commission, with staff support from Ohio EPA.

The framework and guidance provide clarity for how the state and local AOC advisory committees will work together to implement the needed management actions and remove BUIs and delist the AOC. The guidance also assists in tracking progress toward achieving the stated delisting goals under the associated Great Lakes Restoration Initiative Action Plan.

Ashtabula AOC

A series of projects since 2006 were conducted to remediate contaminated sediments and restore habitat conditions in the Ashtabula River Area of Concern. These projects were funded by the Great Lakes Legacy

Act (GLLA) Program and Great Lakes Restoration Initiative (GLRI). Since the implementation of these projects, the river has continued to see improvement in its condition.

In 2018, the Degradation of Benthos BUI was removed. There are two BUIs that remain for removal prior to proceeding with the delisting process for the Ashtabula River AOC. Ohio EPA is in the process of evaluating the remaining BUIs as the river continues to recover from past degradation. Once monitoring indicates that the river has responded as anticipated and restoration targets have been achieved, the Ashtabula River will be delisted as an AOC.

Black AOC

Seven BUIs remain in the Black River AOC. Since 2015, the Ohio AOC program has been working with U.S. EPA, the local advisory committee and local implementers to complete the management actions set forth for this AOC. Since 2015, all but one project has been completed. The implementation of the final management action was initiated in 2019 with anticipation of substantial completion in 2020. Further evaluation of the remaining BUIs have continued to be a priority for the Ohio AOC program and the local Advisory Committee and determination of recommendations for their removal in the coming years.

Cuyahoga AOC

There are seven BUIs that remain in the Cuyahoga River AOC. In March 2019, the Loss of Fish and Wildlife Consumption BUI was removed. In 2018, a management action list was submitted and approved by U.S. EPA for implementation projects for the aquatic-related BUIs including fish populations, benthic community and fish habitat. A number of those management actions have been initiated in partnership with local implementers. Data collected in 2017 and 2018 continue to show biological improvements especially in the mainstem of the river. Management Actions include projects such as Canal Diversion Dam and Gorge Dam. Many of the remaining BUIs continue to be evaluated for their current state and removal consideration. A final Management Action list for all remaining BUIs is being evaluated and determined. A milestone to substantially complete management actions by 2024 continues to drive the current work forward.

Maumee AOC

The Maumee AOC is Ohio’s largest and most complex AOC. Contaminated sediments, nonpoint sources, nutrient loads and habitat loss are all major causes of BUIs. The Maumee River watershed is also a significant contributor to water quality concerns in the western basin of Lake Erie, however the Maumee AOC only includes a very small portion of the Maumee River watershed (<4%). There are nine BUIs remaining in the Maumee AOC. A GLLA sediment remediation project has been completed and a Natural Resource Damage Assessment is nearly settled on the Ottawa River. A GLLA remedy effectiveness study on the Ottawa River was conducted in late 2019. GLLA work on the mainstem Maumee River, Swan Creek and Otter Creek continue to progress. These GLLA contaminated sediment assessments, along with Ohio EPA’s biological stream assessments, are vital in helping Ohio EPA and the local advisory committee determine restoration needs and priority management actions. In 2017, Ohio EPA, in coordination with the local Advisory Committee, established a management action list for the wildlife portion of BUI 14: Loss of Fish and Wildlife Habitat. Those projects have been initiated for implementation through state and local partners and continue to progress towards completion. Ohio EPA is working with the local Advisory Committee to establish management actions for the remaining BUIs in the Maumee AOC with a focus on the aquatic-related biological BUIs (fish populations, benthic community, fish habitat) and associated projects. Once these actions are established, progress in the Maumee AOC will continue to accelerate towards addressing BUIs.

Lake Erie Lakewide Action and Management Plan (LAMP, formerly LaMP)

Annex 2 of the GLWQA addresses binational lakewide management and specifies that the LAMPs for each of the Great Lakes shall document and coordinate the management actions required in the Annex. The LAMP is a comprehensive framework that outlines the management actions needed to bring Lake Erie back to chemical, physical and biological integrity. Specifically, Annex 2 calls for the following:

- establish lake ecosystem objectives;
- assemble, assess and report on existing scientific information;
- identify research, monitoring and other priorities to support management actions;
- conduct surveys, inventories and studies and support outreach efforts;
- identify additional action needed to address priority water quality threats;
- develop and implement lake-specific binational strategies; and
- develop an integrated near shore framework for implementation by 2015 (see Section G2.3 for additional information).

The Lake Erie LAMP also serves as the primary mechanism to assess ecosystem condition, identify environmental threats, set priorities for research and monitoring, and identify further actions to be taken by governments and the public that address the key threats to the waters of Lake Erie and the St. Clair-Detroit River System (Environment and Climate Change Canada and U.S. EPA, 2019).

The Lake Erie LAMP is being updated for 2019-2023. Five priorities identified include nutrients and bacterial pollution, chemical contamination pollution, loss of habitat and native species, invasive species, and climate change impacts. Ohio, as a member of the Lake Erie Partnership, has worked with a variety of entities on determining implementation measures of the strategies and actions outlined under these five priorities. For example, Ohio has representatives on the Annex 4 Subcommittee which addresses nutrient reductions and is responsible for evaluating state of the science, developing targets, and coordinating actions among the state, province, and federal governments.

For both the AOCs and the LAMP, it is important to maintain the engagement of local communities and stakeholders. In Ohio's AOCs, the local communities and partners play significant roles in engaging local entities in the work to accomplish, serving as local project sponsors and providing outreach to the community-at-large on AOC program milestones and accomplishments. A reliable, long-term source of funding is essential to continue to fund the administration and outreach costs associated with local coordinator leadership efforts. Public outreach efforts are also needed to connect the decisions and projects in the watersheds called for in the AOC program and in the LAMP to the environmental condition of the lake.

National Pollutant Discharge Elimination System (NPDES) Permits

To protect Ohio's water resources, Ohio EPA issues NPDES permits. These permits authorize the discharge of substances and establish other conditions related to activities such as CSOs, pretreatment, storm water and sludge disposal. This is an overview of the process for the development of individual NPDES permits.

Limit Types

The Clean Water Act has provisions for technology based effluent limits (TBELs) and water quality-based effluent limits (WQBELs). When deriving an NPDES permit, the writer will compare applicable TBELs and WQBELs and apply the most stringent limit. Additionally, when the receiving stream has an approved final TMDL in place, the permit writer will incorporate the TMDL requirements.

Technology Based Effluent Limits

U.S. EPA issues effluent guidelines which are national standards for industrial discharges to surface waters and sewage treatment plants. The standards are based on the performance of treatment and control technologies and are linked to production amount or size. Therefore, permit writers only need the production amount or size to develop TBELs.

For example, a company which pours 1,000 tons of steel will have more allowable loading discharged than a company which pours one ton of steel. At the same time, the same TBEL will be applied whether you discharge to a large river like Ohio River or a small creek.

Water Quality Based Effluent Limits

Ohio rules require NPDES permits to be protective of the receiving stream uses, including public water supply, industrial, agricultural, aquatic life, human health and recreational. To develop limits to protect these uses, the first step is determining:

- Discharge Information
  - Concentrations of pollutants
  - Proposed flows
- Receiving Stream Information
  - In-stream chemistry data
  - Low-flow conditions
  - Applicable uses

The permit writer does a mass balance to determine the allowable discharge amounts which will be protective of the water quality criteria.

Total Maximum Daily Load

Receiving streams which are impaired may result in a TMDL for a certain pollutant, such as phosphorus. In these cases, point sources are allocated an amount (or load) of pollutant which will result in the stream fully obtaining its designated uses. The permit writer will use the TMDL as a technical document to justify permit limits.

NPDES Permit Implementation

NPDES permits are issued for a period of up to five years. Ohio EPA may re-open NPDES permits if the discharge is having adverse effects on human health or the environment, or if new quality standards are promulgated or existing ones are changed. If not, the permit writer will reassess permit limits during the renewal process of the NPDES permit.

The keystone of the NPDES program is self-monitoring data provided by the permittee. The permittee monitors and submits effluent data throughout the duration of the permit. If limits are exceeded, the permittee is required to provide notice to Ohio EPA, state what caused the exceedance and what will be done to prevent future exceedances.

Ohio EPA may also perform sampling of the effluent, typically as part of a permit renewal or as part of a larger survey on the receiving stream watershed. A stream survey would also determine any potential biological impacts of the NPDES permit discharge. This sampling information is used to further evaluate the impacts the discharge may be having on the receiving stream and to justify any additional permit limits or conditions needed to eliminate adverse impacts.

Nonpoint Source (NPS) Program

The framework for Ohio's NPS program is provided in Ohio's Nonpoint Source Management Plan (NSMP). The updated NSMP, which outlines strategies and objectives for Ohio's NPS program through 2019 was approved by U.S. EPA Region 5 in 2015. The updated plan includes a description of Ohio's NPS Section 319(h) grant funding sources as well as a listing of state, federal and local partners that implement the strategies outlined in the updated plan.

The NSMP plan provides four sections outlining the strategic vision along with aggressive (yet reasonable) goals and objectives of Ohio's NPS program over the next five years. These sections include:

- Urban Sediment and Nutrient Reduction Strategies—including recommended practices;
- Altered Stream and Habitat Restoration Strategies—including recommended practices;
- NPS Reduction Strategies—including practices and management actions to reduce silt, sediment and nutrient losses from agricultural lands; and
- High Quality Waters Protection Strategies.

The most current version of Ohio's NSMP is available at ***epa.ohio.gov/Portals/35/nps/NPS_Mgmt_Plan.pdf***.

Much of Ohio's population is in urban areas and many are located near major rivers that are impacted by hydromodification, riparian corridor losses and inputs from storm sewers. Ohio's NPS program is committed to partner with local communities, to provide leadership and funding in order to prioritize readily implementable projects, so that high magnitude causes of impairment are eliminated and impaired stream segments in urban areas are incrementally restored.

Progress toward achievement of Ohio's Section 319(h) grants program goals will continue to be measured as part of Ohio's NPS monitoring and assessment initiative. Ohio EPA staff conducts all monitoring (physical, chemical and biological) to determine the effectiveness of Section 319(h)-funded NPS projects. This initiative provides cost savings and improved data quality as well as critical information about 319(h) project effectiveness.

Pretreatment

In addition to regulating direct discharges to waters of the state, Ohio regulates industrial wastewaters that are indirectly discharged. These indirect discharges are those that flow from industrial sources, known as industrial users (IUs), to a publicly owned treatment works (POTW) for treatment prior to reaching a stream, river or lake. On July 27, 1983, Ohio received authorization to administer and enforce these indirect discharges through a pretreatment program.

The goals of Ohio EPA's pretreatment program are to ensure the following:

1) all POTWs authorized to implement their own pretreatment programs are in compliance with the pretreatment regulations;
2) all IUs discharging to a POTW within Ohio are in compliance with the pretreatment regulations; and
3) all IUs discharging to a POTW within Ohio are covered under a permit, whether it be a permit-by-rule, indirect discharge permit (IDP) or a control mechanism issued by a POTW with an approved pretreatment program.

As of April 2018, Ohio EPA has approved pretreatment programs for 128 POTWs and continues to provide pretreatment training and guidance. These pretreatment programs have the authority to issue permits to their own indirect industrial dischargers and enforce their own local regulations. Many of these programs, such as Cincinnati's Metropolitan Sewer District and Cleveland's Northeast Ohio Regional Sewer District, are regarded as model pretreatment programs.

For municipalities that do not operate an approved pretreatment program, it is Ohio EPA's responsibility to enforce pretreatment regulations on the indirect industrial discharges. The pretreatment regulations are enforced through permits – specifically those issued through Ohio EPA's IDP program. In addition to issuing IDPs to significant industrial users (SIUs), the IDP program monitors, inspects and provides enforcement to the IUs that discharge into POTWs that do not have approved pretreatment programs. Through the IDP program, Ohio EPA prevents toxic discharges to these smaller POTWs and thereby reduces the potential for severe environmental harm.

Those SIUs discharging to a POTW with an approved pretreatment program are identified by industrial user surveys, inspections and other activities conducted by the POTW. SIUs discharging to a POTW without an approved program are identified primarily through Ohio EPA's inspections, permit to install applications and communication with WWTP operators. For more information, please visit Ohio EPA's pretreatment program webpage at ***epa.ohio.gov/dsw/pretreatment/index.aspx***.

Section 208 Plans and State Water Quality Management Plan

Ohio EPA oversees the State Water Quality Management (WQM) plan. The State WQM plan is a requirement of CWA Section 303 and must include nine discrete elements:

1) TMDLs;
2) Effluent limits;
3) Municipal and industrial waste treatment;
4) NPS management and control;
5) Management agencies;
6) Implementation measures;
7) Dredge and fill program;
8) Basin plans; and
9) Ground water.

The State WQM plan is an encyclopedia of information used to plot and direct actions that abate pollution and preserve clean water. A wide variety of issues are addressed and framed within the context of applicable laws and regulations. For some issues and locales, information about local communities may be covered in the plan. Other issues are covered only at a statewide level. Many of the topics or issues overlap with planning requirements of CWA Section 208 (items 3-9 above). The state WQM plan includes, through references to separate documents, all 208 plans in the State.

Local governments typically conduct planning to meet the sewage disposal needs of the community. Ohio EPA has established guidelines for planning that are useful in the context of Section 208 and the State WQM plan. Local governments that follow these guidelines are more likely to have the results of their planning work incorporated into the state 208 plan prepared by Ohio EPA.

Under Section 208 of the federal CWA, states may designate regional planning agencies to prepare, maintain and implement water quality management plans. Ohio has six areawide planning agencies that have established their own operating protocols, committees and processes to involve local governments in shaping their 208 plans. All six areawide planning agencies updated their 208 plans in 2011, thanks to increased funding through the American Recovery and Reinvestment Act of 2009 (ARRA) and the state's biennium budget. Additional updates occur on an ongoing basis. The most recent 208 Plan amendments were approved by U.S. EPA on April 8, 2016.

Section 401 Water Quality Certifications

The CWA requires anyone who wishes to discharge dredged or fill material into the waters of the United States, regardless of whether on private or public property, to obtain a CWA Section 404 permit from the U.S. Army Corps of Engineers and a CWA Section 401 water quality certification (WQC) from the state. Ohio EPA is responsible for administering the CWA Section 401 WQC process in Ohio.

Rules governing the 401 review process are currently found in OAC 3745-1-05 (stream antidegradation), 3745-1-50 through 54 (wetland water quality standards) and 3745-32-01 through 03 (Section 401 WQCs). Under Ohio's antidegradation review, the director may authorize the lowering of water quality resulting from the discharge of dredged or fill material only after determining that the lowering of water quality will not result in the violation of state water quality standards. This is achieved through: 1) conducting an alternatives analysis; 2) intergovernmental coordination with other state and federal resource agencies; and 3) a public involvement process.

Applicants must develop alternatives for each development in accordance with 40 C.F.R. Part 230. The alternatives analysis is intended to walk applicants through a deliberate process to avoid and minimize impacts to aquatic resources while still achieving the project's purpose and need. Applicants must provide compensatory mitigation for any unavoidable impacts to streams and/or wetlands. The program emphasizes evaluation of physical habitat and biocriteria to determine potential impacts to water quality and to evaluate potential mitigation sites.

Ohio EPA strongly encourages applicants to engage in pre-application coordination early in the development phase to help identify high quality resources, discuss potential alternatives and identify mitigation obligations. Under state law, the 401 application must contain 10 specific items for the technical review to begin. When the application is formally considered complete, Ohio EPA has 180 days to conduct its technical review and either approve or deny the project. During this time, the applicant may withdraw the application. All projects are subject to minimum 30-day public comment period. Controversial projects may also require a public hearing.

Nationwide permits (NWPs) are general permits issued by the Corps for certain types of projects that are similar in nature and cause minimal degradation to surface waters of the state. There are currently 52 NWPs. Ohio EPA issued a conditioned 401 for 45 of the 52 NWPs on March 17, 2017. The NWPs must be renewed every five years.

401 staff are assigned a specific region of the state based on Ohio EPA districts. In addition, Ohio EPA has staff dedicated specifically to the review of coal mining and Ohio Department of Transportation (ODOT) projects, as well as the review of stream and wetland mitigation project compliance. Additional staff are dedicated to wetland research in support of the 401 WQC program.

Semi-Public Disposal System Inspection Contracts (HB 110)

Annually, Ohio EPA issues hundreds of permits for the installation and operation of small, commercial/industrial wastewater treatment and/or disposal systems. These may be onsite soil dissipation systems or discharging systems under the NPDES permit program for the treatment and disposal of sewage generated within the operation. To date, there are thousands of these small systems operating in Ohio. These semi-public systems may include apartment complexes, small businesses, industrial parks, etc. and, by definition, are any system that treats sewage from human activities up to a capacity of 25,000 gallons per day. Because of the magnitude and resources available, many of these systems have the potential of going without regular inspections to determine if they are complying with state rules, laws and regulations and ultimately protecting water quality.

As an aid to support this program, the Ohio General Assembly created Ohio EPA's HB110 program. The program is a contractual partnership between local health districts (LHDs) and Ohio EPA, whereby LHDs conduct, on behalf of the Agency, inspection and enforcement services for commercial sanitary waste treatment/disposal systems discharging up to 25,000 gallons per day (semi-publics).

Ohio EPA operates the HB110 program to better protect the public health and welfare and to protect the environment. Ohio EPA believes that because of the proximity, multitude of facilities and the availability of resources, oversight of operations for sanitary waste disposal at semi-publics may best be accomplished locally by qualified personnel. To offset costs of local oversight, state law (ORC 3709.085) authorizes LHDs to charge fees for inspection services to be paid by semi-publics.

Inspection Program

In accordance with Ohio EPA's HB110 contracts, LHDs regularly inspect sanitary facilities at semi-publics for compliance with Ohio's water pollution control laws and regulations. Investigations of complaints regarding waste disposal by semi-publics are also accomplished locally. LHDs are consulted prior to Ohio EPA approval of plans and issuance of PTIs for semi-publics. Installation inspections may be performed locally to ensure compliance with Ohio EPA's PTI conditions.

Enforcement Activities

In coordination with Ohio EPA, LHDs may notify entities of noncompliance with Ohio's water pollution control regulations. LHDs are also instrumental in identifying semi-publics installed without PTIs, of which Ohio EPA may not be aware. Where noncompliance notification and informal requests fail to correct violations, entities may be referred to Ohio EPA for enforcement or the county prosecutor may bring an action under local nuisance ordinances. All discharges of pollutants in a location where they cause pollution to waters of the state that are unpermitted or above permitted amounts are statutory nuisances under Revised Code 6111.04.

Training Program

Ohio EPA intends to provide periodic training for LHDs. Training programs will focus on sanitary waste disposal for semi-public facilities, technical assistance, inspection issues and enforcement case development.

Summary

The HB110 program is a unique opportunity for Ohio EPA and LHDs to assist one another in achieving the mutual goal of protecting public health and welfare. Through responsible regulation of semi-public facilities, the local community will benefit from decreased health risks and the state will benefit from improvements in water quality. Ohio EPA welcomes the participation of all LHDs.

Storm Water Permit Program

Ohio EPA implements the federal regulations for storm water dischargers. Dischargers currently covered include certain municipalities (Phases I and II of the program) with separate storm sewer systems (MS4s) and those facilities that meet the definition of industrial activity in the federal regulations, including construction.

In 1992, Ohio EPA issued two NPDES general storm water permits: one for construction activity and the other for all remaining categories of industrial activity. The strategy was to permit most storm water dischargers with these baseline general permits (33 USC Section 1342; OAC Chapter 3745-38). It is estimated that more than 50,000 storm water discharges have been granted general permit coverage since that time.

The industrial permit has been renewed five times. The construction permit was renewed in April 2018 for the fourth time and addresses large and small constructions sites. The one-page application form is called a Notice of Intent (NOI). Ohio EPA responds to NOIs with approval letters for coverage under one of the general permits or, in limited instances, instructions to apply for an individual permit.

After the baseline general permits were issued, Ohio EPA directed its efforts toward additional permitting, compliance and enforcement activities, education and technical assistance. Inspections and complaint investigations for compliance and enforcement have been handled at the district level as resources allow. BMPs and pollution prevention have been the major thrust of education and technical assistance activities.

On the municipal side of permitting, five large and medium municipalities in Ohio submitted applications between November 1991 and November 1993. A work group was formed with the cities to draft acceptable permit language for the municipal permits. BMPs included in a citywide storm water management plan were the primary focus of the permits. The cities of Dayton, Toledo and Akron received their original permits in 1997. Exceptions for Cleveland and Cincinnati were also processed[2]. Columbus received its initial permit in 2000. Permits for Columbus, Toledo and Akron have been renewed twice. Dayton's permit has been renewed three times.

Additional categories of discharges, both public and privately owned, were included in Phase II. U.S. EPA issued Phase II regulations in December 1999. The Phase II storm water regulations required a general permit for small MS4s be issued by December 2002 and required applications by March 2003.

Ohio EPA issued two general permits for small MS4s during 2002. One was a baseline permit and the second was for MS4s in rapidly developing watersheds. This latter permit accelerated construction and post-construction measures to protect surface waters from the impacts of high-density land use development. Federal regulations allowed small MS4s to apply for individual NPDES permits in lieu of general permit coverage. No small MS4 within Ohio chose the individual permit option. The third generation of the small MS4 general permit was renewed on Sept. 11, 2014.

[2] Phase I federal storm water regulations required permit coverage for municipal separate storm sewer systems (MS4s), which had an MS4 service population of 100,000 or more to obtain NPDES permits. The cities of Cleveland and Cincinnati demonstrated that their MS4 service population was less than 100,000 people because of large areas of these cities being served by combined sewers. These two cities were permitted under Phase II of the small MS4 general permit in March 2003. Cleveland and Cincinnati currently have coverage under the third-generation small MS4 general permit.

On the construction side of permitting, Ohio EPA has developed and issued watershed-specific construction permits if recommended by a TMDL. On Sept. 12, 2006, Ohio EPA issued a watershed-specific construction permit for the Big Darby Creek watershed. This permit was renewed on Oct. 1, 2012. On Jan. 23, 2009, Ohio EPA issued a watershed-specific construction permit for portions of the Olentangy River watershed. This permit was renewed on June 2, 2014. These permits contained conditions/requirements that differ from the standard construction permit and each other. On April 23, 2018, Ohio EPA issued the fifth-generation statewide construction permit (OHC000005). Permit OHC000005 incorporates the Big Darby Creek watershed and Portions of the Olentangy River watershed conditions, that exceed statewide permit requirements, as appendices. This approach has combined all three general permits into one general permit. Ohio EPA anticipates developing additional watershed specific requirements when recommended by TMDLs.

Total Maximum Daily Load (TMDL) Program

The TMDL program identifies and restores polluted waters. TMDLs can be viewed simply as problem solving: investigate the problem; decide on a solution; implement the solution; and check back to make sure the solution worked. By integrating programs and aligning resources, Ohio is pursuing TMDLs as a powerful tool to develop watershed-specific prescriptions to improve impaired waters.

Ohio uses three key enhancements to the basic federal TMDL requirements to increase the chances that real, measurable improvements in Ohio's water resources will result:

1) an initial, in-depth watershed assessment to obtain recent data for analysis of problems and discussion of alternatives;
2) implementation actions identified as part of the TMDL with follow-through in permitting and incentive programs such as 319 and loan funds; and
3) involving others – citizens, landowners, officials, natural resource professionals – in the process.

Involving others is critical to restoring waters. Working watershed by watershed, Ohio EPA meets with citizens and landowners to explain the findings of our water quality studies and to identify workable solutions to the problems found. Ohio EPA includes other agencies that can improve water resources either by exercising their authority in new ways or through relationships they have already established with critical decision makers. After solutions are identified and recommendations are made, Ohio EPA meets with consultants, elected officials and others to ensure that projects continue to completion.

Recent Developments in the TMDL Program

On March 24, 2015, the Supreme Court of Ohio determined that "A TMDL established by Ohio EPA pursuant to the Clean Water Act is a rule that is subject to the requirements of R.C. Chapter 119, the Ohio Administrative Procedure Act. Ohio EPA must follow the rulemaking procedure in R.C. Chapter 119 before submitting a TMDL to U.S. EPA for its approval and before the TMDL may be implemented in an NPDES permit." (*Fairfield Cty. Bd. of Commrs. v. Nally,* 143 Ohio St.3d 93, 2015-Ohio-991 available online at ***supremecourt.ohio.gov/rod/docs/pdf/0/2015/2015-Ohio-991.pdf***).

Subsequently, Ohio EPA collaborated with stakeholders and the Ohio General Assembly which passed legislation exempting TMDLs from the ORC Chapter 119 rulemaking procedure. The statute was revised effective Sept. 29, 2017, and includes the following: 1) reinstates previously approved TMDLs; 2) requires stakeholder outreach at several points in the project; 3) mandates consideration of several technical and financial items; 4) affirms that TMDLs are not actions of the director and challenges are made through the NPDES permit appeal process; and 4) requires Ohio EPA to adopt administrative rules for stakeholder notification and significant public interest by December 2018. Ohio EPA's revised TMDL rule became effective on February 15, 2019. Ohio EPA has begun implementing the new program requirements for new projects and is in the process of updating existing projects to incorporate the new requirements where needed.

All TMDLs are available on Ohio EPA's website at ***epa.ohio.gov/dsw/tmdl/index.aspx***.

Water Quality Standards (WQS) Program

Many different sources and types of pollution affect Ohio's water quality. The CWA states that authorized states and tribes must adopt water quality standards that protect public health or welfare; enhance water quality; and provide for the protection and propagation of fish, shellfish and wildlife and for recreation in and on the water. Water quality standards contain three elements to ensure the goals of the CWA are met: designated uses; numerical or narrative criteria designed to protect and measure attainment of the use designation; and antidegradation policy.

The key components of Ohio's WQS (OAC Chapter 3745-1) are described below.

Beneficial use designations describe existing or potential uses of water bodies. They take into consideration the use and value of water for public water supplies, protection and propagation of aquatic life, recreation in and on the water, agricultural, industrial and other purposes. Ohio EPA assigns beneficial use designations to water bodies in the state. There may be more than one use designation assigned to a water body. Examples of beneficial use designations include public water supply, primary contact recreation and aquatic life uses (warmwater habitat, exceptional warmwater habitat and coldwater habitat.).

Numeric criteria are concentrations of specific chemicals or levels of parameters in water that protect aquatic life and human health. Numeric criteria are based on sound scientific rationale and must contain enough parameters to be protective of designated uses. Numeric criteria are developed to protect human health and both acute and chronic toxicity for aquatic life and form the basis of discharge permit (NPDES) limits.

Narrative criteria are general water quality criteria that apply to all surface waters. These criteria state that all waters shall be free from sludge, floating debris, oil and scum, color and odor producing materials, substances that are harmful to human, animal or aquatic life, public health nuisances associated with raw or poorly treated sewage and nutrients in concentrations that may cause algal blooms. Narrative criteria also state that discharges from human activity must be free from substances in concentrations that are toxic or rapidly lethal in the mixing zone.

Biological criteria are based on aquatic community characteristics and provide a direct measure of attainment of aquatic life uses. The principal biological evaluation tools used by Ohio EPA are the index of biotic integrity (IBI), the modified index of well-being (MIwb) and the invertebrate community index (ICI). These three indices are based on species richness, trophic composition, diversity, presence of pollution-tolerant individuals or species, abundance of biomass and the presence of diseased or abnormal organisms. The IBI and the MIwb apply to fish. The ICI applies to macroinvertebrates. Ohio EPA uses the results of sampled reference sites to set minimum criteria index scores for use designations in water quality standards. During biological assessments, depression of indices can be used to identify causes for impairment of designated uses.

Antidegradation policy aims to keep clean waters cleaner than the applicable chemical criteria set by the standards wherever possible. The policy is adopted in rule (OAC 3745-1-05) and describes the conditions under which lowering water quality may be authorized under a discharge permit from Ohio EPA. Existing beneficial uses must be maintained and protected. Water quality better than that needed to protect existing beneficial uses must be maintained unless lower quality is deemed necessary to allow important economic or social development (existing beneficial uses must still be protected).

Public participation is mandated and encouraged in all administrative rule makings, including the WQS. Any interested individuals are afforded an opportunity to participate in the process of developing water quality standards. Ohio EPA reviews and, as appropriate, revises water quality standards at least once every three years. When water quality standards revisions are proposed, the public is notified of these revisions. A public hearing is held to gather input and comments.

Wetland Bioassessment Program

Numerous grants from U.S. EPA over many years have funded work that is advancing the science of wetland assessment methodologies in Ohio. Published work includes an amphibian index of biotic integrity (AmphIBI) for wetlands, a vegetation index of biotic integrity (VIBI) for wetlands and a comparison of natural and mitigation (constructed) wetlands. More recently, reports on an assessment analysis of the association between streams and wetland condition and functions in the Big Run Scioto River watershed, incorporating wetland information with data from other surface water resources to develop a TMDL analysis of a central Ohio watershed and the development of a GIS tool to identify potential vernal pool habitat restoration areas have been made available on DSW's webpage (***epa.ohio.gov/dsw/401/ecology.aspx***).

DSW recently finalized a report from a U.S. EPA grant to assess the ecological condition of 50 randomly selected natural wetlands across Ohio to generate a scorecard of wetland condition. This grant intensified data collected as part of U.S. EPA's National Wetland Condition Assessment conducted across the United States in 2011. Also in progress is a detailed study to improve mitigation success in Ohio, which will include: a publicly-accessible GIS website for selecting sites with a high likelihood of achieving ecological success; the creation of a simple soil health assessment tool to better identify sites that may require remediation due to historical soil disturbances; and a survey of reference condition riparian habitats to develop specific ecological performance goals for riparian vegetation restoration projects.

DSW has also recently streamlined its VIBI procedure to simplify data collection, analysis and interpretation, with the goal of enhancing the utility of this assessment as a monitoring tool for wetland restoration projects. The modified procedure, called the VIBI-Floristic Quality (VIBI-FQ), is beginning to be used to monitor compensatory mitigation, 319 grants and contaminated clean-up sites, which have required the establishment of wetland habitat. The initial results have been extremely encouraging. Additionally, DSW has conducted VIBI-FQ monitoring on 10 reference condition riparian forests and in 2018 began using the VIBI-FQ to monitor non-wetland riparian habitats associated with stream restoration projects. DSW will use this riparian vegetation data to establish consistent performance standards for stream mitigation and restoration projects.

Wetland Protection Program

Ohio's Wetland Water Quality Standards (OAC 3745-1-50 to -54) contain definitions, beneficial use designations, narrative criteria and antidegradation provisions that guide Ohio EPA's review of projects in which applicants are seeking authorization to discharge dredged or fill material into wetlands. OAC 3745-1-53 gives all wetlands the wetland designated beneficial aquatic life use. However, wetlands are further defined as Category 1, 2 or 3 based on the wetland's relative functions and values, sensitivity to disturbance, rarity and potential to be adequately compensated for by wetland mitigation.

Category 1, 2 and 3 wetlands demonstrate minimal, moderate and superior wetland functions, respectively. Category 1 wetlands are typified by: low species diversity; a predominance of non-native species; no significant habitat or wildlife use; and limited potential to achieve beneficial wetland functions. Category 2 wetlands may be typified by: wetlands dominated by native species but generally without the presence of, or habitat for, rare, threatened or endangered species; as well as wetlands that are degraded but have a reasonable potential for reestablishing lost wetland functions. Category 3 wetlands typically possess: high levels of diversity; a high proportion of native species; high functional values; and may contain the presence of, or habitat for rare, threatened and endangered species. Wetlands that are scarce, either regionally or statewide, form a subcategory of Category 3 wetlands for which, when allowable, only short-term disturbances may be authorized.

The rigor of the antidegradation review conducted under OAC 3745-1-50 through -54 is based on the category of the wetland(s) proposed to be impacted. Category 1 wetlands are classified as limited quality waters and may be impacted after examining avoidance and minimization measures and determining that no significant impacts to water quality will result from the impacts. Category 2 and 3 wetlands are classified as general high-quality waters and may be impacted only after a formal examination of alternatives and a determination that the lowering of water quality is necessary to accommodate social and economic development. In addition, an applicant must demonstrate that public need is achieved to receive authorization to impact Category 3 wetlands. Compensatory mitigation ratios are based on wetland category, vegetation class and proximity of the mitigation to the impact site.

C2. Program Summary – Environmental and Financial Assistance

The Division of Environmental and Financial Assistance (DEFA) includes the Office of Financial Assistance (OFA), which promotes water quality benefits by financing cost-effective and environmentally sound wastewater and drinking water infrastructure improvements and other water resource projects. OFA works in conjunction with the Ohio Water Development Authority (OWDA) to administer two state revolving loan funds (SRFs) — the Ohio Water Pollution Control Loan Fund (WPCLF) and the Water Supply Revolving Loan Account (WSRLA). More information about the specific financial assistance provided by OFA and OWDA during this report cycle can be found in Section C6: Funding Sources for Pollution Controls.

Water Pollution Control Loan Fund

Projects eligible for financing under the WPCLF include municipal wastewater treatment improvements (for example, sewage treatment facilities, interceptor sewers, sewage collection systems and storm sewer separation projects) and nonpoint pollution control projects. This state revolving fund, jointly administered by Ohio EPA and OWDA, was established in 1989 to replace the construction grants program. Construction loans from the WPCLF are available at several interest rates: a standard rate, which is below market rates; a small community interest rate, which is below the standard interest rate; and one percent and zero percent interest rate loans for hardship communities. Principle forgiveness is also available for communities that are of the greatest financial need. Planning and design loans are available at a short-term interest rate.

Eligible activities include:

- improvements to and/or expansions of wastewater treatment facilities;
- improvement or replacement of on-lot wastewater treatment systems;
- brownfield/contaminated site remediation;
- agricultural runoff control and BMPs;
- urban storm water runoff;
- septage receiving facilities;
- landfill closure;
- septic system improvement;
- development of BMPs; and
- forestry BMPs.

More information about the WPCLF can be found at ***epa.ohio.gov/defa/ofa.aspx***.

Water Resource Restoration Sponsor Program (WRRSP)

A satellite program of the WPCLF is the Water Resource Restoration Sponsor Program (WRRSP). The WRRSP was developed by Ohio EPA and has been a part of the WPCLF since 2000. The intent of the WRRSP is to address a limited and under-assisted category of water resource needs in Ohio through direct WPCLF loans. The goal of the WRRSP is to counter the loss of ecological function and biological diversity that jeopardize the health of Ohio's water resources. The program achieves this goal by providing funds, through WPCLF loans, to finance implementation of projects that protect or restore water resources and by ensuring either maintenance or attainment of warmwater habitat or higher designated aquatic life uses under Ohio's water quality standards. Since its inception, more than $180 million has been awarded through the WRRSP.

Water Supply Revolving Loan Account Fund

The Ohio Water Supply Revolving Loan Account (WSRLA) provides an opportunity for mutually beneficial partnerships between Ohio EPA and Ohio's public water systems to assure a safe and adequate supply of drinking water for all the citizens of Ohio. This is accomplished primarily by providing below-market interest rates for compliance-related improvements to community (public) water systems and non-profit non-community public water systems. Additionally, the WSRLA can provide technical assistance to public water systems in a variety of areas from the planning, design and construction of improvements to enhancing the technical, managerial and financial capacity of these systems.

The WSRLA is administered by Ohio EPA's DDAGW and DEFA. Certain financial management services are also provided by OWDA. More information about WSRLA can be found at ***epa.ohio.gov/defa/EnvironmentalandFinancialAssistance.aspx***.

C3. Program Summary – Drinking and Ground Waters

The mission of Ohio EPA's Division of Drinking and Ground Waters (DDAGW) is to "protect human health by characterizing and protecting ground water quality and ensuring that Ohio's public water systems provide adequate supplies of safe drinking water." The division has several programs in place to achieve this mission.

Drinking Water Program

Every Ohioan relies on a safe source of drinking water. DDAGW's drinking water program has jurisdiction over 4,500 public water systems that are required to ensure a safe and adequate supply of drinking water to more than 11 million Ohioans.

The drinking water program's functions include: overseeing the design and construction of drinking water treatment facilities through plan approval; conducting sanitary survey inspections; administering an operator certification program and a drinking water revolving loan fund; managing compliance monitoring for bacteriological and chemical contaminants; working with public water systems to implement corrective actions when significant deficiencies are identified; developing state rules and guidance for implementing new federal drinking water regulations; and sharing public water system information with the public on the division's website. Significant interdivision and interagency efforts are being expended to assist public water systems and implement Ohio's *Public Water System Harmful Algal Bloom Response Strategy*.

Ground Water Program

DDAGW's ground water program maintains a statewide ambient ground water quality monitoring program; shares ground water quality data on the division website; conducts ground water quality investigations; provides technical support to other Ohio EPA programs by providing technical expertise on local hydrogeology and ground water quality; and protects ground water resources through the regulation of waste fluid disposal in its underground injection control program for Class I, IV and V wells.

HABs Program

In 2016, DDAGW established a new program section to address harmful algal blooms (HABs). The purpose of this program is to provide oversight and implementation of the new rules for public water systems and to coordinate Ohio's HAB response strategy for drinking water and recreational waters. Ohio Senate Bill 1, passed in July 2015, established ORC 3745.50 and directed Ohio EPA to serve as the coordinator of harmful algae management and response. New and revised HAB rules became effective on June 1, 2016, and include analytical protocols, establishment of health advisories and public notification protocols and triggers, sampling, treatment technique, algaecide application and reporting requirements.

DDAGW manages and coordinates response to bloom reports, maintains the website ***ohioalgaeinfo.com*** and an online HABs database and mapping application and provides technical assistance and training related to HAB sampling procedures, treatment optimization, reservoir management and other related topics. Significant interdivision and interagency efforts are being expended to assist public water systems to assure the safety of finished drinking water. Additionally, Ohio EPA's HABs program conducts outreach to local health districts and other local agencies to provide guidance and technical expertise in response to HABs in recreational waters.

State of Ohio Coordinated Response

As incidents of HABs have increased, Ohio's response continues to evolve. The ***ohioalgaeinfo.com*** website provides links to the State of Ohio's HAB response strategies; background information about HABs; tips for staying safe when visiting public lakes; links to sampling information; and current advisories and contact information for reporting suspected HABs. It also includes historic and current cyanotoxin data for public water supplies and a link to the ODH BeachGuard site, which has information about recreation advisories for both bacteria and algae (***http://publicapps.odh.ohio.gov/BeachGuardPublic/Default.aspx***).

Ohio EPA, ODH and ODNR have continued a close partnership to develop and implement the unified state response strategy for recreational waters. The agencies regularly review and revise the State of Ohio's *Harmful Algal Bloom Response Strategy for Recreational Waters* and work together throughout the season under an interagency communication and coordination framework.

Algal Toxin Monitoring and Phytoplankton Monitoring

Monitoring of HABs has occurred in a variety of ways across the state. Ohio EPA-DSW conducts ambient HAB sampling at inland lakes and Lake Erie as part of its inland lakes (Section I3) and nearshore Lake Erie monitoring programs (Section C1), and public water systems routinely monitor for HABs on their source waters and provide that data to Ohio EPA. DSW's Inland Lakes data also provided paired cyanobacteria screening (via qPCR) and cyanotoxin results which was used to evaluate the cyanobacteria screening tool.

Additional information about algal toxin monitoring at public water systems and assessment of the public drinking water supply beneficial use is addressed in Section H.

The routine microcystin and cyanobacteria screening analysis required by Ohio's public water systems using surface water sources provides an indication of HAB occurrence across the state. Microcystins continue to be the most commonly detected cyanotoxin, detected at 57 percent of Ohio's PWS source waters. Microcystin-producing genes were detected at 75 percent of source waters and saxitoxin-producing genes were detected at 49 percent of source waters. Cylindrospermopsin-producing genes were only detected at three sites with the actual toxin only detected at one location. Ohio EPA's follow up sampling, triggered by saxitoxin-producing gene detections, indicated saxitoxins were detected at 24 percent of PWS source waters.

Recreational waters across the state continue to be impacted by HABs, and during 2018-2019 the state had at least nine waters with posted recreational advisories. Ohio DNR routinely monitors the state beaches and waters for HABs and analyzes for microcystins at beaches if a bloom is suspected. All state park beaches and boat ramps have informational HAB signs posted during the season. Local health districts and park managers are becoming more involved in HAB response, including sample collection and posting local advisories. Ohio EPA continues to provide technical and analytical assistance to support local response as needed.

Use of Satellite Imagery to Evaluate HABs on Lake Erie and Inland Waters

The State uses remotely sensed imagery collected and processed by the National Oceanic and Atmospheric Administration (NOAA) or the National Aeronautical and Space Administration (NASA) to assist in identifying the location of cyanobacteria blooms in Lake Erie, inland state park lakes, and portions of the Ohio River. For state recreation managers, the imagery is used as a tool to assist in visual confirmation of algal bloom presence. These remote sensing tools can provide information on lakes or rivers that are at least 300 meters wide. A processed image can detect HABs approximately 1-2 feet below the surface when the human eye cannot. It can also detect algal blooms in turbid waters when the blooms can be difficult to visually identify. Hyperspectral imaging by airplane may also be used during times of increased cloud cover to supplement the satellite images. For Lake Erie, NOAA prepares a bi-weekly bulletin depicting satellite images of HABs, predicted algal bloom densities and wind directions. NOAA's experimental Lake Erie forecast system switched to operational status in 2017 and remains an invaluable tool provided to thousands of subscribers in the state, including state agencies, public water systems, beach managers and the public. More information on the NOAA HAB detection and monitoring program for Lake Erie can be found at the Great Lakes Environmental Research Lab website at ***glerl.noaa.gov/res/HABs_and_Hypoxia/***.

Ohio is also one of four states participating in NOAA's Cyanobacteria Assessment Network (CyAN) Project. Beginning in May 2017, Ohio EPA reviewed near daily images for cyanobacteria detections, generated maps of cyanobacteria detections for individual lakes, and shared a summary of current cyanobacteria detections and lake maps with ODNR, ODH and public water systems. This tool provided valuable information about Ohio's inland waters and early warning on HAB formation. Beginning in 2019, the CyAN project launched a mobile application (Android) allowing public access to weekly summary satellite products for inland lakes. More information about the CyAN project can be found at the U.S. EPA website at ***epa.gov/water-research/cyanobacteria-assessment-network-cyan***.

Outreach

Ohio EPA continues to coordinate a workshop at Ohio Sea Grant Stone Laboratory in August of each year. This two-day workshop, Dealing with Cyanobacteria, Algal Toxin and Taste and Odor Compounds, attracts public water supply operators and water managers from Ohio and other states. Instructors include experts from NOAA, OSU and public water supply operators with experience dealing with HABs. Ohio EPA also provided training for ODNR park managers on HAB sampling and response. Since 2016 Ohio EPA provided webinars and in-person workshops to public water systems, local health departments, emergency management agencies and local governmental officials throughout the state. Ohio EPA also provided presentations and share the State's HAB monitoring and response experience with numerous U.S. EPA regions, states and other groups.

Source Water Protection Program

Several programs are in place or are being implemented to help protect Ohio's water resources. The source water assessment and protection program protects aquifers and surface water bodies that are used by public water systems. A public water supply beneficial use assessment methodology has been developed in conjunction with DSW and it is being implemented.

C4. Program Summary – Environmental Services

For Ohio EPA to protect public health and the environment, Agency staff depend on scientific data to make well-informed decisions. The Division of Environmental Services (DES), Ohio EPA's laboratory, provides most of this data. DES analyzes environmental samples for more than 300 parameters. The laboratory provides chemical and microbiological analyses of drinking, surface and ground water; wastewater effluent; sediment; soil; sludge; manure; air filters and air canisters; and fish tissue.

DES processes approximately 10,000 samples annually, comprised of 80,000 tests for up to 450 parameters each. DES also administers U.S. EPA's Discharge Monitoring Report-Quality Assurance Study Program, inspects drinking water and wastewater laboratories and provides technical assistance to Ohio EPA divisions as well as state and local agencies.

C5. Cooperation among State Agencies and Departments

Ohio Lake Erie Commission

The Ohio Lake Erie Commission (OLEC) is comprised of the directors of Ohio EPA and the Ohio departments of natural resources, transportation, development, health and agriculture and up to five additional public members appointed by the governor. The role of OLEC is to preserve Lake Erie's natural resources; to protect the quality of its waters and ecosystem; and to promote economic development and tourism in the region. OLEC develops and is guided by the *Lake Erie Protection and Restoration Strategy*, which identifies priority issues on which the member state agencies and other partners focus their attention. OLEC administers Ohio's Lake Erie Protection Fund, which was established to finance research and implementation projects aimed at protecting, preserving and restoring Lake Erie and its watershed. The fund is supported through tax-deductible donations and purchases of Lake Erie license plates, which display the Marblehead Lighthouse, Toledo Harbor Lighthouse or the Lake Erie life preserver. The Commission also receives Ohio's share of the interest earnings from the Great Lakes Protection Fund, an interstate trust fund established in 1989 to protect and restore the Great Lakes. Since its inception in 1993, the Commission has awarded approximately $15 million for projects that focus on issues critical to the effective state management of Lake Erie and that further the goals of the *Lake Erie Protection and Restoration Strategy*. More information is available online at ***lakeerie.ohio.gov***.

C6. Funding Sources for Pollution Controls

It is beyond the means of this report to place a dollar value on the environmental improvements gained to date. However, Ohio EPA has documented the recovery of numerous major river segments including the Cuyahoga River, Licking River, Paint Creek and Scioto River. The most successful restoration efforts in Ohio have been those that have combined one or more funding sources to reach water resource goals. Different funding sources are directed toward many facets of water resource management, so there is always a challenge to pursue and coordinate the various programs at once. Such coordination takes time and administrative effort to be successful.

There are several funding sources for water quality improvement projects in Ohio. Funding for wastewater and drinking water infrastructure improvement projects is available through: Ohio EPA (WPCLF and WSRLA); the Ohio Water Development Authority (OWDA); Ohio Public Works Commission (OPWC); U.S. Department of Agriculture (USDA) Rural Development; and the Community Development Block Grant (CDBG) program. Ohio EPA's *State and Federal Funding for Drinking Water and Wastewater Systems* details some of these funding sources. There is also funding available for preservation, conservation and restoration projects that directly benefit water quality. These include: Clean Ohio Fund; Section 319 Grants Program; Great Lakes Restoration Initiative (GLRI); Conservation Reserve Program (CRP); and Ohio EPA's WRRSP. Additional funds from the federal government, as well as the investment in water pollution control measures made by municipal and county governments and the private sector, are the reason for dramatic improvements in water quality in Ohio since the inception of the federal CWA in 1972.

A summary of funding sources, amounts and trends is presented here. Efforts have been made to include sources not traditionally associated strictly with water quality improvement, but that nevertheless have the potential to positively impact Ohio's water resources.

Clean Ohio Fund

Although not tied directly to measures of water resource improvement, a major Ohio bond fund provides funds for projects that should positively impact water quality in the state. The Clean Ohio Fund, created in November 2000, provides $400 million over four years for brownfield environmental cleanup projects and green space and conservation preservation projects. Placed before Ohio's voters as Issue 2 in 2008, the ballot initiative was overwhelmingly approved in all 88 counties, which extended the Fund with another $400 million bond program. The Fund consists of three competitive funding programs, as described below.

Clean Ohio Green Space Conservation Program

The Clean Ohio Green Space Conservation Program helps to fund preservation of open spaces, sensitive ecological areas and stream corridors. The program awards grants up to 75 percent if the estimated costs to projects that:

- Protect habitat for rare, threatened or endangered species;
- Preserve high quality wetlands and other scarce natural resources;
- Preserve streamside forests, natural stream channels, functioning floodplains, and other natural features of Ohio's waterways;
- Support comprehensive open space planning;
- Secure easements to protect stream corridors, which may be planted with trees or vegetation to help reduce erosion and fertilizer/pesticide runoff;
- Enhance eco-tourism and economic development related to outdoor recreation in economically challenged areas;
- Provide pedestrian or bicycle passageways between natural areas and preserves;

- Reduce or eliminate nonnative, invasive plant and animal species;
- Provide safe areas for fishing, hunting and trapping in a manner that provides a balanced eco-system.

Clean Ohio Agricultural Easement Purchase Program

The Clean Ohio Local Agricultural Easement Purchase Program (LAEPP) provides funding to assist landowners and communities in preserving Ohio's farmland. The program purchases agricultural easements from landowners who volunteer to keep their land in agricultural production in perpetuity. As of June 2019, 65,652 acres of farmland have been preserved through this program.

Clean Ohio Trails Fund

The Clean Ohio Trails Fund, administered through the Ohio Department of Natural Resources, provides funding to local governments, park and joint recreation districts, conservancy districts, soil and water conservation districts and non-profit organizations to improve outdoor recreational opportunities for Ohioans by funding trails for outdoor pursuits of all kinds. Eligible projects include: land acquisition for a trail; trail development; trailhead facilities; engineering; and design. In 2017, just over $7.2 million was awarded through this program; and, in 2018, $1.1 million was awarded.

More information about Clean Ohio Fund can be found at ***development.ohio.gov/cleanohio/***.

Ohio Water Development Authority

Created in 1968, OWDA offers financial assistance for several project types, either alone or in conjunction with a state agency (including Ohio EPA). In addition to solid waste, brownfields and emergency programs, OWDA oversees the Fresh Water Program. The Fresh Water Program provides loans to local governments for the costs of planning, designing, acquiring and constructing wastewater collection and treatment facilities, and drinking water distribution and treatment facilities. The OWDA 2018 annual report provides an overall summary of loan expenditures for all State of Ohio water and wastewater programs in 2018 (OWDA 2018). More information about OWDA can be found at ***www.owda.org***.

Table C-1 — OWDA loans administered during calendar years 2017 - 2018.

	2017		2018	
Project Type	Number	Amount	Number	Amount
Planning				
Water	34	$11,500,826	56	$4,692,382
Wastewater	46	$48,103,613	40	$31,350,225
Subtotal	**80**	**$59,604,439**	**96**	**$36,042,607**
Construction				
Water	85	$130,914,213	93	$285,172,535
Wastewater	161	$908,452,854	180	$590,450,283
Alternative Storm Water	3	$6,096,500	0	0
Brownfield	4	$17,500,000	1	$5,000,000
Local Economic Development	1	$19,869,400	3	$7,386,423
Loan Advance	1	$3,000,000	2	$15,663,870
Un-Sewered Area Assistance	4	$3,100,000	4	$2,750,000
Solid Waste	1	$1,605,600	1	$1,204,200
Subtotal	**260**	**$1,090,538,567**	**284**	$907,627,311
Total	340	$1,150,143,006	380	$943,669,918

Water Pollution Control Loan Fund

In calendar years 2017 and 2018, the WPCLF financed many municipal wastewater treatment needs as well as NPS pollution control needs. Through this program, $1,469,500,811in financing was provided for 338 projects, of which 215 projects were for municipal point sources and 123 projects assisted NPS controls.

The WPCLF financed implementation of 215 municipal wastewater treatment projects costing $1,469,500,811. These projects directly addressed sources of impairment for Ohio water resources. Nearly half of these loans (38 percent or 83 loans), totaling $146,541,394, were made to communities with a service population of fewer than 5,000 people.

During calendar years 2017 and 2018, a total of $26,601,200 was awarded for 123 NPS pollution control projects. The Water Resource Restoration Sponsor Program (WRRSP) financed 16 projects for $21,612,318 to protect and restore stream and wetland aquatic habitats. NPS pollution control projects awarded through the WPCLF included 123 direct (principal forgiveness) loans, administered through county health departments, totaling $26,601,200 for the correction of failing household sewage treatment systems for economically distressed individuals.

Water Supply Revolving Loan Account

The Water Supply Revolving Loan Account focuses on drinking water supplies. In SFY 2017 and SFY 2018, the fund made 105 loans totaling $251,314,954, which included $39,070,161 to economically disadvantaged communities.

Section 319 Grants Program

Ohio EPA receives federal CWA Section 319(h) funding to implement a statewide NPS program, including offering grants to implement local projects to reduce the impacts of nonpoint sources of pollution. Annual funding for local sub-grant awards typically averages $2.5 million. Section 319(h) grants are awarded for projects such as low-head dam removal, natural stream channel restoration, wetland restoration and other types of projects designed to restore impaired waters. Projects identified in watersheds approved 9-element plans that focus on eliminating identified sources of impairment or restoring impaired waters are most likely to receive funding. Other eligible activities include lake management projects and agricultural BMPs that are not funded under Farm Bill programs. More information can be found at ***epa.ohio.gov/dsw/nps/index.aspx***.

Federal Farm Bill Funding in Ohio

Funding sources from the federal conservation programs connected to the federal Farm Bill are most notable. Administered by USDA, several programs provide cost-share, technical assistance and economic incentives to install and/or implement NPS pollution reduction practices. The 2016 Farm Bill included significant changes in programs such as:

- consolidation of conservation programs for flexibility, accountability and adaptability at the local level;
- linkage of basic conservation practices to crop insurance premium subsidy for highly erodible lands and wetlands; and
- building upon previous successful partnerships and encouraging agricultural producers and partners to design conservation projects that focus on and address regional priorities.

Ohio EPA works closely with the USDA Natural Resources Conservation Service (NRCS) on several water quality related landscape initiatives, including the Great Lakes Restoration Initiative and the National Water Quality Initiative (NWQI). Ohio EPA has assisted with selecting priority watersheds and practices in these initiatives and provides water quality monitoring.

Programs that set aside farmlands such as the Conservation Reserve Program (CRP) and the Conservation Reserve Enhancement Program (CREP) are among the most popular of available programs in Ohio. This program targets cropped acreage that is environmentally sensitive or may have a particularly deleterious impact on natural resources when farmed. Examples include highly erodible land, land near waterways, land that was formerly wetland and lands that can serve as habitat critical to declining wildlife populations. It is a potential concern that once contracts expire on the marginal or environmentally sensitive lands, those acres may revert to agricultural production.

Conservation Reserve Enhancement Program

The CREP is a federal-state conservation partnership program intended to protect environmentally sensitive cropland and convert it to native grasses, trees and other vegetation. The CREP uses financial incentives to encourage farmers and ranchers to enroll in contracts of 10-15 years. In return, participants are incentivized annually 150-175 percent of crop rental rates, depending on the type of vegetation planted. Ohio is one of two states in the nation to have three CREP watersheds. Most existing CRP and CREP land retirement program acres involve stream-side grass strips. There are opportunities to further expand acreage under these programs to include practices that better reduce rate and amount of agricultural runoff. These practices include: filter area; wooded riparian corridors; and/or wetlands designed to trap, retain, intercept, distribute, store and/or treat runoff from cropland.

Environmental Quality Incentives Program

The Environmental Quality Incentives Program (EQIP) is another widely used, well-funded program in the Farm Bill. EQIP is designed to improve management practices and facilities on working farms to achieve environmental quality goals. Several specific practices are eligible for funding through EQIP, covering broad categories such as nutrient and pesticide management and storage, manure management and storage, livestock fencing, conservation tillage, cover cropping, conservation crop rotation and drainage water management, among others. Historically, most EQIP-funded practices in Ohio have gone toward installation of livestock fencing, access roads, manure storage units and other structural practices). Recognizing that NPS pollution from agriculture is largely related to management (for example, crop rotations and tillage management, or fertilizer application timing, method, rate and form), Ohio-NRCS offered incentive payments to farming operations to adopt a suite of management practices, including conservation tillage, nutrient management plan implementation and cover crops.

More information about the Agricultural Act of 2014 and related programs in Ohio is available at ***nrcs.usda.gov/wps/portal/nrcs/main/national/programs/farmbill/*** and ***nrcs.usda.gov/wps/portal/nrcs/site/oh/home***.

C7. New 303(d) Vision Implementation in Ohio

In December 2013, U.S. EPA announced a new "Vision" for the CWA Section 303(d) program to provide an updated framework for implementing the responsibilities under the impaired waters program. U.S. EPA recognized that "… there is not a one-size-fits-all approach to restoring and protecting water resources." Under the new Vision, states will be able to develop tailored strategies to implement the 303(d) program in the context of their water quality goals.

The Vision effort grew out of frustration caused by the 1990s-era litigation concerning the pace at which TMDL analyses were being completed. The resulting consent decrees forced many states to produce great *quantities* of TMDLs that many felt did not contain the necessary *quality* to effectively improve water quality. As the decrees were completed, discussion centered on how to produce better TMDLs that could be implemented to bring about measurable improvements in the quality of the nation's waters.

Fortunately, Ohio was not burdened by a harsh consent decree and was able to carefully consider how to proceed with TMDLs. Nineteen years ago, Ohio EPA developed an approach to TMDLs that already aligns with the spirit of the Vision. The Ohio TMDL program strives to:

- focus on CWA responsibilities across programs;
- build on the state's investments in monitoring, especially biological monitoring;
- use data efficiently, for multiple programs and purposes;
- restore beneficial uses;
- focus on watersheds: maintain rotating basin structure to enable adaptive management; and
- recognize that water quality is impacted by the actions of many and that it will change over time.

Ohio's program grew out of the Agency's water mission, which is rooted in the CWA. Today's new national Vision developed from the same roots, so it should not be surprising that Ohio has been on the Vision path for several years.

Ohio TMDL Program Relative to the Vision Goals

The national Vision contains six goal statements related to prioritization, assessment, protection, alternatives, engagement and integration. While its TMDL program is generally well placed relative to these goals, Ohio expects to continue to improve its program. Potentially, the biggest opportunities are in the areas of protection and engaging other organizations to help with implementation. The following is a summary of the goals and how Ohio has been addressing each goal to date as detailed in U.S. EPA's *A Long-Term Vision for Assessment, Restoration and Protection under the Clean Water Act Section 303(d) Program* (U.S. EPA, 2013), available at ***epa.gov/sites/production/files/2015-07/documents/vision_303d_program_dec_2013.pdf***.

Prioritization Goal

For the 2016 integrated reporting cycle and beyond, States review, systematically prioritize, and report priority watersheds or waters for restoration and protection in their biennial integrated reports to facilitate State strategic planning for achieving water quality goals.

The intent of the Prioritization Goal is for States to express CWA 303(d) Program priorities in the context of the State's broader, overall water quality goals.

-- U.S. EPA, 2013

Based on the state's established monitoring investment and expertise, Ohio's initial priority (in approximately 2000) was on aquatic life use impairments in streams. This priority led to the development of nutrient, sediment, habitat, dissolved oxygen and related TMDLs. A few years later, the agency began to focus on recreation use impairments, which yielded bacteria TMDLs. More recently, work has involved public drinking water use impairments involving nitrate and pesticides TMDLs.

In addition to a focus on restoring uses, other priorities were to begin with headwaters and work downstream. To date, the state has not adopted a geographic priority, choosing instead to work statewide which helps to maintain work balance among district offices. In cases where other agencies or stakeholders have initiated projects, TMDLs in watersheds have been delayed.

Moving forward, Ohio intends to use the following prioritization framework (**bold** items indicate clarification or change from past practices).

Long-Term General Priorities:

- continue to work statewide, using rotating basin scheduling for assessment and listing;
- sharpen focus on Public Water Supply Use;
- **Incorporate HAB considerations into priorities (both PDWS use and ultimately Recreation use)**;
- follow up on effectiveness of current TMDLs and support additional implementation efforts where necessary;
- continue to make mercury and legacy/sediment metals low-priority TMDLs as other approaches are anticipated to be more effective

Annual Prioritization of Impaired Waters for TMDL Development: Ohio is modifying its approach to prioritizing impaired waters to align with the reporting requirements of U.S. EPA's Assessment, Total Maximum Daily Load (TMDL) Tracking and Implementation System (ATTAINS). See Section J2 of this report for additional information.

In addition, the Agency will consider geographic coverage, severity of the impairments and add the following considerations:

- Social Factors (highly used recreational waters, drinking water supply for significant populations, ongoing/sustained involvement of any local groups or government, etc.)
- Value Added (is a TMDL the most efficient way to achieve improved water quality?)
- Is there an approved Nine-Element Nonpoint Source Implementation Strategic Plan – if so, how many implemented projects?
- How much regulatory authority exists over sources?
- Is there an alternative way to improve water quality more quickly than a TMDL? (for example, immediate implementation of an existing plan or projects, or imposing more stringent permit limits to address a localized problem)

- Are there other factors in play? Examples include:
  - pending enforcement for a discharger (possible 4B option);
  - local or statewide strategy or requirements in place to address a particular issue/pollutant (for example, new health department rules for HSTS if they are sole/primary source of impairment)

Over time, Ohio will strive to develop a more objective system for weighing the social factors and value-added concepts. In each IR, the state plans to provide results of the most recent assessments and prioritization exercise as outlined above; list resulting high-priority TMDL projects; and include schedules for those anticipated to be completed in the next two years.

Assessment Goal

By 2020, States identify the extent of healthy and CWA Section 303(d) impaired waters in each State's priority watersheds or waters through site-specific assessment.

The purpose of this Goal is to encourage a comprehensive understanding of the water quality status of at least each State's priority areas.

-- U.S. EPA, 2013

Ohio has maintained a robust biology and chemistry monitoring program for more than 30 years, maintaining consistent protocols and systematically expanding into new water body types. Assessments are based on surveys conducted using a rotating basin approach. The assessments use site-specific data of the highest quality and the status of waters is reported in watershed reports and summarized in biennial IRs that meet the reporting requirements of CWA 305(b) and 303(d). A framework of goals and measures has been in place for several years and reported on biennially in the Ohio IR.

Protection Goal

For the 2016 reporting cycle and beyond, in addition to the traditional TMDL development priorities and schedules for waters in need of restoration, States identify protection planning priorities and approaches along with schedules to help prevent impairments in healthy waters, in a manner consistent with each State's systematic prioritization.

The intent of the Protection Goal is to encourage a more systematic consideration of management actions to prevent impairments in healthy waters (i.e., unimpaired waters) in order to maintain water quality or protect existing uses or high-quality waters.

-- U.S. EPA, 2013

Protection of the water resource is built into Ohio's CWA programs in multiple ways. Watershed surveys measure the attainment potential and status for all waters; thus, they identify waters to restore and to protect. Tiered aquatic life uses identify "better than CWA" goals for high-quality streams. About 14 percent of Ohio's streams already have this higher use designation. TMDLs have included protection strategies and informational TMDLs to encourage protection of streams currently meeting their designated uses. Ohio also has an active antidegradation process to protect existing uses and plans to update the list of waters afforded higher protection under antidegradation.

Ohio has also issued NPDES permits to protect against water quality impairment and anticipates continuing that approach where warranted. One example is the general construction storm water permits for the Olentangy River and Darby Creek watersheds. Those permits include measures designed to protect the high quality of the streams from development impacts. Other watersheds are being considered for similar actions.

Ohio will explore how other types of plans (Nine-Element Nonpoint Source Implementation Strategic Plans for instance) or regulatory actions could be used more effectively to protect our highest quality waters and/or those that are of high importance for drinking water or recreation.

Alternatives Goal

By 2018, States use alternative approaches, in addition to TMDLs, that incorporate adaptive management and are tailored to specific circumstances where such approaches are better suited to implement priority watershed or water actions that achieve the water quality goals of each state, including identifying and reducing nonpoint sources of pollution.

The purpose of this Goal is to encourage the use of the most effective tool(s) to address water quality protection and restoration efforts.

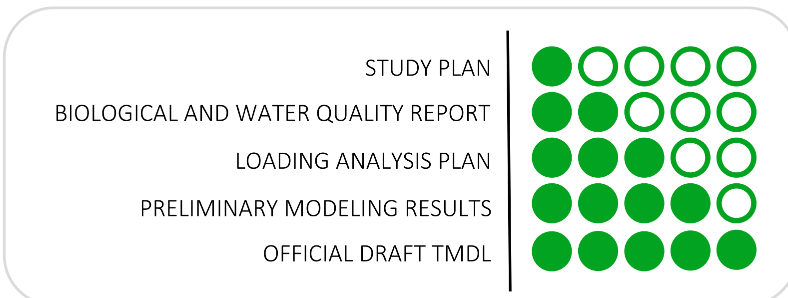
-- U.S. EPA, 2013

Ohio has been using several alternatives to improve water quality. Relying on the biological criteria as the measure for aquatic life attainment means that restoring habitat to build a stream's capacity to process pollutants can be as or more effective than load reduction; Ohio TMDLs have routinely promoted habitat enhancement. After the first few TMDLs recommended dam modifications to enhance capacity, dam modifications were pursued in areas without TMDLs. The state has used CWA Section 319 funds to remove or modify many dams.

In the past, Ohio EPA worked with mining agencies and the Corps to develop a standard alternative for acid mine drainage problems by aligning processes to quantify load reductions, thus meeting the needs of multiple programs with one project. There have also been several instances where NPDES permits have been adjusted to address point source impairments as monitoring identifies them, in advance of completing a TMDL. In other cases, TMDLs have recommended a stressor study to address impairment where the source could not be identified. This follow-up attention increases the chances that the problem may be eliminated or, at a minimum, data will be available for a future TMDL.

Under the new Vision, Ohio EPA also plans to use approaches that are an alternative to a TMDL. These approaches will be designed to address specific impairments caused by pollutants. Approaches may include developing Nine-Element Nonpoint Source Implementation Strategic Plan, revising NPDES permit limits or conditions, funding installation of BMPs, supporting local health departments in implementing new rules for household sewage treatment systems, etc. These approaches will be pursued where there is clear legal authority to do so and circumstances are such that they are likely to result in water quality improvements more efficiently than a TMDL.

Engagement Goal



By 2014, EPA and the States actively engage the public and other stakeholders to improve and protect water quality, as demonstrated by documented, inclusive, transparent, and consistent communication; requesting and sharing feedback on proposed approaches; and enhanced understanding of program objectives.

The purpose of the Engagement Goal is to ensure the CWA 303(d) Program encourages working with stakeholders to educate and facilitate actions that work toward achieving water quality goals.

-- U.S. EPA, 2013

Ohio engages the public and other stakeholders in several ways. Ohio EPA maintains an extensive website with information about TMDLs, monitoring and implementation in watersheds across the state[3].

In addition to the outreach in individual CWA programs, the TMDL program has established five stakeholder outreach steps throughout the development process. The five steps are depicted in the graphic below.

In recent years, the CWA Section 319 program has strived to reach beyond stakeholders with general interest to focus on local decision makers and groups who have the wherewithal to act on the ground to improve water quality. These include local governments and park districts.

The preparation of the IR (containing the 303(d), or impaired waters, list) is an open process. Several years ago, an incubator section was added to preview changes that were being contemplated for future listings (for example, adding new beneficial use analyses, revising methodologies or assessment unit types). The section allows for longer-term feedback for public consideration of changes that can have significant

[3] ***epa.ohio.gov/dsw/tmdl/index.aspx***

impacts. Ohio will strive to complete the IR every two years so that the process remains dynamic and reliable.

Integration Goal

By 2016, EPA and the States identify and coordinate implementation of key point source and nonpoint source control actions that foster effective integration across CWA programs, other statutory programs (e.g., CERCLA, RCRA, SDWA, CAA), and the water quality efforts of other Federal departments and agencies (e.g., Agriculture, Interior, Commerce) to achieve the water quality goals of each state.

The intent of this Goal is to integrate the CWA Section 303(d) Program with other relevant programs that play a role in influencing water quality, in order to collectively and more effectively achieve the water quality goals of States, Tribes, and Territories.

-- U.S. EPA, 2013

As described earlier, program integration is the foundation of Ohio's TMDL work, including both technical and funding programs. Ohio has adopted the Safe Drinking Water Act into the 303(d) listing process and has completed TMDLs for drinking water impairments. Ohio has directed CWA Section 319 funding to park districts and local governments that can directly implement actions to improve water quality by using TMDLs to identify suitable projects. Ohio EPA has also worked with the U.S. Forest Service, U.S. Army Corps of Engineers and state and federal mining agencies to address common water quality goals and to complete TMDLs and TMDL alternatives.

On a practical level, each TMDL project is completed by a team of Ohio EPA staff that represents many aspects of the clean water programs, including drinking water. The team members include staff from various CWA program areas. At a minimum, these program areas include: monitoring and assessment; water quality modeling; NPDES permits; enforcement; water quality standards; and TMDL. Staff from the Agency's Public Water Supply program are also part of each team where applicable. Ohio EPA district offices and central office both contribute to the effort. On some projects, local representatives such as active watershed group leaders or Soil and Water Conservation District staff are involved during the study plan phase and throughout the project.

External input is sought for developing the implementation portion of the TMDL. Soil and Water Conservation Districts and watershed groups are consulted, in addition to permittees or other entities depending upon the issues in the watershed. While there is always room for improvement, Ohio EPA does not propose significant changes in the integration aspect over the next few years in terms of our internal coordination.

Section

D

Framework for Reporting and Evaluation

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D1. Framework for Reporting and Evaluation

This section describes the framework and basic elements for evaluating and reporting the water quality information in this report.

The 2020 Integrated Report (IR) continues Ohio's evolution to a fully formed watershed basis for reporting on water quality conditions. Since 1988, Ohio has maintained strong linkages between Clean Water Act (CWA) Section 305(b) reporting and Section 303(d) listing. Under the title Water Resource Inventories, Ohio prepares CWA Section 305(b) reports every two years using a biologically based assessment methodology[1]. Subsequently, CWA Section 303(d) lists were compiled using the output of CWA Section 305(b) reporting in 1992, 1994, 1996 and 1998. In 2002, the first IR was produced, addressing the needs of both reporting requirements.

Reporting on Ohio's water resources continues to develop, including more data types and more refined methodologies. The basic framework for this report is built on four beneficial uses:

- **Aquatic Life** — Analysis of the condition of aquatic life was the long-standing focus of reporting on water quality in Ohio and continues to provide a strong foundation. The 2020 methodology is unchanged from what was used in the 2018 IR. Additionally, as in the 2012, 2014, 2016 and 2018 IRs, a methodology for assessing the aquatic life condition of inland lakes is previewed.
- **Recreation** — A methodology for using bacteria data to assess recreation suitability was developed for the 2002 report and was refined several times in subsequent reports. The 2020 methodology is unchanged from what was used in the 2018 IR. In addition, the 2020 methodology is also unchanged from what was used in the 2018 IR for recreation use based on algae blooms for the western basin of Lake Erie. New methodologies are included for recreation use based on algae blooms for the Sandusky and central basin units.
- **Human Health** — A methodology for comparing fish tissue contaminant data to human health criteria via fish consumption advisories was included in the 2004 report. That methodology has been refined in each subsequent report to align more directly with the human health water quality criteria. The methodology was changed in the 2010 report to be consistent with the methodology described in U.S. EPA's 2009 guidance for implementing the methylmercury water quality criterion. The methodology has not changed for the 2020 report.
- **Public Drinking Water** — The assessment methodology for the public drinking water supply (PDWS) beneficial use was first presented in the 2006 report. Updates to the methodology have been presented in subsequent reports. For the 2014 report, it was revised to include a new core indicator based on algae and associated cyanotoxins, and assessment units listed as impaired for algae. The methodology has been aligned with adult drinking water threshold values for cyanotoxin indicators for the 2020 report.

The methodology for assessing support of each beneficial use is described in more detail in Sections E through H.

[1] In 1990, the linkage of fish and macroinvertebrate community index scores and attainment of aquatic life use designations was established in Ohio's Water Quality Standards (OAC 3745-1).

D2. Assessment Units

The 2020 IR continues the watershed orientation outlined in previous reports; the assessment units have not changed significantly from the 2010 report. Throughout this report, references are made to large rivers and watersheds as assessment units defined for 303(d) listing purposes. Data from individual sampling locations in an assessment unit are accumulated and analyzed; summary information and statewide statistics are provided in this report. The three types of assessment units (AUs) are:

- **Watershed Assessment Units (WAUs)** — 1,538 watersheds that align with the 12-digit hydrologic unit code (HUC) system. Ohio HUC numbers are lowest in the northwest corner of the state, proceeding approximately clockwise around the state. The first two digits of Ohio numbers are either 04 (draining to Lake Erie) or 05 (draining to the Ohio River).
- **Large River Assessment Units (LRAUs)** — 38 segments in the 23 rivers that drain more than 500 square miles; the length of each river included is from the mouth of each river upstream to the point where the drainage area reaches approximately 500 square miles.
- **Lake Erie Assessment Units (LEAUs)** — Seven segments for the entire Ohio portion of Lake Erie. Each of three basins (western, Sandusky, central) are divided into two units (shoreline and open water). The shoreline area is defined as the portion that extends along each basin out to and including a depth of three meters from the shore; the open water is the area in Ohio beyond three meters. The islands shoreline is its own unit and includes the shoreline of each island up to and including a depth of three meters.

  Each basin's extent is described as follows:
  - western basin shoreline and open water (OH-MI state line to Marblehead);
  - Lake Erie islands shoreline (including South Bass Island, Middle Bass Island, North Bass Island, Kelleys Island, West Sister Island and other small islands);
  - Sandusky basin shoreline and open water (Marblehead to Lorain Ridge); and
  - central basin shoreline and open water (Black River/Lorain Ridge to OH-PA state line).

Ohio River assessment units have been defined by the Ohio River Valley Water Sanitation Commission (ORSANCO). See Section D3 for additional discussion of ORSANCO's work.

It is important to remember that the information presented here is a summary. All the underlying data observations are available and can be used for more detailed analysis of water resource conditions on a more localized, in-depth scale. Much of the information is available in watershed reports available at ***epa.ohio.gov/dsw/document_index/psdindx.aspx***.

Total Maximum Daily Load (TMDL) reports, available at ***epa.ohio.gov/dsw/tmdl/index.aspx***, are another source of more in-depth analyses.

Ohio's large rivers, defined for this report as draining greater than 500 square miles, are illustrated in Figure D-1. Ohio's watershed units are shown in Figure D-2. Lake Erie assessment units are shown in Figure D-3.

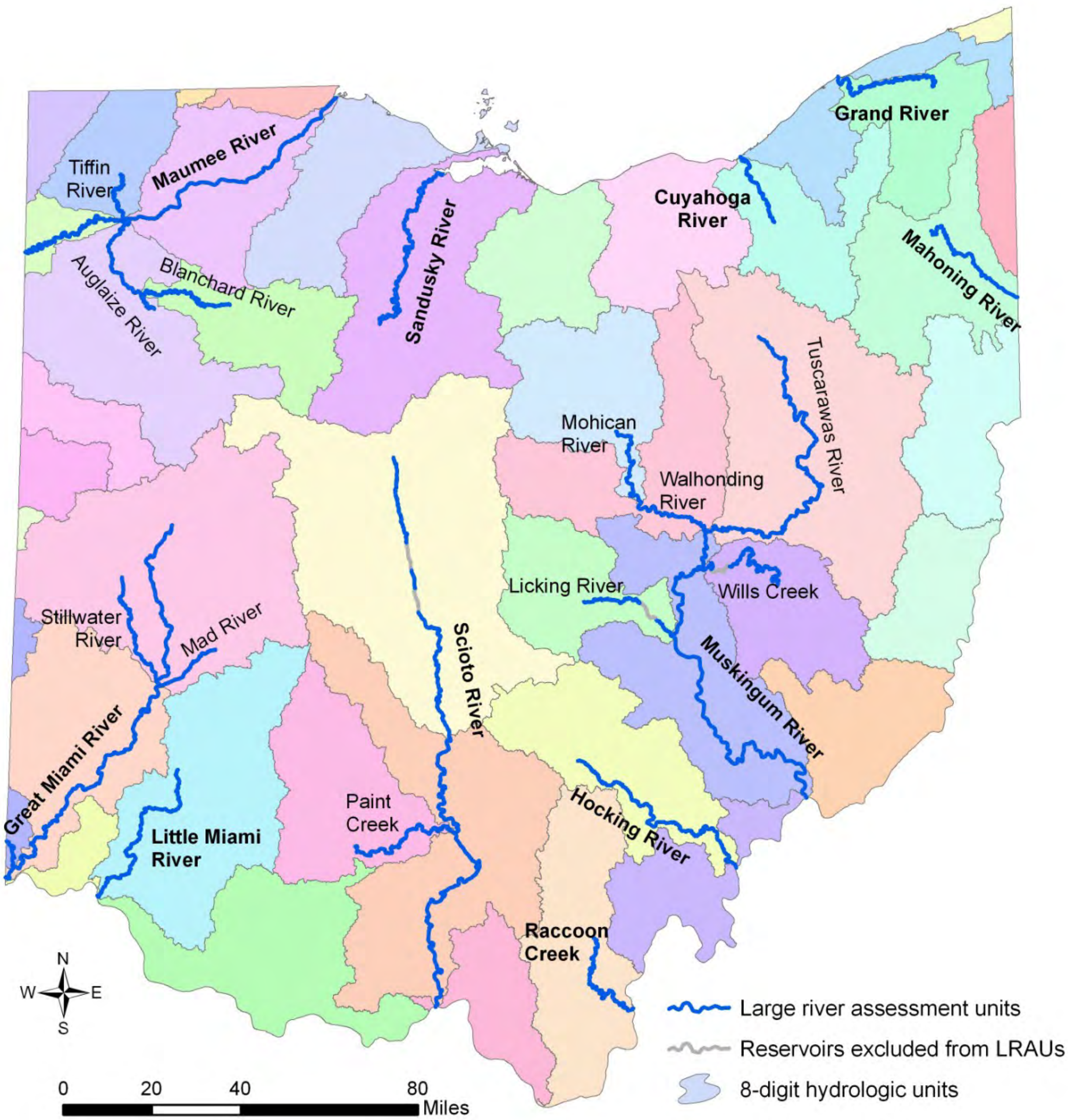

Figure D-1 — Ohio's large rivers (rivers with drainages greater than 500 mi2) and their watersheds.

Figure D-2 — Ohio's 12-digit WAUs (gray lines) and 8-digit hydrologic units (heavy black lines).

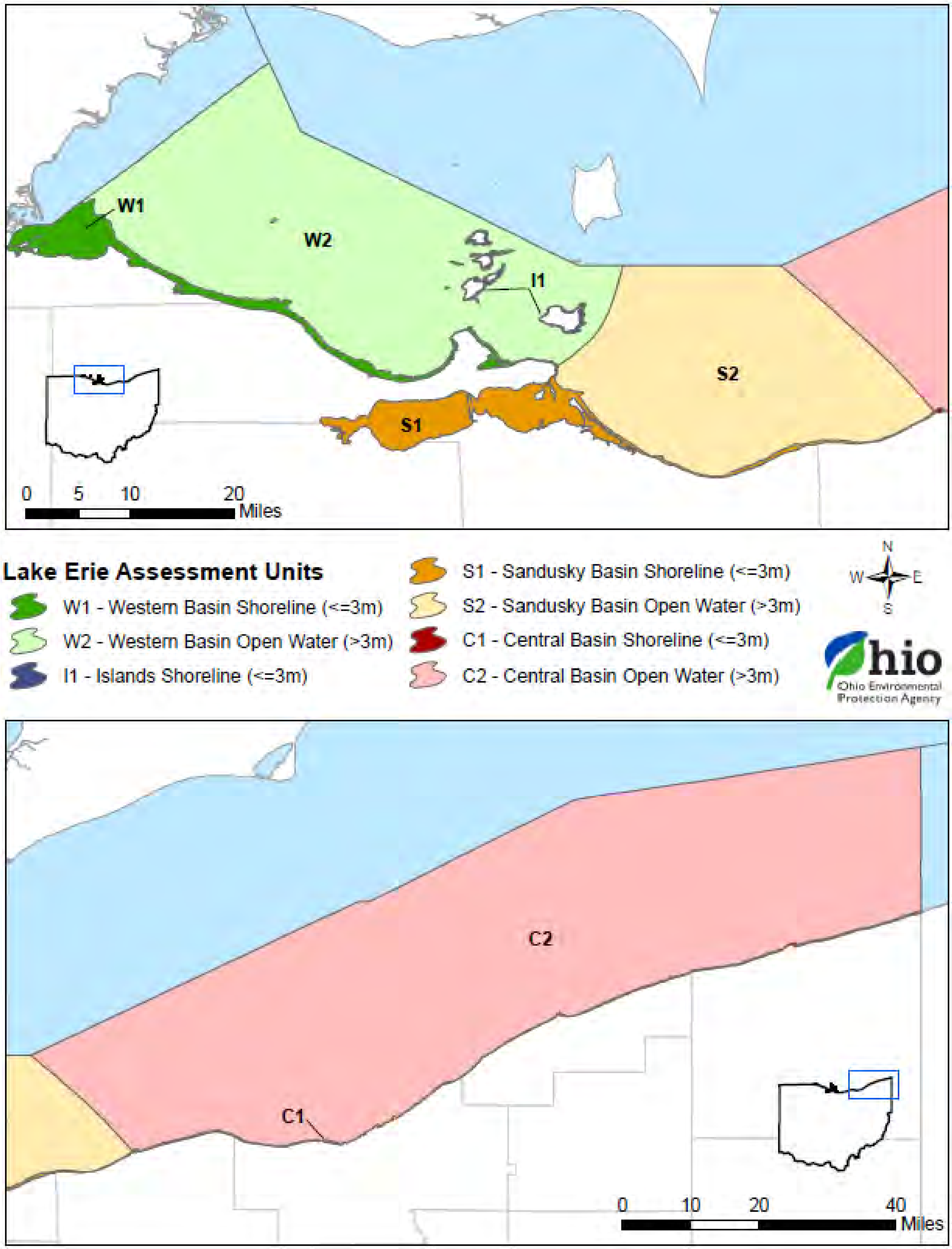

Figure D-3 — Ohio's Lake Erie assessment units – western basin, islands, Sandusky basin and central basin shorelines and open water areas.

D3. Evaluation of the Ohio River

For evaluation of the Ohio River, Ohio EPA defers to the Ohio River Valley Water Sanitation Commission (ORSANCO). ORSANCO is an interstate commission, established on June 30, 1948, to control and abate pollution in the Ohio River Basin. It represents eight states and the federal government. Member states include Illinois, Indiana, Kentucky, New York, Ohio, Pennsylvania, Virginia and West Virginia. ORSANCO operates programs to improve water quality in the Ohio River and its tributaries including: setting wastewater discharge standards; performing biological assessments; monitoring for the chemical and physical properties of the waterways; and conducting special surveys and studies. ORSANCO also coordinates emergency response activities for spills or accidental discharges to the river and promotes public participation in the programs such as the Ohio River Sweep, River Watchers Volunteer Monitoring Program and Friends of the Ohio.

Since 1948, ORSANCO and its member states have cooperated to improve water quality in the Ohio River Basin so that the river and its tributaries can be used for drinking water, industrial supplies and recreational purposes; and can support healthy and diverse aquatic communities. ORSANCO operates monitoring programs to check for pollutants and toxins that may interfere with specific uses of the river and conducts special studies to address emerging water quality issues.

As a member of the Commission, the State of Ohio supports ORSANCO activities, including monitoring of the Ohio River mainstem, by providing funding based on state population and miles of Ohio River shoreline. As such, monitoring activities on the Ohio River are coordinated and conducted by ORSANCO staff or its contractors. More information about ORSANCO and the Ohio River monitoring activities conducted through that organization can be found online at ***orsanco.org***.

Ohio EPA participates in an ORSANCO workgroup to promote consistency in 305(b) reporting and 303(d) listing. The workgroup discussed and agreed upon methods to evaluate attainment/non-attainment of aquatic life, recreation and public water supply uses, as well as impairments based on sport fish consumption advisories. ORSANCO prepares the Section 305(b) report for the Ohio River and has indicated the impaired beneficial uses and segments of the Ohio River. Ohio EPA defers to the ORSANCO analysis and the list of impaired Ohio River segments found in 2018 Biennial Assessment of Ohio River Water Quality Conditions (ORSANCO 2018). ORSANCO plans to complete a biennial assessment in 2020 that will be available at: ***orsanco.org/programs/water-quality-assessment/***.

D4. Evaluation of Lake Erie

Lake Erie is bordered by four states and one Canadian province. As such, it has federal oversight by two sovereign nations. Unlike most other waters in Ohio, Lake Erie has a more complicated governance structure with a binational agreement (GLWQA) between the U.S. and Canada providing a framework to identify binational priorities and implement actions that improve water quality. For comparison, assessment and reporting on one of Ohio's other multi-state waters, the Ohio River, is conducted by ORSANCO, which, as stated above, is an interstate commission representing eight states and the federal government.

Ohio's assessment and impairment designation for Lake Erie has been the focus of considerable discussion between Ohio EPA, U.S. EPA and local stakeholders. In 2018 Ohio, with the considerable aid of several universities and NOAA, developed a method for assessing the western basin open waters in Ohio for algae blooms. This methodology was used in the 2018 report and continues to be employed in this cycle. It is presented in Section F4 and utilizes the assessment units defined above in Section D2. In addition, Section F4 contains new methodologies for the Sandusky and central basin units.

As in the past two reports, the shoreline units have been assessed for all four beneficial uses using the already established methods. All but the central basin shoreline is listed as impaired for all four uses (the central basin shoreline is not impaired for public water supply since the intakes are located in the open water assessment unit). See Sections E through H for more information on each use assessment.

D5. Ohio's Water Quality Standards Use Designations

Beneficial use designations describe existing or potential uses of water bodies. They take into consideration the use and value of water for public water supplies, protection and propagation of aquatic life, recreation in and on the water, agricultural, industrial and other purposes. Ohio EPA assigns beneficial use designations to water bodies in the state. There may be more than one use designation assigned to a water body. Examples of beneficial use designations include: public water supply; primary contact recreation; and numerous sub-categories of aquatic life use. Table D-1 lists all of Ohio's water quality standards (WQS) designated uses and outlines how the use was evaluated for the Ohio 2020 IR. Additional information is included in Section F4 about the WQS and uses evaluated for Lake Erie related to algae.

Table D-1 — Ohio water quality standards in the 2020 IR.

Beneficial Use Category	Key Attributes[2]	Evaluation status in the 2020 IR
Categories for the protection of aquatic life		
Coldwater habitat (CWH)	native cold water or cool water species; put-and-take trout stocking	Assessed on case by case basis
Seasonal salmonid habitat (SSH)	supports lake run steelhead trout fisheries	No direct assessment, streams assessed as EWH or WWH
Exceptional warmwater habitat (EWH)	unique and diverse assemblage of fish and invertebrates	65.5 percent of the WAUs and 99.7 percent of the LRAUs fully assessed using direct comparisons of fish and macroinvertebrate community index scores to the biocriteria in Ohio's WQS; sources and causes of impairment were assessed using biological indicators and water chemistry data.
Warmwater habitat (WWH)	typical assemblages of fish and invertebrates	
Modified warmwater habitat	tolerant assemblages of fish and macro-invertebrates; irretrievable condition precludes WWH	
Limited resource water	fish and macroinvertebrates severely limited by physical habitat or other irretrievable condition	Assessed on case by case basis
Categories for the protection of human health		
Human health [fish consumption]	all waters outside mixing zones	43 percent of the WAUs, 100 percent of the LRAUs assessed and all seven LEAUs assessed using applicable water quality criteria
Categories for the protection of recreational activities		
Bathing Waters	Lake Erie (entire lake); for inland waters, bathing beach with lifeguard or bathhouse facility	All four Lake Erie shoreline AUs fully assessed based on analysis of data collected from 65 public beaches
Primary Contact Recreation (PCR)	waters suitable for one or more full-body contact recreation activity such as wading and swimming; three classes are recognized, distinguished by relative potential frequency of use	11 percent of the WAUs and 26 percent of the LRAUs assessed using applicable PCR geometric mean *E. coli* criteria
Secondary Contact Recreation (SCR)	waters rarely used for recreation because of limited access; typically located in remote areas and of very shallow depth	Assessed as part of the WAU using applicable SCR geometric mean *E. coli* criteria
Categories for the protection of water supplies		
Public Water Supply	waters within 500 yards of all public water supply surface water intakes, publicly-owned lakes, waters used as emergency supplies	Sufficient data were available to assess 50 percent of the 118 AUs with PDWS use; assessed using chemical water quality data; only waters with active intakes were assessed
Agricultural Water Supply	water used, or potentially used, for livestock watering and/or irrigation	Not assessed
Industrial Water Supply	water used for industrial purposes	Not assessed

[2] Reasons for which a water body would be designated in the category.

D6. Sources of Existing and Readily Available Data

For two decades Ohio EPA has placed a high priority on collecting data to accurately measure the quality of Ohio's rivers and streams. Therefore, the Agency has a great deal of information and data to draw upon for the IR. The available data sets from Ohio EPA and external sources, including efforts used to obtain additional data, are also discussed below. The 2008 IR marked the first time that Ohio's credible data law was fully implemented in generating external data for consideration.

The credible data law, enacted in 2003 (ORC 6111.50 to 6111.56), requires that the director of Ohio EPA adopt rules which would, among other things, do the following:

- establish a water quality monitoring program for the purpose of collecting credible data under the act; require qualified data collectors to follow plans pertaining to data collection; and require the submission of a certification that the data were collected in accordance with such a plan; and
- establish and maintain a computerized database or databases of all credible data in the director's possession and require each state agency in possession of surface water quality data to submit that data to the director.

Ohio EPA adopted rules in 2006, which were revised in 2011 and 2018, to establish criteria for three levels of credible data for surface water quality monitoring and assessment and to establish the necessary training and experience for persons to submit credible data. Apart from a few exceptions, people collecting data and submitting it to Ohio EPA for consideration as credible data must have status as a qualified data collector (QDC). Only Level 3 data can be used for decisions about beneficial use assignment and attainment; water quality standards; listing and delisting (303(d) list); and TMDL calculations.

Ohio EPA solicited data from all Level 3 QDCs for the 2020 IR. The letter requesting data and the website containing information about how to submit data are included in Section D7. Table D-2 summarizes the WQS uses evaluated in the 2020 IR, the basic types of data used, the period of record considered, the sources of data and the minimum amount of data needed to evaluate a water body. Specific methodologies used to assess attainment of the standards are described in more detail in Sections E through H.

Table D-3 summarizes the data Ohio EPA used in the 2020 IR. Ohio EPA's 2020 IR uses fish contaminant data to determine impairment using the human health-based water quality criteria. Fish consumption advisories (FCAs) were not used in determining impairment status. However, the public should use the FCAs in determining the safety of consuming Ohio's sport fish.

The evaluation of bacteria, biological and water quality survey data was not changed from the approach used in the 2010 IR. Data collected by Ohio EPA and Level 3 QDCs were evaluated. The following QDCs and state and federal environmental agencies that are excepted from the QDC requirement submitted data or the data were available from readily obtained reports:

- Ohio Department of Natural Resources
- U.S. Geological Survey
- Northeast Ohio Regional Sewer District
- Midwest Biodiversity Institute/Center for Applied Bioassessment and Biocriteria
- Heidelberg College
- The Ohio State University
- Ohio Department of Health
- Cuyahoga County Board of Health
- EnviroScience, Inc.
- EA Science and Technology, Inc.
- Cleveland Metroparks
- Clermont County Office of Environmental Quality
- Ohio University Voinovich School
- MAD Scientist
- National Oceanic and Atmospheric Administration
- Bowling Green State University
- University of Toledo

Table D-2 — Data types used in the 2020 IR.

WQS Uses and Criteria Evaluated (basic rationale[3])	Type of Data Time Period	Source(s) of Data	Minimum Data Requirement
Human health, single route exposure via food chain accumulation and eating sport fish (criteria apply to all waters of the State)	Fish Tissue Contaminant Data 2009 to 2018	Fish Tissue Contaminant Database	Data collected within past 10 years[4]. Two samples, each from trophic levels 3 and 4 in each WAU or inland lake.
Recreation uses - evaluation based on a comparison of E. coli levels to applicable geometric mean and STV E. coli criteria in the WQS.	E. coli counts 2015 to 2019 (May through October only)	Ohio Dept of Health Cuyahoga County Health Department Northeast Ohio Regional Sewer District (NEORSD)	Five or more E. coli samples collected within a 90-day period; at least one site per AU; data period 2015-2019
Aquatic life (specific sub-categories), fish and macroinvertebrate community index scores compared to biocriteria in WQS [OAC 3745-1-07(C) and Table 7-1]	Watershed scale biological and water quality surveys and other more targeted monitoring 2005 to 2018	ODNR U.S. Geological Survey NEORSD Midwest Biodiversity Institute Heidelberg College Ohio State University EnviroScience, Inc.	Fish and/or macroinvertebrate samples collected using methods cited in WQS [OAC 3745-1-03(A)(5)]. Generally, two to three locations sampled per WAU (12-digit HUC).
Public drinking water supply (criteria apply within 500 yards of active drinking water intakes, all publicly owned lakes, and all emergency water supplies)	Chemical water quality data 2010 to 2019	SDWIS (PWS compliance database) Syngenta Crop Protection, Inc. (Atrazine Monitoring Program)[5]	Data collected within past five years. Minimum of 10 samples with a few exceptions (noted in Section H).

[3] Additional explanation is provided in the text of Section D5.

[4] Data more than 5 years old are historical data. The rules provide that "Credible data may include historical data if the director identifies compelling reasons as to why the data are credible." ORC 6111.51(D) also says: "If the director has obtained credible data for a surface water, the director also may use historical data for the purpose of determining whether any water quality trends exist for that surface water."

[5] These data were collected as part of an intensive monitoring program at community water systems required by the January 2003 Atrazine Interim Reregistration Eligibility Decision and subsequent Memorandum of Agreement between U.S. EPA and the atrazine registrants (including Syngenta Crop Protection, Inc.).

Table D-3 — Description of data used in the 2020 IR from sources other than Ohio EPA.

Entity	Dates data were collected	Data description	Basis of qualification[6]
NPDES permittees	2013 – 2017 (May – Oct only)	Bacteria	Data credible – submittal pursuant to permit
Ohio Department of Health (ODH)	2015 – 2019 (May – Oct only)	Bacteria	State environmental agency
Cuyahoga County Health Department	2015 – 2019 (May – Oct only)	Bacteria	Level 3 qualified data collector (under ODH's study plan)
Northeast Ohio Regional Sewer District	2015 – 2019 (May – Oct only)	Bacteria	Level 3 qualified data collector
	Jul 2006 – Oct 2016	Physical habitat	
	Jun 2006 – Oct 2016	Biology	
	Apr 2006 – Oct 2016	Chemistry	
	2008	Fish tissue	
Ohio Department of Natural Resources	Apr 2009 – Nov 2018	Fish tissue	State environmental agency/Level 3 qualified data collector
	Sep 2006 – Oct 2016	Biology (fish only)	
	Jun – Oct 2016	Physical habitat	
PWS compliance database (permittees)	Jan 2013 – Oct 2019	Chemistry	Data credible – submittal pursuant to permit
Syngenta Corp Protection, Inc.	Jan 2012 – Dec 2018	Chemistry	See footnote[7]
The Ohio State University	May – Oct 2006	Biology (macroinvertebrates only)	Level 3 qualified data collector
Midwest Biodiversity Institute	Jul 2010 – Oct 2016	Biology	Level 3 qualified data collector
		Physical habitat	
		Chemistry	
Enviroscience, Inc.	Sep – Nov 2011	Biology	Level 3 qualified data collector
		Physical habitat	
Ohio Department of Transportation	Jun 2007 – Oct 2010	Biology (fish only)	State environmental agency/Level 3 qualified data collector
		Physical habitat	
Heidelberg College	Jun 2012 – Oct 2012	Biology (macroinvertebrates only)	Level 3 qualified data collector
EA Science and Technology, Inc.	Jul 2014 – Oct 2014	Biology	Level 3 qualified data collector
Cleveland Metroparks	Jun 2012 – Sep 2014	Biology (fish only)	Level 3 qualified data collector
Clermont County Office of Environmental Quality	May 2009 – Sep 2016	Chemistry	Level 3 qualified data collector
Ohio University – Voinovich School	Jun 2016 – Sep 2017	Biology (fish only)	Level 3 qualified data collector
		Physical Habitat	
		Chemistry	
MAD Scientist, Inc	Jun 2016 – Sep 2016	Biology (fish only)	Level 3 qualified data collector
NOAA	2002 – present	Algal (cyanobacteria equivalent) density interpolated by satellite data	Federal environmental agency
Bowling Green State University	Jun 2018 – Sep 2019	Microcystin (cyanotoxin)	Level 3 qualified data collector; samples analyzed by Ohio EPA's Division of Environmental Services

[6] Level 3 Qualified Data Collector requirements are described in OAC Rule 3745-4-03(A)(4). Included above are Qualified Data Collectors Ohio EPA has approved for stream habitat assessment, fish community biology, benthic macroinvertebrate biology and/or chemical water quality assessment. Data submitted by state and federal environmental agencies used in this IR have been determined to be Level 3 Credible Data in accordance with OAC Rule 3745-4-06(B)(6).

[7] These data were collected as part of an intensive monitoring program at community water systems required by the Jan 2003 Atrazine Interim Reregistration Eligibility Decision and subsequent Memorandum of Agreement between U.S. EPA and the atrazine registrants (including Syngenta Crop Production, Inc.).

D7. Public Involvement in Compiling Ohio's Section 303(d) List of Impaired Waters

The public was involved in various ways in the development of the 2020 IR. Several means of public communication are discussed below.

Much of the data used in this report have been presented to the public in meetings and publications concerning individual watersheds. Data and assessments have also been available in previous 305(b), 303(d) and IRs. All this information can be accessed from the following websites: ***epa.ohio.gov/dsw/tmdl/index*** and ***epa.ohio.gov/dsw/tmdl/OhioIntegratedReport*** .

The draft 2020 303(d) list will be also available for public review and comment prior to submitting the final list and report to U.S. EPA.

Solicitation for External Water Quality Data, 2020 IR Project (Feb. 26, 2019)

The following memorandum soliciting level 3 qualified data was emailed to all Level 3 qualified data collectors on Feb. 26, 2019.

Ohio Environmental Protection Agency

Mike DeWine, Governor
Jon Husted, Lt. Governor
Laurie A. Stevenson, Director

Date February 26, 2019

Re Solicitation of Water Quality Data, 2020 Integrated Report
(No action is required on your part - submission of data is voluntary)

To Interested Parties: Stream Monitoring Personnel

From Tiffani Kavalec, Chief
Division of Surface Water

The Ohio Environmental Protection Agency (Ohio EPA) is asking for chemical, biological and/or physical habitat data you may wish to submit for consideration as the Agency prepares its 2020 Integrated Water Quality Monitoring and Assessment Report, commonly referred to as the Integrated Report. Both state and federal governments have an interest in utilizing all available data to make informed decisions about managing Ohio's aquatic resources; however, Ohio EPA is only able to use data from a limited number of external sources, including Level 3 certified data collectors and National Pollutant Discharge Elimination Systems (NPDES) discharge permit holders[1].

Ohio EPA's Division of Surface Water (DSW) is soliciting readily available data for use in the 2020 Integrated Report. This document fulfills the State's reporting obligations under Sections 305(b) and 303(d) of the Clean Water Act. Information is available at http://www.epa.ohio.gov/dsw/tmdl/OhioIntegratedReport.aspx.

Credible Data Law
Credible Data rules (OAC 3745-4-01 to 06), developed in accordance with the 2003 credible data law (ORC 6111.50 to 6111.56), established a citizen water quality monitoring program for the purpose of collecting credible data under the act and required qualified data collectors to follow plans pertaining to data collection. The law further required that collectors submit a certification that the data were collected in accordance with such a plan. Furthermore, as required by the law, a computerized database was developed to track and maintain all credible data in the director's possession.

Additionally, the law established that external data found to be compliant with the specifications for "level 3 credible data," which generally means data from a level 3 qualified

[1] It is unnecessary to resubmit data that have already been submitted to the Division of Surface Water.

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data collector, can be used for certain regulatory and reporting purposes, such as the Section 303(d) list of Ohio's impaired waters.

According to Ohio EPA's administrative rules, you may meet the qualifications of a level 3 qualified data collector in one or more areas of water quality data. Therefore, in pursuit of all readily available data for use in the state's reporting documents, the Agency is requesting your voluntary participation by submitting any recent water quality data that you have on Ohio's waters (e.g., lakes, rivers and streams) that you are qualified and authorized to collect.

Data submission deadlines are dependent on the type of data and are as follows:

- **Biological, physical habitat, chemical and fish tissue = April 30, 2019**
- **Bacteria = September 15, 2019**

More information about the specific types of data being requested by Ohio EPA, and **how** to submit such data, may be found at:
https://epa.ohio.gov/dsw/tmdl/2020IntReport/2020CallForData

Web Page with Instructions for Submitting Level 3 Credible Data

For organizations interested in submitting data to Ohio EPA, a web page was established with instructions on what qualified data to be submitted and how to do so. The website content is displayed below.

2020 Integrated Water Quality Monitoring and Assessment Report - Call for Level 3 Credible Data

Information about submitting Level 3 credible data to Ohio EPA is organized as outlined below. More information about the Integrated Report is on the ***Ohio Integrated Water Quality Monitoring and Assessment Report*** page.

- What kind of data does Ohio EPA want?
  - Microbiological data
  - Biological and physical habitat data
  - Chemical water quality data
  - Fish tissue data
- Do I have level 3 data?
- Have I already given Ohio EPA my data?
- What will be needed in addition to data?
  - Microbiological data requirements
  - Biological, chemical, fish tissue and physical data requirements
- How do I send the data?
- To whom do I send the data?

To access the information, click on the relevant link below.

What kind of data does Ohio EPA want?

Ohio EPA is asking for biological, physical habitat and/or chemical data you may wish to submit for consideration as the Agency prepares its 2020 Integrated Report. Both the state and federal governments have an interest in utilizing all available data to make informed decisions about managing Ohio's aquatic resources. Ohio EPA is soliciting data primarily from NPDES major permit holders, level 3 qualified data collectors and others that may be in possession of level 3 credible data. The data can be of various types (bacteria, biological, physical and chemical water quality data) and must have been collected during the following time frames:

- Bacteria = 2018 – 2019 (recreation season)
- Biological, physical habitat, chemical and fish tissue = 2017 – 2018

Microbiological Data

Ohio EPA measures recreation use attainment by comparing the level of indicator bacteria present in ambient water samples against the bacteria criteria contained in ***rule 3745-1-37 of Ohio's water quality standards***. These indicator bacteria serve as predictors for the possible presence of enteric pathogens in the water that can cause a variety of illnesses. The type of indicator bacteria that Ohio EPA is utilizing in the 2020 Integrated Report is ***E. coli***.

Data collected by NPDES discharge permit holders at ambient stream sites upstream and downstream of discharge locations and reported in discharge monitoring reports will be extracted from the SWIMS database. **It is unnecessary to resubmit data already submitted into SWIMS.** However, if bacteria data were collected at additional ambient stations and not reported through SWIMS, permit holders may voluntarily submit this data to the Agency. Data must have been collected between May 1, 2018, and September 15, 2019, and must meet the basic terms of acceptability found in the requirements listed below.

Biological and Physical Habitat Data

Ohio EPA measures aquatic life use attainment in Ohio streams and rivers by comparing indices generated from fish and aquatic macroinvertebrate data against the biological criteria contained in Ohio's water quality standards, ***OAC 3745-1-07, Table 7-1***. Field collection and data analysis methodologies for fish and macroinvertebrate community assessments are strictly adhered to and must follow procedures as outlined in documents available from Ohio EPA's biological criteria website: ***http://www.epa.ohio.gov/dsw/bioassess/BioCriteriaProtAqLife.aspx***.

Physical habitat data should be in the form of the Qualitative Habitat Evaluation Index (QHEI) and must be included if fish community data are being submitted. QHEI procedure manuals and forms can also be found at the above website location.

Chemical water quality data collected in conjunction with biological data is of interest to Ohio EPA. Data should follow the parameters discussed below.

Chemical Water Quality Data

Ohio EPA primarily uses sampling methods described in the "***Surface Water Field Sampling Manual***." Sample collection and analysis method references are listed in ***paragraph (C) of OAC 3745-4-06***. Ohio EPA is interested in other chemical water quality data collected and analyzed by these methods or others of similar quality control/quality assurance rigor.

Fish Tissue Data

Ohio EPA primarily uses sampling methods described in the "***State of Ohio Cooperative Fish Tissue Monitoring Program Fish Collection Guidance Manual***" and analysis methods from "***Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories. Volume 1, Fish Sampling and Analysis. Third edition***." Sample collection and analysis method references are listed in ***paragraph (C) of OAC 3745-4-06***. Ohio EPA is interested in other fish tissue data collected and analyzed by these methods or others of similar quality control/quality assurance rigor.

Do I have Level 3 data?

Credible Data rules (***OAC 3745-4-01 to 06***), developed in accordance with the 2003 credible data law (***ORC 6111.50 to 6111.56***), established a water quality monitoring program for the purpose of collecting credible data under the act and required qualified data collectors to follow plans pertaining to data collection. The law further required that collectors submit a certification that the data were collected in accordance with such a plan. Furthermore, as required by the law, a computerized database was developed to track and maintain all credible data in the director's possession.

Additionally, the law established that external data found to be compliant with the specifications for "level 3 credible data," which generally means data from a level 3 qualified data collector, can be used for certain regulatory and reporting purposes, such as the Section 303(d) list of Ohio's impaired waters.

If you have collected data following these procedures, then you may have level 3 credible data eligible for inclusion in the Integrated Report.

Have I already given Ohio EPA my data?

External data Ohio EPA has received and may use for 305(b)/303(d) reporting:

Entity	Dates data were collected	Data description	Basis of qualification[1]
NPDES permittees	2013 – 2017 (May – Oct only)	Bacteria	Data credible – submittal pursuant to permit

Ohio Department of Health (ODH)	2013 – 2017 (May – Oct only)	Bacteria	State agency
Cuyahoga County Health Department	2013 – 2017 (May – Oct only)	Bacteria	Level 3 qualified data collector (under ODH's study plan)
Northeast Ohio Regional Sewer District	2013 – 2017 (May – Oct only)	Bacteria	Level 3 qualified data collector
	Jul 2006 – Oct 2016	Physical habitat	
	Jun 2006 – Oct 2016	Biology	
	Apr 2006 – Oct 2016	Chemistry	
	2008	Fish tissue	
Ohio Department of Natural Resources	Apr 2006 – Nov 2016	Fish tissue	State agency/Level 3 qualified data collector
	Sep 2006 – Oct 2016 Jun – Oct 2016	Biology (fish only)	
		Physical habitat	
PWS compliance database (permittees)	Jan 2012 – Oct 2017	Chemistry	Data credible – submittal pursuant to permit
Syngenta Corp Protection, Inc.	Jan 2012 – Oct 2017	Chemistry	See footnote[2]
The Ohio State University	May – Oct 2006	Biology (macroinvertebrates only)	Level 3 qualified data collector
Midwest Biodiversity Institute	Jul 2010 – Oct 2016	Biology	Level 3 qualified data collector
		Physical habitat	
		Chemistry	
Enviroscience, Inc.	Sep – Nov 2011	Biology	Level 3 qualified data collector
		Physical habitat	
Ohio Department of Transportation	Jun 2007 – Oct 2010	Biology (fish only)	State agency/Level 3 qualified data collector
		Physical habitat	
Heidelberg College	Jun 2012 – Oct 2012	Biology (macroinvertebrates only)	Level 3 qualified data collector
EA Science and Technology, Inc.	Jul 2014 – Oct 2014	Biology	Level 3 qualified data collector
Cleveland Metroparks	Jun 2012 – Sep 2014	Biology (fish only)	Level 3 qualified data collector
Clermont County Office of Environmental Quality	May 2009 – Sep 2016	Chemistry (drinking water)	Level 3 qualified data collector
MAD Scientist, Inc.	Jun 2016 – Sep 2016	Biology (fish only)	Level 3 qualified data collector
Ohio University – Voinovich School	Jun 2016 – Sep 2017	Biology (fish only)	Level 3 qualified data collector
		Physical habitat	

		Chemistry	

1 Level 3 qualified data collector requirements are described in OAC Rule 3745-4-03(A)(4). Included above are qualified data collectors Ohio EPA has approved for stream habitat assessment, fish community biology, benthic macroinvertebrate biology and/or chemical water quality assessment.

2 These data were collected as part of an intensive monitoring program at community water systems required by the Jan 2003 Atrazine Interim Reregistration Eligibility Decision and subsequent Memorandum of Agreement between U.S. EPA and the atrazine registrants (including Syngenta Crop Protection, Inc.).

What will be needed in addition to data?

Specific guidelines for submission of data are listed below. While these guidelines correspond to the regulations regarding credible data, they are not verbatim. To see the regulations, please go to ***OAC 3745-4-06***.

Microbiological Data Requirements

An individual or organization that submits bacteria data to Ohio EPA for consideration in the 2020 Integrated Report shall attest to the validity of the data and adhere to the data quality specification listed here. The submission of data must cover the following:

- Sampling and test methods, QA/QC specifications: Sampling must be conducted in a manner consistent with procedures contained in *Standard Methods for the Examination of Water and Wastewater* or the most relevant version of the "***Surface Water Field Sampling Manual***."

  Analytical testing must be conducted in accordance with U.S. EPA approved methods under ***40 CFR 136.3***. Acceptable references for methods for qualified data collectors are given in ***paragraph (C) of OAC 3745-4-06*** and include Ohio EPA references, U.S. EPA references and Standard Methods. Data submissions must include a description of the Quality Assurance/Quality Control (QA/QC) plans under which the bacteria sample analysis occurred. This should address topics such as sample handling and preservation, sample holding time, chain of custody, precision, accuracy, etc.
- Description of Sampling Program: A brief description of the purpose of data collection and the sampling design considerations should be provided. Were specific sources of potential contamination under investigation? Were samples collected at fixed station locations? How often and under what kinds of environmental conditions were samples collected? Have the results been published in a report or the scientific literature?
- Minimum Data Submission: Ohio EPA is requesting only bacteria data (*E. coli*) collected during the recreation season (May 1st to October 31st) for 2018 and (May 1st to September 15th) for 2019. The following information must be included in the data submission in an electronic spreadsheet or database format:
  - Sample collection date
  - Sample collection method (with reference)
  - Sample site location including waterbody name, county, river mile (if known), latitude/longitude (decimal degrees or degrees, minutes, and seconds)
  - *E. coli* count
  - Identification of units associated with bacteria counts
  - Any applicable data qualifiers (as received from the lab, if applicable)
  - Contact name, address, telephone number and e-mail address of the person submitting the data set
  - Identification of the laboratory performing the sample analysis

Bacteria data must have been collected on or after May 1, 2018, and must meet the basic acceptability specifications listed above. Data must be provided in an electronic format such as Excel or Access.

Biological, Chemical, Physical Habitat and Fish Tissue Data Requirements

An individual or organization than submits biological, chemical, physical habitat and/or fish tissue data to Ohio EPA for consideration in the 2020 Integrated Report shall attest to the validity of the data and adhere to the data quality specifications listed here. The submission of data must cover the following:

- Analytical and sampling procedures (examples):
    - ***Surface Water Field Sampling Manual***
    - ***Habitat and biology sampling manuals***
    - Only data that are consistent with these guidelines can be considered Level 3 data.
- Description of Sampling Program: A brief description of the purpose of data collection and the sampling design considerations should be provided. Were specific sources of potential contamination under investigation? Were samples collected at fixed station locations? How often and under what kinds of environmental conditions were samples collected? Have the results been published in a report or the scientific literature?

If the data have been or will be submitted as part of the Credible Data Program and there is an approved project study plan, this requirement is potentially waived, pending a successful data review that confirms study plan was adhered to as written.

- Minimum Data Submission: Ohio EPA is requesting biological, chemical, physical habitat and fish tissue data collected from 2017 – 2018. The following information must be included in the data submission in an electronic spreadsheet or database format:
    - Sample collection date
    - Sample collection method (with reference)
    - Sample site location including waterbody name, county, river mile (if known), latitude/longitude (decimal degrees or degrees, minutes and seconds)
    - Type of data collected (fish, macroinvertebrate, chemical and physical parameters)
    - Analytical and collection methodologies used (include references)
    - Any applicable data qualifiers (as received from the lab, if applicable)
    - Contact name, address, telephone number and e-mail address of the person submitting the data set
    - Identification of the laboratory performing the sample analysis (if applicable)
    - Weather conditions, flow and precipitation (all optional)

Biological, chemical, physical habitat or fish tissue data must have been collected on or after January 1, 2017, and must meet the basic acceptability specifications listed above. Data must be provided in an electronic format such as Excel or Access.

How do I send the data?

Ohio EPA already has data from some credible data collectors, as listed in the table above. Additional data may be available and Ohio EPA is soliciting these data.

The Agency's capacity to accept and utilize the data in preparation of the Integrated Report is dependent upon a variety of factors and the use of all data brought to our attention may not be possible. Data must be provided in electronic format such as Excel or Access.

If you would like to discuss the possible use of data in the 2020 Integrate Report, please contact Jared Burson at (614) 721-8697 or ***jared.burson@epa.ohio.gov*** before preparing and submitting any information.

To whom do I send the data?

Submit all data and supporting information listed above to Jared Burson, jared.burson@epa.ohio.gov, Ohio EPA/DSW, P.O. Box 1049, Columbus, Ohio 43216-1049.

Bacteria data must be received by September 15, 2019, all other data must be received by April 30, 2019.

Web Page Announcing 2020 Integrated Report Preparation

As shown below, Ohio EPA announced the preparation and anticipated schedule of the 2020 Integrated Report on its website (***epa.ohio.gov/dsw/tmdl/OhioIntegratedReport.aspx***).

Preparation of 2020 Integrated Report is Underway

Ohio EPA is preparing the 2020 Integrated Report, which fulfills the State's reporting obligations under Section 305(b) (33 U.S.C. 1315) and Section 303(d) (33 U.S.C. 1313) of the Federal Clean Water Act. The report will indicate the general condition of Ohio's waters and list those waters that are currently impaired and may require Total Maximum Daily Load (TMDL) development in order to meet water quality standards. The most recent Ohio Integrated Report was approved by U.S. EPA on July 9, 2018 (see 2018 tab on this website).

When will the report be completed?

Major project milestones and expected dates for completion are shown below. Please continue to check this website for updates.

Refine methodologies/compile data	June - October 2019
External level 3 credible data are due to Ohio EPA	April 30, 2019 (bio/physical/chem/fish tissue); Sept. 15, 2019 (bacteria)
Prepare list/internal review	October - December 2019
Public notice draft 303(d) list	December 2019 – January 2020
Respond to comments/prepare final list	February - March 2020
Submit to U.S. EPA Region V for approval	April 1, 2020

Call for Level 3 Credible Data

Information regarding level 3 credible data submission can be found at the following webpage: https://epa.ohio.gov/dsw/tmdl/2020IntReport/2020CallForData.

Notice of Availability and Request for Comments CWA Section 303(d) TMDL Priority List for 2020

Public Notice Date: February 17, 2020

OHIO ENVIRONMENTAL PROTECTION AGENCY PUBLIC NOTICE

NOTICE OF AVAILABILITY and REQUEST FOR COMMENTS Federal Water Pollution Control Act Section 303(d) TMDL PRIORITY LIST FOR 2020

Public notice is hereby given that the Ohio Environmental Protection Agency (Ohio EPA) Division of Surface Water (DSW) is providing for public review and comment the *2020 Integrated Water Quality Monitoring and Assessment Report.* This report includes the Total Maximum Daily Load (TMDL) priority list for 2020 as required by Section 303(d) of the Federal Water Pollution Control Act (a.k.a., Clean Water Act), 33 U.S.C. Section 1313(d). The list indicates the waters of Ohio that are currently impaired and may require TMDL development in order to meet water quality standards. The priority list is contained within Section J and a list of all categories of waters is available on Ohio EPA's website at the address below. The report describes the procedures that Ohio EPA used to develop the list and indicates which areas have been assigned high priority for TMDL development during the next two years.

Ohio EPA will present information about the list through a webinar on March 2, at 2:00 p.m. The webinar may be viewed at Ohio EPA's Central Office, 50 West Town Street, Suite 700, Columbus, Ohio 43215 or by registering and joining online at: https://ohioepa.webex.com/mw3300/mywebex/default.do?siteurl=ohioepa&service=6&main_url=%2Fec3300%2Feventcenter%2Fmainframe.do%3Fsiteurl%3Dohioepa%26main_url%3D%252Fec3300%252Feventcenter%252Fevent%252FeventAction.do%253Fsiteurl%253Dohioepa%2526theAction%253Dinfo_start%2526path%253Dinfo%2526confViewID%253D152891092052784280. All visitors to Ohio EPA must register at the Security desk in the lobby upon arrival. Please bring photo identification (such as a valid driver's license). For security reasons, visitors are required to wear their badge at all times while in the building. Please arrive early to complete these procedures.

All interested persons wishing to submit comments on the list for Ohio EPA's consideration may do so by email to EPATMDL@epa.ohio.gov or in writing to Ohio EPA, Division of Surface Water, P.O. Box 1049, Columbus, Ohio 43216-1049 Attn: 303(d) Comments, by the close of business, March 13, 2020. Comments received after this date may be considered as time and circumstances allow.

After reviewing the comments, Ohio EPA will submit a final document to the United States Environmental Protection Agency (U.S. EPA) for approval.

The report is available for review on Ohio EPA's Division of Surface Water website at http://epa.ohio.gov/dsw/tmdl/OhioIntegratedReport.aspx. To arrange to inspect Agency files or records pertaining to the document, please contact Richard Bouder at (614) 644-3037. To request notice of when Ohio EPA submits the document to U.S. EPA, please contact the e-mail address above or call Melinda Harris at (614) 728-1357.

Response to Comments Received regarding the Request for Comments CWA Section 303(d) TMDL Priority List for 2020

To be completed after the public notice comment period deadline and prior to final submittal to U.S. EPA.

Comments Received during the Request for Comments CWA Section 303(d) TMDL Priority List for 2020

To be completed after the public notice comment period deadline and prior to final submittal to U.S. EPA.

Section

E

Evaluating Beneficial Use:
Human Health (Fish Consumption)

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Figures

Tables

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 (Ohio EPA). 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 purpose of the water quality criteria for the protection of human health [fish consumption] 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 fish consumption human health criterion to the FCA risk assessment protocols is explained below.

E2. Rationale and Evaluation Method

U.S. EPA's guidance for preparing the 2006 Integrated Report (IR) states:

> *Although the CWA [Clean Water Act] 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 water body 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.

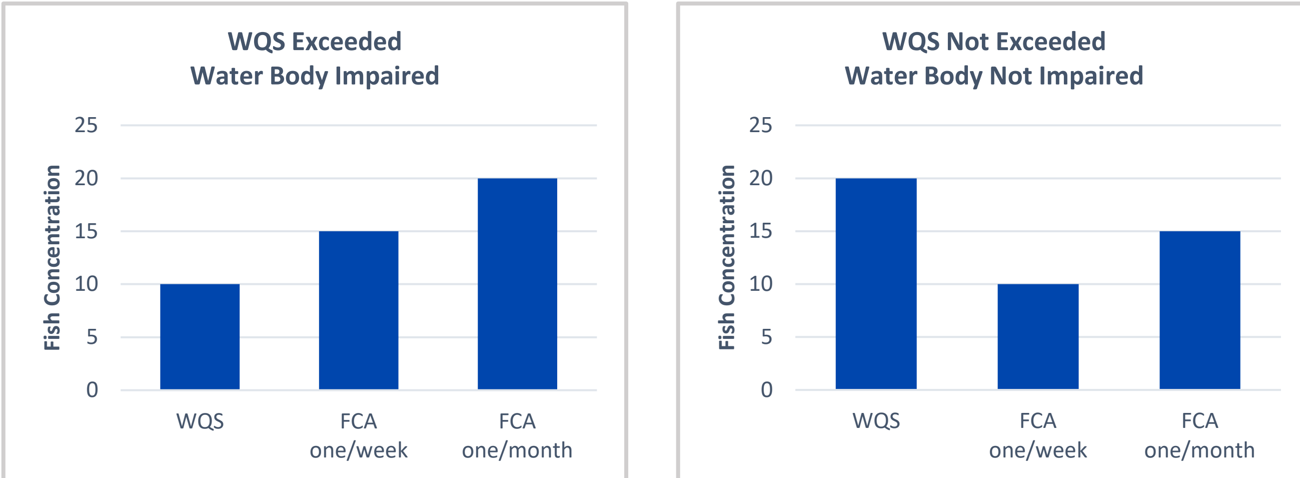


Figure E-1 — Illustration of the relationship among the WQS values, the values that trigger issuance of FCAs and the resulting decision regarding water body impairment associated with an FCA.

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 fish consumption 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 fish consumption water criterion. Because Ohio human health criteria differ between the Lake Erie and Ohio River basins, separate comparisons are presented.

The constituents shown in Table E-1 were chosen based on U.S. EPA's recommendations on page 53 of its 2006 IR Guidance (***epa.gov/sites/production/files/2015-10/documents/2006irg-report.pdf***; U.S. EPA, 2006a). Hexachlorobenzene and mirex were added because of historic fish tissue contamination with those contaminants.

Table E-1 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.

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	<u>**50 - 220 µg/kg**</u>	<u>**221 - 1,000 µg/kg**</u>
Ohio River/PCB	54 µg/kg	<u>**50 - 220 µg/kg**</u>	<u>**221 - 1,000 µg/kg**</u>
Lake Erie/mercury	350 µg/kg	110 - 220 µg/kg	<u>221 - 1,000 µg/kg</u>
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	<u>**800 - 3,499 µg/kg**</u>	<u>**3,500 - 15,099 µg/kg**</u>
Ohio River/hexachlorobenzene	67 µg/kg	<u>**800 - 3,499 µg/kg**</u>	<u>**3,500 - 15,099 µg/kg**</u>
Lake Erie/mirex	88 µg/kg	<u>**200 - 874 µg/kg**</u>	<u>**875 - 3,783 µg/kg**</u>
Ohio River/mirex	200 µg/kg	<u>**200 - 874 µg/kg**</u>	<u>**875 - 3,783 µg/kg**</u>

Key	
Values	Advisory is less protective than the WQS criterion, WQS exceeded, water body impaired
<u>Values</u>	Advisory is more protective than WQS criterion, WQS not exceeded, no impairment from FCA
Values (highlighted)	Advisory may be more, or less, protective than WQS criterion

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 2020 IR. The most recent 10-years of data collections, 2009-2018, were used for making category 1 (unimpaired) and category 5 (impaired) 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 2009, the category of the assessment unit was retained and the most recent year of data was noted.

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 if 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. This is 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 determine whether to issue or rescind an advisory. Owing to limited staff time and budget resources, it sometimes takes more than 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.

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

Step 2: Determine fish tissue contaminant concentrations

For streams in each assessment unit (AU)[2], 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 category 5 (impaired) or category 1 (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 was then compared against the contaminant levels listed in Table E-1 and categorized as category 1 or 5.

In cases where those data requirements were not met, an AU was classified as category 3. In cases where no data were available, an AU was also 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 (***epa.gov/wqc/human-health-criteria-methylmercury***).

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 (*Pomoxis nigromaculatus*)	3	1	0.085
Bluegill Sunfish (*Lepomis macrochirus*)	3	2	0.098
Channel Catfish (*Ictalurus punctatus*)	3	2	0.145
Common Carp (*Cyprinus carpio*)	3	3	0.120
Largemouth Bass (*Micropterus salmoides*)	4	3	0.212
Smallmouth Bass (*Micropterus dolomieu*)	4	1	0.421
Spotted Bass (*Micropterus punctulatus*)	4	1	0.347

[2] Assessment units include watershed assessment units (12-digit hydrologic units); large river assessment units (generally rivers that drain more than 500 square miles of landscape); and Lake Erie assessment units.

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 water bodies, extrapolations to water bodies without data are made. In some cases, water bodies that have no data will be categorized as impaired if they are within an impaired AU.

Inland lakes are treated as individual water bodies 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 water bodies 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, mirex 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 (5).

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 2007, remains unimpaired (1).

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 is listed as category 3. If no data is available for an AU, the category is listed as 3.

E3. Results

Fish tissue data for six contaminants were reviewed to determine an IR attainment status. The methodology for selecting, reviewing and categorizing fish tissue data is given in Section E2. The six parameters monitored were mercury, PCBs, chlordane, DDT, mirex and hexachlorobenzene. These parameters 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 parameters.

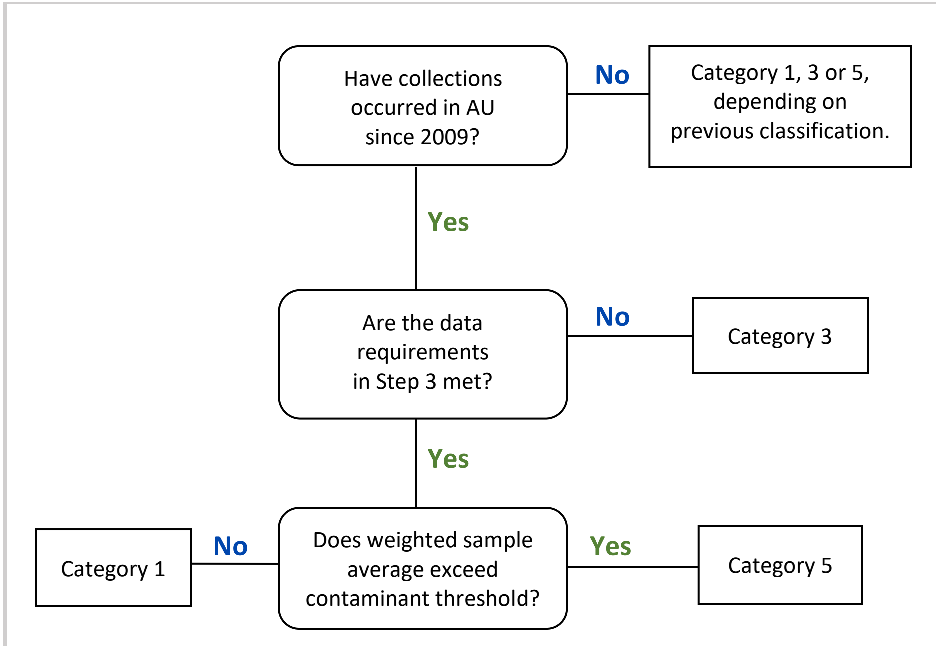


Figure E-2 — Flow chart for the categorization of fish tissue data for the IR.

There was a total of 59 changes to the human health attainment statuses of assessment units for the 2020 IR which are summarized in Table E-3. The primary reasons for change in status include data having become historical and the collection and analysis of new information.

Table E-3 — A summary of changes in attainment status from 2018 to 2020 IR.

Reason for change		Changes	
Data have become historical (older than 2009)			45
	Category 1	14	
	Category 3	10	
	Category 5	21	
New data			14
	Category 1 to 5	0	
	Category 5 to 1	5	
	Category 3 to 5	0	
	Category 3 to 1	6	
	Remained Category 3	3	
Total changes			59

Detailed results are presented in Table E-4 through Table E-11. Please note that the year of most recent data may not have contained adequate sample sizes for each trophic level, resulting in no change of categorization. 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 ***epa.ohio.gov/dsw/fishadvisory/index.aspx***.

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 nine WAUs in Ohio with significant pollution resulting in 303(d) listings from other contaminants that affect fish tissue, as shown in Table E-7. Table E-8 lists waters with fish tissue data, both current and historical, where inadequate samples exist to determine level of impairment. Table E-9 lists large rivers and their impairment status. Table E-10 lists inland lake impairment status. Table E-11 lists Lake Erie assessment units and their 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. These waters are category 5.

Water Body	Assessment Unit	Impairment Cause	Most Recent Data
Shantee Creek	04100001 03 01	Historical	1993
Halfway Creek	04100001 03 02	Historical	1993*
Prairie Ditch	04100001 03 03	Historical	1993*
North Tenmile Creek	04100001 03 05	Historical	1993
Tenmile Creek	04100001 03 06	Historical	2011
Heldman Ditch-Ottawa River	04100001 03 07	PCBs	2011
Sibley Creek-Ottawa River	04100001 03 08	PCBs	2016
West Branch St Joseph River	04100003 02 04	PCBs	2018
Cogswell Cemetery-St Joseph River	04100003 03 02	PCBs	2013
Eagle Creek	04100003 03 03	Historical	1995*
Village of Montpelier-St Joseph River	04100003 03 04	Historical	1995
Bear Creek	04100003 03 05	Historical	1995*
West Buffalo Cemetery-St Joseph River	04100003 03 06	Historical	2013
Bluff Run-St Joseph River	04100003 05 01	Historical	1995*
Big Run	04100003 05 02	Historical	1995*
Russell Run-St Joseph River	04100003 05 03	Historical	2013
Willow Run-St Joseph River	04100003 05 05	PCBs, Mercury	2013
Sol Shank Ditch-St Joseph River	04100003 05 06	Historical	1995*
Muddy Creek	04100004 01 01	Historical	1999*
Center Branch St Marys River	04100004 01 02	Historical	1999*
East Branch St Marys River	04100004 01 03	Historical	1999*
Kopp Creek	04100004 01 04	Historical	1999*
Sixmile Creek	04100004 01 05	Historical	1999*
Fourmile Creek-St Marys River	04100004 01 06	PCBs	2015
Hussey Creek	04100004 02 01	Historical	1999*
Eightmile Creek	04100004 02 02	Historical	1999*
Blierdofer Ditch	04100004 02 03	Historical	1999*
Twelvemile Creek	04100004 02 04	Historical	1999*
Prairie Creek-St Marys River	04100004 02 05	PCBs	2015
Little Black Creek	04100004 03 01	Historical	1999*
Black Creek	04100004 03 02	Historical	1999*
Yankee Run-St Marys River	04100004 03 03	PCBs	2015
Duck Creek	04100004 03 04	Historical	1999*
Leatherwood Creek	04100006 03 02	Historical	1997*
Flat Run-Tiffin River	04100006 03 03	Mercury	2013
Beaver Creek	04100006 05 01	Historical	2000*
Brush Creek	04100006 05 02	Historical	2013
Village of Stryker-Tiffin River	04100006 05 03	PCBs	2013
Buckskin Creek-Tiffin River	04100006 06 04	PCBs	2002*
Headwaters Auglaize River	04100007 01 01	Historical	2000*
Blackhoof Creek	04100007 01 02	Historical	2000*
Wrestle Creek-Auglaize River	04100007 01 03	Historical	2000*

Water Body	Assessment Unit	Impairment Cause	Most Recent Data
Pusheta Creek	04100007 01 04	Historical	2000*
Two Mile Creek	04100007 02 01	Historical	2000*
Sixmile Creek-Auglaize River	04100007 02 04	PCBs	2014
Upper Hog Creek	04100007 03 01	Historical	2004*
Middle Hog Creek	04100007 03 02	Historical	2004*
Little Hog Creek	04100007 03 03	Historical	2004*
Lower Hog Creek	04100007 03 04	Historical	2004*
Lima Reservoir-Ottawa River	04100007 03 06	PCBs	2009
Little Ottawa River	04100007 04 01	Historical	1994*
Dug Run-Ottawa River	04100007 04 02	Historical	2009
Honey Run	04100007 04 03	Historical	1994
Pike Run	04100007 04 04	Historical	1994*
Leatherwood Ditch	04100007 04 05	Historical	1994*
Beaver Run-Ottawa River	04100007 04 06	Historical	2009
Sugar Creek	04100007 05 01	Historical	2000
Plum Creek	04100007 05 02	Historical	2000*
Village of Kalida-Ottawa River	04100007 05 03	Historical	2009
Dog Creek	04100007 08 01	PCBs	2014
Lower Town Creek	04100007 08 04	PCBs	2014
Upper Jennings Creek	04100007 09 01	Historical	2000*
West Jennings Creek	04100007 09 02	Historical	2000*
Lower Jennings Creek	04100007 09 03	Historical	2000*
Prairie Creek	04100007 09 06	Historical	2000*
Big Run-Flatrock Creek	04100007 12 06	PCBs	2014
Cessna Creek	04100008 01 01	Historical	2005*
Headwaters Blanchard River	04100008 01 02	Historical	2005*
The Outlet-Blanchard River	04100008 01 03	Historical	2005*
Potato Run	04100008 01 04	Historical	2005*
Ripley Run-Blanchard River	04100008 01 05	Historical	2005
Brights Ditch	04100008 02 01	Historical	2005*
The Outlet	04100008 02 02	Historical	2005*
Findlay Upground Reservoirs-Blanchard River	04100008 02 03	Historical	2005
Lye Creek	04100008 02 04	Historical	2005*
City of Findlay Riverside Park-Blanchard River	04100008 02 05	PCBs	2015
Upper Eagle Creek	04100008 03 01	PCBs	2005*
Lower Eagle Creek	04100008 03 02	Historical	1996
Aurand Run	04100008 03 03	PCBs	2005*
Howard Run-Blanchard River	04100008 03 04	PCBs	2005
Tiderishi Creek	04100008 05 01	Historical	2005*
Ottawa Creek	04100008 05 02	Historical	2005*
Moffitt Ditch	04100008 05 03	Historical	2005*
Dukes Run	04100008 05 04	Historical	2005*
Dutch Run	04100008 05 05	Historical	2005*
Cutoff Ditch	04100009 05 07	PCBs	2015
Lower Beaver Creek	04100009 05 09	PCBs	2015
Heilman Ditch-Swan Creek	04100009 08 04	PCBs	2017
Rhodes Ditch-South Branch Portage River	04100010 02 04	PCBs	2010
North Branch Portage River	04100010 03 01	PCBs	2015
Town of Pemberville-Portage River	04100010 03 02	Historical	2000*
Sugar Creek	04100010 04 01	Historical	2006
Larcarpe Creek Outlet #4-Portage River	04100010 04 02	Historical	2006*
Little Portage River	04100010 05 01	Historical	1994*

Water Body	Assessment Unit	Impairment Cause	Most Recent Data
Portage River	04100010 05 02	PCBs	2008
Upper Tousant Creek	04100010 06 01	Historical	2008
Packer Creek	04100010 06 02	Historical	1997*
Lower Toussaint Creek	04100010 06 03	PCBs	2008
Headwaters Paramour Creek-Sandusky River	04100011 04 01	Historical	2005*
Loss Creek-Sandusky River	04100011 04 02	Historical	2005*
Headwaters Middle Sandusky River	04100011 04 03	PCBs	2005
Grass Run	04100011 04 04	Historical	2005*
Headwaters Lower Sandusky River	04100011 04 05	Historical	2014
Town of Upper Sandusky-Sandusky River	04100011 07 02	PCBs	2001
Negro Run	04100011 07 03	Historical	2004*
Cranberry Run-Sandusky River	04100011 07 04	Historical	2004*
Sugar Run-Sandusky River	04100011 07 05	Historical	2014
Town of Lindsey-Muddy Creek	04100011 14 04	PCBs	2009
Clear Creek-Vermilion River	04100012 01 01	Historical	1998
Buck Creek	04100012 01 02	Historical	1998*
Southwest Branch Vermilion River	04100012 01 03	Historical	1998*
Indian Creek-Vermilion River	04100012 01 05	Historical	1997
East Branch Vermilion River	04100012 02 01	Historical	1997*
East Fork Vermilion River	04100012 02 02	Historical	1974
Town of Wakeman-Vermilion River	04100012 02 03	Historical	1997
Mouth Vermilion River	04100012 02 04	PCBs	2015
Mouth West Branch Huron River	04100012 05 06	PCBs	2016
Mouth East Branch Huron River	04100012 06 04	PCBs	2016
Huron River-Frontal Lake Erie	04100012 06 06	PCBs	2016
Plum Creek	04110001 01 01	Historical	2000*
North Branch West Branch Rocky River	04110001 01 02	Historical	2000*
Headwaters West Branch Rocky River	04110001 01 03	Historical	2000*
Mallet Creek	04110001 01 04	Historical	2000*
Plum Creek	04110001 01 07	Historical	2000*
Baker Creek-West Branch Rocky River	04110001 01 08	PCBs	2014
Rocky River	04110001 02 03	PCBs	2014
East Fork of East Branch Black River	04110001 03 01	Historical	2000*
Headwaters West Fork East Branch Black River	04110001 03 02	Historical	2000*
Salt Creek-East Branch Black River	04110001 04 02	Mercury	2014
Willow Creek	04110001 04 03	Historical	2010
Jackson Ditch-East Branch Black River	04110001 04 04	Mercury	2012
Upper West Branch Black River	04110001 05 02	Historical	2012
Middle West Branch Black River	04110001 05 04	Historical	2012
Plum Creek	04110001 05 05	Historical	2002*
Lower West Branch Black River	04110001 05 06	PCBs	2012
French Creek	04110001 06 01	Historical	2014
Black River	04110001 06 02	PCBs	2012
West Branch Cuyahoga River	04110002 01 02	Historical	2002*
Tare Creek-Cuyahoga River	04110002 01 03	Historical	2002*
Black Brook	04110002 01 05	Historical	2002*
Potter Creek-Breakneck Creek	04110002 02 01	Historical	2005*
Feeder Canal-Breakneck Creek	04110002 02 02	Historical	2018
Lake Rockwell-Cuyahoga River	04110002 02 03	PCBs	2018
Plum Creek	04110002 03 01	Historical	2005*
City of Akron-Little Cuyahoga River	04110002 03 04	Historical	2018
Fish Creek-Cuyahoga River	04110002 03 05	PCBs	2018

Water Body	Assessment Unit	Impairment Cause	Most Recent Data
Yellow Creek	04110002 04 02	Historical	2005*
Furnace Run	04110002 04 03	Historical	2005*
Brandywine Creek	04110002 04 04	Historical	2005*
Boston Run-Cuyahoga River	04110002 04 05	PCBs	2008
Pond Brook	04110002 05 01	Historical	2005*
Headwaters Tinkers Creek	04110002 05 02	Historical	2005*
Headwaters Chippewa Creek	04110002 05 03	Historical	2005*
Town of Twinsburg-Tinkers Creek	04110002 05 04	Historical	2018
East Branch Ashtabula River	04110003 01 01	Historical	2002*
West Branch Ashtabula River	04110003 01 02	Historical	2002*
Upper Ashtabula River	04110003 01 03	Historical	2014
Lower Ashtabula River	04110003 01 05	PCBs	2011
Griswold Creek-Chagrin River	04110003 04 02	PCBs, DDT	2008
Dead Branch	04110004 01 01	Historical	2004*
Headwaters Grand River	04110004 01 02	Historical	2004
Baughman Creek	04110004 01 03	Historical	2004*
Swine Creek	04110004 01 06	Historical	2004*
Upper Rock Creek	04110004 02 01	Historical	2004*
Lower Rock Creek	04110004 02 03	Historical	2004*
Phelps Creek	04110004 03 01	Historical	2004*
Hoskins Creek	04110004 03 02	Historical	2004*
Mill Creek-Grand River	04110004 03 03	Historical	2004
Mud Creek	04110004 03 04	Historical	2004*
Plumb Creek-Grand River	04110004 03 05	Mercury	2018
Town of Jefferson-Mill Creek	04110004 04 03	Mercury	2007
Three Brothers Creek-Grand River	04110004 05 01	Historical	2003
Bronson Creek-Grand River	04110004 05 02	PCBs, Mercury	2016
East Branch Middle Fork Little Beaver Creek	05030101 04 01	Historical	1990
Headwaters Middle Fork Little Beaver Creek	05030101 04 02	Mirex	2010
Stone Mill Run-Middle Fork Little Beaver Creek	05030101 04 03	Mirex	2010
Lisbon Creek-Middle Fork Little Beaver Creek	05030101 04 04	Historical	1987
Elk Run-Middle Fork Little Beaver Creek	05030101 04 05	PCBs	2005
Longs Run	05030101 06 01	Historical	2001*
Honey Creek	05030101 06 02	Historical	2001*
Headwaters North Fork Little Beaver Creek	05030101 06 03	Historical	2001*
Little Bull Creek	05030101 06 04	Historical	1985
Headwaters Bull Creek	05030101 06 05	Historical	2001*
Leslie Run-Bull Creek	05030101 06 06	Historical	2001*
Dilworth Run-North Fork Little Beaver Creek	05030101 06 07	Historical	1999
Brush Run-North Fork Little Beaver Creek	05030101 06 08	Historical	1997
Rough Run-Little Beaver Creek	05030101 06 09	PCBs	2001
Bieler Run-Little Beaver Creek	05030101 06 10	PCBs	2001
Headwaters Yellow Creek	05030101 07 01	Historical	2005*
Elkhorn Creek	05030101 07 02	Historical	2005*
Upper North Fork	05030101 07 03	Historical	2005*
Long Run-Yellow Creek	05030101 07 04	PCBs	2007
Headwaters North Fork Yellow Creek	05030101 08 02	Historical	2005*
Salt Run-North Fork Yellow Creek	05030101 08 03	Historical	2005
Hollow Rock Run-Yellow Creek	05030101 08 04	PCBs	2007
Upper Cross Creek	05030101 10 01	Historical	2000*
Salem Creek	05030101 10 02	Historical	2000*
Middle Cross Creek	05030101 10 03	Historical	2014

Water Body	Assessment Unit	Impairment Cause	Most Recent Data
Lower Cross Creek	05030101 10 05	PCBs	2010
Willow Creek	05030103 02 02	Historical	2006*
Mill Creek	05030103 02 03	Historical	2006*
Island Creek-Mahoning River	05030103 02 04	PCBs	2006
Kale Creek	05030103 03 01	Historical	2006*
Headwaters West Branch Mahoning River	05030103 03 02	Historical	2006*
Barrel Run	05030103 03 03	Historical	2006*
Kirwin Reservoir-West Branch Mahoning River	05030103 03 04	PCBs	2008
Charley Run Creek-Mahoning River	05030103 03 06	PCBs	2008
Headwaters Eagle Creek	05030103 04 01	Historical	1995*
South Fork Eagle Creek	05030103 04 02	Historical	1995
Camp Creek-Eagle Creek	05030103 04 03	Historical	2012
Tinkers Creek	05030103 04 04	Historical	1995*
Lower Mosquito Creek	05030103 05 03	PCBs	2015
Burgess Run-Yellow Creek	05030103 08 06	PCBs	1999
Coffee Run-Mahoning River	05030103 08 09	PCBs	2013
Frontal Pymatuning Reservoir	05030102 01 04	Historical	1998*
Fish Creek-Mahoning River	05030103 01 03	PCBs	2007
Dry Fork-Short Creek	05030106 02 07	PCBs	2009
Crabapple Creek	05030106 03 01	Historical	1998*
Headwaters Wheeling Creek	05030106 03 02	Historical	1998*
Cox Run-Wheeling Creek	05030106 03 03	PCBs	2009
Flat Run-Wheeling Creek	05030106 03 04	Historical	2009
Lower McMahon Creek	05030106 07 04	PCBs	2009
Pea Vine Creek-Captina Creek	05030106 09 05	PCBs	2009
Eightmile Creek-Little Muskingum River	05030201 07 05	PCBs	2015
Buffalo Run-West Fork Duck Creek	05030201 09 02	Historical	2006*
New Years Creek-Duck Creek	05030201 09 03	Historical	2009
Sugar Creek-Duck Creek	05030201 09 04	PCBs	2009
Horse Cave Creek	05030202 03 01	Historical	1997*
Headwaters East Branch Shade River	05030202 03 02	Historical	1997*
Big Run-East Branch Shade River	05030202 03 03	Historical	1997*
Spruce Creek-Shade River	05030202 03 04	Historical	2015
Baldwin Run	05030204 04 02	Historical	2004*
Pleasant Run	05030204 04 03	Historical	2004*
Tarhe Run-Hocking River	05030204 04 04	PCBs	2004
Scott Creek	05030204 06 02	Historical	2004*
Oldtown Creek	05030204 06 03	Historical	2004*
Fivemile Creek	05030204 06 04	Historical	2004*
Headwaters Tuscarawas River	05040001 01 01	Historical	2004
Pigeon Creek	05040001 01 02	Historical	2004*
Hudson Run	05040001 01 03	Historical	1994
Wolf Creek	05040001 01 04	Historical	1994
Portage Lakes-Tuscarawas River	05040001 01 05	PCBs	2016
Headwaters Chippewa Creek	05040001 02 01	Historical	2015
Hubbard Creek-Chippewa Creek	05040001 02 02	Historical	2004*
Little Chippewa Creek	05040001 02 03	Historical	2004*
River Styx	05040001 02 04	Historical	2004*
Tommy Run-Chippewa Creek	05040001 02 05	Historical	2004*
Red Run	05040001 02 06	Historical	2004*
Silver Creek-Chippewa Creek	05040001 02 07	Hexachlorobenzene	2004*
Pancake Creek-Tuscarawas River	05040001 03 01	PCBs	2017

Water Body	Assessment Unit	Impairment Cause	Most Recent Data
Lake Lucern-Nimisila Creek	05040001 03 03	Historical	2007*
Fox Run	05040001 03 04	Historical	2004*
Headwaters Newman Creek	05040001 03 06	Historical	2004*
Town of North Lawrence-Newman Creek	05040001 03 07	Historical	2004*
Conser Run	05040001 04 01	Historical	1998
Middle Branch Sandy Creek	05040001 04 02	Historical	1998*
Pipes Fork-Still Fork	05040001 04 03	Historical	1998*
Muddy Fork	05040001 04 04	Historical	1998*
Reeds Run-Still Fork	05040001 04 05	Historical	2010
Headwaters Sandy Creek	05040001 04 06	PCBs	2010
Swartz Ditch-Middle Branch Nimishillen Creek	05040001 05 01	Historical	2000*
East Branch Nimishillen Creek	05040001 05 02	Historical	1993
West Branch Nimishillen Creek	05040001 05 03	Historical	2000
City of Canton-Middle Branch Nimishillen Creek	05040001 05 04	PCBs	2015
Sherrick Run-Nimishillen Creek	05040001 05 05	PCBs	2015
Town of East Sparta-Nimishillen Creek	05040001 05 06	PCBs	2015
Hugle Run	05040001 06 01	Historical	1997*
Pipe Run	05040001 06 02	Historical	1997*
Black Run	05040001 06 03	Historical	1997*
Little Sandy Creek	05040001 06 04	Historical	1997*
Armstrong Run-Sandy Creek	05040001 06 05	PCBs	2010
Indian Run-Sandy Creek	05040001 06 06	Historical	1997
Beal Run-Sandy Creek	05040001 06 07	PCBs, Hexachlorobenzene	2010
Village of Pavonia-Black Fork Mohican River	05040002 02 01	Historical	1997*
Headwaters Rocky Fork	05040002 02 03	Historical	1997
Outlet Rocky Fork	05040002 02 04	Historical	2010
Charles Mill-Black Fork Mohican River	05040002 02 05	PCBs	2015
Headwaters Clear Fork Mohican River	05040002 03 01	PCBs	2008
Switzer Creek-Clear Fork Mohican River	05040002 04 05	PCBs	2014
Headwaters Wakatomika Creek	05040004 01 01	Historical	2003*
Winding Fork	05040004 01 02	Historical	2003*
Brushy Fork	05040004 01 03	Historical	2003*
Black Run-Walatomika Creek	05040004 02 01	Historical	2003
Mill Fork	05040004 02 02	Historical	2003*
Little Wakatomika Creek	05040004 02 03	Historical	2003
Claylick Creek	05040006 05 01	Historical	2002*
Lost Run	05040006 05 02	Historical	2002*
Dudley Run-Rush Creek	05060001 02 03	PCBs	2005
Rock Fork	05060001 03 01	Historical	1992*
Honey Creek-Little Scioto River	05060001 03 04	Historical	1992
Panther Creek	05060001 04 02	Historical	2004*
Wolf Creek-Scioto River	05060001 04 03	Historical	2004
Wildcat Creek	05060001 04 04	Historical	2004*
Glade Run-Scioto River	05060001 04 06	Historical	2009
Mud Run	05060001 08 02	Historical	2001*
Flat Run	05060001 08 03	Historical	2001*
Town of Caledonia-Olentangy River	05060001 08 04	Historical	2012
Shaw Creek	05060001 09 01	Historical	2004*
Otter Creek-Olentangy River	05060001 10 01	Historical	2004*
Grave Creek	05060001 10 02	Historical	2004*
Qu Qua Creek	05060001 10 04	Historical	2004*
Pawpaw Creek	05060001 17 01	Historical	2007

Water Body	Assessment Unit	Impairment Cause	Most Recent Data
Poplar Creek	05060001 17 03	Historical	2005*
Sycamore Creek	05060001 17 04	Historical	2005*
Georges Creek	05060001 18 01	Historical	2005*
Tussing Ditch-Walnut Creek	05060001 18 02	PCBs	2005
Turkey Run	05060001 18 03	Historical	2005*
Little Walnut Creek	05060001 18 04	Historical	2005*
Big Run-Walnut Creek	05060001 18 05	PCBs	2007
Mud Run-Walnut Creek	05060001 18 06	PCBs	2005
Headwaters Big Darby Creek	05060001 19 01	Historical	2002*
Buck Run	05060001 19 03	Historical	2002*
Sugar Run	05060001 19 04	Historical	2002*
Headwaters Treacle Creek	05060001 20 01	Historical	1997*
Proctor Run-Treacle Creek	05060001 20 02	Historical	2012
Headwaters Little Darby Creek	05060001 20 03	Historical	1997
Spring Fork	05060001 20 04	Historical	1997*
Gay Run-Big Darby Creek	05060001 22 02	Historical	2014
Greenbrier Creek-Big Darby Creek	05060001 22 03	PCBs	2014
Lizard Run-Big Darby Creek	05060001 22 04	PCBs	2014
Grove Run-Scioto River	05060001 23 04	Historical	1999*
Hargus Creek	05060002 04 01	Historical	2014
Yellowbud Creek	05060002 04 02	Historical	2001*
Congo Creek	05060002 04 04	Historical	2001*
Scippo Creek	05060002 04 05	PCBs	2011
Lick Run-Scioto River	05060002 05 03	PCBs	2011
Beech Fork	05060002 06 01	Historical	1995*
Headwaters Salt Creek	05060002 06 02	Historical	1995*
Laurel Run	05060002 06 03	Historical	1995*
Pine Creek	05060002 06 04	Historical	1995*
Sour Run-Little Salt Creek	05060002 08 05	PCBs	2007
East Fork Queer Creek	05060002 09 01	Historical	2005*
Queer Creek	05060002 09 02	PCBs	2007
Pretty Run	05060002 09 03	Historical	2005*
Pike Run	05060002 09 04	Historical	2005*
Village of Eagle Mills-Salt Creek	05060002 09 05	Historical	2005
Poe Run-Salt Creek	05060002 09 06	PCBs	2007
Indian Creek	05060002 10 01	Historical	2002*
Dry Run	05060002 10 02	Historical	2002*
Headwaters Walnut Creek	05060002 10 03	Historical	2002*
Lick Run-Walnut Creek	05060002 10 04	Historical	2011
Pee Pee Creek	05060002 11 04	PCBs	2014
Leeth Creek-Sunfish Creek	05060002 12 06	PCBs	2011
Big Run-Scioto River	05060002 16 02	PCBs	2011
Headwaters Paint Creek	05060003 01 01	Historical	1974*
East Fork Paint Creek	05060003 01 02	Historical	1974
Indian Creek-Paint Creek	05060003 06 01	Historical	2006
Farmers Run-Paint Creek	05060003 06 02	Historical	2006
Cherokee Mans Run	05080001 03 01	Historical	1993*
Rennick Creek-Great Miami River	05080001 03 02	Historical	2008
Rum Creek	05080001 03 03	Historical	1993*
Blue Jacket Creek	05080001 03 04	Historical	1993*
Bokengehalas Creek	05080001 03 05	Historical	1993*
Brandywine Creek-Great Miami River	05080001 03 06	Historical	2008

Water Body	Assessment Unit	Impairment Cause	Most Recent Data
McKees Creek	05080001 04 01	Historical	2000*
Lee Creek	05080001 04 02	Historical	2012
Indian Creek	05080001 04 04	Historical	2000*
Plum Creek	05080001 04 05	Historical	2000*
Turkeyfoot Creek-Great Miami River	05080001 04 06	Historical	2008
Dividing Branch-Greenville Creek	05080001 11 03	PCBs	2013
Machochee Creek	05080001 15 01	Historical	2003*
Headwaters Mad River	05080001 15 02	Historical	2003*
Kings Creek	05080001 15 03	Historical	2000
Glady Creek-Mad River	05080001 15 04	Historical	2003
Muddy Creek	05080001 16 01	Historical	1994*
Dugan Run	05080001 16 02	Historical	1994*
Nettle Creek	05080001 16 03	Historical	1974
Anderson Creek	05080001 16 04	Historical	1994*
Storms Creek	05080001 16 05	Historical	1994*
Chapman Creek	05080001 16 06	Historical	1994
Bogles Run-Mad River	05080001 16 07	Historical	2016
Moore Run	05080001 18 01	Historical	2003*
Pondy Creek-Mad River	05080001 18 02	Historical	2016
Mill Creek	05080001 18 03	Historical	2003*
Donnels Creek	05080001 18 04	Historical	2003*
Rock Run-Mad River	05080001 18 05	Historical	2003
Jackson Creek-Mad River	05080001 18 06	Historical	2003*
Mud Creek	05080001 19 01	Historical	2003*
Mud Run	05080001 19 02	Historical	2003*
Poplar Creek-Great Miami River	05080001 20 05	PCBs	2008
North Branch Wolf Creek	05080002 01 01	Historical	2002*
Headwaters Wolf Creek	05080002 01 02	Historical	2002*
Dry Run-Wolf Creek	05080002 01 03	PCBs	2009
Holes Creek	05080002 01 04	Historical	2009
Millers Fork	05080002 02 01	Historical	2004*
Headwaters Twin Creek	05080002 02 02	Historical	1986
Swamp Creek	05080002 02 03	Historical	2004*
Price Creek	05080002 02 04	Historical	2004*
Bantas Fork	05080002 03 01	Historical	2004*
Aukerman Creek	05080002 03 02	Historical	2004*
Toms Run	05080002 03 03	Historical	2004*
Little Twin Creek	05080002 03 05	Historical	2004*
Elk Creek	05080002 07 01	Historical	2002*
Shaker Creek	05080002 07 03	Historical	2002*
Dicks Creek	05080002 07 04	PCBs	2010
Gregory Creek	05080002 07 05	Historical	2002*
Beals Run-Indian Creek	05080002 08 03	PCBs	2005
Pleasant Run	05080002 09 01	Historical	1989*
Paddys Run	05080002 09 03	Historical	1989*
Taylor Creek	05080002 09 05	Historical	1989
Ice Creek	05090103 01 03	PCBs	2010
Hales Creek	05090103 02 01	Historical	1995*
Headwaters Pine Creek	05090103 02 02	Historical	1995*
Little Pine Creek	05090103 02 03	Historical	1995*
Wards Run-Little Scioto River	05090103 06 05	PCBs	2010
Soldiers Run-Ohio Brush Creek	05090201 05 06	PCBs	2007

Water Body	Assessment Unit	Impairment Cause	Most Recent Data
Big Threemile Creek	05090201 06 04	Historical	1998*
Headwaters Little Miami River	05090202 01 01	Historical	1993*
North Fork Little Miami River	05090202 01 02	Historical	1993*
Buffenbarger Cemetery-Little Miami River	05090202 01 03	Historical	1993*
Yellow Springs Creek-Little Miami River	05090202 01 04	Historical	2011
North Fork Massies Creek	05090202 02 01	Historical	1996*
South Fork Massies Creek	05090202 02 02	Historical	1996*
Massies Creek	05090202 02 03	Historical	2011
Little Beaver Creek	05090202 02 04	Historical	1996*
Beaver Creek	05090202 02 05	Historical	1996*
Shawnee Creek-Little Miami River	05090202 02 06	Historical	1996*
Sugar Creek	05090202 05 01	Historical	2006
Town of Bellbrook-Little Miami River	05090202 05 02	Historical	1993*
Glady Run	05090202 05 03	Historical	1993*
Newman Run-Little Miami River	05090202 05 04	PCBs	2007
East Fork Mill Creek-Mill Creek	05090203 01 01	Historical	2002*
West Fork Mill Creek	05090203 01 02	Historical	2002
Sharon Creek-Mill Creek	05090203 01 03	Historical	2014
Congress Run-Mill Creek	05090203 01 04	Historical	2010
West Fork-Mill Creek	05090203 01 05	PCBs	2010
Chickasaw Creek	05120101 02 01	Historical	1998*
Headwaters Beaver Creek	05120101 02 02	Historical	1998*
Coldwater Creek	05120101 02 03	Historical	1998
Grand Lake-St Marys	05120101 02 04	PCBs	2008

Years with asterisks (*) indicate that the analysis was completed before 2010, when using larger assessment units, and these sections may not have actual data within these units.

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. These waters are category 1.

Water Body (Category 1: Unimpaired)	Assessment Unit	Most Recent Data
Clear Fork-East Branch St Joseph River	04100003 01 06	2012
Nettle Creek	04100003 03 01	2013
Town of Willshire-St Marys River	04100004 03 05	2015
Bates Creek-Tiffin River	04100006 03 01	2013
Village of Buckland-Auglaize River	**04100007 02 02**	**2012**
Sims Run-Auglaize River	04100007 02 03	2012
Lost Creek	04100007 03 05	2010
Wolf Ditch-Little Auglaize River	04100007 06 03	2014
Dry Fork-Little Auglaize River	04100007 06 04	2014
West Branch Prairie Creek	04100007 07 02	2014
Prairie Creek	04100007 07 03	2014
Burt Lake-Little Auglaize River	04100007 08 06	2014
Big Run-Auglaize River	**04100007 09 04**	**2014**
Lower Bad Creek	04100009 03 02	2015
North Turkeyfoot Creek	04100009 04 02	2015
East Branch Portage River	04100010 02 02	2017
Green Creek	04100011 12 03	2009
New London Upground Reservoir-Vermilion River	04100012 01 04	2016
Walnut Creek-West Branch Huron River	04100012 04 03	2016
Peru Township-West Branch Huron River	04100012 04 05	2016
City of Medina-West Branch Rocky River	04110001 01 05	2014
Cossett Creek-West Branch Rocky River	**04110001 01 06**	**2014**

Water Body (Category 1: Unimpaired)	Assessment Unit	Most Recent Data
Baldwin Creek-East Branch Rocky River	04110001 02 02	2014
Town of Litchfield-East Branch Black River	**04110001 04 01**	**2014**
Wellington Creek	04110001 05 03	2013
East Branch Reservoir-East Branch Cuyahoga River	04110002 01 01	2010
Ladue Reservoir-Bridge Creek	04110002 01 04	2010
Headwaters West Fork Little Beaver Creek	05030101 05 02	2017
Town Fork	05030101 08 01	2014
Town of Newton Falls-West Branch Mahoning River	05030103 03 05	2012
Mouth Eagle Creek	**05030103 04 05**	**2012**
Middle Mosquito Creek	05030103 05 02	2013
Lower Meander Creek	05030103 07 03	2015
Andersons Run-Mill Creek	05030103 08 03	2013
Upper McMahon Creek	05030106 07 02	2016
South Fork Captina Creek	05030106 09 02	2010
Wingett Run-Little Muskingum River	05030201 07 03	2015
Headwaters Little Rush Creek	05030204 02 01	2016
Buck Run-Hocking River	05030204 04 05	2018
Clear Fork	05030204 06 01	2015
Sippo Creek	05040001 03 08	2015
McGuire Creek	05040001 07 06	2018
Pleasant Valley Run-Indian Fork	05040001 08 02	2016
Brandywine Creek-Sugar Creek	05040001 11 05	2017
Buttermilk Creek-Stillwater Creek	05040001 13 04	2013
Brushy Fork	05040001 14 02	2013
Craborchard Creek-Stillwater Creek	05040001 14 03	2012
Upper Little Stillwater Creek	05040001 15 03	2013
Weaver Run-Stillwater Creek	05040001 16 03	2012
Town of Perrysville-Black Fork Mohican River	05040002 08 02	2015
Big Run-Black Fork Mohican River	05040002 08 03	2015
East Branch Kokosing River	05040003 01 02	2015
Delano Run-Kokosing River	05040003 03 04	2018
Indianfield Run-Kokosing River	05040003 03 07	2016
Big Run-Killbuck Creek	05040003 08 04	2009
Bucklew Run-Killbuck Creek	05040003 08 05	2009
Reasoners Run-Olive Green Creek	05040004 11 04	2012
Trail Run-Wills Creek	05040005 02 07	2014
Beeham Run-Salt Fork	05040005 04 06	2014
Wills Creek Dam-Wills Creek	05040005 06 04	2014
Rocky Fork	05040006 05 03	2014
Town of La Rue-Scioto River	05060001 04 05	2009
Lower Mill Creek	05060001 06 04	2012
Brush Run-Bokes Creek	05060001 07 02	2015
Smith Run-Bokes Creek	05060001 07 03	2015
Indian Run-Olentangy River	05060001 10 06	2018
O'Shaughnessy Dam-Scioto River	05060001 12 02	2010
Hayden Run-Scioto River	05060001 12 04	2014
Hoover Reservoir-Big Walnut Creek	05060001 13 08	2013
Alum Creek Dam-Alum Creek	05060001 14 04	2013
Town of Carroll-Walnut Creek	05060001 17 05	2012
Spain Creek-Big Darby Creek	05060001 19 02	2014
Robinson Run-Big Darby Creek	05060001 19 05	2014
Barron Creek-Little Darby Creek	05060001 20 05	2014

Water Body (Category 1: Unimpaired)	Assessment Unit	Most Recent Data
Thomas Ditch-Little Darby Creek	05060001 20 06	2014
Worthington Ditch-Big Darby Creek	05060001 21 01	2014
Silver Ditch-Big Darby Creek	05060001 21 02	2014
Richmond Ditch-Deer Creek	05060002 01 02	2011
Turkey Run-Deer Creek	05060002 01 06	2011
Town of Mount Sterling-Deer Creek	05060002 02 04	2011
Deer Creek Lake-Deer Creek	05060002 02 05	2011
Stony Creek-Scioto River	05060002 10 05	2011
Headwaters Morgan Fork	05060002 12 02	2011
Rocky Fork Lake-Rocky Fork	05060003 05 04	2017
Cliff Creek-Paint Creek	05060003 06 03	2014
Indian Lake-Great Miami River	05080001 01 03	2017
Stoney Creek	05080001 04 03	2012
Lake Loramie-Loramie Creek	05080001 05 03	2016
Mosquito Creek	05080001 07 02	2014
Headwaters Greenville Creek	05080001 10 04	2013
Bridge Creek-Greenville Creek	05080001 11 02	2014
Town of Covington-Stillwater River	05080001 12 05	2015
Ludlow Creek	05080001 14 02	2015
Sinking Creek	05080001 17 03	2018
Rush Run-Sevenmile Creek	05080002 05 04	2014
Acton Lake Dam-Four Mile Creek	05080002 06 04	2015
Howard Creek-Dry Fork Whitewater River	05080003 08 08	2017
Jameson Creek-Whitewater River	05080003 08 10	2017
Robinson Run-Raccoon Creek	05090101 05 04	2016
Barren Creek-Raccoon Creek	05090101 06 02	2018
Camp Creek-Symmes Creek	05090101 09 03	2014
Pigeon Creek-Symmes Creek	05090101 10 03	2012
Aaron Creek-Symmes Creek	05090101 10 04	2016
Storms Creek	05090103 01 04	2017
Howard Run-Pine Creek	05090103 02 04	2010
Lick Run-Pine Creek	05090103 02 05	2010
Headwaters Turkey Creek	05090201 02 01	2014
Middle Caesar Creek	05090202 04 04	2011
Lower Caesar Creek	05090202 04 06	2013
Wilson Creek-Cowan Creek	05090202 06 05	2013
Headwaters East Fork Little Miami River	05090202 10 02	2012
Lucy Run-East Fork Little Miami River	05090202 12 03	2013
Headwaters Stonelick Creek	05090202 13 01	2018
Lick Fork-Stonelick Creek	05090202 13 04	2012
Salt Run-East Fork Little Miami River	05090202 13 05	2012

BOLD rows indicate 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 2018 IR. These waters have become category 1

Water Body (Newly Unimpaired for 2020)	Assessment Unit	Reason for delisting	Most Recent Data
Ladue Reservoir-Bridge Creek	04110002 01 04	Reevaluation	2010
Buck Run-Hocking River	05030204 04 05	New data	2018
Town of Perrysville-Black Fork Mohican River	05040002 08 02	Reevaluation	2015
Big Run-Black Fork Mohican River	05040002 08 03	Reevaluation	2015
Delano Run-Kokosing River	05040003 03 04	New data	2018

Table E-7 — Waters with contaminants other than PCBs and mercury that affect fish tissue (included on the 303(d) list). These waters are category 5.

Water Body (Impaired by Other Pollutants)	Assessment Unit	Pollutant(s)	Most Recent Data
Willow Run-St Joseph River	04100003 05 05	PCBs, Mercury	2013
Griswold Creek-Chagrin River	04110003 04 02	PCBs, DDT	2008
Bronson Creek-Grand River	04110004 05 02	PCBs, Mercury	2016
Headwaters Middle Fork Little Beaver Creek	05030101 04 02	Mirex	2010
Stone Mill Run-Middle Fork Little Beaver Creek	05030101 04 03	Mirex	2010
Tuscarawas River Mainstem (Chippewa Creek to Sandy Creek)	05040001 09 01	PCBs, Hexachlorobenzene	2017
Tuscarawas River Mainstem (Sandy Creek to Stillwater Creek)	05040001 09 02	PCBs, Hexachlorobenzene	2017
Silver Creek-Chippewa Creek	05040001 02 07	Hexachlorobenzene	2004*
Beal Run-Sandy Creek	05040001 06 07	PCBs, Hexachlorobenzene	2010

Years with asterisks (*) indicate that the analysis was completed before 2010, when using larger assessment units, and these sections may not have actual data within these units.

Table E-8 — Waters with current fish tissue data where inadequate samples exist to determine impairment status. These waters are category 3.

Water Body (Category 3: Insufficient Data)	Assessment Unit	Most Recent Data
Cornell Ditch-Fish Creek	04100003 04 06	2013
Lower Lick Creek	04100006 04 04	2013
Dry Run-Auglaize River	04100007 01 05	2012
Middle Creek	04100007 08 05	2014
Lower Blue Creek	04100007 10 04	2012
Upper Powell Creek	04100007 11 02	2012
Lower Powell Creek	04100007 11 03	2012
Middle South Turkeyfoot Creek	04100009 01 04	2015
Lower South Turkeyfoot Creek	04100009 01 06	2015
Lower Yellow Creek	04100009 05 06	2015
Middle Beaver Creek	04100009 05 08	2015
Haskins Road Ditch-Maumee River	04100009 06 03	2017
Crooked Creek-Maumee River	04100009 09 03	2017
Otter Creek-Frontal Lake Erie	04100010 07 06	2018
Pipe Creek-Frontal Sandusky Bay	04100011 01 02	2018
Mills Creek	04100011 01 03	2009
Pickerel Creek	04100011 02 03	2009
Raccoon Creek	04100011 02 04	2009
Beaver Creek	04100011 12 02	2009
Muskellunge Creek	04100011 13 01	2009
Red Creek-Grand River	04110004 06 07	2009

Water Body (Category 3: Insufficient Data)	Assessment Unit	Most Recent Data
Piney Creek-Captina Creek	05030106 09 04	2009
Cat Run-Captina Creek	05030106 09 06	2009
Lower Sunfish Creek	05030201 01 04	2009
Wolfpen Run-Little Muskingum River	05030201 06 03	2015
Dog Run-Conotton Creek	05040001 08 05	2016
Boggs Fork	05040001 13 03	2013
Town of Uhrichsville-Stillwater Creek	05040001 16 04	2012
Evans Creek	05040001 19 01	2009
Jennings Ditch-Killbuck Creek	05040003 06 04	2009
Buckeye Fork	05040004 04 04	2009
Painter Creek-Jonathon Creek	05040004 04 07	2009
Chapman Run	05040005 02 06	2010
Salt Fork Lake-Sugartree Fork	05040005 04 05	2014
Sarchet Run-Wills Creek	05040005 05 04	2014
Headwaters Little Scioto River	05060001 03 02	2009
City of Marion-Little Scioto River	05060001 03 03	2009
Eversole Run	05060001 12 01	2009
Deer Creek Dam-Deer Creek	05060002 02 07	2011
State Run-Deer Creek	05060002 03 04	2011
Big Branch-Rattlesnake Creek	05060003 04 07	2014
Dismal Creek	05080001 10 01	2012
Town of New Miami-Great Miami River	05080002 07 06	2010
Banklick Creek-Great Miami River	05080002 09 02	2010
Lee Creek-Dry Fork Whitewater River	05080003 08 09	2017
Flat Run-Raccoon Creek	05090101 03 04	2016
Meadow Run-Little Raccoon Creek	05090101 04 03	2016
Deer Creek-Little Raccoon Creek	05090101 04 04	2016
Flatlick Run-Raccoon Creek	05090101 05 03	2016
McKinney Creek-Symmes Creek	05090101 10 05	2016
East Fork Todd Fork	05090202 07 01	2009

Table E-9 — Large rivers and their impairment status.

Water Body (Large Rivers)	Assessment Unit	Impairment Status
Maumee River Mainstem (IN border to Tiffin River)	**04100005 90 01**	**Impaired (PCBs, Mercury)**
Tiffin River Mainstem (Brush Creek to mouth)	**04100006 90 01**	**Impaired (PCBs)**
Auglaize River Mainstem (Ottawa River to mouth); excluding Defiance Power Dam Reservoir	**04100007 90 01**	**Impaired (PCBs)**
Blanchard River Mainstem (Dukes Run to mouth)	**04100008 90 01**	**Impaired (historical)**
Maumee River Mainstem (Tiffin River to Beaver Creek)	**04100009 90 01**	**Impaired (PCBs)**
Maumee River Mainstem (Beaver Creek to Maumee Bay)	**04100009 90 02**	**Impaired (PCBs)**
Sandusky River Mainstem (Tymochtee Creek to Wolf Creek)	**04100011 90 01**	**Impaired (PCBs, Mercury)**
Sandusky River Mainstem (Wolf Creek to Sandusky Bay)	**04100011 90 02**	**Impaired (PCBs)**
Cuyahoga River Mainstem (Brandywine Cr. to mouth); including old channel	**04110002 90 01**	**Impaired (PCBs)**
Grand River Mainstem (Mill Creek to mouth)	**04110004 90 01**	**Impaired (PCBs)**
Mahoning River Mainstem (Eagle Creek to Pennsylvania Border)	**05030103 90 01**	**Impaired (PCBs)**
Hocking River Mainstem (Scott Creek to Margaret Creek)	05030204 90 01	Not impaired
Hocking River (Margaret Creek to Ohio River)	05030204 90 02	Not impaired

Water Body (Large Rivers)	Assessment Unit	Impairment Status
Tuscarawas River Mainstem (Chippewa Creek to Sandy Creek)	**05040001 90 01**	**Impaired (PCBs, Hexachlorobenzene)**
Tuscarawas River Mainstem (Sandy Creek to Stillwater Creek)	**05040001 90 02**	**Impaired (PCBs, Hexachlorobenzene)**
Tuscarawas River Mainstem (Stillwater Creek to Muskingum River)	**05040001 90 03**	**Impaired (PCBs)**
Mohican River Mainstem (entire length)	**05040002 90 01**	**Impaired (historical)**
Walhonding River Mainstem (entire length)	05040003 90 01	Not impaired
Muskingum River Mainstem (Tuscarawas/Walhonding confluence to Licking River)	**05040004 90 01**	**Impaired (PCBs)**
Muskingum River Mainstem (Licking River to Meigs Creek)	**05040004 90 02**	**Impaired (PCBs)**
Muskingum River Mainstem (Meigs Creek to Ohio River)	**05040004 90 03**	**Impaired (PCBs)**
Wills Creek Mainstem (Salt Fork to mouth); excluding Wills Creek Lake	05040005 90 01	Not impaired
Licking River Mainstem (entire length); excluding Dillon Lake	**05040006 90 01**	**Impaired (PCBs)**
Scioto River Mainstem (L. Scioto R. to Olentangy R.); excluding O'Shaughnessy and Griggs reservoirs	**05060001 90 01**	**Impaired (PCBs)**
Scioto River Mainstem (Olentangy River to Big Darby Creek)	**05060001 90 02**	**Impaired (PCBs)**
Scioto River Mainstem (Big Darby Creek to Paint Creek)	**05060002 90 01**	**Impaired (PCBs)**
Scioto River Mainstem (Paint Creek to Sunfish Creek)	**05060002 90 02**	**Impaired (PCBs)**
Scioto River Mainstem (Sunfish Creek to Ohio River)	**05060002 90 03**	**Impaired (PCBs)**
Paint Creek Mainstem (Rocky Fork to mouth)	**05060003 90 01**	**Impaired (historical)**
Great Miami River Mainstem (Tawawa Creek to Mad River)	**05080001 90 01**	**Impaired (historical)**
Stillwater River Mainstem (Greenville Creek to mouth)	05080001 90 02	Not impaired
Mad River Mainstem (Donnels Creek to mouth)	**05080001 90 03**	**Impaired (PCBs)**
Great Miami River Mainstem (Mad River to Four Mile Creek)	**05080002 90 01**	**Impaired (PCBs)**
Great Miami River Mainstem (Four Mile Creek to Ohio River)	**05080002 90 02**	**Impaired (PCBs)**
Whitewater River Mainstem (entire length)	**05080003 90 01**	**Impaired (PCBs)**
Raccoon Creek Mainstem (Little Raccoon Creek to mouth)	05090101 90 01	Not impaired
Little Miami River Mainstem (Caesar Creek to O'Bannon Creek)	**05090202 90 01**	**Impaired (historical)**
Little Miami River Mainstem (O'Bannon Creek to Ohio River)	**05090202 90 02**	**Impaired (historical)**

BOLD text indicates impaired rivers.

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

Water Body (Inland Lakes)	Impairment Status	Most Recent Data
Acton Lake	Not impaired	2015
Adams Lake	Insufficient information	2014
Alum Creek Lake	Not impaired	2013
Apple Valley Lake	Not impaired	2007
Archibold Reservoir #2	Insufficient information	2013
Atwood Lake	Not impaired	2016
Barnesville Reservoir #1	Insufficient information	2010
Barnesville Reservoir #2	Insufficient information	2010
Barnesville Reservoir #3	Insufficient information	2010
Belmont Lake	Not impaired	2016
Buckeye Lake	Not impaired	2008
Caesar Creek Lake	Not impaired	2013
Caldwell Lake	Insufficient information	2011

Water Body (Inland Lakes)	Impairment Status	Most Recent Data
Charles Mill Lake	Insufficient information	2014
Chippewa Lake	Insufficient information	2015
CJ Brown Reservoir	Insufficient information	2014
Clark Lake	Not impaired	2018
Clear Fork Reservoir	**Impaired (PCBs)**	**2008**
Clendening Lake	Not impaired	2013
Cowan Lake	Not impaired	2013
Cutler Lake	Insufficient information	2008
Deer Creek Lake	Not impaired	2011
Delaware Lake	Not impaired	2018
Delphos Reservoir	Insufficient information	2014
Delta Reservoir #2	Not impaired	2015
Dillon Lake	Not impaired	2008
East Branch Reservoir	Not impaired	2010
East Fork Lake	Not impaired	2013
East Reservoir	Insufficient information	2008
Ferguson Reservoir	Not impaired	2010
Findley Lake	Not impaired	2013
Findley Reservoir #2	**Impaired (PCBs)**	**2015**
Friendship Park Lake	Insufficient information	2008
Grand Lake St Marys	Insufficient information	2014
Griggs Reservoir	Not impaired	2014
Guilford Lake	Not impaired	2017
Hammertown Lake	Insufficient information	2007
Hargus Lake	Insufficient information	2014
Hinckley Lake	Insufficient information	2008
Hoover Reservoir	Not impaired	2013
Indian Lake	Not impaired	2017
Jackson Lake	Insufficient information	2007
Jefferson Lake	Not impaired	2014
Kiser Lake	Insufficient information	2014
Knox Lake	Not impaired	2015
LaDue Reservoir	Not impaired	2010
Lake Glacier	Not impaired	2013
Lake Isabella	Insufficient information	2009
Lake Jisco	Insufficient information	2007
Lake Katherine	Insufficient information	2007
Lake La Su An	Not impaired	2018
Lake Logan	Not impaired	2015
Lake Loramie	Not impaired	2016
Lake Milton	**Impaired (PCBs)**	**2008**
Lake Nesmith	**Impaired (PCBs)**	**2016**
Lake Olander	Insufficient information	2011
Lake Rockwell	**Impaired (PCBs)**	**2010**
Lake Vesuvius	Not impaired	2017
Lake White	Not impaired	2014
Leesville Lake	Not impaired	2018
Long Lake	Insufficient information	2007
Madison Lake	Insufficient information	2011
Marysville Reservoir	Insufficient information	2009
Meadowbrook Lake	Insufficient information	2012
Metzger Reservoir	Insufficient information	2010

Water Body (Inland Lakes)	Impairment Status	Most Recent Data
Mogadore Reservoir	Not impaired	2007
Mosquito Creek Lake	Not impaired	2013
Nettle Lake	Insufficient information	2013
New London Reservoir	Not impaired	2016
Nimisila Reservoir	Not impaired	2007
North Fork Kokosing Reservoir	Not impaired	2007
O'Shaughnessy Reservoir	Not impaired	2010
Paint Creek Lake	Not impaired	2014
Piedmont Lake	Not impaired	2013
Pike Lake	Not impaired	2011
Pleasant Hill Lake	Insufficient information	2014
Pymatuning Reservoir	Not impaired	2008
Rocky Fork Lake	Not impaired	2017
Rose Lake	Insufficient information	2011
Rush Creek Lake	Not impaired	2016
Rush Run Lake	Not impaired	2014
Salt Fork Reservoir	Not impaired	2014
Seneca Lake	Insufficient information	2007
Sippo Lake	Not impaired	2015
Stewart Lake	Insufficient information	2011
Stonelick Lake	Not impaired	2018
Summit Lake	**Impaired (PCBs)**	**2016**
Swift Run Lake	Insufficient information	2009
Tappan Lake	Not impaired	2013
Turkey Creek Lake	Not impaired	2014
Tycoon Lake	Not impaired	2018
Van Wert Reservoir #1	Insufficient information	2014
Van Wert Reservoir #2	Insufficient information	2014
Veteran's Memorial Reservoir	Not impaired	2017
Wellington Upground Reservoir	Insufficient information	2013
West Branch Reservoir	**Impaired (PCBs)**	**2008**
Westville Lake	**Impaired (PCBs)**	**2007**
Wills Creek Reservoir	Not impaired	2014
Wingfoot Lake	Not impaired	2007

BOLD text indicates impaired lakes.

Table E-11 — Lake Erie assessment units and their impairment status.

Lake Erie Assessment Unit	Assessment Unit	Impairment Status
LE Central Basin Shoreline	**041202000203**	**Impaired (PCBs)**
LE Central Basin Open Water	**041202000303**	**Impaired (PCBs)**
LE Islands Shoreline	**041202000101**	**Impaired (PCBs)**
LE Sandusky Basin Shoreline	**041202000202**	**Impaired (PCBs)**
LE Sandusky Basin Open Water	**041202000302**	**Impaired (PCBs)**
LE Western Basin Shoreline	**041202000201**	**Impaired (PCBs)**
LE Western Basin Open Water	**041202000301**	**Impaired (PCBs)**

BOLD text indicates impaired units.

E4. Supplemental Information

Calculation of Fish Concentrations from Water Quality Standards Inputs

For carcinogens:

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

For noncarcinogens:

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

For wildlife:

$$Fish\ Concentration\ (mg/kg) = Wildlife\ WQC\ (mg/L) \times BAF\ TL_n\ (L/kg)$$

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

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

Lake Erie Drainage Basin DDT Human Health Fish Concentration

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

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

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

Lake Erie Drainage Basin PCB Wildlife Fish Concentration

Trophic Level 3:

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

Trophic Level 4:

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

Lake Erie Drainage Basin Hexachlorobenzene Human Health Fish Concentration

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

Lake Erie Drainage Basin Mirex Human Health Fish Concentration

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

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

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

Ohio River Drainage Basin DDT Fish Concentration

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

Ohio River Drainage Basin PCB Fish Concentration

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

Ohio River Drainage Basin Hexachlorobenzene Fish Concentration

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

Ohio River Drainage Basin Mirex Fish Concentration

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

Fish Tissue Concentrations for Determining Impairment for the 2020 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

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 2020 IR for fish tissue relates to the fish advisories issued by the State of Ohio. Rather than building on FCA 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 IR 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.

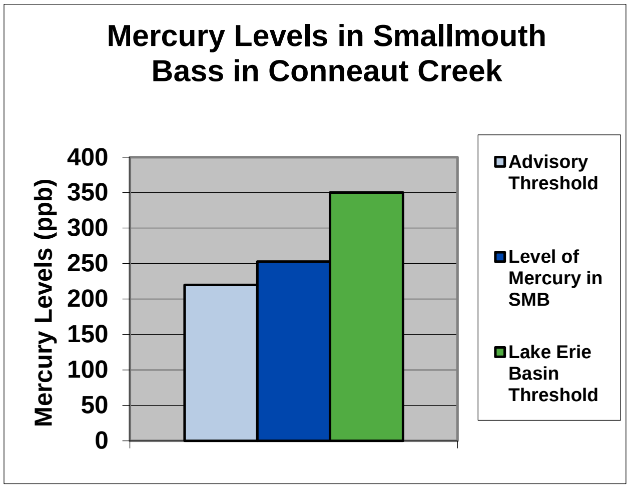
The thresholds used for determining IR categories are based on water quality standards for human health. The water quality standards assume that people are eating a certain quantity of different types of fish over time. The Lake Erie basin WQS calculations for mercury and PCBs assume that people are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

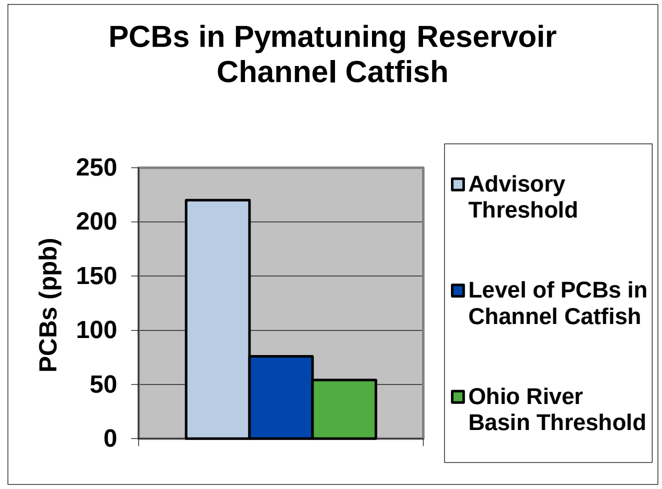
U.S. EPA, in its guidance on developing the IR, indicates that water quality standards are to be used as the basis for determining impairment categories for fish tissue. Because the assumptions used to calculate the advisories are different than the assumptions used to calculate the WQS, this results 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	One meal per week advisory	One 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

The reason the thresholds are different between the two basins is that the assumed fish consumption levels are different. And 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 water body is not impaired.



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

Section

F

Evaluating Beneficial Use: Recreation

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Figures

Tables

F1. Background (Bacteria)

Prior to the 2002 Integrated Report (IR), the reporting of recreation use (RU) impairment in Ohio was sporadic. Clean Water Act (CWA) Section 305(b) reports (1998 and earlier) may have included an indication of the potential for RU impairment in various streams, but a comprehensive listing of recreational use impairment was not included. The 2002 IR employed a uniform methodology to examine readily available data on fecal coliform counts. This approach was based on counting the number of exceedances of the secondary contact RU maximum criterion [5,000 colony forming units (cfu)/100 mL fecal coliform or 576 cfu/100 mL *Escherichia coli (E. coli)]*. Any assessment unit with five or more samples over the last five years above these values was listed as having an impaired RU.

The 2004 IR adopted a more statistically robust methodology for assessing the RU attainment of the state's surface waters linked more directly to the applicable water quality standards (WQS). The methodology adopted in 2004 continued to be used through the 2008 IR. The 2008 IR also included a preview of changes anticipated at the time for the 2010 report based on the expectation that the watershed assessment unit (WAU) would change from a larger watershed size (11-digit HUC) to a smaller watershed size (12-digit HUC) and on four anticipated revisions to the water quality standards: 1) dropping the fecal coliform criteria; 2) creation of a tiered set of classes of primary contact recreation waters based on RU intensity; 3) revision of the geometric mean averaging period; and 4) extension of the recreation season. Revisions to the water quality standards pertaining to the RU were adopted on Dec. 15, 2009. The RU assessment method employed in the 2010, 2012, 2014 and 2016 IRs was essentially consistent throughout this time.

A more recent revision to Ohio's water quality standards became effective in January 2016. This revision included updates to the recreational water quality standards to make them consistent with U.S. EPA's November 2012 section 304(a) recommendations. These substantial revisions to Ohio's recreation use WQS included changes to the applicable numeric criteria and a change in the geometric mean averaging period from a seasonal basis to a 90-day period. Furthermore, the tiered set of primary contact recreational use classes adopted in 2010 were collapsed back into a single use as part of these revisions. The revised WQS were approved by U.S. EPA in April 2016. A subsequent revision to Ohio's WQS resulted in the movement of the water quality criteria for the protection of recreational uses from OAC 3745-1-07 to OAC 3745-1-37. The revision that reorganized the content of the WQS became effective in February 2017 and was approved by U.S. EPA in June 2017. Methodologies and analyses used in the 2018 IR were carried forward into the 2020 IR with no substantive changes other than the data period used in the analysis. The linkage of the assessment methodology to the Ohio WQS is summarized in Table F-1 and detailed in subsequent text.

Table F-1 — Summary of the RU assessment methods.

Bathing Waters		
Indicator	**Criterion (Table 37-2, OAC 3745-1-37)**	**Assessment Method Summary**
E. coli	Geometric mean *E. coli* content* based on samples collected within a 90-day period during the recreation season within a calendar year is 126 cfu/100 mL; statistical threshold value (STV) is 410 cfu/100 mL.	Applied to the four Lake Erie shoreline assessment units and inland lake beaches, exceedance of the geometric mean bathing water criterion or an exceedance of the STV in more than 10 percent of the samples collected during a 90-day period is considered an impairment of the bathing water use, where sufficient data are available.**
Primary Contact and Secondary Contact		
Indicator	**Criterion (Table 37-2, OAC 3745-1-37)**	**Assessment Method Summary**
E. coli	Geometric mean *E. coli* content* based on samples collected within a 90-day period during the recreation season within a calendar year is as follows: Primary Contact Waters 90-day Geometric Mean: 126 cfu/100 mL STV: 410 cfu/100 mL Secondary Contact Waters 90-day Geometric Mean: 1,030 cfu/100 mL STV: 1,030 cfu/100 mL	Applied to streams and inland lake non-beach sites. Data collected within a 90-day period in the recreation season are assessed on a site-by-site basis and compared to the applicable geometric mean and STV *E. coli* criteria whenever sufficient data** are available for the site. Assessment units (AUs) are in full attainment if all sites assessed within the AU meet both the applicable geometric mean and STV criteria and in non-attainment if one or more sites assessed within the AU exceed the applicable geometric mean or STV criteria.

**E. coli* concentrations are expressed in colony forming units (cfu) per 100 milliliters (mL)
** Five or more samples collected within a 90-day period.

F2. Evaluation Method (*Bacteria*)

Lake Erie (Shoreline)

Attainment of the RU designation for the four shoreline Lake Erie assessment units (LEAUs) as delineated in Section D-1 of this report and depicted in Figure D-3 of this report was based upon examination of *E. coli* data from public bathing beaches provided by the Ohio Department of Health (ODH). Routine bacteria monitoring is performed by local health districts, ODH and the Northeast Ohio Regional Sewer District (NEORSD) to monitor bacteria levels at public bathing beaches. They advise the public when elevated bacteria are present that represent an increased risk of contracting waterborne illness resulting from exposure to pathogens while recreating in the water. This monitoring takes place at 67 public beaches in Ohio's eight coastal counties. The public can access the ODH Beachguard website to view beach advisory postings and bacteria monitoring data from monitored beaches. The website, available at ***http://publicapps.odh.ohio.gov/BeachGuardPublic/Default.aspx***, is updated daily during the summer recreation season.

Since 2006, beach advisory recommendations have been based upon exceedance of the single sample maximum *E. coli* criterion of 235 cfu/100 mL, consistent with provisions of the 2004 federal Beaches Environmental Assessment and Coastal Health (BEACH) Act rule and the *E. coli* criterion applicable for bathing waters in Ohio's water quality standards. Bacteria data collected by local or state health agencies at public beaches during the recreation season from 2015 through 2019 were included in the analysis. Ohio's water quality standards define the recreation season as May 1 through October 31, though Lake Erie beach monitoring typically is focused between the Memorial Day and Labor Day weekends.

Each of the 22 public beaches that have traditionally been sampled as part of the Lake Erie bathing beach monitoring program (Figure F-1) was individually analyzed to evaluate the percentage of recreation days during which the bathing water beach action value (BAV) of 235 cfu/100 mL was exceeded, since this is the value used by health departments to post a health advisory at a given beach. The frequency of beach advisory postings is a direct measure of RU impairment, since potential users may be discouraged from utilizing a beach on days when a health advisory is posted or to avoid certain beaches altogether that are prone to frequent advisories. The locations of beaches in Erie and Sandusky Counties are depicted in Figure F-2, while those beaches located in Cuyahoga and Lorain Counties are depicted in Figure F-3.

As of September 13, 2017, there were 188 public access locations in the eight coastal counties along Ohio's Lake Erie coastline. These public access points do not all include a swimming beach, as some are for boat access, fishing access, parks, wildlife viewing areas, etc. The Ohio Department of Natural Resources (ODNR) publishes a *Lake Erie Public Access Guide* available at ***coastal.ohiodnr.gov/gocoast***. This report used data collected from 67 different beaches along the coast as depicted in Figure F-1 through Figure F-3.

The total number of recreation days in a recreation season for each beach was determined by adding the number of days beginning with the first day of sampling and ending with Labor Day, or the date the final sample was collected (whichever was later). The total number of days that a beach exceeded the BAV of 235 cfu/100 mL during the recreation season (as defined above) was tallied. A measured exceedance was assumed to continue until a subsequent sample documented that the BAV was not exceeded. Similarly, a beach was presumed to meet the BAV following a measurement that met the BAV until a subsequent sample was found to exceed the BAV. Sampling frequency varied from year-to-year and from beach-to-beach. A sampling frequency of four times per week was typical, though some beaches were sampled daily while the two beaches in the Lake Erie Islands AU were sampled only once per week.

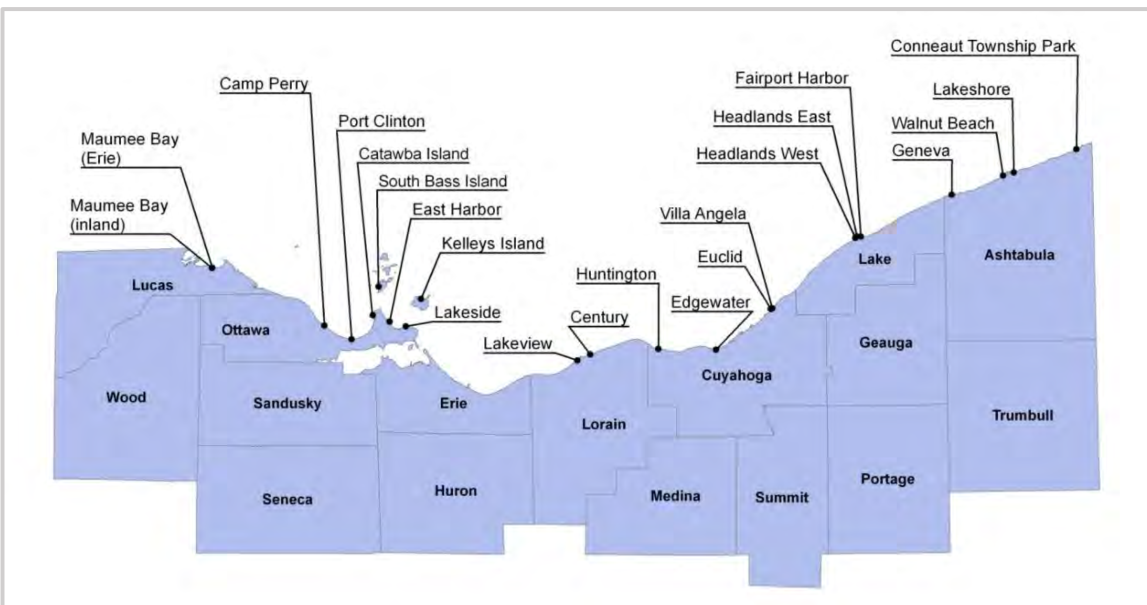

Figure F-1 — Lake Erie public beaches sampled under Ohio's bathing beach monitoring program.

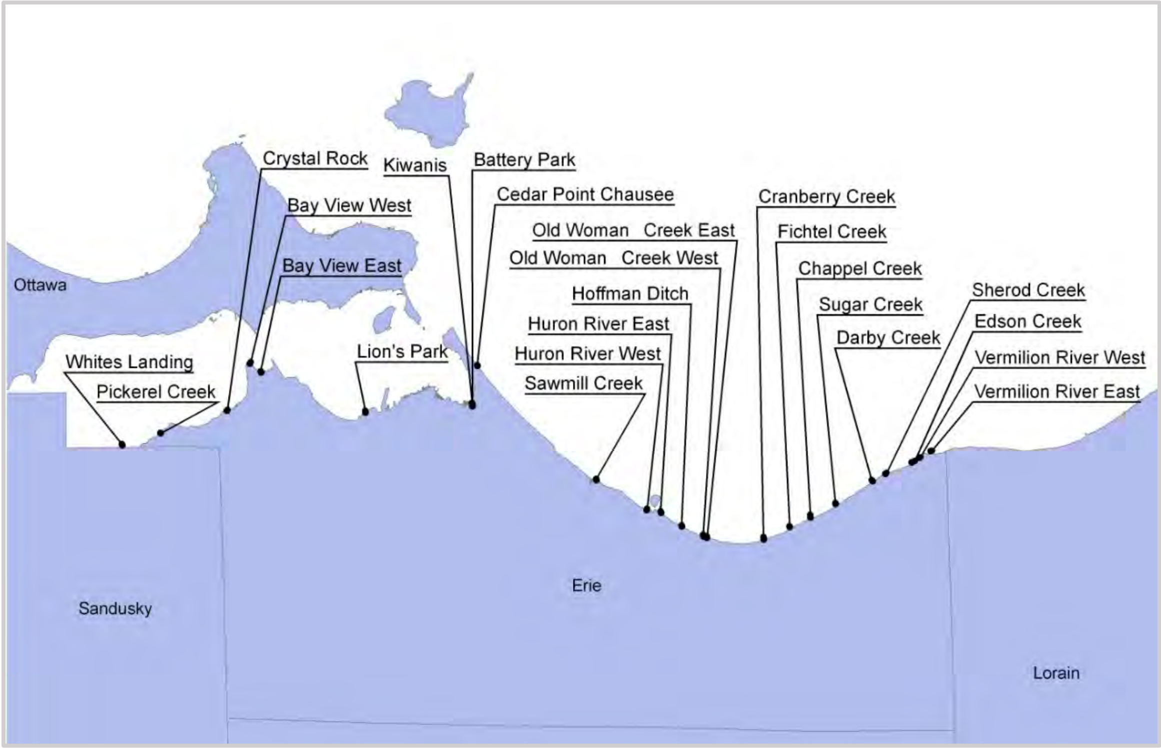

Figure F-2 — Erie and Sandusky County public beaches sampled under Ohio's bathing beach monitoring program.

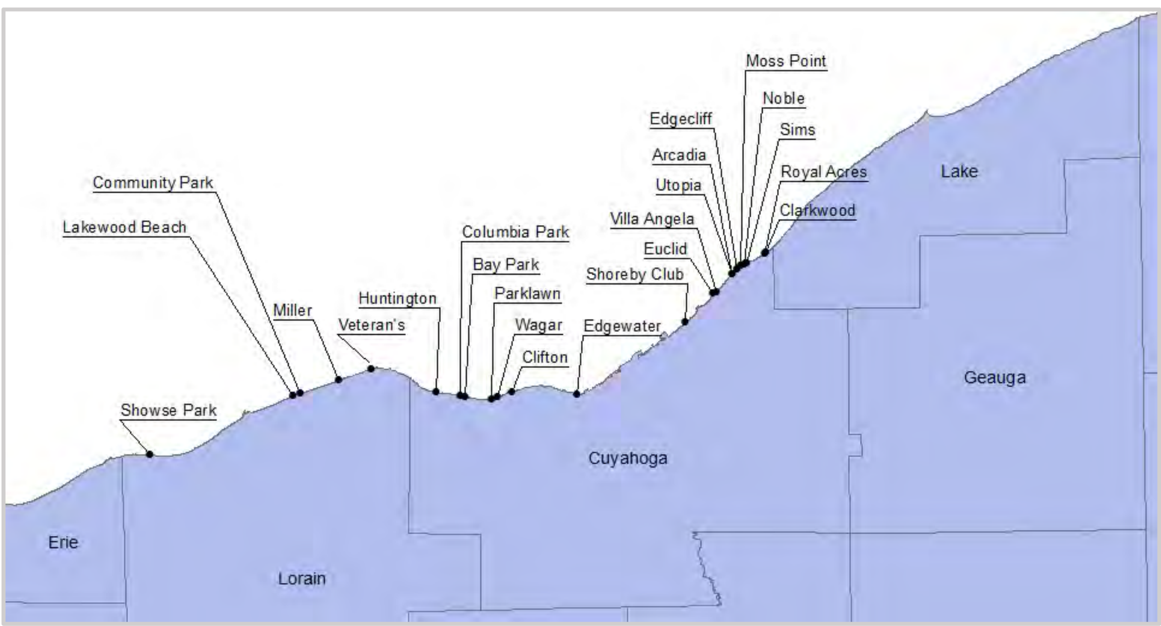

Figure F-3 — Cuyahoga and Lorain County public beaches sampled under Ohio's bathing beach monitoring program.

The exceedance frequency of the bathing water criteria was determined for each beach over a five-year period (2015-2019) on an annual basis. Individual beaches were evaluated for exceedances of both the geometric mean and STV of data collected within 90-day intervals during the recreation season. Results for each individual beach were sorted into the corresponding shoreline LEAU for determining the attainment status of each of the four shoreline LEAUs. The assessment status for each LEAU was based upon whether the frequency of exceedance of the STV was greater than 10 percent for any 90-day period or if the bathing water geometric mean criterion was exceeded within any 90-day period, as described in Table F-2.

Table F-2 — Determining assessment status of Lake Erie shoreline AUs.

LEAU Status	Attainment Status of Individual Beaches
Full	Exceedance frequency of the STV is less than 10 percent and the geometric mean is less than 126 cfu/100 ml based on the samples collected within all 90-day intervals during the recreation season for all the beaches in the AU for all years assessed.
Non	Exceedance frequency of the STV is more than 10 percent or the geometric mean is greater than 126 cfu/100 ml based on the samples collected within all 90-day intervals during the recreation season for one or more of the beaches in the AU for one or more of the years assessed.

A 10 percent exceedance frequency was used as the threshold for attainment determination in the last six assessment cycles and has its origins in the WQS applicable at the time as well as Ohio's 1998 *State of the Lake Report* prepared by the Ohio Lake Erie Commission (Ohio LEC 1998). While the stated goal in the *State of the Lake* report for beaches was to have clean beaches all the time (no days under advisement), the report considered having 10 or fewer days under advisement to be excellent (note that 10 days translates to 10 percent of the season based on a 100-day season). The Ohio Lake Erie Commission last published a *State of the Lake Report* in 2004 (Ohio LEC 2004). That report continued to use these benchmarks in rating the swimmability of Lake Erie beaches along Ohio's 312-mile shoreline. While the 2020 IR continued to track these statistics, which are included in Table F-5 and Table F-6 for individual beaches and further summarized in Table F-7 through Table F-10 and Figure F-5 to provide more detail and allow performance comparisons among individual beaches, the method used to determine the official recreation use status as described above in Table F-2 was revised to reflect the changes to the WQS that became effective in January 2016 (Table F-1).

Rivers and Streams

The 2020 RU impairment list was developed using ambient *E. coli* survey data collected by Ohio EPA from May 2016 through October 2019 by Ohio EPA. These included surveys from the following drainage basins: Conotton Creek, Huron River, Raccoon Creek, Symmes Creek, Southwest Ohio River tributaries, Tuscarawas River, Sugar Creek, Whitewater River, STEM (Swan Creek, Toussaint River and tributaries of the lower Maumee River and direct Lake Erie tributaries), Cuyahoga River, and the upper Auglaize River.

Approximately 2,300 *E. coli* bacteria records were evaluated in this analysis. Data were sorted into their respective 12-digit WAUs and large river assessment units (LRAUs) using a geo-spatial analysis of the latitude/longitude data (and other geographical data if needed) associated with each *E. coli* value. Data within a WAU were further sorted by sampling location and date (calendar year) on which they were collected. Figure F-4 demonstrates the sampling coverage that would be typical for part of a study area. In this case, there are five 12-digit WAUs depicted that drain to one LRAU, the Walhonding River. Each of the five WAUs was sampled in 2010 at one location (depicted by yellow dots) toward the downstream end of the primary tributary in the WAU. Four sampling locations (green dots) are dispersed along the 16-mile stretch of the Walhonding River depicted for an average sampling density of one site per four miles of river length for this LRAU. Sites were sampled on at least five different occasions over the course the 2010 recreation season, though some sites were sampled more frequently. For example, sample collections on some of the LRAU segments such as the Tuscarawas River and Cuyahoga River in 2017 occurred 10 times. Samples were collected within 90-day sample windows during the recreation season to facilitate data evaluation. RU assessment determinations for rivers and streams are based on the following two-step process: site-by-site analysis and assessment unit analysis, as described below.

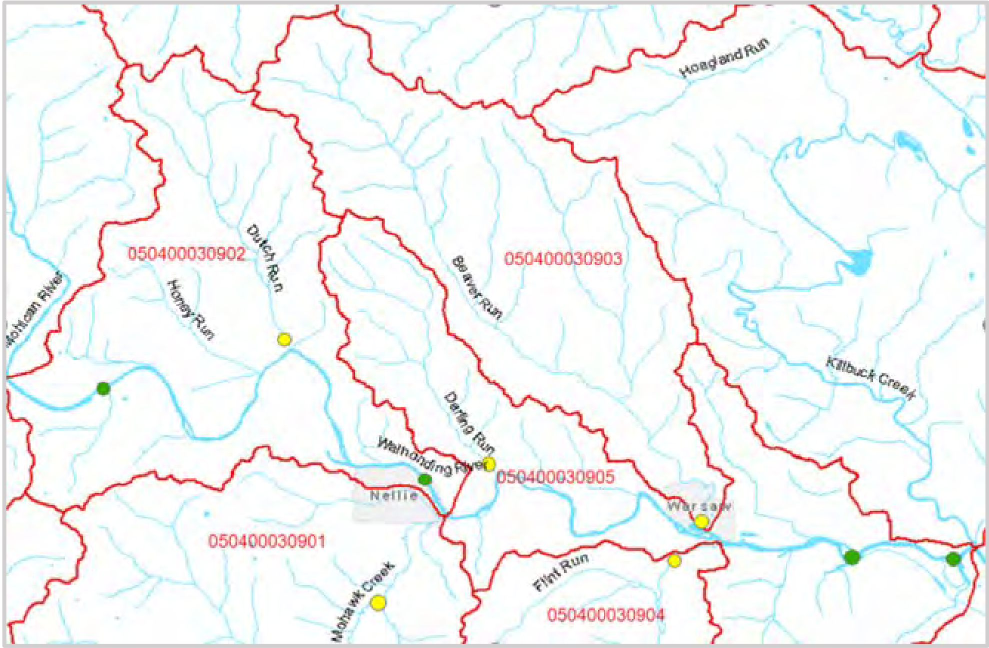

Figure F-4 — Example of bacteria sampling locations, upper Walhonding River study area (2010).

Step One: Site-by-Site Analysis

E. coli data from each site were compared to the geometric mean *E. coli* criterion and STV. The geometric mean was calculated using the "geomean" function in Microsoft Excel 2016® on a site-by-site basis using the pooled dataset of all *E. coli* data (minimum of five data points required) from the site within a 90-day window during a single recreation season. When data were available for multiple recreation seasons, the data from each season were independently analyzed for each recreation season to determine the 90-day geometric mean for each season. Similarly, comparisons were made of the *E. coli* data to the STV to assess sites where the STV was exceeded in more than 10 percent of the samples collected within a 90-day period. Sites in which either the geometric mean or the STV was exceeded did not fully support the recreation use. Further details are listed as follows:

- Data collected outside of the recreation season as defined in Ohio's WQS (May 1 through October 31) were excluded from the analysis.
- Assessments were only made where there were at least five samples within a 90-day period.
- Certain qualified values, such as sample results that exceeded proper holding time or those that have otherwise been indicated to have significant quality assurance deficiencies, were also excluded from the analysis.
- Values reported as too numerous to count (TNTC) were used in the analysis when it was possible to estimate a value based on the dilutions used and/or the maximum reporting limits.
- Values reported as greater than were also used in the analysis. A geometric mean calculated using one or more greater than or TNTC values in the data set was reported as a greater than geometric mean.
- Values reported as less than values of greater than 50 were excluded since acceptable test methods can detect much lower concentrations when appropriate dilutions are used in the analysis. Values reported as 50 or less were used in the analysis. The value used in statistical analysis was one-half the reported less than value. A value of one was substituted for computing the geometric mean in

any case where a value of less than one was reported. Geometric means cannot be calculated using data sets that contain a value of zero.

- Results from duplicate B were used for calculation of the geometric mean in cases where duplicate sample results were reported, except if the E. coli densities of the duplicate samples were more than five times apart from one another, in which case both values were rejected.

Step Two: Assessment Unit Analysis

In the second step of the analysis, the assessment status of the WAU or LRAU was determined based on the attainment status of all the individual sites within the assessment unit and within the assessment period (2016-2019) as described in Table F-3 below.

Table F-3 — Determining assessment status of WAUs and LRAUs.

AU Assessment Status	Attainment Status of Individual Locations
Full (Category 1)	Sufficient data exist to assess at least one location within the WAU (or a minimum of one site for every ~5-7 river miles of a LRAU); the geometric mean criteria and STVs are attained at all assessed sites within the AU
Non (Category 5)	Sufficient data exist to assess at least one location within the WAU (or a minimum of one site for every ~5-7 river miles of a LRAU); the geometric mean or STV is exceeded at one or more assessed sites within the AU
Insufficient Data (Category 3)	No data (category 3) or insufficient data (category 3i) to calculate a geometric mean for any site within the WAU (or for a minimum of one site for every ~5-7 river miles of a LRAU)

Inland Lakes

ODNR, as part of Ohio's Bathing Beach Monitoring Program, monitors *E. coli* levels during the summer at public beaches on lakes located in state parks. While Ohio EPA was unable to establish the level of credibility of these data for use in official listing determinations for this report, a summary of the advisory postings for the 68 beaches monitored in the program is included in Table F-16. Though like the beach monitoring program along Lake Erie, there are several differences. Notably, the sampling frequency is much lower at the inland lake beaches compared to the Lake Erie beaches because of funding disparity. Secondly, because of the large geographic area, beach samples from inland lakes are analyzed by a multitude of consulting laboratories across the state.

F3. Results (Bacteria)

Results for the RU attainment analysis are presented in this section and are based on the methodology outlined in the previous section and available *E. coli* data collected from 67 public beaches along Ohio's Lake Erie 312-mile shoreline (14,848 samples) and at more than 346 locations from Ohio's rivers and streams (2,272 samples) including four of Ohio's largest rivers. Samples used in this analysis were collected from 2015 through 2019 during the recreation season of May 1 through October 31. A summary of the *E. coli* sampling conducted by Ohio EPA in 2016–2019 in presented in Table F-4.

Table F-4 — Summary of Ohio EPA E. coli sampling effort for the 2020 assessment cycle.

Survey	Survey Year	# Sites	# Samples
Raccoon Creek Basin	2016	29	189
Huron River Basin	2016	20	100
Conotton Creek Basin	2016	46	230
Southwest Ohio River Tributaries Basin	2016	18	90
Symmes Creek Basin	2016	19	145
Cuyahoga River Mainstem	2016	16	168
Upper Tuscarawas River Basin	2017	21	208
Lower Tuscarawas River Basin	2017	29	226
Sugar Creek Basin	2017	16	80
Whitewater River Basin	2017	13	65
Swan Creek, Toussaint River, lower Maumee and Western Lake Erie Tributaries Basin	2017	28	140
Cuyahoga River Mainstem	2017	30	171
Cuyahoga River Tributaries Basin	2018	32	315
Upper Auglaize River Basin	2019	29	145

Lake Erie Public Beaches

Information about water quality conditions at Lake Erie public bathing beaches is summarized in Table F-5 through Table F-10 and Figure F-5. The locations of these beaches are shown in Figure F-1 through Figure F-3. The methodology used for assessing the beaches along Ohio's Lake Erie shoreline was consistent in the 2010, 2012, 2014 and 2016 reports. However, as described in section F2, some modifications to the methods for assessing the Lake Erie beach data were made beginning with the 2018 report to accommodate the revisions to the WQS that became effective in January 2016.

Table F-5 contains the seasonal geometric mean *E. coli* levels for 17 public beaches along the coast of Lake Erie's western basin for the past five recreational seasons (2015-2019) while Table F-6 contains the seasonal geometric mean *E. coli* levels for 50 public beaches along the coast of Lake Erie's central basin for the past five recreational seasons (2015-2019).

On a seasonal basis, the geometric mean *E. coli* criterion for bathing waters was exceeded at 16 beaches in 2015; seven beaches in 2016; three beaches in 2017; nine beaches in 2018 and eleven beaches in 2019. The Lakeview beach was the only beach documented to exceed the geometric mean criterion on a seasonal basis each of the past five seasons. Not surprisingly, this beach and others that frequently exceeded the geometric mean criterion on a seasonal basis had among the most days under a swimming advisory during the 2015-2019 reporting period. Highlighted cells in Table F-5 and Table F-6 indicate exceedance of the geometric mean criterion on a seasonal basis or exceedance of the BAV more than 10 percent of season. The table also indicates the number of beach advisories for each beach based upon exceedance of the BAV of 235 cfu/100 mL. This is the threshold that triggers the issuance of beach advisories and has been used since 2006. Use of the BAV to post beach advisories complies with the BEACH Act rule (*Water Quality Standards for Coastal and Great Lakes Recreation Waters*, 69 FR 67217, Nov. 16, 2004), which became effective on Dec. 16, 2004.

In Table F-7 through Table F-10, the beaches are arranged alphabetically according to the LEAU in which they are geographically located. The tables indicate the number of days per recreation season and the total percentage for all years when Ohio's Lake Erie public beaches exceeded the BAV compared to the total number of days in the recreation season sampling period.

As depicted in Figure F-5, the frequency during which individual beaches were under a swimming advisory based on elevated bacteria levels above the advisory level for the entire five-year reporting period (2015-

2019) ranged from near zero at Battery Park, Catawba Island State Park, Conneaut Township Park, East Harbor State Park, Geneva State Park, Lakeside and South Bass Island State Park to more than a third of the season on average at six beaches: Bay View West, Edson Creek, Lakeview, Maumee Bay State Park (Erie and inland) and Villa Angela State Park. Considerable variation in the frequency of advisories was observed between beaches and from season-to-season at many beaches. However, several beaches stand out as consistently good performers over the past several recreation seasons, including Battery Park, Catawba Island, Cedar Point, Conneaut, East Harbor State Park, Geneva State Park, Kelleys Island, Lakeside and South Bass Island State Park, which all had a cumulative exceedance frequency of less than 10 percent on a seasonal basis. These beaches rarely exceeded 10 days per season under advisement. There were also several beaches that consistently performed poorly with three beaches, including Bay View West, Edson Creek and Lakeview under advisement nearly 40 percent of the time or more during the past five recreation seasons on a cumulative basis. High variation in bacteria levels was also seen between seasons for some beaches. For example, Kiwanis beach was under advisement for 44 days in 2015, but under advisement for just seven days in 2016. Crystal Rock beach was under advisement for just two days in 2016, but under advisement for 20 days in 2017. The annual median frequency of advisement for all beaches by calendar year in this reporting cycle was highest in 2015 at 21 days compared to the rest of the reporting years, which had an annual median advisory frequency of 9-12 days per beach. The annual average geometric mean *E. coli* level for all beaches by year within this reporting cycle ranged from a low of 55 in 2017 to a high of 96 in 2015.

In IR cycles prior to 2018, impairment of the bathing water RU was determined by pooling data from beaches in each of the LEAUs and calculating the percentage of days in the recreational season when the *E. coli* criterion was exceeded. A threshold of impairment was set at 10 days per season based on the Ohio Lake Erie Commission's evaluation system (Ohio LEC 1998). This translates to a seasonal exceedance frequency of 10 percent, as the recreation season at Lake Erie's beaches in Ohio typically runs from Memorial Day weekend through Labor Day weekend. Results are shown in Table F-11. As in previous assessment cycles, the 2020 assessment results indicate that the Lake Erie Islands assessment unit would fully support the RU on a seasonal basis while the Western basin, Sandusky basin and Central basin assessment units would not support the RU. The overall total recreation days in exceedance of the bathing waters criterion on a percentage basis was 14.4 percent in the western basin (7 beaches), 16.9 percent (28 beaches) in the Sandusky basin and 15.5 percent in the central basin compared to just 2.8 percent for the Lake Erie Islands (two beaches).

With the revision of Ohio's WQS effective Jan. 4, 2016, the averaging period was revised from a seasonal basis to a 90-day period. Furthermore, the revised WQS specify that the STV is not to be exceeded in more than 10 percent of the samples taken during any 90-day period. As such, the Lake Erie beach data were examined to ensure that all the beaches in each of the Lake Erie shoreline AUs during the reporting cycle of 2015-2019 attained both the geometric mean and STV on a 90-day basis rather than the seasonal basis as has historically been done. As historically observed at numerous beaches in both the Western basin and Central basin on a seasonal basis, numerous beaches also failed to attain the criteria on a 90-day basis as well (Table F-11). In fact, of the 67 total Lake Erie beaches monitored, 23 failed to attain the geometric mean criterion every year during the reporting cycle on a 90-day averaging period basis, while only three beaches attained both the geometric mean and STV criteria every year throughout the monitoring cycle, including East Harbor State Park, Lakeside, and South Bass Island. Both Battery Park beach and Walnut beach experienced no exceedances of the 90-day geometric mean criterion over the 5-year reporting cycle and only experienced an exceedance of the STV during a portion of a single year during the five-year reporting cycle thus falling just short of full attainment at these two beaches.

Table F-5 — Seasonal geometric mean E. coli levels and advisory postings at public Lake Erie shoreline beaches in the western basin (Sandusky Bay and west).

Beach	2015		2016		2017		2018		2019	
	Seasonal geomean	number of days posted	Seasonal geomean	number of days posted	Seasonal geomean	number of days posted	Seasonal geomean	number of days posted	Seasonal geomean	number of days posted
Battery Park	11	4	11	4	7	0	10	0	15	10
Bay View East	94	21	51	18	62	11	89	20	53	5
Bay View West	142	42	542	76	210	50	303	46	77	14
Camp Perry	84	26	125	13	76	19	93	9	107	9
Catawba Island	47	11	20	0	9	2	17	0	29	0
Crystal Rock	43	18	25	2	24	20	39	0	47	3
East Harbor	10	5	6	2	7	3	8	0	13	5
Kelleys Island	36	0	63	0	33	4	46	6	81	8
Kiwanis (Pipe Cr)	141	44	67	7	38	10	63	2	29	3
Lakeside	12	7	8	0	9	4	9	0	26	1
Lion’s Park	54	12	65	22	40	10	71	7	94	28
Maumee - Erie	167	45	150	39	122	34	141	31	99	23
Maumee - Inland	92	28	95	29	151	37	259	37	294	41
Pickerel Creek	68	24	33	13	29	13	42	6	61	38
Port Clinton	48	32	21	7	38	13	47	7	NS	NS
South Bass Island	7	2	18	0	15	0	5	0	18	0
Whites Landing	158	45	136	36	71	22	55	6	74	8

Shaded cells indicate exceedance of the geometric mean criterion on a seasonal basis *(seasonal geomean)* or exceedance of the BAV more than 10 percent of the time during a season. The beach season is defined for this analysis as the time *E. coli* monitoring commences, typically in late May though the end of the Labor Day weekend. The number of days posted is determined by counting the number of days the BAV was exceeded. Days for which no monitoring data were collected are presumed to be in exceedance if the preceding day’s bacteria level exceeded the BAV. Unmonitored days are presumed to meet the BAV when preceded by a monitored day that was below the BAV. NS = Not Sampled.

Table F-6 — Seasonal geometric mean E. coli levels and advisory postings at public Lake Erie shoreline beaches in the central basin (east of Cedar Point).

Beach	2015		2016		2017		2018		2019	
	Seasonal geomean	number of days posted	Seasonal geomean	number of days posted	Seasonal geomean	number of days posted	Seasonal geomean	number of days posted	Seasonal geomean	number of days posted
Arcadia Beach	279	39	53	4	82	28	124	12	285	35
Bay Park Beach	59	13	45	3	20	4	11	7	35	13
Beulah Beach (Chappel Creek)	110	27	53	26	62	19	76	15	70	19
Cedar Point Chausee	35	8	20	7	35	11	28	7	25	5
Century	110	34	19	10	43	13	106	23	117	29
Clarkwood	117	22	79	4	113	23	176	15	140	8
Clifton	49	22	34	11	44	6	65	23	80	14
Columbia Park	105	20	41	6	67	13	34	4	122	19
Community Park	108	29	23	16	36	9	48	8	86	24
Conneaut	24	3	28	2	17	4	16	2	21	2
Cranberry	39	20	21	4	21	17	23	14	25	10
Darby	86	30	56	16	72	22	94	18	105	27
Edgecliff	288	37	41	8	88	19	171	15	100	19
Edgewater	80	22	36	11	30	7	36	13	57	7
Edson	193	56	151	14	NS	NS	NS	NS	NS	NS
Euclid State Park	152	42	81	27	100	30	87	25	172	19
Fairport Harbor	96	28	44	23	58	20	44	17	31	5
Fichtel Creek (Heidelberg Beach)	34	15	30	4	18	9	49	10	46	18
Geneva State Park	29	3	17	0	17	2	16	2	13	5
Headlands East	53	18	45	16	46	15	45	13	NS	NS
Headlands West	56	18	45	16	46	16	45	15	57	11
Hoffman Ditch	60	25	32	9	39	17	NS	NS	NS	NS
Huntington	68	30	38	15	36	12	48	15	32	6
Huron River East (Nickel Plate Beach)	57	28	64	33	54	16	41	15	41	4
Huron River West (Lake Front Park)	161	28	75	11	106	33	115	27	71	11
Lakeshore Park	228	33	308	38	55	0	88	16	50	2
Lakeview	248	65	264	53	195	38	195	30	139	24
Lakewood Beach Park	84	28	21	13	33	19	71	8	68	23
Miller Beach	82	19	32	10	39	15	49	7	NS	NS
Moss Point	113	21	113	11	27	4	110	8	197	24
Noble	96	25	80	10	45	6	179	13	127	17
Nokomis	NS	NS	NS	NS	44	17	109	24	181	33
Old Woman East (Oberlin Beach)	27	15	14	2	16	3	32	5	33	13

Beach	2015		2016		2017		2018		2019	
	Seasonal geomean	number of days posted	Seasonal geomean	number of days posted	Seasonal geomean	number of days posted	Seasonal geomean	number of days posted	Seasonal geomean	number of days posted
Old Woman West	56	24	18	5	26	3	32	8	17	5
Orchard Beach	NS	NS	NS	NS	NS	NS	52	15	54	16
Parklawn	47	9	55	9	21	0	16	0	51	6
Royal Acres	104	13	69	6	126	24	153	22	146	13
Sawmill Creek	42	11	24	11	26	12	24	0	23	6
Sherod Creek	89	49	49	19	67	12	103	16	95	24
Shoreby Club	90	14	13	0	23	2	64	13	NS	NS
Showse	44	24	22	10	28	13	22	2	55	14
Sims	184	32	227	33	91	21	197	10	196	19
Sugar Creek	60	30	46	12	62	13	NS	NS	NS	NS
Utopia	235	34	43	2	54	10	62	8	124	24
Vermilion East (Lagoons Beach)	65	26	38	16	52	26	49	10	99	24
Vermilion West (Main Street Beach)	143	46	52	9	51	6	87	15	96	23
Veteran's Beach	198	39	53	28	78	27	91	17	118	32
Villa Angela	231	54	122	39	114	39	99	33	158	24
Wagar	65	16	46	9	29	7	48	2	43	8
Walnut	16	14	22	2	10	2	13	2	13	0

Shaded cells indicate exceedance of the geometric mean criterion on a seasonal basis *(seasonal geomean)* or exceedance of the BAV more than 10 percent of the time during a season. The beach season is defined for this analysis as the time *E. coli* monitoring commences, typically in late May though the end of the Labor Day weekend. The number of days posted is determined by counting the number of days the BAV was exceeded. Days for which no monitoring data were collected are presumed to be in exceedance if the preceding day's bacteria level exceeded the BAV. Unmonitored days are presumed to meet the BAV when preceded by a monitored day that was below the BAV. NS = Not Sampled

Table F-7 — The number of days per season (and the percentage for all years) when Ohio Lake Erie public beaches exceeded the BAV relative to the total number of days in the sampling period, 2015 – 2019, for the central basin shoreline AU.

Beach	2015	2016	2017	2018	2019	All years (%)
Arcadia Beach	39/104	4/97	28/98	12/97	35/97	118/493 (23.9%)
Bay Park Beach	13/105	3/98	4/98	7/98	13/98	40/497 (8.0%)
Century Beach	34/113	10/106	13/106	23/106	29/106	109/537 (20.3%)
Clarkwood Beach	22/104	4/97	23/97	15/97	8/97	72/492 (14.6%)
Clifton Beach	22/105	11/98	6/98	23/98	14/98	76/497 (15.3%)
Columbia Park Beach	20/105	6/98	13/96	4/92	19/98	62/489 (12.7%)
Community Park Beach	29/113	16/106	9/106	8/106	25/106	87/537 (16.2%)
Conneaut Township Park	3/92	2/76	4/92	2/106	2/106	13/472 (2.8%)
Edgecliff Beach	37/104	8/97	19/97	15/97	19/97	98/492 (19.9%)
Edgewater State Park	22/109	11/104	7/102	13/131	7/71	60/517 (11.6%)
Euclid State Park	42/109	27/104	33/109	25/131	19/71	146/524 (27.9%)
Fairport Harbor	28/112	23/102	20/106	17/104	5/98	93/522 (17.8%)
Geneva State Park	3/92	0/76	2/92	2/106	5/106	12/472 (2.5%)
Headlands State Park East	18/112	16/106	15/106	13/104	NS	62/428 (14.5%)
Headlands State Park West	18/113	16/106	16/106	15/104	11/98	76/527 (14.4%)
Huntington Beach	30/113	15/106	12/106	15/106	6/105	78/536 (14.6%)
Lakeshore Park	33/92	38/76	0/92	16/106	2/106	89/472 (18.9%)
Lakewood Beach	28/113	13/99	19/106	9/106	24/106	93/530 (17.5%)
Miller Beach	19/105	10/99	15/106	7/106	NS	51/416 (12.3%)
Moss Point Beach	21/104	11/97	4/97	8/97	24/97	68/492 (13.8%)
Noble Beach	25/104	10/97	6/97	13/97	17/97	71/492 (14.4%)
Parklawn Beach	9/105	9/98	0/98	0/98	6/98	24/497 (4.8%)
Royal Acres Beach	13/104	6/97	24/97	22/97	13/97	78/492 (15.9%)
Shoreby Club Beach	14/104	0/97	2/97	13/97	NS	29/395 (7.3%)
Sims Beach	32/104	33/97	21/97	10/97	19/97	115/492 (23.4%)
Utopia Beach	34/104	2/97	10/98	8/97	24/97	78/493 (15.8%)
Veteran’s Beach	39/105	28/99	27/106	17/106	32/106	143/522 (27.4%)
Villa Angela State Park	54/109	39/104	39/110	33/131	24/85	189/539 (35.1%)
Wagar Beach	16/105	9/98	7/92	2/92	8/98	42/485 (8.7%)
Walnut Beach	14/92	2/76	2/92	2/106	0/106	20/472 (4.2%)

Table F-8 — The number of days per season (and the percentage for all years) when Ohio Lake Erie public beaches exceeded the BAV relative to the total number of days in the sampling period, 2015 – 2019, for the western basin shoreline AU.

Beach	2015	2016	2017	2018	2019	All years (%)
Camp Perry	26/113	13/106	19/106	9/106	9/107	76/538 (14.1%)
Catawba Island State Park	11/113	0/106	2/104	0/106	0/106	13/535 (2.4%)
East Harbor State Park	5/113	2/106	3/106	0/106	5/106	15/537 (2.8%)
Lakeside Beach	7/113	0/106	4/106	0/106	1/106	12/535 (2.2%)
Maumee Bay State Park (inland)	28/105	29/103	37/98	37/104	41/98	172/508 (33.9%)
Maumee Bay State Park (Erie)	45/105	39/103	34/98	31/104	23/98	172/508 (33.9%)
Port Clinton	32/113	7/106	13/106	7/106	NS	59/431 (13.7%)

Table F-9 — The number of days per season (and the percentage for all years) when Ohio Lake Erie public beaches exceeded the BAV relative to the total number of days in the sampling period, 2015 – 2019, for the islands shoreline AU.

Beach	2015	2016	2017	2018	2019	All years (%)
Kelleys Island State Park	0/111	10/106	4/106	6/106	8/106	28/535 (5.2%)
South Bass Island State Park	2/113	0/106	0/104	0/106	0/106	2/535 (0.4%)

Table F-10 — The number of days per season (and the percentage for all years) when Ohio Lake Erie public beaches exceeded the BAV relative to the total number of days in the sampling period, 2015 – 2019, for the Sandusky basin shoreline AU.

Beach	2015	2016	2017	2018	2019	All years (%)
Battery Park	4/113	0/106	0/106	0/106	10/106	14/537 (2.6%)
Bay View East	21/113	18/106	11/105	20/106	5/106	75/537 (14.0%)
Bay View West	42/113	76/106	50/106	46/106	14/105	228/537 (42.5%)
Cedar Point Chausee	8/113	7/106	11/106	7/106	5/106	38/537 (7.1%)
Chappel Creek (Beulah Beach)	27/113	26/106	19/106	15/105	19/106	106/536 (19.8%)
Cranberry Creek	20/113	4/106	17/106	14/102	11/107	66/534 (12.4%)
Crystal Rock	18/113	2/106	20/106	0/106	3/106	43/537 (8.0%)
Darby Creek	30/113	16/106	22/106	18/104	27/106	113/535 (21.1%)
Edson Creek	56/113	14/45	NS	NS	NS	70/158 (44.3%)
Heidelberg Beach (Fichtel Creek)	15/113	4/106	9/106	10/105	18/106	56/537 (10.4%)
Hoffman Ditch	25/113	9/106	17/106	NS	NS	51/325 (15.7%)
Huron River East	28/113	33/106	16/106	15/105	4/107	96/537 (17.9%)
Huron River West	28/113	11/82	33/106	27/106	11/106	110/513 (21.4%)
Kiwanis (Pipe Creek)	44/113	7/106	10/106	2/106	3/106	66/537 (12.3%)
Lakeview Beach	65/113	53/106	38/106	30/106	24/106	210/537 (39.1%)
Lion’s Park	12/113	22/106	10/106	7/102	28/101	79/528 (15.0%)
Nokomis	NS	NS	17/78	24/105	35/106	76/289 (26.3%)
Old Woman Cr. East (Oberlin Beach)	15/113	2/106	3/106	5/105	13/106	38/536 (7.1%)
Old Woman Creek West	24/113	5/106	3/106	8/105	5/106	45/536 (8.4%)
Orchard Beach	NS	NS	NS	15/105	16/106	31/211 (14.7%)
Pickerel Creek	24/113	13/106	13/106	6/106	38/106	94/537 (17.5%)
Sawmill Creek	11/113	11/106	12/106	0/106	6/106	40/537 (7.4%)
Sherod Creek	49/113	19/106	12/106	16/105	24/106	120/536 (22.4%)
Showse Park	24/113	10/106	13/105	2/105	15/106	64/535 (12.0%)
Sugar Creek	30/113	12/106	13/106	NS	NS	55/325 (16.9%)
Vermilion River East	26/113	16/106	26/106	10/105	24/106	102/537 (19.0%)
Vermilion River West (Main St Beach)	46/113	9/106	6/106	15/105	23/106	99/536 (18.5%)
Whites Landing	45/113	36/106	22/106	6/106	8/106	117/537 (21.8%)

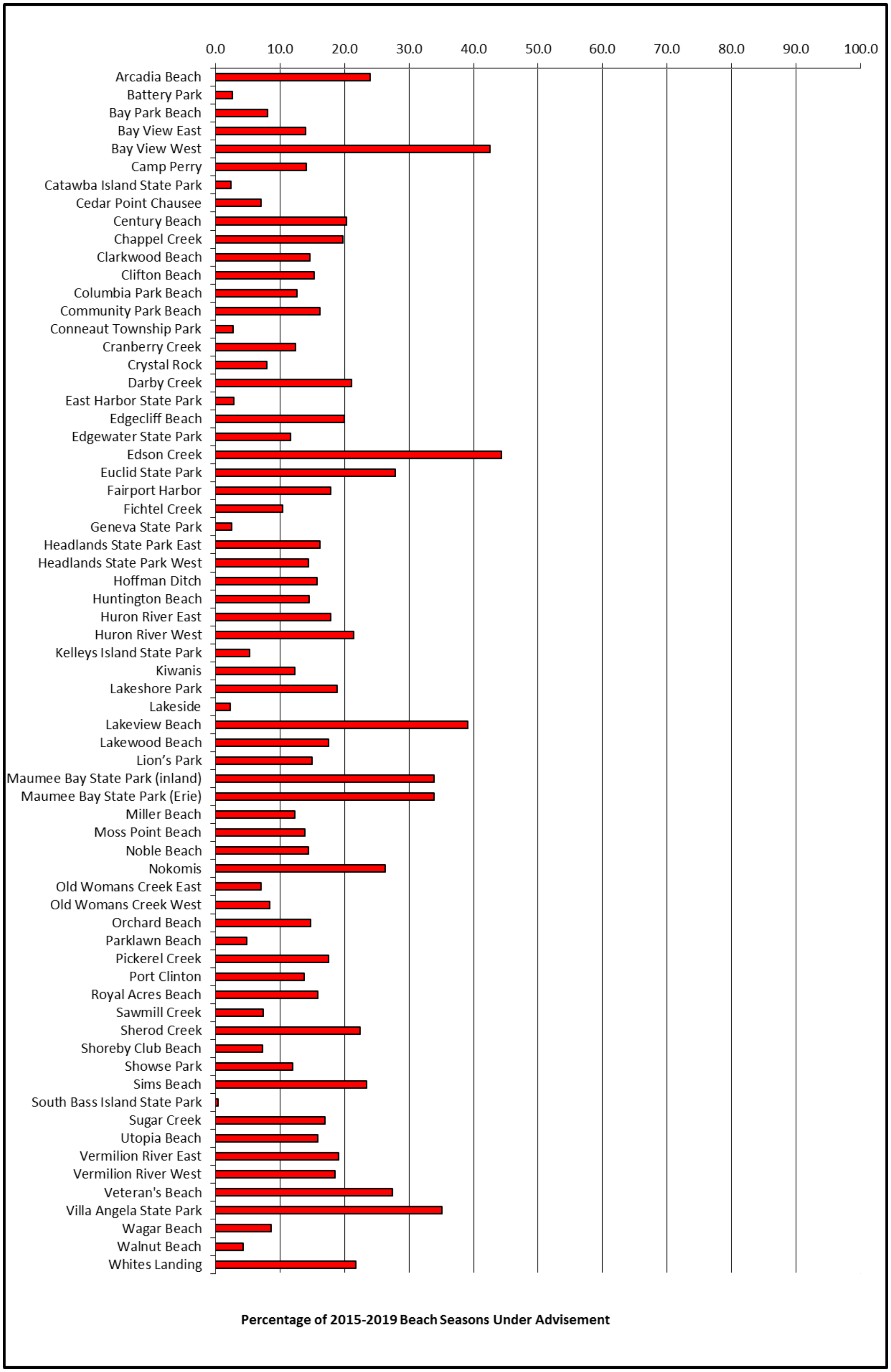

Figure F-5 — Frequency of advisory postings at Ohio's Lake Erie public beaches.

Table F-11 — Aggregated exceedance frequencies at 65 Lake Erie public beaches from 2015-2019 (pooled by Lake Erie shoreline AU to report use support).

	Western Basin	Central Basin	Sandusky Basin	Lake Erie Islands
Number of beaches	7	30	28	2
Total recreation days	3,594	14,821	13,610	1,070
Total days in exceedance	519	2,292	2,302	30
Percentage of days in exceedance	14.4%	15.5%	16.9%	2.8%
Total beach seasons[1]	34	147	128	10
Average # of days *E. coli* BAV exceeded per beach per season[2]	15.3	15.6	18.0	3.0
Number of beaches exceeding 90-d geomean one or more years during reporting cycle[3]	2	13	8	0
Number of beaches exceeding STV within a 90-day period in one or more years during the reporting cycle[3]	5	30	28	1
Attainment status	Does not support	Does not support	Does not Support	Does not Support

[1] The total number of beach seasons in a basin is equal to aggregated sum of the total number of beaches for which monitoring was conducted during each season for the 2015-2019 reporting period.
[2] Calculated by dividing the total days in exceedance in the basin by the total number of beach seasons in the basin.
[3] Used to determine attainment status.

Rivers and Streams

Ohio's RU support analysis is based on an examination of *E. coli* data collected from Ohio's rivers, streams and inland lakes during the recreation season. Approximately 2,300 bacteria measurements were collected and evaluated to support the recreational use assessment of streams and rivers in Ohio as part of this reporting cycle (Table F-4). This is comparable to the number of *E. coli* measurements used in the 2018 assessment cycle (about 2,100 samples). Assessments for this cycle consist of data collected by Ohio EPA in 2016-2019, which are summarized in Table F-4.

Table F-12 provides a summary of Ohio EPA's RU monitoring effort and its translation to use assessment annually for the past nine recreation seasons. Sample collection in the 2016-2017 biennium was down by about one-third compared to the previous biennium and dropped another 25% in the 2018-2019 biennium compared to the 2016-2017 sampling effort.

Table F-12 — Annual Ohio EPA E. coli sampling effort and RU assessment (using Ohio EPA data) in Ohio's surface waters, 2011-2019 recreation seasons.

	2011	2012	2013	2014	2015	2016	2017	2018	2019
Number of samples collected by Ohio EPA	1,674	1,173	1,635	1,423	1,231	922	890	315	145
Number of site geometric means computed	276	219	269	222	219	119	137	32	29
Number of unique WAUs assessed	130	92	131	121	115	85	74	22	15
Number of unique LRAUs assessed	3	5	2	1	0	2	5	0	0

The *E. coli* data used in this report to assess rivers and streams were collected by Ohio EPA staff as part of routine ambient monitoring associated with annual drainage basin surveys conducted around the state. One of the objectives of the annual basin surveys is to collect data to support use assessments needed to fulfill obligations under Section 303 and 305 of the Clean Water Act, which includes the E. *coli* data collected as part of these surveys and used in this report. Using the methodology described in Section F2 and the ambient E. coli data collected by Ohio EPA in 2016-2019, it was possible to determine the RU attainment status of 196 of the 1,538 (13 percent) WAUs in Ohio.

Widespread impairment of the recreation use was documented in Ohio's streams and rivers based on the *E. coli* data collected from 2016-2019. A total of 180 of the 196 WAUs assessed this cycle failed to support the recreational use (Table F-13). This is similar to the widespread and pervasive impairment of the recreation use observed in previous reporting cycles and documented in numerous integrated reports. As can be readily seen in Table F-13, high impairment rates were observed in all the basins sampled and regardless of sample year.

In addition to Ohio's 1,538 WAUs, there are also 23 large rivers in Ohio, eight of which are further divided into two or more subdivisions for a total of 38 large river assessment units. Large river assessment units have drainage areas greater than 500 square miles and comprise, in total, 1,236 river miles in the state. The large river assessment units were analyzed independently of the WAUs through which they flow and LRAU data were not included in WAU assessments. Table F-13 summarizes the results of the analysis of *E. coli* data for the large river assessment units and the resulting RU support determinations. Sufficient data were available to determine the use support status for just six of the 38 LRAUs (16 percent) in the 2020 reporting cycle. No new LRAUs were sampled or assessed in the past two years. However, as part of the new monitoring strategy that is scheduled to be implemented in 2020, all of Ohio's large rivers will be sampled providing a statewide assessment snapshot of these water bodies for the first time.

Table F-13 — Recreational use assessment summary of Ohio's streams and rivers for the 2020 assessment cycle.

				HUC 12s			LRAU Segments	
Survey	Year	Sites	Samples	#	Supporting	Not Supporting	Supporting	Not Supporting
Raccoon Creek Basin	2016	29	189	22	0	22	0	1
Huron River Basin	2016	20	100	17	2	15	N/A	N/A
Conotton Creek Basin	2016	46	230	11	2	9	N/A	N/A
Southwest Ohio River Trib Basin	2016	18	90	17	4	13	N/A	N/A
Symmes Creek Basin	2016	19	145	16	2	14	N/A	N/A
Cuyahoga River Mainstem	2016	16	168	2	0	2	0	1
Upper Tuscarawas River Basin	2017	21	208	15	1	14	0	1
Lower Tuscarawas River Basin	2017	29	226	13	0	13	0	2
Sugar Creek Basin	2017	16	80	15	1	14	N/A	N/A
Whitewater River Basin	2017	13	65	6	0	6	0	1
Swan Creek, Toussaint River, lower Maumee and Western Lake Erie Tributaries Basin	2017	28	140	19	2	17	N/A	N/A
Cuyahoga River Mainstem	2017	30	171	6	0	6	0	1
Cuyahoga River Tributaries Basin	2018	32	315	22	2	20	N/A	N/A
Upper Auglaize River Basin	2019	29	145	15	0	15	N/A	N/A
	Totals	**346**	**2,182**	**196**	**16**	**180**	**0**	**7**

The overall attainment and impairment rates and the changes between reporting years are summarized in Table F-14. Attainment and impairment rates in Table F-14 are based on the total number of watersheds for which sufficient data were available in the respective reporting cycle and not on the total number of assessment units in the state. For the 196 assessment units for which sufficient data were available to determine the RU assessment status in 2020, only eight percent fully supported the recreation use while 92 percent did not support the recreation use. These results are comparable to the results from previous cycles that consistently show only a small proportion of the state's watersheds demonstrate full support of the RU. Only seven percent of the individual stream locations sampled by Ohio EPA in 2017-2018 were found to attain the applicable recreation criteria compared to just 15 percent of the individual sites sampled by Ohio EPA in 2015 and 2016.

Table F-14 — Overall differences in the assessment of RU attainment, 2010-2020.

	2010 Report		2012 Report		2014 Report		2016 Report		2018 Report		2020 Report	
	#	%	#	%	#	%	#	%	#	%	#	%
Total AUs[1]	1,576	100	1,576	100	1,576	100	1,576	100	1,576	100	1,576	100
Assessed	487	31	588	37	680	43	713	45	170	11	203	13
Not Assessed	1,089	69	988	63	896	57	863	55	1,406	89	1,380	87
Supporting Use[2]	65	13	88	15	130	19	73	10	14	8	16	8
Not Supporting Use[2]	422	87	500	85	550	81	640	90	156	92	180	92

[1] Includes LRAUs.

[2] Note: The percentage of AUs reported as supporting the RU and not supporting the RU are based on the total AUs that were assessed that calendar year (e.g., 203 for the 2020 calendar year).

The RU attainment status of Ohio's 1,538 WAUs is summarized in Table F-15. This table differs slightly from the summary presented in Table F-14 as this table accounts for those watersheds for which TMDLs have been completed and placed into category 4 and it also includes historic categorizations carried over from previous reporting cycles. WAUs attaining the recreational WQS appear to have leveled off at around 10 percent. WAUs not supporting the recreation use, and in need of a TMDL, increased to 50 percent. The number of WAUs that have never been assessed for recreational use attainment stands at about 14 percent. To date, Ohio has completed total maximum daily loads (TMDLs) for bacteria in 404 of the 1,538 WAUs in Ohio (26 percent).

Bacteria data collected in support of the past six IR cycles clearly shows that the swimmable goal of the CWA is largely unsupported across Ohio with very little improvement evident over time. Because of the ubiquitous nature of the problem, Ohio EPA is now pursuing a statewide TMDL for bacteria and exploring opportunities for substantial implementation activities in cooperation with state and local partners to identify and address bacteria loading sources. These activities should be coupled with continued monitoring to measure success and trends.

Table F-15 — Summary assessment status of the RU in Ohio's WAUs by Assessment Cycle[1].

Assessment Category	Number of Assessment Units Categorized						Percentage of Assessment Units Categorized					
	2010	2012	2014	2016	2018	2020[2]	2010	2012	2014	2016	2018	2020
1	59	103	141	153	141	159	4%	7%	9%	10%	9%	10%
3	888	673	511	252	182	208	58%	44%	33%	16%	12%	14%
4	266	341	425	449	449	404	17%	22%	28%	29%	29%	26%
5	325	421	461	685	766	769	21%	27%	30%	45%	50%	50%
Total	**1,538**	**1,538**	**1,538**	**1,538**	**1,538**	**1,538**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

[1] See Section J for assessment category descriptions.

[2] During the transition of data into U.S. EPA's ATTAINS, refinement was made on the number of WAUs included in TMDL reports, which is why the number of WAUs in category 4 decreased and the number of WAUs in category 3 increased.

Inland Lakes

ODNR's Division of Parks and Recreation also conducts routine bacteria sampling of public bathing beaches at inland state park beaches pursuant to Ohio Revised Code sections 1541.032 and 3701.18. Advisory signs are posted whenever notified by the director of the Ohio Department of Health that the bacteria levels in the waters tested present a possible health risk to swimmers. Advisory postings are recommended whenever the *E. coli* density of a water sample exceeds the bathing water BAV of 235 cfu/100 mL. Sampling frequency at the inland state park beaches is generally once every two weeks. This sampling frequency is much less intense compared to sampling frequency at many of the Lake Erie beaches, which typically occurs at a frequency of four or more days per week.

Table F-16 summarizes the advisory postings from 2015 through 2019 at 50 inland public recreation lakes, primarily located at Ohio's state parks. Some of these lakes had multiple beach locations. Beaches at which more than 10 percent of the samples collected over a recreation season exceeded the BAV of 235 cfu/100 mL are highlighted in blue. The inland lake data from ODNR are presented in the IR for informational purposes and not for official use support determinations since the level of data credibility was indeterminate at the publication of this report. Its inclusion here is intended to notify readers of the existence of this sampling program for these popular recreational resources in Ohio and to provide some information as to the relative amount of data and relative water quality conditions with respect to bacteria indicators. Should Ohio EPA affirm the data as Level 3 credible data in the future, it will be considered in the process for making official use support determinations.

Beaches at inland state park lakes are tested for bacteria less frequently compared to those beaches along Lake Erie. Sampling was most frequent at Seneca Lake (2016-2019), Atwood Lake (2016-2018), Charles Mill Lake, (2017-2018), Pleasant Hill Lake (2017-2018) and Tappan Lake (2016-2019). Even at these beaches, the sampling frequency is roughly only half as intense as that of many Lake Erie beaches (Figure F-5).

The sample results in Table F-16 indicate that at most of the inland lake beaches, the BAV of 235 cfu/100mL is not frequently exceeded, resulting in fewer postings compared to some of the beaches along Lake Erie. There were 39 inland lake beach locations where the overall exceedance frequency was less than 10 percent of the samples collected during the five-year reporting period. Overall, the frequency of exceedances for all the inland lake beaches during the five-year reporting period was 11.9 percent, slightly lower than the 13.8 percent rate reported in the previous cycle and similar to the 12.4 percent rate reported in the 2011-2015 cycle, which in turn was slightly higher than the 10.5 percent reported in the 2008-2012 reporting period. There were 29 inland lake beaches where the aggregated exceedance frequency was more than 10 percent. The highest aggregated exceedance frequency of 42 percent was found at the Dillon Reservoir followed by Madison Lake at 36 percent and Buckeye Lake's Crystal Beach at 32 percent. Twelve beaches exceeded the BAV 20 percent or more of the time over the five-year reporting period total: Alum Creek's main beach, Buckeye Lake's Fairfield and Crystal beaches; Caesar Creek Lake (south beach); Charles Mill Lake; Dillon Reservoir; Jackson Lake; Lake Loramie; Madison Lake; Pike Lake; Seneca Lake; and Tappan Lake.

Sample results at some inland lake beaches indicated a need for posting an advisory much more frequently during certain years. For example, five of 18 (28 percent) of the samples collected at Stonelick Lake exceeded the BAV in 2017 while none of the 15 samples exceeded the BAV in 2016 at Stonelick Lake. More frequent sampling, particularly at beaches where previous sampling data indicates an increased likelihood of exceeding the recreation criteria, should be considered by beach managers so that the public can be adequately informed of actual water quality conditions at the time of their visit. Sampling results at other lakes appear remarkably consistent, such as Alum Creek Lake's main beach, where from 2013-2017 the annual exceedance rate of the BAV ranged from 20 to 30 percent per year or Findlay Lake, where no exceedances were observed during annual sampling over the past five years.

Table F-16 — Swimming advisory postings at 50 Ohio inland lake public beaches (2015-2019).

Park	Beach	County	2015[1]	2016[1]	2017[1]	2018[1]	2019[1]	Total[1]
Alum Creek	Main	Delaware	2/9	2/10	3/11	2/10	2/8	11/48
	Camp	Delaware	1/8	0/8	0/8	0/7	1/8	2/39
Atwood Lake		Carroll	--	11/44	1/28	1/26	2/12	15/110
Barkcamp		Belmont	0/12	0/9	0/7	0/8	0/8	0/44
Blue Rock		Muskingum	2/10	3/10	0/7	--	1/5	6/32
Buck Creek	Main	Clark	1/9	1/9	0/8	0/8	5/11	7/45
	Camp	Clark	0/8	0/7	0/8	0/8	1/9	1/40
Buckeye Lake	Crystal Beach	Fairfield	3/4	0/1	3/7	--	0/7	6/19
	Fairfield Beach	Fairfield	2/4	--	0/7	4/6	0/6	6/23
Burr Oak	Main	Athens	1/10	0/9	0/8	0/8	0/9	1/44
Caesar Creek	North	Warren	3/11	1/9	0/8	1/9	1/8	6/45
	South	Warren	1/11	2/9	4/10	3/10	0/8	10/48
Charles Mill Lake		Ashland	--	0/1	4/23	6/24	7/15	17/63
Cowan Lake	Main (S)	Clinton	1/10	0/7	0/8	2/10	1/9	4/44
	Camp (N)	Clinton	1/10	0/7	0/8	2/10	0/9	3/44
Deer Creek		Pickaway	0/10	0/7	2/10	0/6	2/9	4/42
Delaware		Delaware	3/9	1/10	2/10	0/8	3/11	9/48
Dillon		Muskingum	6/11	1/9	3/10	6/10	4/8	20/48
East Fork	Main	Clermont	0/16	0/15	2/16	0/14	2/15	4/76
Findlay		Lorain	0/9	0/8	0/5	0/8	0/8	0/38
Forked Run		Meigs	2/12	0/7	0/7	0/8	1/9	3/43
Grand Lake St. Marys	Main East	Auglaize	2/9	2/9	0/9	1/9	0/9	5/45
	Main West	Auglaize	3/11	1/9	0/9	0/8	0/8	4/45
	Camp	Auglaize	1/9	3/11	1/10	2/10	0/8	7/48
	Windy Point	Auglaize	4/10	0/8	0/9	0/8	1/8	5/43
Guilford Lake	Main	Columbiana	0/8	0/6	0/8	1/8	1/7	2/37
	Camp	Columbiana	0/7	0/6	1/8	1/8	0/6	2/35
Harrison Lake		Fulton	1/10	1/9	0/8	2/9	3/10	7/46
Hueston Woods		Preble	1/9	0/8	0/8	0/8	1/10	2/43
Indian Lake	Fox Island	Logan	1/9	2/10	1/9	0/8	1/9	5/45
	Camp	Logan	1/9	0/8	1/9	1/9	1/9	4/44
	Oldfield	Logan	1/9	0/8	0/8	0/8	1/9	2/42
Jackson Lake		Jackson	2/10	1/8	1/8	0/8	7/14	11/48
Jefferson Lake		Jefferson	1/8	0/8	0/8	0/8	1/7	2/39
Kiser Lake		Champaign	2/9	1/9	0/8	1/9	1/7	5/42
Lake Alma	#1-West	Vinton	0/6	0/8	0/8	0/8	0/8	0/38
Lake Hope		Vinton	0/8	0/8	0/8	0/8	0/8	0/40
Lake Logan		Hocking	0/8	0/7	3/11	1/8	0/8	4/42
Lake Loramie		Shelby	5/12	3/11	1/10	1/9	2/10	12/52
Lake Milton		Mahoning	0/8	1/9	0/6	1/9	2/9	4/36
Madison Lake		Madison	6/12	3/11	4/10	4/11	3/11	20/55
Monroe Falls		Summit	--	0/10	--	0/5	0/6	0/21
Mosquito		Trumbull	3/9	1/7	0/8	1/9	0/8	5/40
Paint Creek		Ross	0/8	1/9	1/8	1/9	1/8	4/42
Pike Lake		Pike	2/7	1/9	4/11	2/8	1/6	10/41
Pleasant Hill		Richland	--	0/1	0/24	0/24	0/18	0/67
Portage Lakes	Main	Summit	1/9	2/10	0/8	1/8	1/8	5/43

Park	Beach	County	2015[1]	2016[1]	2017[1]	2018[1]	2019[1]	Total[1]
Punderson		Geauga	0/7	0/8	1/8	1/9	0/8	2/40
Pymatuning	Main	Ashtabula	0/7	0/6	0/9	0/8	1/9	1/39
	Camp	Ashtabula	1/7	0/6	0/9	0/8	0/8	1/38
	Cabins	Ashtabula	0/6	0/6	0/9	0/8	0/8	0/37
Rocky Fork	North Shore	Highland	1/8	1/9	0/8	0/8	0/8	2/41
	South Shore	Highland	1/8	0/9	1/9	2/10	2/10	6/46
Salt Fork	Main	Guernsey	0/8	0/9	1/9	0/6	0/7	1/39
	Camp	Guernsey	0/8	0/9	0/8	0/6	0/8	0/39
Scioto Trail		Ross	1/8	0/7	0/8	0/8	2/9	3/40
Seneca Lake		Noble	--	10/45	3/25	1/26	10/24	24/120
Shawnee	Turkey Cr Lodge	Scioto	1/9	0/7	0/9	1/8	0/3	2/36
	Roosevelt Camp	Scioto	0/6	1/8	0/9	4/8	0/3	5/34
Silver Creek		Summit	--	1/10	--	2/5	1/6	4/21
Stonelick		Clermont	0/16	0/15	4/18	7/18	3/16	14/83
Strouds Run		Athens	2/10	0/8	0/7	2/10	0/8	4/43
Tappan Lake		Harrison	--	12/46	2/25	5/24	11/23	30/118
Tar Hollow	Main	Ross	2/9	0/7	0/8	0/8	0/8	2/40
	Camp	Ross	1/8	1/8	0/8	1/9	0/9	3/42
West Branch	Main	Portage	0/8	0/9	1/9	0/8	2/8	3/43
	Camp	Portage	0/8	0/9	0/8	0/8	1/7	1/40
Wolf Run		Noble	0/8	1/8	0/7	0/8	0/9	1/40
	Total Advisory Postings[a]		76	72	55	74	94	371/ 3,121

[1] Indicates the number of advisories posted, based on a measured E. coli density exceeding 235 cfu/100 mL, followed by the number of samples collected.

F4. Recreation Assessment for Algae in Lake Erie

Background

A healthy Lake Erie is a vital component of Ohio's economic and ecological health. Funding under the Great Lakes Restoration Initiative (GLRI) and other sources has led to the availability of data and opportunities to expand assessment and reporting of water quality conditions in Lake Erie. These combined data sets, along with advances in the use of satellite imagery to detect, quantify and track algal blooms, allow Ohio to include in this report methods to assess Lake Erie for recreation impairment caused by algae.

In 2017, Ohio EPA requested input from representatives from The Ohio State University Sea Grant College Program, University of Toledo, Bowling Green State University and NOAA to identify metrics that would provide a scientifically relevant determination of impairment. The request stated that the metrics needed to provide a reasonable, objective assessment method for the western basin open water using targets that will meet the goals established by the GLWQA Annex 4 committee and provide assurance that the WQS are met. The results of the first phase of this method development have been applied to the western basin. This method is explained below and has been published in the scientific journal *Harmful Algae* (Davis, et al 2019).

In 2019, Ohio EPA received additional input from the same government and university experts to consider recreation use assessment methods for the other Lake Erie AUs. Specific metrics now exist for four assessment units: western open water, Sandusky shoreline, Sandusky open water and central open water. See Figure F-6 for a map of Lake Erie's assessment units.

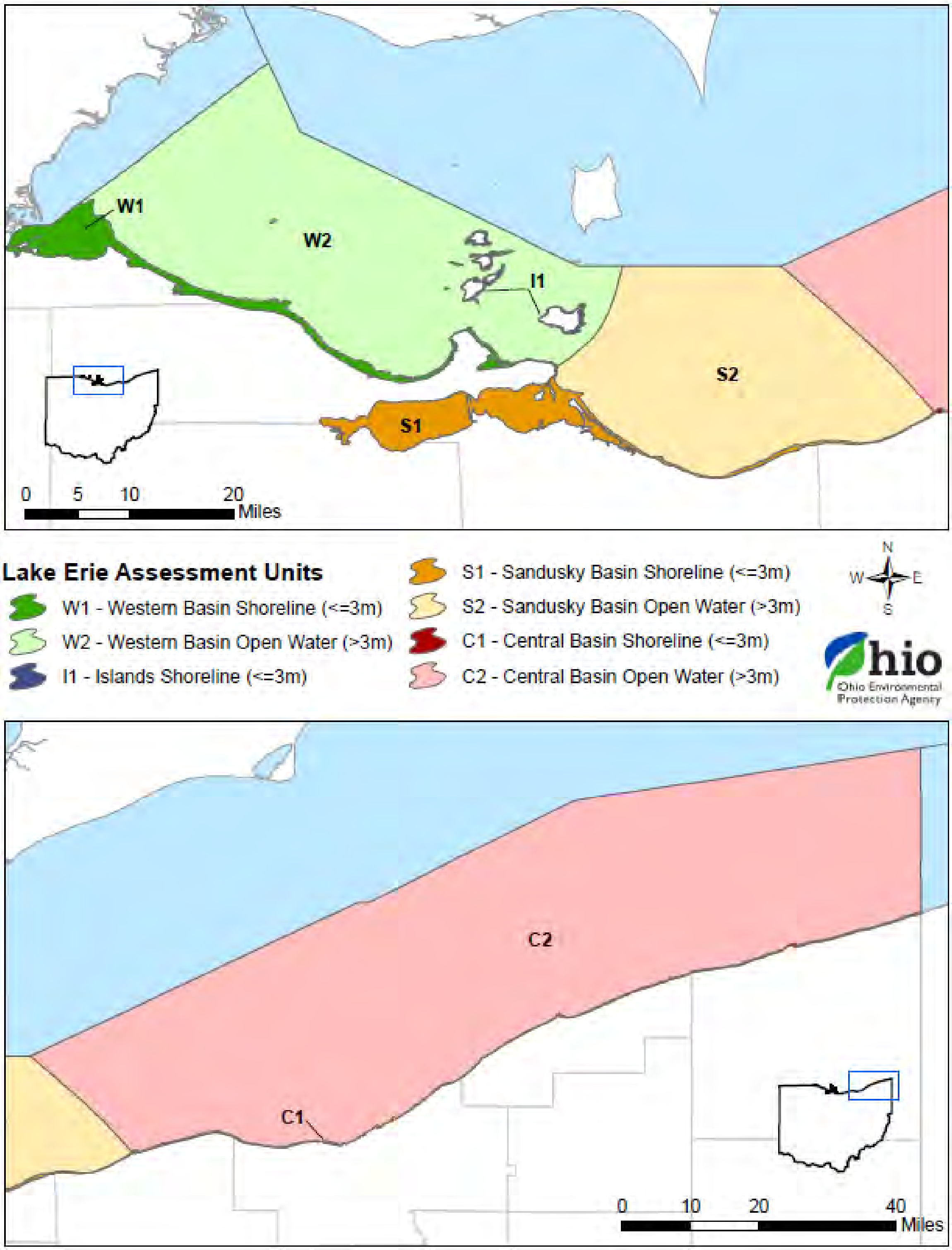

Figure F-6 — Ohio's Lake Erie assessment units – western basin, islands, Sandusky basin, and central basin shorelines and open water areas.

Evaluation Method

Targets for Lake Erie Algal Blooms

A common means to estimate algal productivity and trophic status is to measure the photosynthetic pigment chlorophyll a in a filtered water sample. The importance of phosphorus as the limiting nutrient that feeds algal blooms is also recognized. Ohio does not have numeric criteria for these constituents in Lake Erie and no federal criteria have been established to date. The use of discreet sampling of these parameters to assess a large, dynamic lake would require a great deal of extrapolation. Davis, et al 2019 points out that the this would be problematic in Lake Erie because of the "patchy and temporally variable nature of blooms." Given the great spatial and temporal interpolation assumptions that would be required in using traditional water quality parameters, the researchers explored using remote sensing/satellite data to develop targets for the open water AUs.

Ohio water quality standards (OAC 3745-1-04) do contain narrative requirements that all surface waters be:

> *"(D) Free from substances entering the waters as result of human activity in concentrations that are toxic or harmful to human, animal or aquatic life or are rapidly lethal in the mixing zone.*
> *(E) Free from nutrients entering the water as a result of human activity in concentrations that create nuisance growths of aquatic weeds and algae."*

These narrative criteria provide the basis for the following descriptions of algal bloom targets for the Lake Erie AUs.

Lake Erie Western Basin

The foundation of Ohio's assessment method for algae is an evaluation of the western basin algal bloom pattern over time, such as that conducted by NOAA in 2012 (Stumpf, 2012). Data sets from the MODIS (or Moderate Resolution Imaging Spectroradiometer) satellite (2012 to 2017) were used for this first assessment. For long-term sustainability, Ohio will transition to using the Ocean Land Colour Imager on Sentinel-3 series of satellites. The GLWQA Annex 4 committee set goals for phosphorus loadings to the lake at levels that are expected to produce a bloom no greater than those that occurred in 2004 or 2012. The extent of algal bloom coverage considered acceptable, or attaining the recreation use designation, should be no greater than that in 2004 or 2012.

In addition, the algae (cyanobacteria) cell count level in the bloom as observed via the satellite data sets should be no greater than 20,000 cells/mL. In the western basin of Lake Erie, when cyanobacteria capable of producing cyanotoxins, especially *Microcystis*, exceed concentrations of 20,000 cells/mL, there is a higher likelihood that cyanotoxins will be present at detectable concentrations. The relationship between the presence of *Microcystis* blooms and elevated microcystin concentrations has been well documented in the Lake Erie western basin (Bridgeman, 2013). This density (20,000 cells/mL) corresponds to the nominal floor used by NOAA to analyze satellite images with a comfortable degree of certainty (Wynne and Stumpf, 2015). In Lake Erie's western basin scum formation is likely at this cell density. Potential for skin irritations also may occur at 20,000 cells/mL, but this does not drive the recommended threshold value. The threshold is based on elevated likelihood of scum formations at 20,000 cells and data show that scums consistently have toxin concentration exceeding microcystin concentrations protective of human health recreation exposure.

Furthermore, in large systems like western Lake Erie, blooms can be patchy therefore it is critical to integrate data over large areas. Each pixel from a satellite image represents an average cell count across ~9 hectares (~22 acres). Thus the 20,000 cells/mL that is detected by satellite imagery represents an average cell concentration. Clearly, there will be locations within each pixel that exceed 20,000 cells/mL.

To account for the way that algal blooms shift in time and space in a large water body like the western basin, the method developed is as follows:

- In each 10-day frame, an exceedance means that a bloom with greater than 20,000 cells/mL covers (is present in) more than 30 percent of the western basin open water unit area.
- If three[1] or more 10-day frames have an exceedance in one year (July-Oct.), then that year exceeds the goal (is above the threshold target of the 2004 and 2012 blooms under Annex 4 of the GLWQA).
- Because of the year-to-year variation, if any two or more years in a rolling six-year window exceeds the goal (is above the threshold target of the 2004 and 2012 blooms under Annex 4 of the GLWQA) then the assessment unit is impaired.

Ten-day frames are used as they were determined to be a long enough time period to become a nuisance impeding recreation at a significant level. Within each 10-day frame, an average percent coverage by a bloom at 20,000 cell/mL or greater was calculated for the western basin open water assessment unit (W2 in Figure F-6). In the western basin, blooms typically begin developing by July 22 and peak between August 10 and September 18 (Wynne and Stumpf, 2015). The 10-day time frames used in the assessment method are:

July 1 – July 10	Aug. 10 – Aug. 19	Sept. 19 – Sept. 28
July 11 – July 20	Aug. 20 – Aug. 29	Sept. 29 – Oct. 8
July 21 – July 30	Aug. 30 – Sept. 8	Oct. 9 – Oct. 18
July 31 – Aug 9	Sept. 9 – Sept. 18	Oct. 19 – Oct. 31[2]

The threshold of 30 percent coverage is based on an examination of the bloom coverage in Lake Erie's western basin since 2002 and which blooms were considered to meet the Annex 4 target severity index (the Target Bloom in Figure F-7). Severity Index (SI) is the measure of the peak bloom biomass over a 30-day period (in each year, whichever 30-days captured/represents the most biomass in that year). As illustrated in Figure F-7, bloom severity meets the target in 2004 and very nearly in 2012. In those years the bloom was not considered to significantly impede the recreational use of the water and the extent of coverage did not exceed 30 percent of the western basin open water AU in three or more 10-day frames. Based on this method, it requires five of the last six years to not exceeded the thresholds outlined in order to meet this designated use (or to delist existing impairment). This allows for multiple years of mild or no blooms to be considered without an anomalous occurrence affecting the outcome.

[1] The 2018 Integrated Report mistakenly noted that "more than three" 10-day frames having exceedances is required for a year not to meet its goal. Having three or more exceeding windows however has always been the intent of this method; see Davis, et al. 2019 and Ohio EPA's 2018 Integrated Report public presentation on April 26, 2018 available at ***https://www.youtube.com/watch?v=nlKoBZSQwYU&t=827s***. This clarification does not change the conclusions of the assessments made in the 2016 and 2018 IRs.

[2] Window has 13 days to complete the season.

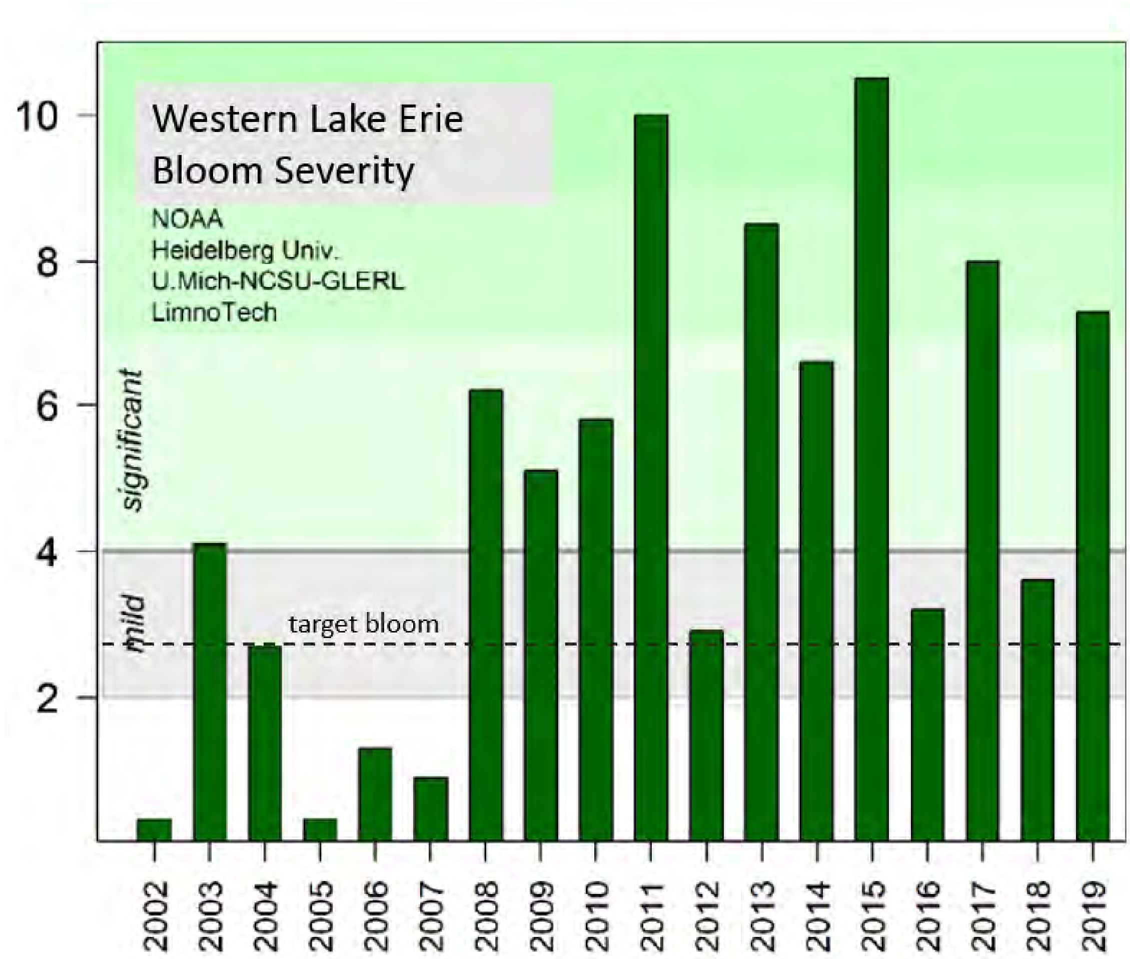

Figure F-7 — Bloom severity observed since 2002. Adapted from figure by Dr. Rick Stumpf, NOAA National Centers for Coastal Ocean Science

Lake Erie Sandusky Shoreline

Each year persistent *Planktothrix* blooms exist in the Sandusky Bay throughout the bloom season (Davis, 2015; Rinta-Kanto, 2006). Unlike the open waters of Lake Erie, the Sandusky Bay bloom is spatially consistent throughout the bay. This results in the bay being a more manageable size for reliable and representable water quality sampling. Therefore, the use of remote sensing was deemed not necessary for the development of an assessment methodology.

Further, although the *Planktothrix* bloom in the bay is persistent, nutrient concentrations change over the course of the bloom season and affect concentration of microcystins. *Planktonthrix* does not typically form scums; rather it is distributed throughout the water column. Because of this we cannot use the rationale applied to the open water assessments that associates *Microcystis* dominated blooms at a certain density with reasonably high microcystins concentrations.

Due to these factors, microcystin data sampled directly from the bay is, therefore, appropriate to be used as the primary attainment determinate. The following outlines the methodology:

- During the June through September Sandusky Bay bloom season, the microcystin value for each 10-day frame, when sampling occurs, will be determined.
  - Each microcystin sampling event value will be calculated by the result of a spatial composite sample collected at seven defined locations in the bay. See Table F-17 and Figure F-8 for the defined sampling locations.
    - The average concentration of total microcystins from a subset of four of the defined locations in the bay can be used for a retrospective analysis. These subset of sampling locations are noted in Table F-17.
  - Microcystin will be collected with 1-meter (from the surface) Van Dorn grab samples.
    - Analysis has shown that 0-2 meter (from the surface) vertically integrated samples are equivalent to 1-meter Van Dorn grab samples in the Sandusky Bay and can be used for this impairment determination in retrospect. See Figure F-9.
  - If more than one microcystin sampling event occurs in a 10-day window, the results of the sampling event with the greatest value will be used to represent that 10-day window.
- In order to address seasonable variation of bloom occurrences, if three or more 10-day frames exceed 6 ug/L microcystin in one year, then that year exceeds the goal.
- In order to address year-to-year variation, if any two or more years in a rolling six-year window exceeds the goal then the unit is impaired.
  - When fewer than six years of results are available, if two years exceed the seasonal goal the unit will be considered impaired. However, the five most recent seasons of results not exceeding the goal are required in order to declare the unit in full attainment.

The bloom season assessed for this AU differs from the open water assessments in that it includes June through September for this AU versus July through October for the open water AUs. This timeframe is based on historical occurrence of microcystins observed by Bowling Green State University (BGSU).

The assessment locations (Table F-17 and Figure F-8) were recommended by BGSU. These stations provide coverage over the full length of Sandusky Bay from the mouth of Muddy Creek Bay in the west to the middle of the lower Bay to the east (Salk, 2018). The subset of four sampling locations noted as appropriate for retrospective analysis were selected based on monitoring carried out by BGSU that went into Salk, 2018 and continued efforts. BGSU has determined that these four locations provide a thorough assessment of bloom characteristics as they occur throughout the Sandusky Bay system.

Ten-day frames are used as they were determined to be a long enough time period to become a nuisance impeding recreation at a significant level. The 10-day time frames used in the assessment method are:

June 1 – June 10	July 11 – July 20	Aug. 20 – Aug. 29
June 11 – June 20	July 21– July 30	Aug. 30 – Sep. 8
June 21 – June 30	July 31 – Aug. 9	Sep. 9 – Sep. 18
July 1 – July 10	Aug. 10 – Aug. 19	Sep. 19 – Sep. 30[3]

[3] Window has 12 days to complete the season.

Table F-17 — Sandusky Bay (S1) Sampling Locations

Station Name	Lat decimal N	Lon decimal W
Environment Canada Station 1163 (or 'EC 1163')	41.469000°	-82.715000°
ODNR 1*	41.477367°	-82.739783°
Sandusky Buoy 2 (or Buoy 2)	41.463222°	-82.769028°
ODNR 2*	41.479817°	-82.782867°
ODNR 6*	41.457300°	-82.898655°
Edison Bridge (or 'Bridge')	41.480156°	-82.834328°
ODNR 4*	41.453333°	-82.960767°

* Denotes the four sites that are appropriate to use for retrospective analysis.

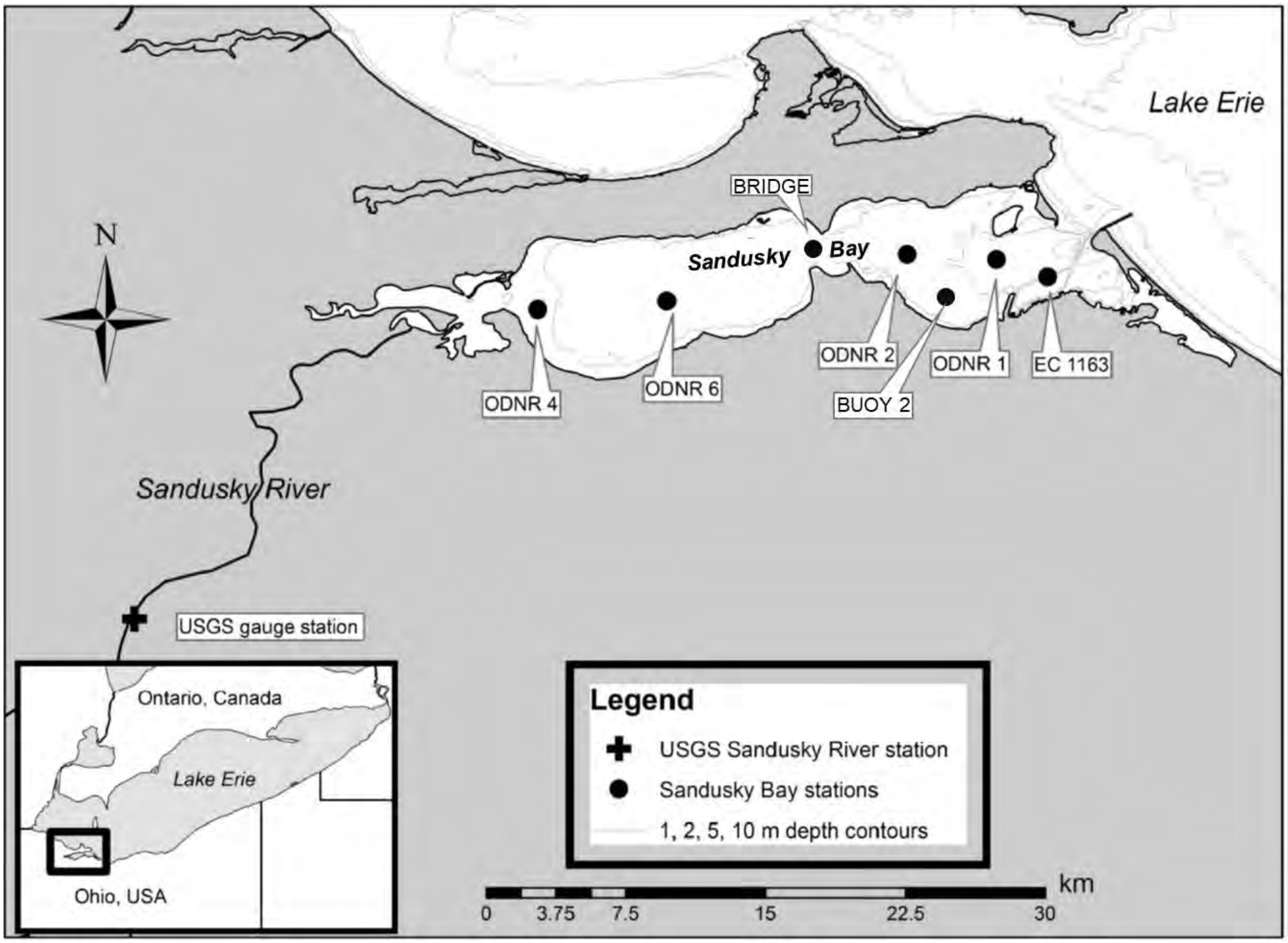

Figure F-8— Sampling locations in the Sandusky Bay; map adapted from Salk, 2018.

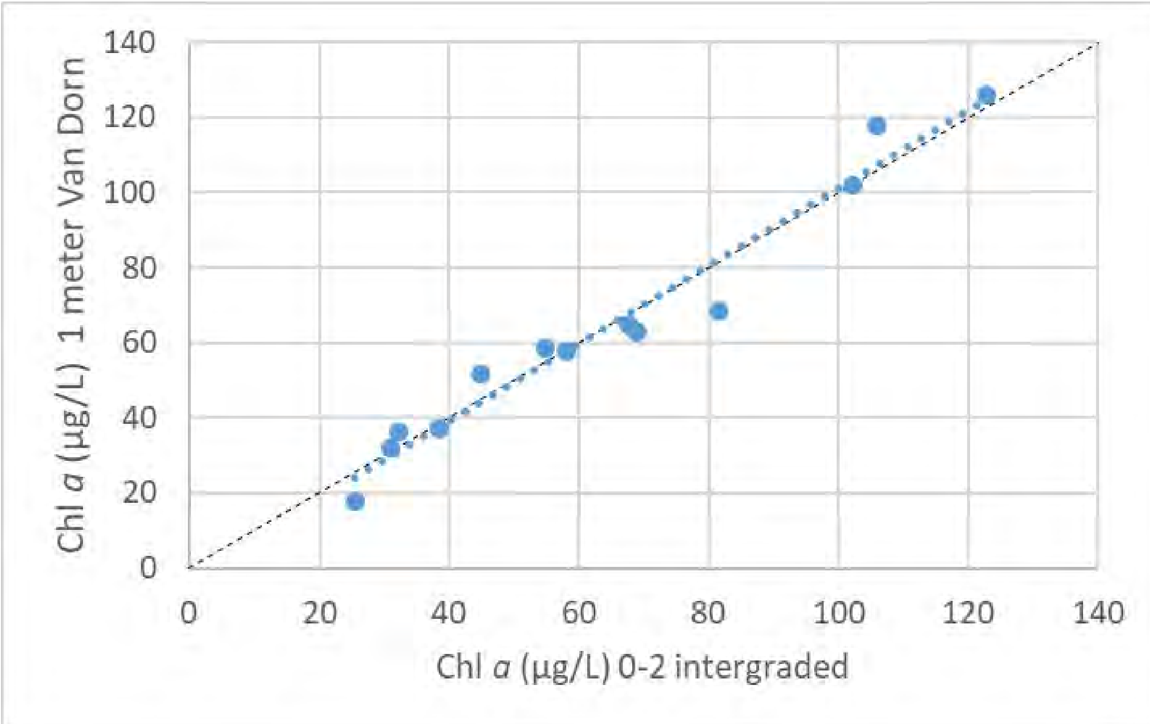

Figure F-9 —A comparison of chlorophyll-a concentration data collected by a 1-meter Van Dorn sampler and a 0-2 meter integrated sample from two Sandusky Bay sites (bay mouth and the center of east/outer bay) by the Ohio State University Stone Laboratory. The dotted blue line is the regression line between the two methods and the thin black dashed line is the 1-to-1 line.

Lake Erie Sandusky Open Water

Algal blooms originating from Sandusky Bay generally do not migrate out of the bay into the Sandusky open water AU (LimnoTech, 2019; Bridgeman, 2020). Because of this, recreation assessment of the Sandusky Basin open water AU will not rely on Sandusky Bay algal bloom occurrences.

Dolichospermum blooms normally associated with Lake Erie's central basin do occasionally form in this AU. However, algal blooms in this AU are most often dominated by *Microcystis* that originate in the western open waters and migrate east. Because of this, the researchers assisting Ohio EPA with assessment methodology development recommended investigating whether assessment of the Sandusky open water AU could be carried out in a similar fashion to the western basin AU method.

Figure F-10 shows 10-day frames of the percent of this AU's area covered by algal bloom greater than 20,000 cyanobacterial count per mL 10-day going back to 2002.

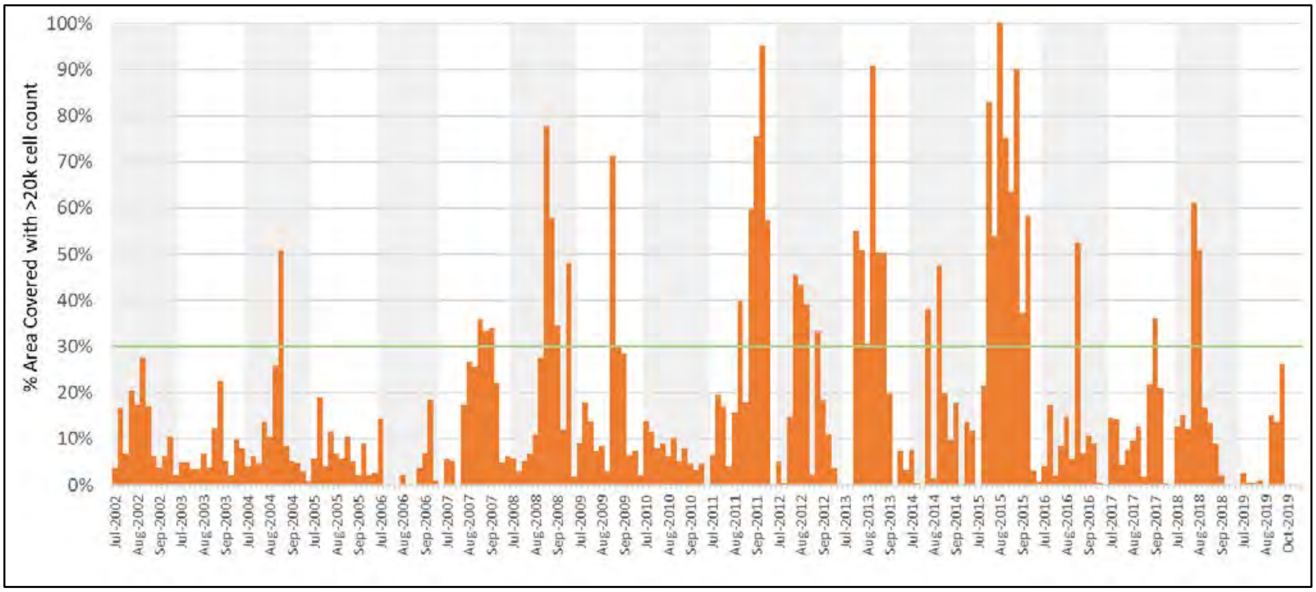

Figure F-10 — Sandusky Open Waters HAB cell densities shown for greater than 20,000 and 100,000 cells per mL by percent of the assessment unit's surface area. Each bar shows a 10-day time frame during the July - October bloom season; this results in 12 10-day frames per year. Frames that show 0% coverage indicates no bloom present the majority of the time. In a few instances, cloud cover or other interferences with the satellite images occurred.

An analysis of the Sandusky open water AU (S2) compared to western basin open water AU (W2) was carried out. Figure F-11 shows the percent of area within each AU covered by algae for the top three 10-day frames of each year. The algae coverage in this analysis uses the same greater than 20,000 (*Microcystis* equivalent) cyanobacteria cell count per mL that is used in the western basin assessment method. On Figure F-11 there is also a black outlined circle that shows the average of these top three for each AU in each year. Focusing on 2008 and more recent data, in most years the blue S2 top three average area coverages are well below the yellow W2 top three average. However, the variance is great. The years 2017, 2014 and 2010 had the large variances (at 52%, 38% and 36%, respectively, based on the averages). In 2015 and 2008 they were much tighter; within 10% of each other. The bloom in 2012 stands out in particular because the average S2 window was greater than W2's.

The Figure F-12 shows the third greatest 10-day frame greater than 20,000 (*Microcystis* equivalent) cyanobacteria cell count per mL coverage for the Sandusky open water and Western basin open water AUs in each year. For the W2, when the yellow dots are above the 30% line that year does not meet the annual western method expectation (see the western open water's AU methodology above). If the same method were to apply to the S2 unit it would exceed the annual expectation in some of the years, but not nearly as many as W2.

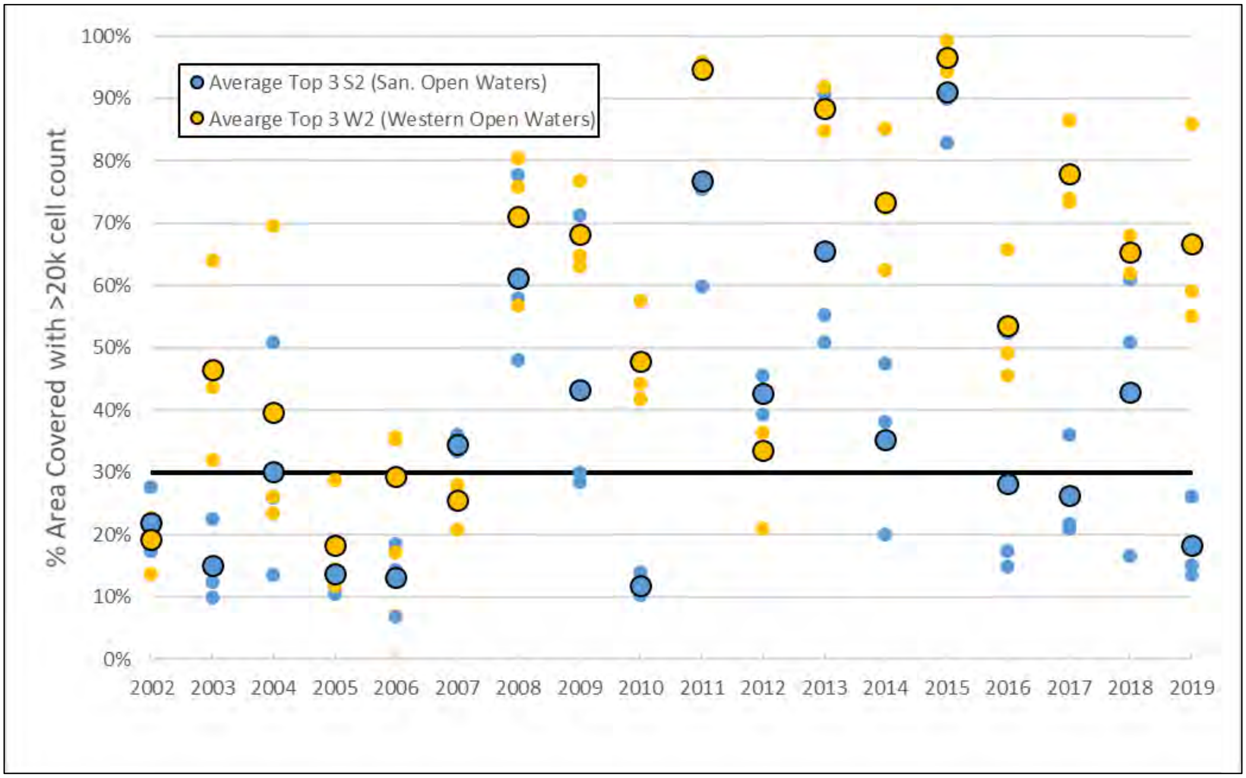

Figure F-11 — Top three 10-day frames with greater than 20,000 cell cyanobacteria count per mL by year for the S2 and W2 assessment units. A black outlined circle for each unit shows the average of each year.

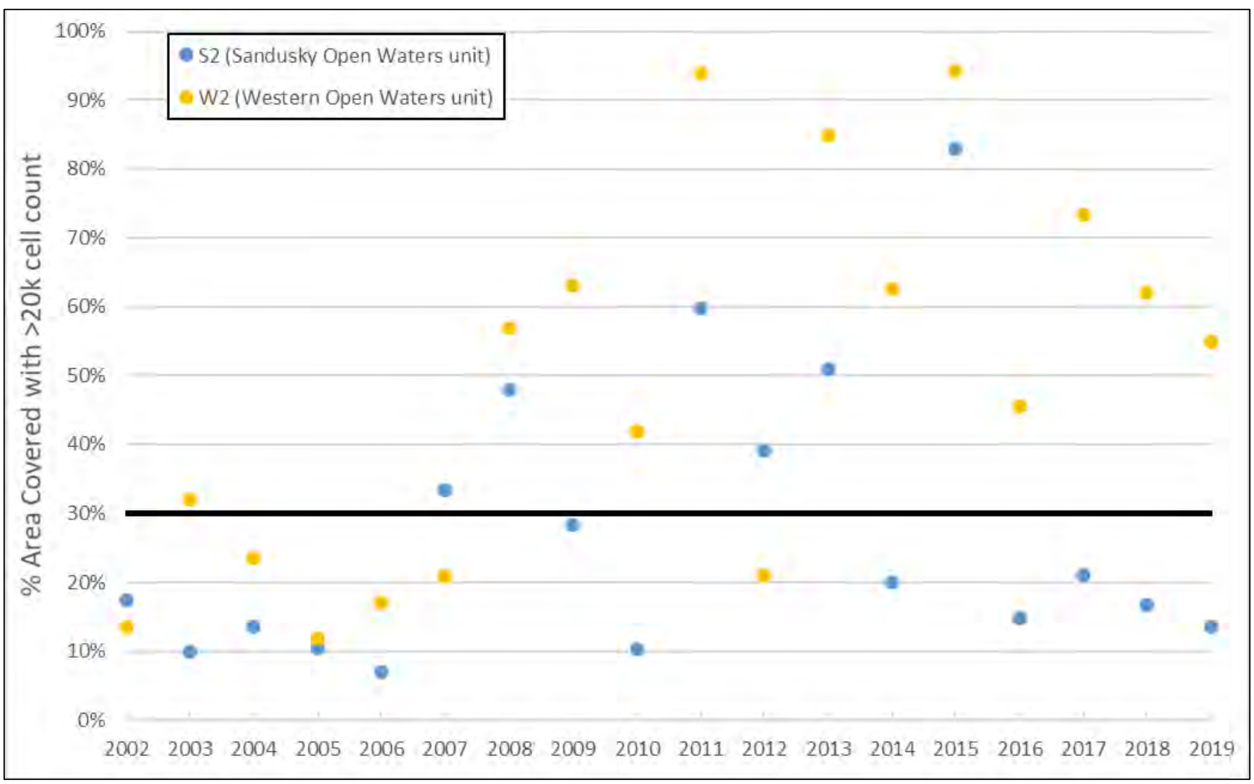

Figure F-12 — The percent of assessment unit area covered by the third greatest 10-day frame with greater than 20,000 cell cyanobacteria count per mL by year for the S2 and W2 assessment units.

Table F-18 shows the number of 10-day frames exceeding 30% of the assessment unit area with >20k cyanobacterial cell density for W2 with S2. In looking at the last six years ending in 2019 the S2 would currently meet its use (since only 2015 exceeds the annual expectation). However, were the six-year window to end in 2018, this use would be impaired as the 2013 bloom would be included.

Using the 30% area coverage breakpoint for assessing 10-day frames in the W2 AU was derived based on benchmarking the actual acceptable bloom sizes in the western basin. Therefore, the same cutoff for S2 is reasonable because much of its blooms mass/aerial extent originates from the west. The fact that western blooms do not always blow over to S2, and also due to occasional sizable *Dolichospermum* blooms, warrants S2 to be analyzed based on its own HABs occurrences.

Table F-18 — The number of 10-day frames exceeding 30% of the assessment unit area with >20k cyanobacterial cell density

Year	Western Open waters	Sandusky Open waters	Year	Western Open waters	Sandusky Open waters
2002	0	0	2011	**8**	**5**
2003	**3**	0	2012	2	**4**
2004	1	1	2013	**10**	**6**
2005	0	0	2014	**6**	2
2006	2	0	2015	**9**	**8**
2007	0	**3**	2016	**5**	1
2008	**4**	**4**	2017	**7**	1
2009	**6**	1	2018	**6**	2
2010	**8**	0	2019	**5**	0

In summary, this comparison of the two assessment units shows that a small annual bloom season in W2 usually means a small bloom in S2. However, large blooms in W2 may or may not lead to large blooms in S2. The researchers mainly attribute the latter to the weather the lake experiences. Since the S2's HAB bloom is directly linked to the W2, using the same Annex 4 of the GLWQA reduction goal is an appropriate benchmark for this AU. Based on this, the same use methodology used in the W2 AU will be applied to the S2 AU using satellite data specific to the S2 AU. The following outlines this method:

To account for the way that algal blooms shift in time and space in a large water body like the Sandusky open water basin, the method developed is as follows:

- In each 10-day frame, an exceedance means that a bloom with greater than 20,000 cells/mL covers (is present in) more than 30 percent of the Sandusky open water unit area.
- If three or more 10-day frames have an exceedance in one year (July-Oct.), then that year exceeds the goal.
- Because of the year-to-year variation, if any two or more years in a rolling six-year window exceeds the goal then the assessment unit is impaired.

Lake Erie Central Basin Open Water

The central basin of Lake Erie experiences HABs dominated by *Dolichospermum* in June and July followed by a community shift to *Microcystis* blooms in August and September. The *Microcystis* generally originate from the western basin. It is understood that these blooms occur independently from one another. Overall however, HAB trends indicate that degrading water quality and resulting eutrophication that has been documented in the western basin is occurring in the central basin (Chaffin, 2019).

The Great Lakes Water Quality Agreement's Annex 4 sub-committee did not set phosphorus loadings goals to address HABs in Lake Erie's central basin similar to the western basin[4]. Due to this, a reference "acceptable" bloom has not been determined for the central basin which could be used as a benchmark for this assessment methodology.

An analysis of the MODIS (or Moderate Resolution Imaging Spectroradiometer) satellite data for this AU was carried out. While these data report *Microcystis* equivalence cell densities, *Dolichospermum* blooms are captured in this analysis. Figure F-13 shows the MODIS HAB results[5] from 2002 through 2018 of how much area of the Ohio's Lake Erie central basin open waters AU was covered at two levels of cell density. Each bar on this figure shows the maximum percentage of area covered for a 10-day frame during the July through October HAB bloom season (this results in 12 frames per year).

Without established benchmark bloom years, analysis focused on the MODIS results from 2011. A measurable *Dolichospermum* bloom occurred early summer 2011 (Chaffin, 2019) and was followed by a large *Microcystis* bloom that spread from the western basin to the to the central basin in late summer (Chaffin, 2013). The 2011 bloom was deemed as unacceptable by the general public (Michalak, 2013; Mangels, 2013). Ohio EPA recognizes that if blooms of this nature were the norm for the central basin that this would result in impairment of the recreation use.

In reviewing the 2011 HAB satellite results on Figure F-13, the peak of the two HAB blooms can be detected. Three 10-day frames met or exceeded an area covering 15 percent of the Central Basin Open Waters AU at the greater than 20,000 cell density level. This bloom year will be used as an assessment method benchmark.

The spatial and temporal nature of HABs are considered in the central basin's method. Therefore, this method will follow a similar structure:

- In each 10-day frame, an exceedance means that a bloom with greater than 20,000 cells/mL covers (is present in) 15 percent or more of the central basin open water unit area.
- If three or more 10-day frames have an exceedance in one year (July-Oct.), then that year exceeds the goal.
- Because of the year-to-year variation, if any two or more years in a rolling six-year window exceeds the goal then the unit is impaired.

Based on this proposed method, the 2011 bloom in the central basin open water exceeds the yearly goal. However due to smaller and less frequent HABs in recent years, this AU is not currently impaired. In fact, since 2011, only one 10-day frame in 2015 exceeded 15 percent area at the greater than 20,000 cells/mL.

[4] Note that the GLWA's Annex 4 has set phosphorus loading goals for the central basin to address seasonal hypoxia. However, using that goal is not appropriate in evaluating loss of recreation use due to HABs.
[5] For long-term sustainability, Ohio will transition to using the Ocean Land Colour Imager on Sentinel-3 series of satellites.

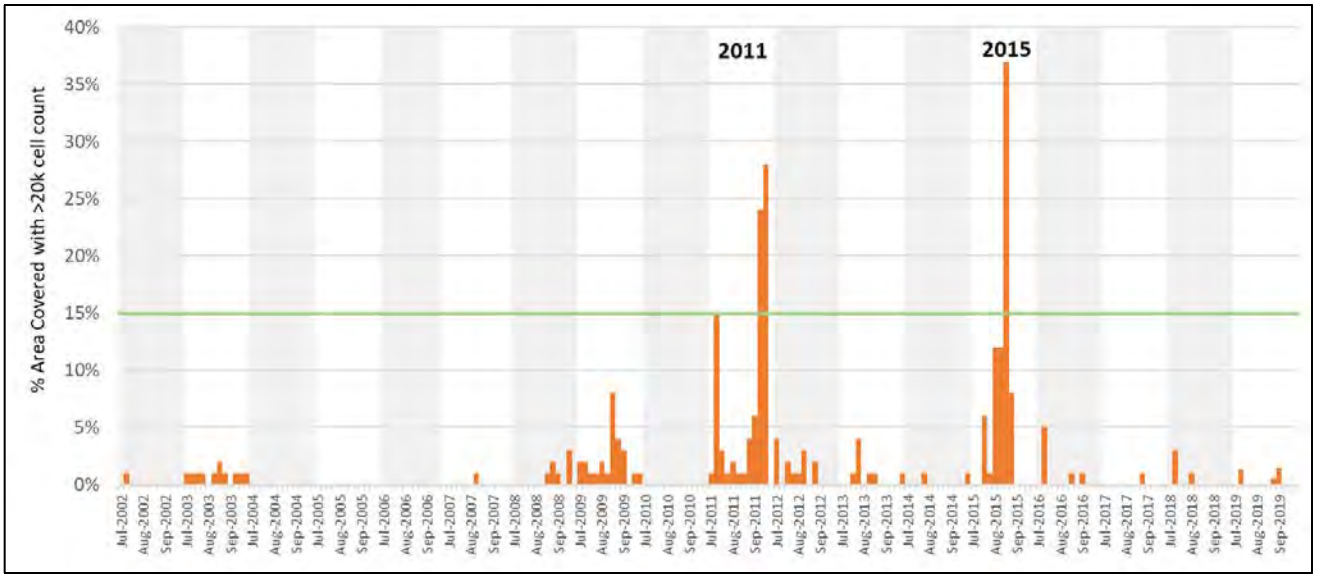

Figure F-13 — Central Basin Open Waters HAB cell densities shown for greater than 20,000 and 100,000 cells per mL by percent of the assessment unit's surface area. Each bar shows a 10-day time frame during the July - October bloom season; this results in 12 10-day frames per year. The green line at 15% area shows the exceedance level set by this proposed method. Frames that show 0% coverage indicates no bloom present the majority of the time. In a few instances, cloud cover or other interferences with the satellite images occurred.

Additional Phases of Method Development for Lake Erie Algal Blooms

The water quality sampling results and available data were discussed with the researchers during the first, western open water AU, method development. The concern then was that amount of sampling locations, sampling frequency and methods need to be evaluated to determine what is appropriate to conclude that, for instance, the microcystin levels are high enough and/or frequent enough to result in a recreation impairment in such a large body of water. During the 2019 efforts to develop methods to address this use in the remainder of the Lake Erie AUs, additional assessments metrics to the western open water AU were again considered. At this time, Ohio EPA finds the existing assessment methods accetapble. Further metrics can be considered in an adaptive management approach in future Integrated Reports if necessary. This will be particularly considered if direct calculations of HAB toxins can be reliably measured via remote sensing.

Results

Lake Erie Western Basin Results

Table F-19 shows the results of the analysis, using satellite data from 2014-2019 for the full six-year window in the assessment. Some years do not include all 12 of the 10-day frames because of extended cloud cover or other interferences with the satellite images. The western basin open waters are considered impaired since all six years exceeded the thresholds outlined above (more than three 10-day frames exceeded within the year).

The 2018 cyanobacterial bloom in the western Lake Erie basin experienced six 10-day frames exceeding 30% coverage of greater than 20,000 cells per mL during the May to October period, with five of these occurring between late July and early September. The 2019 bloom had five 10-day frames exceeding the benchmark. The 2019 bloom started and ended earlier than previous years. However, the windows exceeding 30% coverage occurred from late July through early September. The greatest aerial extent, at 86% of the AU covered, occurred on a frame that centered on September 3, 2019.

Based on the current results, this AU could not attain the recreation use until after the 2024 bloom season. For that to happen there must be fewer than three 10-day frames exceeding the 30% area coverage of algae at the outlined density each year 2020-2024.

Table F-19 — The number of 10-day time frames exceeding the 30 percent coverage threshold

	≥30% coverage at ≥20,000 cell/mL	
Year	10-day frames exceeding	total frames
2014	6	12
2015	9	11
2016	5	10
2017	7	11
2018	6	11
2019	5	12

Since the island shoreline assessment units are contained within the western basin open water unit satellite assessment zone that was used to conduct the analysis, the island shoreline unit is also considered impaired. As people are more likely to come into direct contact with the water and algae along the shoreline than in the open water, Ohio EPA is also including the western basin shoreline unit on the impaired waters list. This is based on proximity to the open waters that are clearly impaired, and the expectation that, reviewing the patterns of blooms over the past six years, the shoreline area would be just as impacted by the blooms as the open water.

Lake Erie Sandusky Shoreline Results

As noted in the methodology explanation above, it is acceptable to use the average microcystin result from four key sites within the Sandusky Bay for analysis of retrospective data prior to when this methodology has been established. Ohio EPA will depend on data collected by credible data collectors from Bowling Green State University for retrospective analysis and future assessment of this AU. Currently two years, 2018 and 2019, have data available to be used for this analysis. Table F-20 shows the number of 10-day frames exceeding the annual benchmark and the number of frames where data was collected. Of the 2018 data collection all frames exceeded the benchmark. However, in 2019 only two of the six frames with data collected exceeded. As noted in the methodology section, while the HAB bloom is regularly dense in the Sandusky Bay, this bloom is Planktothrix dominated. This group of algae does not produce microcystins as consistently as the Microcystis dominated western basin, nor does it form scums like Microcystis.

Because the existing data set does not contain two seasons that exceed the goal and contains fewer than five seasons that do not exceed the goal; this AU is considered to have insufficient information to determine impairment. In the next integrated report, if either 2020 or 2021 exceed the annual goal, this use will be listed as impaired.

Table F-20 — The number of 10-day time frames exceeding the annual threshold for Sandusky Shoreline Assessment unit for each year beginning in 2018.

	Average of four sites >6ug/L microcystin	
Year	10-day frames exceeding	total frames
2018	4	4
2019	2	6

Lake Erie Sandusky Open Water Results

Table F-21 shows the results of the analysis, using satellite data 2014-2019 for the full six-year window in this AU. Some years do not include all 12 of the 10-day frames because of extended cloud cover or other interferences with the satellite images. Based on these results, the Sandusky open water AU meets the recreation use. It is considered attaining since only one of the last six years exceeds the threshold outlined above (more than two 10-day frames exceeding 30% aerial coverage of algae at the outlined density).

Table F-21 — The number of 10-day time frames at or exceeding 30 percent coverage threshold

	≥30% coverage at ≥20,000 cell/mL	
Year	10-day frames exceeding	total frames
2014	2	12
2015	**8**	11
2016	1	10
2017	1	11
2018	2	11
2019	0	12

Lake Erie Central Open Water Results

Table F-22 shows the results of the analysis, using satellite data from 2014-2019 for the full six-year window in this AU. Some years do not include all 12 of the 10-day frames because of extended cloud cover or other interferences with the satellite images. Based on these results, the central open water AU meets the recreation use. It is considered attaining since there were no exceedances of the threshold outlined above in the last six years (more than two 10-day frames exceeding 15% aerial coverage of algae at the outlined density).

Table F-22 — The number of 10-day time frames at or exceeding 15 percent coverage threshold

	≥15% coverage at ≥20,000 cell/mL	
Year	10-day frames exceeding	total frames
2013	0	12
2014	0	11
2015	1	10
2016	0	11
2017	0	11
2018	0	12

Section

G

Evaluating Beneficial Use: Aquatic Life

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G1. Background and Rationale

Background

Ohio EPA has been evaluating streams using standardized biological field collection methods since the 1970s. Stream assessments are based on the experience gained through the collection of more than 28,300 fish population samples, nearly 15,100 macroinvertebrate community samples and close to 235,000 water chemistry samples. Aquatic life use assessments for the 2020 Integrated Report (IR) are based on biological and chemical data collected from primarily 2009-2018 at more than 4,750 wadeable stream, large river and Lake Erie shoreline sampling locations; some earlier data collected between 2003-2008 were retained for specific watershed and large river assessments. Ohio's Credible Data Law states that all data greater than five years in age will be considered historical, but that it can be used if the director has identified compelling reasons as to why the data are credible. In the case of biological monitoring data, the use of data older than five years is necessary. The use of historical data is necessary because not enough biological samples are gathered from enough locations each year to conduct a thorough assessment of aquatic life use status across the state. Owing to limited staff and budget resources, it may take up to 20 years to visit enough assessment units and sufficiently monitor them to make aquatic life use assessments. A more complete picture of statewide aquatic life use health is presented when data are utilized based on the longer timeframe. Since water resource quality in many watersheds in Ohio today is most susceptible to changing land use patterns that are often subtle, slow to evolve, and difficult to monitor and assess, the use of older data is justified.

Ohio's water quality standards (WQS) have seven subcategories of aquatic life uses for streams and rivers (see Ohio Administrative Code 3745-1-07, ***epa.ohio.gov/portals/35/rules/01-07.pdf***). The WQS rule contains a narrative for each aquatic life use and the three most commonly assigned aquatic life uses have quantitative, numeric biological criteria that express the minimum acceptable level of biological performance based on three separate biological indices. These indices are the Index of Biotic Integrity (IBI) and Modified Index of Well-Being (MIwb) for fish and the Invertebrate Community Index (ICI) for aquatic macroinvertebrates. A detailed description of Ohio EPA's biological assessment and biocriteria program, including specifics on each index and how each was derived, is available (see Biological Criteria for the Protection of Aquatic Life, ***epa.ohio.gov/dsw/bioassess/BioCriteriaProtAqLife.aspx***).

Procedures established in a specially designed 1983-1984 U.S. EPA study known as the *Stream Regionalization Project* (Whittier et al. 1987) were used to select reference, or least-impacted sites, in each of Ohio's five Level III ecoregions (Omernik 1987). Biological data from a subset of these sites in addition to supplemental data from other least-impacted Ohio reference sites were used to establish the ecoregion-specific biocriteria for each aquatic life use. Note that some criteria vary according to stream size and some indices do not apply in certain circumstances. Ohio's WQS rule stipulates that "biological criteria provide a direct measure of attainment of the warmwater habitat, exceptional warmwater habitat and modified warmwater habitat aquatic life uses" (OAC 3745-1-07(C)). The numeric biological criteria based on IBI, MIwb and ICI thresholds applicable to exceptional warmwater habitat (EWH), warmwater habitat (WWH), and modified warmwater habitat (MWH) waters are found in Table 7-1 of the WQS rule. Neither coldwater habitat (CWH) nor limited resource water (LRW) streams have numeric biological criteria at this time, so attainment status must be determined on a case-by-case basis. For sites and segments designated with these aquatic life uses, attainment status was determined by using biological data attributes (for example, presence and abundance of coldwater species in CWH streams) and/or interim assessment index targets (for example, those for LRW streams, Lake Erie lacustuaries, Lake Erie shoreline) to assess consistency with the narrative aquatic life use definitions in the WQS.

General Determination of Attainment Status

A biological community at an EWH, WWH or MWH sampling site must achieve the relevant criteria for all three indices, or those available and/or applicable, to be in full attainment of the designated aquatic life use criteria. Partial attainment is determined if one criterion is not achieved while non-attainment results when all biological scores are less than the criteria or if poor or very poor index scores are measured in either fish or macroinvertebrate communities.

A carefully conceived ambient monitoring approach, using cost-effective indicators consisting of ecological, chemical and toxicological measures, can ensure that all relevant pollution sources are judged objectively based on environmental results. Ohio EPA relies on a tiered approach in attempting to link the results of administrative activities with true environmental measures. This integrated approach includes a hierarchical continuum from administrative to true environmental indicators. The six levels of indicators include: 1) actions taken by regulatory agencies (permitting, enforcement, grants); 2) responses by the regulated community (treatment works, pollution prevention); 3) changes in discharged quantities (pollutant loadings); 4) changes in ambient conditions (water quality, habitat); 5) changes in uptake and/or assimilation (tissue contamination, biomarkers, wasteload allocation); and, 6) changes in health, ecology or other effects (ecological condition, pathogens). In this process, the results of administrative activities (levels 1 and 2) can be linked to efforts to improve water quality (levels 3, 4 and 5), which should translate into the environmental results (level 6). Thus, the aggregate effect of billions of dollars spent on water pollution control since the early 1970s can now be determined with quantifiable measures of environmental condition.

Superimposed on this hierarchy is the concept of stressor, exposure and response indicators. Stressor indicators generally include activities that have the potential to degrade the aquatic environment, such as pollutant discharges (permitted and unpermitted), land use effects and habitat modifications. Exposure indicators are those that measure the effects of stressors and can include whole effluent toxicity tests, tissue residues and biomarkers, each of which provides evidence of biological exposure to a stressor or bioaccumulative agent. Response indicators are generally composite measures of the cumulative effects of stress and exposure and include the more direct measures of community and population response that are represented here by the biological indices that comprise Ohio's biological criteria. Other response indicators could include target assemblages (rare, threatened, endangered, special status, and declining species) or bacterial levels that serve as surrogates for the recreation uses. These indicators represent the essential technical elements for watershed-based management approaches. The key, however, is to use the different indicators within the roles that are most appropriate for each indicator.

Identifying the most probable causes of observed impairments revealed by the biological criteria and linking this with pollution sources involves an interpretation of multiple lines of evidence including water chemistry data, sediment data, habitat data, effluent data, biomonitoring results, land use data and biological response signatures within the biological data themselves. Thus, the assignment of principal causes and sources of impairment represents the association of impairments (defined by response indicators) with stressor and exposure indicators. The identified causes of impairment will serve as the target parameters for future total maximum daily load (TMDL) development or regulatory program actions.

Adequate sampling is necessary to represent the aquatic life use attainment status for large river assessment units (LRAUs, each average 32 miles in length) or watershed assessment units (WAUs, each an average 28 mi^2 in surface area). These assessment units are defined in Sections D1 and G2 of this report. Despite Ohio EPA's significant commitment to biological sampling efforts, 100 of Ohio's 1,538 WAUs (6.5

percent) are precluded from this analysis because of no or insufficient data. All large Ohio rivers with LRAU reaches have sufficient data to be evaluated for aquatic life use attainment. While some data may be available for some of the WAUs, many have no water quality monitoring data, or the scope of monitoring was judged to be too limited to adequately generate an assessment. Generally, at least two sample sites are minimally considered necessary for a WAU assessment, although under specific circumstances, a WAU may be evaluated with one site. Presently, Ohio EPA prefers that the principal investigators make informed decisions about the data relevance for a particular AU evaluation rather than institute specific guidance on minimum effort.

Recognizing the state's limited resources, one way to increase assessment unit coverage is to utilize all available relevant Level 3 credible data. While Ohio EPA uses data from a variety of sources, the data used to determine the aquatic life use status in this report were primarily collected by Ohio EPA. For this report and some past reports, additional biological data were provided by the Ohio Department of Natural Resources (ODNR), Northeast Ohio Regional Sewer District (NEORSD), U.S. Geological Survey (USGS), the University of Toledo, the Ohio State University, National Center for Water Quality Research (NCWQR) at Heidelberg College, Midwest Biodiversity Institute (MBI), Cleveland Metroparks and EnviroScience, Inc. Those interested in providing data to Ohio EPA for aquatic life use attainment status determinations must attend appropriate training provided by Ohio EPA or its designee through the Ohio Credible Data Program Level 3 Certification, and document and retain competency in Ohio EPA biological sampling protocols. All data used to make attainment determinations are carefully reviewed for consistency with all Ohio EPA methods and guidance.

G2. Evaluation Method

Rivers and Streams: Large River Assessment Units (LRAUs)

Decades of monitoring work by Ohio EPA have resulted in an extensive data set that includes data for all 38 large river assessment units in Ohio with sampling spanning 2003-2018. The longitudinal sampling pattern (upstream to downstream and bracketing pollution sources and tributaries) used to measure fish community health, macroinvertebrate community condition and water chemistry allows WQS biocriteria attainment status to be rather precisely estimated based on linear distances. The length of the large river deemed to be in full attainment, as described in the previous section, is divided by the total assessed length of the large river and multiplied by 100 to yield a value between 0 (no miles in attainment) and 100 (all miles in attainment). An LRAU is considered meeting its designated aquatic life use only if a score of 100 is reported. In other words, if all miles are not in full attainment of the designated aquatic life use, the entire LRAU is listed as impaired and placed in IR Category 4 or 5, depending on whether a TMDL is required.

Rivers and Streams: Watershed Assessment Units (WAUs)

Beginning with the 2010 IR, the aquatic life use assessment methodology defined the WAU as the U.S. Geological Survey 12-digit hydrologic unit code watershed, or HUC12 (1,538 HUC12s averaging 28 mi^2 drainage areas), rather than the 11-digit HUC watershed (331 HUC11s averaging 130 mi^2 drainage areas) used in prior IRs. Reporting on the HUC12 scale provides information on a finer scale and allows for better reporting of watershed improvements.

This dramatic reduction in assessment unit size requires consideration of what constitutes adequate sampling within each HUC12 WAU and appropriate evaluation of the sampling results. The relatively small drainage area of the HUC12 WAU requires that the sites evaluated adequately characterize the smaller watershed. For that reason, three scores will be determined for each WAU when sufficient data make this possible. A headwater assessment score that characterizes the aquatic community of the WAU by itself will occur by evaluating all sites with drainage area <20 mi^2 together. A wading stream score will be determined for all sites with drainage area between 20 mi^2 and 50 mi^2 that occur within the WAU. The wading stream score is necessary since a site between 20 mi^2 and 50 mi^2 characterizes the entire watershed upstream from the site, potentially two or more HUC12s, not just to the extent of the WAU boundary where the site resides. A principal stream score for sites >50 mi^2 will also be calculated, as these larger streams reflect a much greater land area than sites at a smaller drainage area. The final assessment unit score will be derived from these three scores. The table below represents this graphically.

Table G-1 — Watershed Assessment Unit Score Determination

WAU (HUC12)	Headwater Assessment — HA (<20 mi^2)			Wading Assessment — WA (≥ 20 mi^2 <50 mi^2)			Intermediate Score (IS)	Principal Assessment — PA (≥ 50 mi^2 <500 mi^2)			WAU Score
	Total Sites	# Sites Full	HA Score	Total Sites	# Sites Full	WA Score	$\frac{HA+WA}{2}$	Total Sites	# Sites Full	PA Score	$\frac{IS+PA}{2}$

While the smaller size of the HUC12 WAU greatly reduces the number of sites necessary to be assessed, this creates an emphasis on appropriate sampling locations within the assessment unit. To ensure that decisions regarding adequate coverage are uniformly carried out, a flow chart for the process was created (Figure G-1). The flow chart considers the drainage area associated with a minimal number of sites and incorporates questions as to spatial proximity of the sites within the watershed, land use consistency among sampling locations, and location of significant dischargers within the WAU. Final determination of adequate coverage is guided by the flow chart but can be overridden by the assessor in unique circumstances.

Once it is determined that sampling coverage is adequate to conduct a WAU assessment, the number of headwater sites demonstrating full aquatic life use attainment are divided by the total number of headwater sites within the WAU. The quotient is then multiplied by 100 to provide the headwater score.

Determining the wading stream and principal stream scores involve a similar approach. The wading stream score is based on the number of wading stream sites (sites draining a watershed between 20 mi^2 and 50 mi^2) demonstrating full attainment of aquatic life use. The total number of wading stream sites in full attainment are divided by the total number of wading stream sites. The quotient is then multiplied by 100 to provide the wading stream score. The same methodology is used to produce the principal stream score, but the scoring is limited to those sites in the WAU draining >50 mi^2.

An intermediate WAU score is calculated as the average of the headwater and wading stream scores. The overall WAU score is derived by averaging the intermediate score and the principal stream score. For HUC12s without principal streams, the intermediate stream score will represent the overall WAU score. This procedure provides some weighting to the assessment when principal stream miles are present (more influence on the final watershed score by principal streams). This weighting is important in that full use or impairment within the principal streams reflects the overall condition of the much larger primary watershed. A manual scoring adjustment is made in those few instances when a WAU score, with many principal stream sites, is unduly affected by the results from one headwater or one wading site. A WAU meets its aquatic life designated use only if a score of 100 is reported. In other words, if all sites are not in full attainment of the designated aquatic life use, the WAU is listed as impaired and placed in IR Category 4 or 5, depending on whether a TMDL is required.

Additional synthesis of data was used to provide aggregate statewide statistics for Ohio's universe of assessed wading and principal streams and rivers (> 20 mi^2 drainage areas) and large rivers (> 500 mi^2 drainage areas). Baseline IR statistics generated beginning with the 2010 IR were used along with the updated 2020 IR results to track trends of attainment levels across Ohio's watersheds and large rivers to quantify progress made in point and nonpoint source pollution controls and in meeting Ohio's goals of 80 percent full aquatic life use attainment by 2020 for assessed WAU wading and principal stream and river sites and 100 percent full aquatic life use attainment by 2020 for assessed LRAU miles.

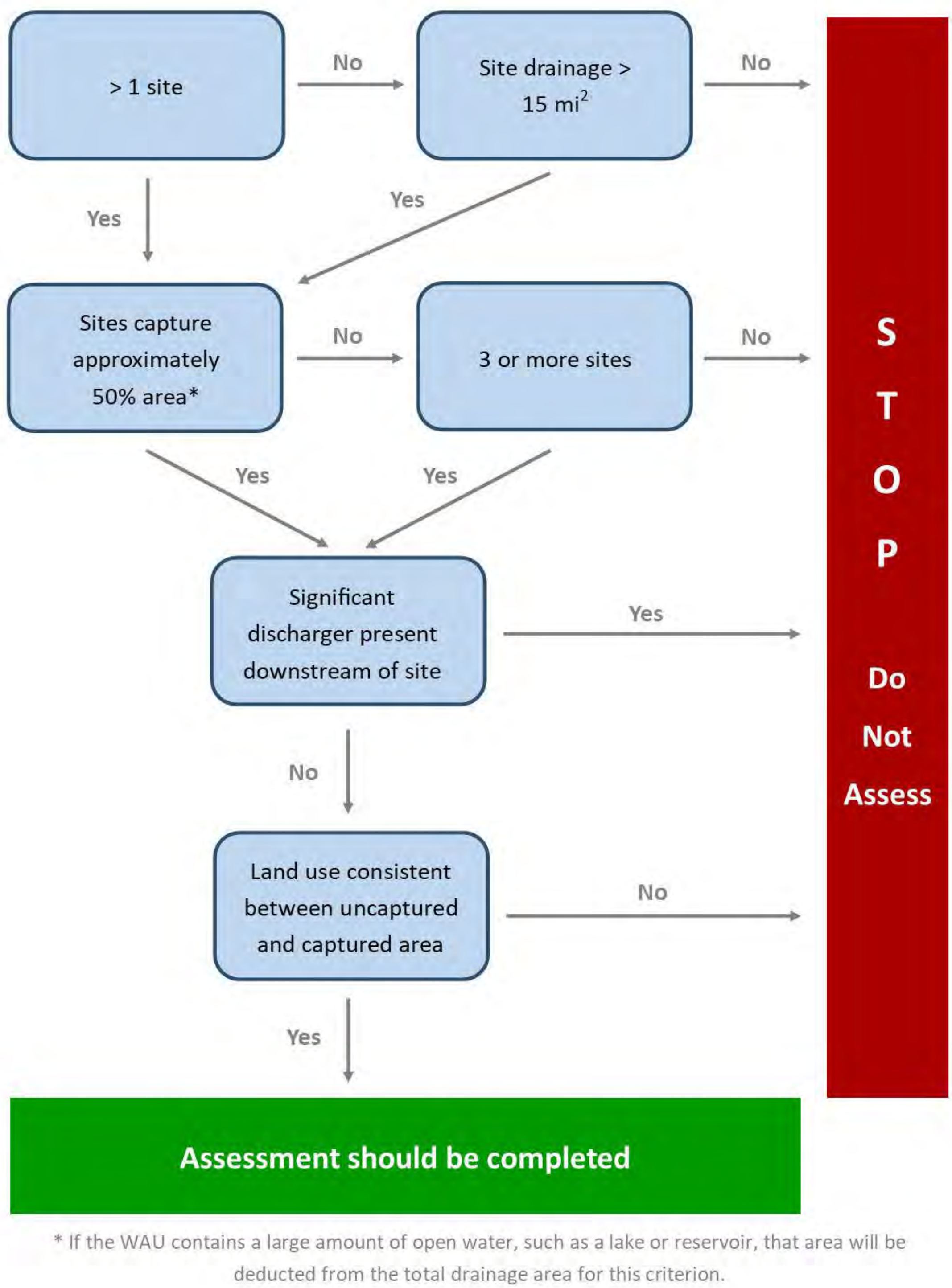

Figure G-1 — Flowchart for determining if WAU score can be derived based on available sampling locations.

Lake Erie Shoreline and Islands: Lake Erie Assessment Units (LEAUs)

Aquatic life use determinations are predicated on a narrative description of the aquatic community associated with the relevant use tier. In the absence of numeric criteria, the narrative expectation provides the impairment determination. In 1997, Ohio EPA completed the *Development of Biological Indices Using Macroinvertebrates in Ohio Nearshore Waters, Harbors, and Lacustuaries of Lake Erie in Order to Evaluate Water Quality* (Ohio EPA, 1995). In 1999, *Biological Criteria for the Protection of Aquatic Life: Volume IV: Fish and Macroinvertebrate Indices for Ohio's Lake Erie Nearshore Waters, Harbors, and Lacustuaries* was produced (Ohio EPA, 1997 Draft). Also, in 1999, *Biological Monitoring and an Index of Biotic Integrity for Lake Erie's Nearshore Waters* (Thoma, 1999) was published as a book chapter in *Assessing the Sustainability and Biological Integrity of Water Resources Using Fish Communities* (Simon, editor, 1999). The data analyses in these documents, including refinement of field sampling protocols and development of assessment indices, provide a foundation to establish numeric biological targets/expectations using IBI and MIwb scores for aquatic life use in Lake Erie along the Ohio shoreline and in lacustuary areas. The term lacustuary was coined to specify the zone where Lake Erie water levels have intruded into tributary river channels. The aquatic life use status of a lacustuary is included as part of the assessment of the tributary WAU or LRAU.

Excluding lacustuaries, the status of the Lake Erie shoreline and islands is currently evaluated using fish community assessment targets for the Lake Erie IBI and MIwb based on night electrofishing at sites included in the four shoreline LEAUs: Lake Erie Western Basin Shoreline (including Maumee Bay); Lake Erie Sandusky Basin Shoreline; Lake Erie Central Basin Shoreline; and Lake Erie Islands Shoreline. All available fish data were collected within 100 meters of the mainland, bay or island shoreline. Status of LEAUs was determined by the percentage of sites in narrative full attainment of biological targets (scaled to prevailing shoreline habitat type) and where sufficient and current biosurvey data were available.

Ohio EPA was awarded a Great Lakes Restoration Initiative (GLRI) grant in 2010 to develop a comprehensive Lake Erie shoreline monitoring program. This 2011-2013 project included a strategy to design and implement a monitoring program for the Ohio Lake Erie shoreline zone (including bays, harbors and lacustuaries) that can be maintained on an annual basis.

The GLRI grant was a collaborative effort between state agencies (Ohio EPA and ODNR) and major universities with Lake Erie basin research interests and expertise (the Ohio State University, University of Toledo, John Carroll University and Heidelberg University). Physical, chemical and biological parameters monitored from 2011-2013 provided data to support long-term trend analysis, establish background conditions in selected areas and conduct sampling related to the impacts of projects implemented in tributaries of the Lake Erie watershed. Data will be used to monitor the progress of implementation projects in Areas of Concern (AOCs) to restore beneficial uses, track implementation of WAPs, develop TMDLs for pollutants impairing beneficial uses, support Balanced Growth Initiative actions on the shoreline, and provide updated information for IRs, Lake Erie quality index updates, and updates to the Lake Erie Lakewide Management Plan (LAMP). More information about the Great Lakes Restoration Initiative and projects which have been proposed can be found at the Ohio Lake Erie Commission website (see Great Lakes Restoration Initiative, ***lakeerie.ohio.gov/GLRI.aspx***).

Details of the monitoring conducted in 2017 and 2018 are provided in the study plans available at ***epa.ohio.gov/dsw/lakeerie/index.aspx#125073721-nearshore-monitoring***. Of note for future Lake Erie assessments will be the collection of shoreline data for the National Aquatic Resource Survey (NARS) of coastal waters of the United States (the National Coastal Condition Assessment - NCCA) which was conducted during the summer of 2015. Coordinated by U.S. EPA in collaboration with Great Lake states, these one-visit snapshots of lake water quality will be used to provide statistically valid national and regional assessments of Great Lakes resource condition. Additional information about the 2010 NCCA and the latest 2015 NCCA results, when available, can be found at the U.S. EPA NARS website (see National Aquatic Resource Surveys, ***epa.gov/national-aquatic-resource-surveys***).

G3. Results

For the 2020 IR, new aquatic life data collected in 2017 and 2018 were incorporated into the assessment database. During this period, biosurvey data from 530 sampling sites located in 96 HUC12 WAUs, 40 sampling sites located in five LRAUs and 22 sampling events in four of the seven LEAUs were available to completely or partially update previously assessed AUs or provide new assessments for AUs with unknown aquatic life status. All data were collected by Ohio EPA or Level 3 Qualified Data Collector external sources. Watersheds intensively monitored during 2017 and 2018 included the Tuscarawas River basin, Sugar Creek basin, Whitewater River basin, Swan Creek basin, Toussaint River basin, lower Maumee River basin, Western Lake Erie tributaries, and Cuyahoga River basin. The large rivers comprehensively reassessed were the Tuscarawas River, Whitewater River, and Cuyahoga River. Detailed watershed survey reports for many of the basins mentioned above are or will be available from Ohio EPA's Division of Surface Water (see Biological and Water Quality Report Index, ***epa.ohio.gov/dsw/document_index/psdindx.aspx***).

Summarized 2020 IR statistics for aquatic life assessments for large river, watershed and Lake Erie AUs as well as the comparable statistics from the 2002-2018 IRs are tabulated in Table G-4. More detailed aquatic life use results and statistics for each 2020 AU (watershed, large river and Lake Erie units), along with similar data from previous IRs, are provided via interactive maps at ***epa.ohio.gov/gis.aspx***.

LRAUs

LRAUs in Ohio (38 LRAUs spanning 23 rivers with watersheds greater than 500 square miles and totaling 1,248 river miles) remained essentially unchanged in percent of monitored miles in full attainment compared to the same statistic reported in the 2018 IR (Table G-4, Figure G-2). Based on monitoring through 2018, the full attainment statistic now stands at 88.2 percent (1,097 of 1,243 assessed LRAU miles), up 0.7 percent from the 2018 IR. Significant large rivers assessed for the 2020 IR included the Tuscarawas River (2017), Whitewater River (2017), and Cuyahoga River (2017). Attainment statistics for these three rivers (five LRAUs) are as follows.

- Tuscarawas River: 88.8 percent full attainment over 103.2 miles
- Whitewater River: 100 percent full attainment over 8.3 miles
- Cuyahoga River: 77.9 percent full attainment over 24.2 miles

Progress toward the 100 percent by 2020 aquatic life use goal for Ohio's large rivers is depicted in Figure G-2. Between the 2002 and 2020 reporting cycles, the percentage of large river miles in full attainment has increased from 62.5 percent to 88.2 percent and nearly 100 percent of total miles have been assessed. While the 100 percent full attainment by 2020 goal for large rivers was not reached, Ohio EPA is committed to continued support of this effort. In 2020, the Agency will complete a statewide large river survey covering every LRAU, the results of which will be reported in the 2022 IR. This statewide survey is planned to occur every 10 years thereafter to continue monitoring long-term trends.

Figure G-3 shows the top five aquatic life use impairment causes across the state for LRAUs. Principal causes for LRAU impairments are commonly linked back to impoundments, whether that be directly through habitat/hydromodification or with sediment/nutrient/organic loading that is exacerbated by the impounded sections. Figure G-4 depicts the attainment status breakdown of the 38 LRAUs by designated or recommended (existing) aquatic life use. As would be expected, most LRAUs (78.9 percent) include reaches assigned the base warmwater habitat (WWH) aquatic life use, for which attainment of biocriteria signifies meeting the fishable/swimmable goal of the Clean Water Act (CWA). For this cycle, about 40 percent of LRAUs with WWH segments are fully meeting the WWH use. About 36.8 percent of the LRAUs have segments assigned the more protective aquatic life use of exceptional warmwater habitat (EWH), and these have a higher rate of attainment. Three of the five LRAUs with modified warmwater habitat – impounded (MWH-I) segments are meeting the biocriteria for that sub-goal use.

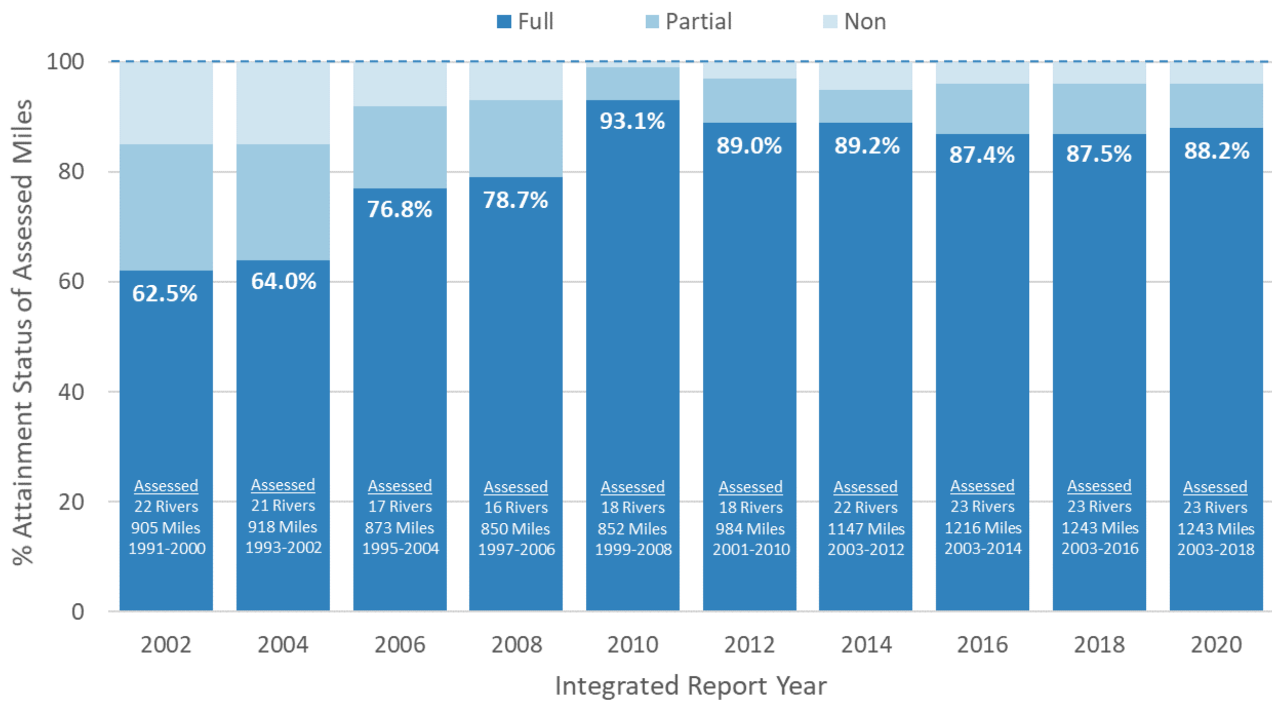

Figure G-2 — Percent attainment status and goal progress ("100% by 2020") for monitored miles of Ohio's large river assessment units (23 rivers/38 AUs/1247.54 miles total).

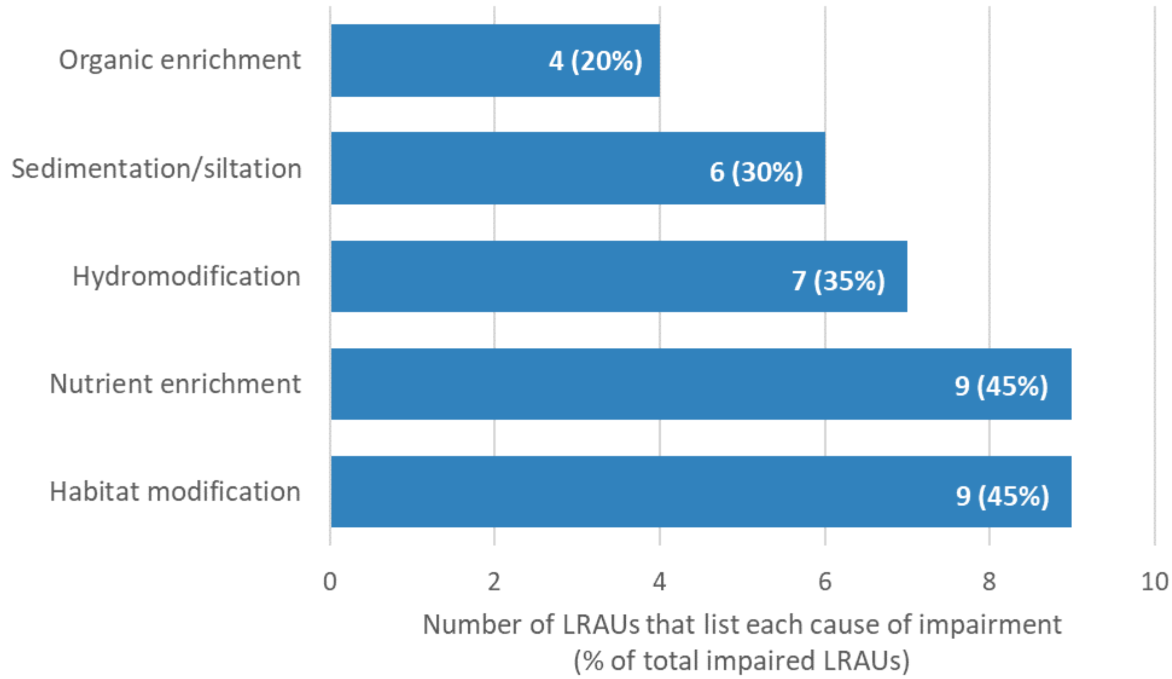

Figure G-3 — Top five causes of impairment in LRAUs.

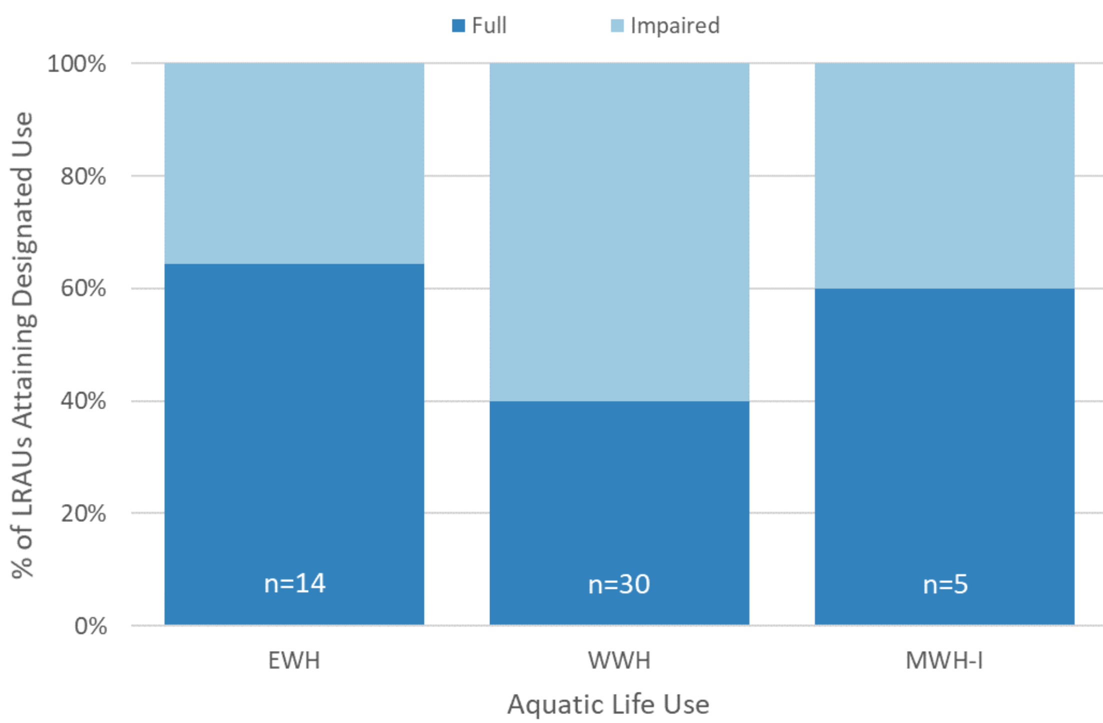

Figure G-4 — Summary of attainment status of LRAUs by aquatic life use.

EWH: exceptional warmwater habitat, WWH: warmwater habitat, and MWH-I: modified warmwater habitat – impounded. LRW: limited resource water and SSH: seasonal salmonid habitat not included due to negligible dataset size.

WAUs

For the 2020 IR, the average HUC12 WAU score remained essentially unchanged from the corresponding score reported in the 2018 IR (Table G-4, Figure G-6). Based on monitoring through 2018, the average HUC12 WAU score stands at 64.3, a 0.1-point increase from the 2018 IR and a 7.6-point increase from the HUC12 baseline year of 2010. The WAU score is roughly equivalent to the percentage of monitored sites with full aquatic life use attainment in WAUs assessed for this IR cycle. Included in Table G-4 and depicted in Figure G-6 is the corresponding average score based on the old HUC11 WAUs, which were tracked from 2002 through 2010.

Table G-2 depicts the breakdown of site full attainment based on the watershed size category used to determine an individual watershed's score based on available sites in the HUC12 WAU. As in previous reports, the results show that biological impairment is more likely at sites on small streams (more than four in 10 headwater sites are impaired) and that impairment lessens significantly as sites drain larger areas (nearly seven in 10 assessed principal stream and small river sites, 68.7 percent, are in full attainment).

Progress towards the 80 percent by 2020 aquatic life use goal for Ohio's wading and principal stream and river sites (those monitored sites draining watersheds between 20 and 500 square miles) is depicted in Figure G-5 for the 2020 IR cycle. Contrasted with the 2010 IR statistic, when the 2020 goal benchmark was established, the percentage of qualifying sites in full attainment has increased more than seven percentage points from 61.4 percent to 68.7 percent. While the 80 percent goal was not met, Ohio EPA will continue to fund implementation and monitoring across the state with the constant goal of improvement. Moving forward, it will be critical that resources be directed to follow-up monitoring in areas with implemented restoration and protection projects so that success of efforts can be documented and reflected in future goal statistics. This latter effort is now well underway in survey areas with TMDLs approved and implemented beginning in the late 1990s and is an ongoing activity in support of the Ohio EPA Nonpoint Source Program (see ***epa.ohio.gov/dsw/nps/index.aspx*** for more program information).

Figure G-7 shows the top five aquatic life use impairment causes across the state. Principal causes for HUC12 WAU impairments were those primarily related to landscape modification issues involving agricultural land use and urban development. These types of impairments would be most manifest in smaller streams. Over half of the impaired WAUs had at least one monitored site impaired by one of these individual causes and many WAUs had several sites affected by three or more of the five causes listed as responsible for the aquatic life use impairment. This would not be an unusual situation given the frequently close association between these impairment causes (for example, nutrients, sedimentation/siltation, habitat modifications and hydromodifications in rural/agricultural landscapes relying on channelization and field tiles for drainage).

Figure G-8 depicts the attainment status breakdown of the 1,538 WAUs by designated or recommended (existing) aquatic life use. As would be expected, most WAUs (87.6 percent) include streams assigned the base warmwater habitat (WWH) aquatic life use, for which attainment of biocriteria signifies meeting the fishable/swimmable goal of the Clean Water Act (CWA). For this cycle, about 32 percent of WAUs with WWH streams are fully meeting the WWH use. Assessment units with streams assigned more protective aquatic life uses (exceptional warmwater habitat-EWH, coldwater habitat-CWH or a dual use which includes both-EWH/CWH) are much more likely to be in full attainment (between 60 and 85 percent). Assessment units with streams assigned less than goal CWA uses (modified warmwater habitat-MWH and limited resource water-LRW) have lower achievement of the lessened expectations (between 22 and 45 percent full attainment). Both more protective and less than goal uses are only assigned after a use attainability analysis has been conducted based on rigorous field data and this study determines that the assigned aquatic life use is the most appropriate to protect existing high-quality/unique biological communities or set reasonable restoration benchmarks for communities challenged by pervasive anthropogenic or natural influences.

Table G-2 — Breakdown by watershed size category of sites in full, partial and non-attainment in monitored WAUs based on data collected primarily from 2009-2018.

Watershed Size Category (mi^2)	# of Sites (% of total)	Number of Sites in Full Attainment (%)	Number of Sites in Partial Attainment (%)	Number of Sites in Non-Attainment (%)
0-20 (headwater)	2,242 (63.5%)	1,274 (56.8%)	445 (19.8%)	523 (23.3%)
20-50 (wading)	557 (15.8%)	354 (63.6%)	122 (21.9%)	81 (14.5%)
50-500 (principal)	734 (20.8%)	533 (72.6%)	135 (18.4%)	66 (9.0%)
Total	**3,533**	**2,161 (61.2%)**	**702 (19.9%)**	**670 (19.0%)**

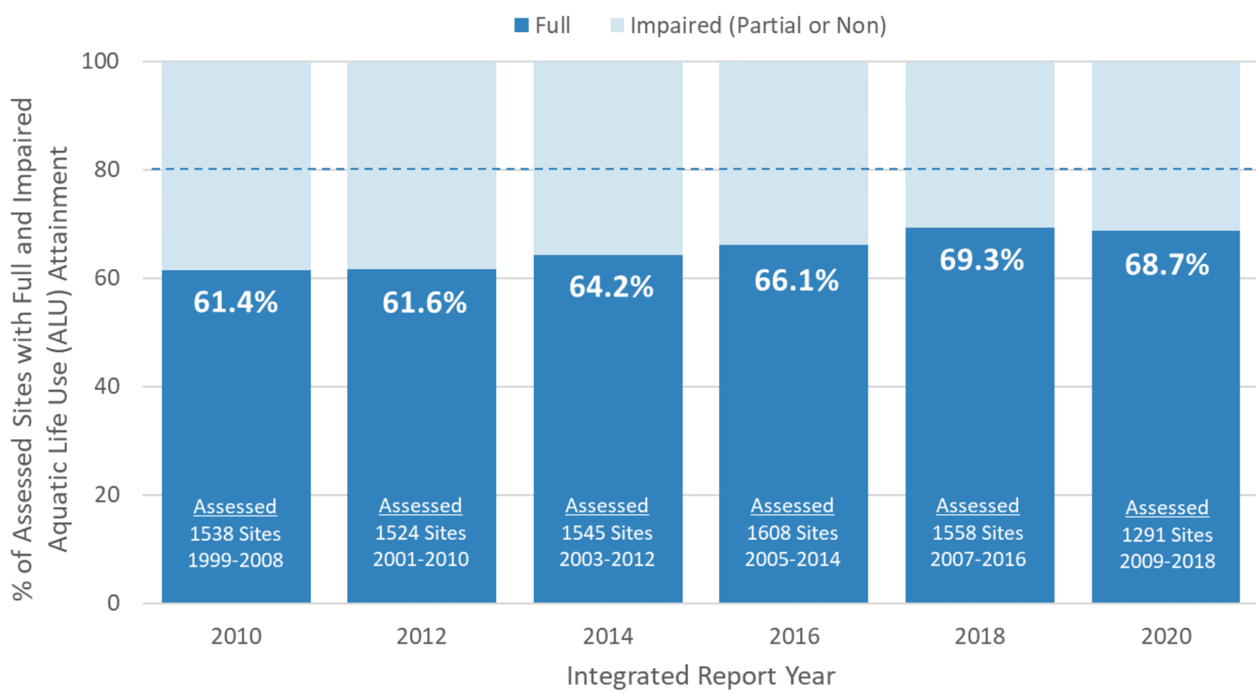

Figure G-5 — Status and trend of aquatic life use 80 percent by 2020 goal for wading and principal stream and river sites in Ohio based on the last six IR cycles.

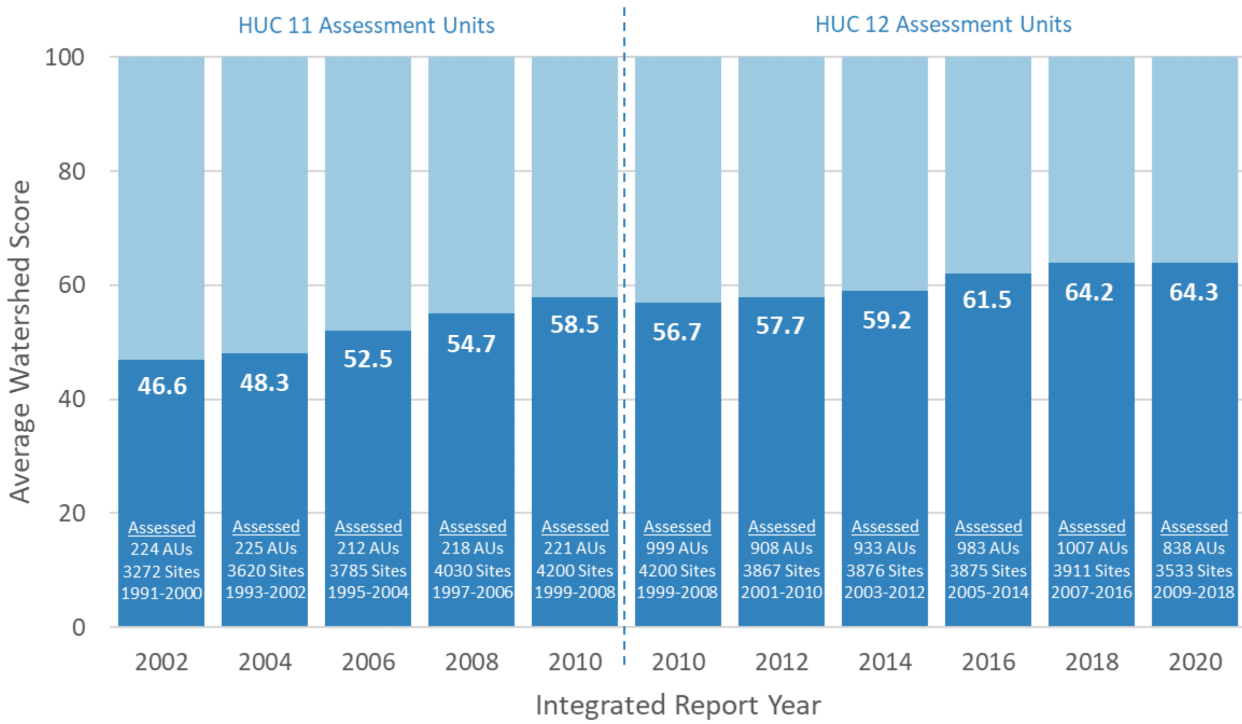

Figure G-6 — Average full attainment watershed score for monitored Ohio HUC11 watershed assessment units (IR cycles 2002-2010) and HUC12 watershed assessment units (IR cycles 2010-2018).

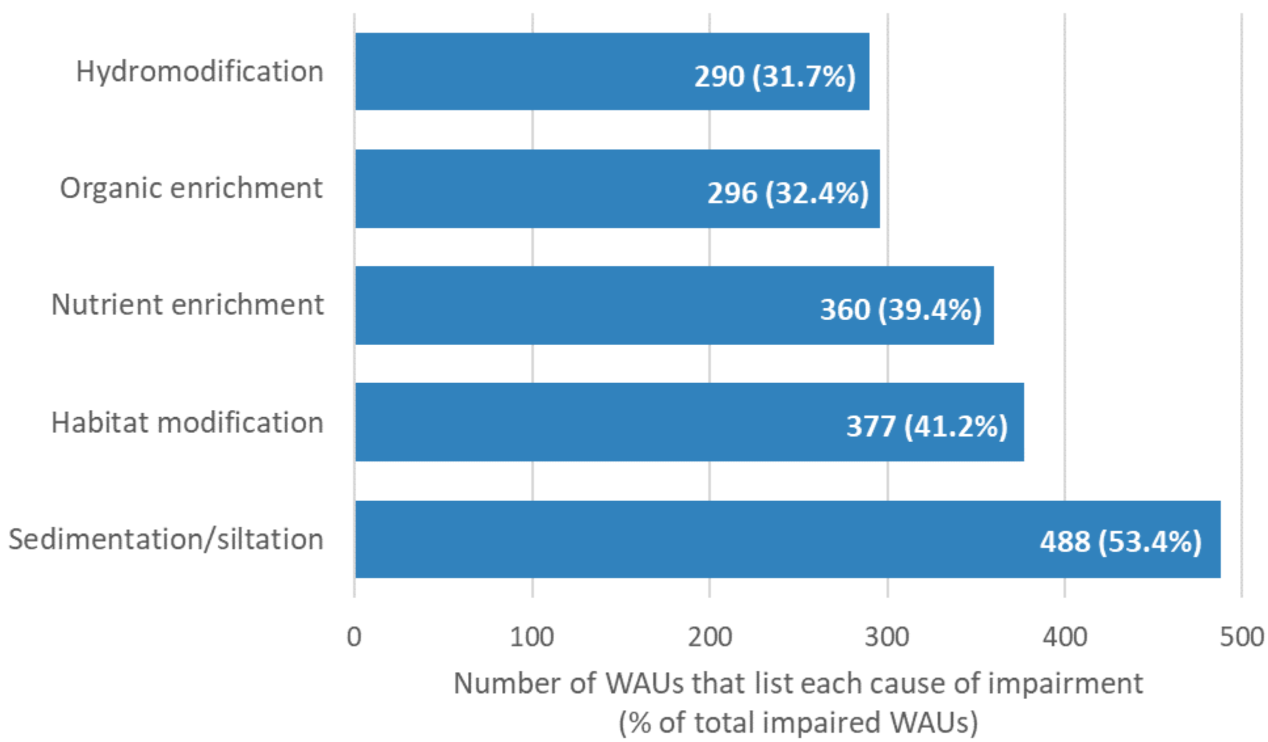

Figure G-7 — Top five causes of impairment in WAUs.

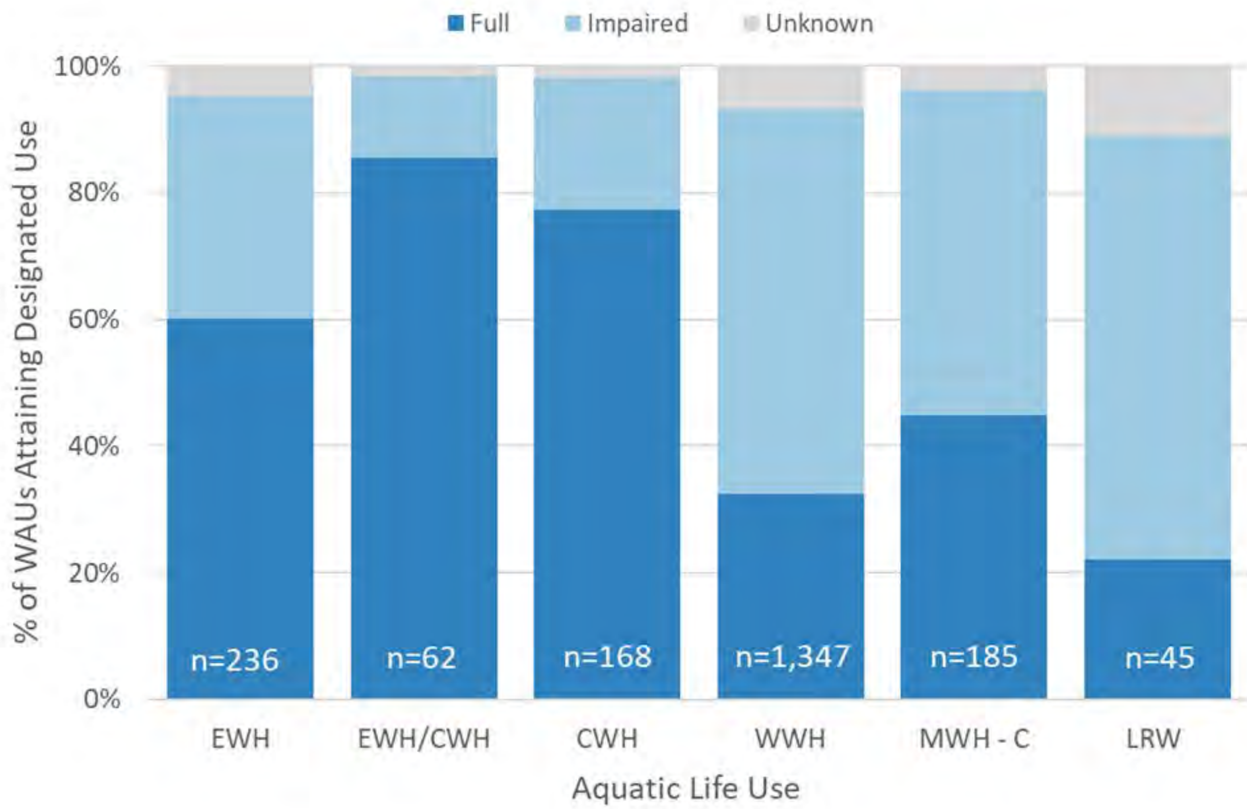

Figure G-8 —Summary of attainment status of WAUs by aquatic life use.

EWH: exceptional warmwater habitat, CWH: coldwater habitat, WWH: warmwater habitat, MWH-C: modified warmwater habitat – channel modified, LRW: limited resource water. MWH-I: modified warmwater habitat – impounded, MWH-MA: modified warmwater habitat – mine affected, and SSH: seasonal salmonid habitat not included due to negligible dataset size.

LEAUs

For previous IRs, assessments were based on past data collected in the mid-1990s through the early 2000s. Significant changes appear to be ongoing in Lake Erie, and, as a result, these older data are no longer being used to determine aquatic life use attainment status in the LEAUs. However, these data are used in the following discussion to highlight key trends in fish community condition over two time periods of sampling.

Ohio EPA is in the process of developing new metrics for determining ALU attainment in all LEAUs. Section I4 of this report provides details about this work.

From 2011-2018, 161 fish community collections using electrofishing methods were taken from 35 sites spread over the shoreline LEAUs; these data serve as the core data set for assessment of Lake Erie status. For this cycle, and despite the rather limited amount of data, the assessment methodology as used in past IRs was once again used to determine aquatic life use status in the LEAUs. This included analysis of IBI and MIwb scores for all sampling passes available at a given sampling location compared to target expectations based on the prevailing bottom substrate type at that location (hard bottoms — bedrock, boulder, rubble or soft bottoms — sand, silt, muck). Results for the IBI and MIwb scores at 35 shoreline sites (excluding the shoreline located in Sandusky Bay and the Lake Erie Islands sites) compared to expectations are presented in Figure G-9 and Figure G-10.

All the shoreline LEAUs assessed remain Category 5 with significant impairment of sites due primarily to tributary loadings of nutrients and sediment, exacerbated by continued trophic disruptions caused by the proliferation of exotic species, algal blooms and shoreline habitat modifications. It is graphically apparent in Figure G-9 and Figure G-10 that most sampling events fail to meet expectations. Table G-3 below shows that fewer than 25% of the sampling events in the western, islands and Sandusky Basin shoreline LEAUs meet full attainment expectations. In the central basin 74% of the sampling events meet full attainment expectations.

Table G-3 — Sampling results attainment status for each of the shoreline LEAUs.

AUID	AU Name	# Sites	Electrofishing sampling results			
			Samples	# Full (% of total)	# Partial	# Non
041202000201	Lake Erie Western Basin Shoreline (including Maumee Bay)	11	93	23 (24.7%)	18	52
041202000101	Lake Erie Islands Shoreline	3	5	1 (20.0%)	2	2
041202000202	Lake Erie Sandusky Basin shoreline	4	25	5 (20.0%)	11	9
041202000203	Lake Erie Central Basin shoreline	17	38	28 (73.7%)	6	4

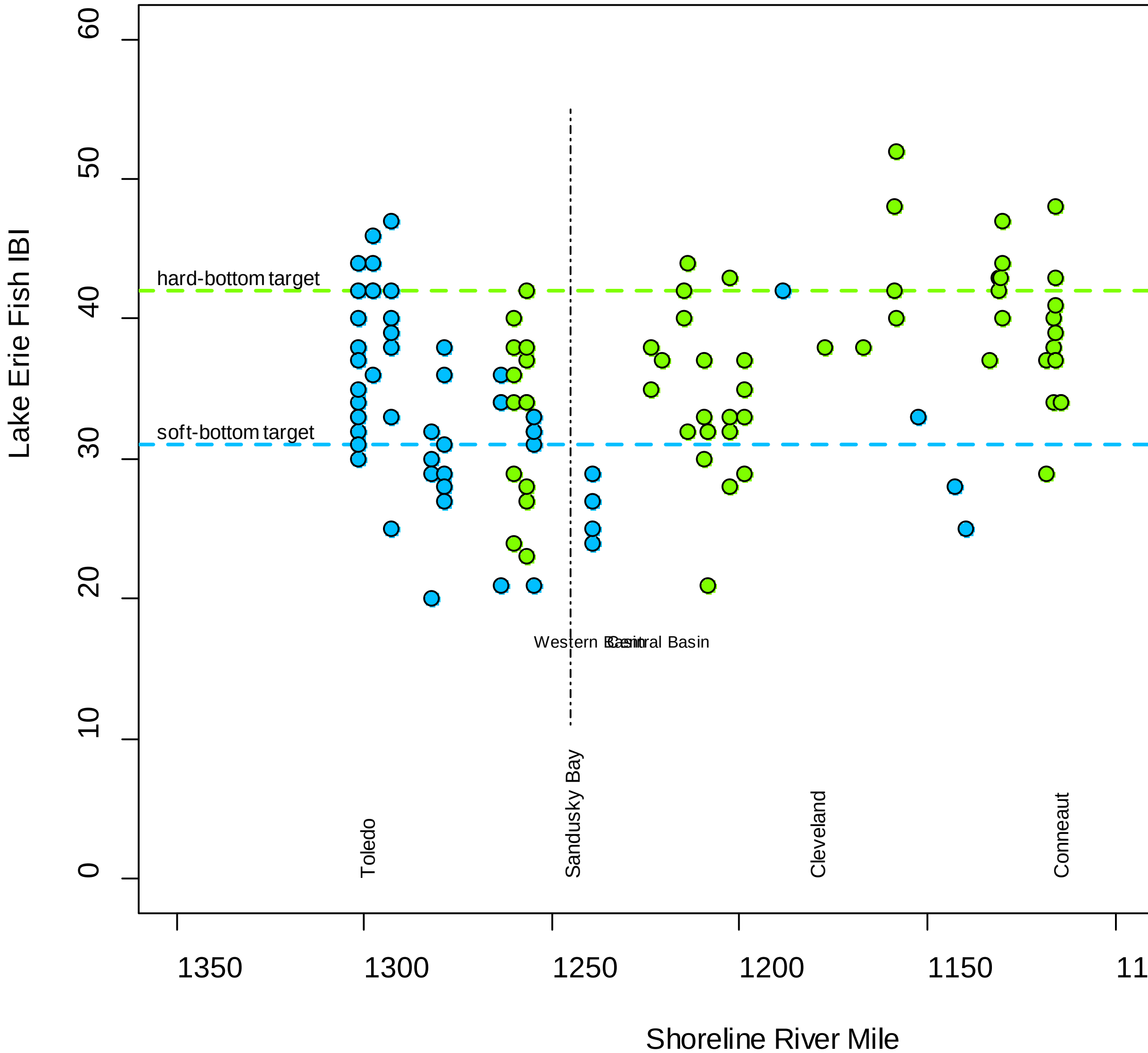

Figure G-9—IBI scores compared to habitat-scaled targets showing all sampling passes available for each site along the Lake Erie shoreline from Toledo to Conneaut, 2011-2018.

Figure does not include IBI scores for Sandusky Bay or Lake Erie Islands shoreline sites.

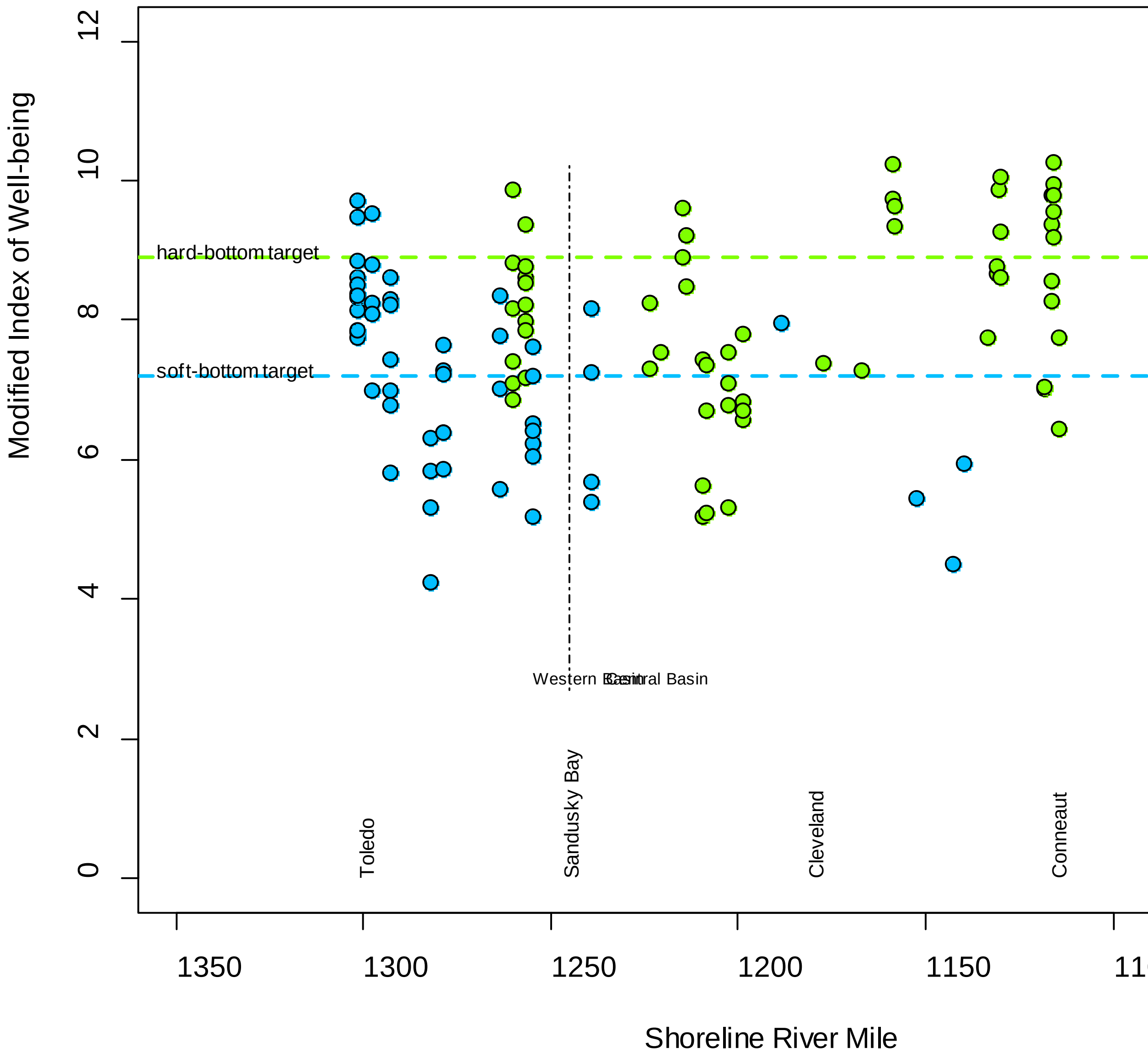

Figure G-10 — Average MIwb scores compared to habitat-scaled targets showing all sampling passes available for each site along the Lake Erie shoreline from Toledo to Conneaut, 2011-2018.

Figure does not include MIwb scores for Sandusky Bay or Lake Erie Islands shoreline sites.

For this IR, Ohio EPA incorporated multivariate statistical techniques to examine historical trends in LEAU ALU data. These techniques have been made accessible by the combination of modern computing power, open-source software, and highly approachable books[1], guides[2] and online texts[3].

Distance measures evaluate a similarity distance between sites in terms of the species abundances. The most common distance measure used on biological assemblages is the Bray-Curtis[4] distance. This distance is essentially the ratio between the total abundance of commonly held species between two sites, and the total abundance of all species collected at the two sites. With more species in common, the ratio will track closer to one. The other frequently used distance is Euclidean distance, and that can be thought of as the hypotenuse resulting if a given species abundance (or parameter measure) at two sites were taken as x-y coordinates (for instance, for three found at one site and four at the other, the coordinates would be 0,3 for the x; 0,4 for the y)[5]. Euclidean distances are more typically calculated for the environmental table after the environmental measures have been standardized based on how much each parameter at each assessment site deviated from the mean of all sites (z scores).

Once distance measures have been calculated for the biological matrix, groups of sites can be identified using hierarchical clustering. Essentially, the clustering algorithm identifies the two most similar sites (or least dissimilar) and joins them with a branch, finds the next two most similar objects (for instance, the sites joined previously are considered an object) and joins them, and so forth.

For the LEAU distance and hierarchical cluster analysis each electrofishing sampling event was considered. Ten cluster groups were derived with each group representing a different assemblage of fish species and abundance. These results were bifurcated by the Lake Erie period of rapid expansion of the invasive round goby (*Neogobius melanostomus)* in 1996. Assessment site sampling event results are presented by cluster group for pre and post 1996 sampling seasons in Figure G-11 and Figure G-12, respectively. These figures plot the results on an unprojected latitude and longitude matrix that can be easily interpreted as a map of Ohio's Lake Erie lacustuaries and shoreline. Each figure includes a general description of the nature of the cluster groups.

A notable change in examining these two periods is the movement away from group 6, the primarily carp X goldfish group, in the Cuyahoga, Ottawa and Maumee lacustuaries. This is generally attributed to water quality improvements in those urbanized/industrial areas and not due to the goby invasion. A shift away from an assemblage characterized by shorthead redhorse, white bass and silver chub in the lower Maumee after 1996, is more generally attributed to community changes due to the goby and expansion of flathead catfish.

1 Gauch, H.G., 1982. *Multivariate analysis in community ecology* (No. 1). Cambridge University Press.

2 McCune, B. and Mefford, M.J., 1999. PC-ord. *Multivariate analysis of ecological data, version*, *4*(0).

3 Oksanen, J., 2009. Multivariate analysis of ecological communities in R: vegan tutorial. *URL:[http://cc. oulu. fi/, jarioksa/opetus/metodi/vegantutor. pdf]*.
Zuur, A.F., Ieno, E.N., Walker, N.J., Saveliev, A.A. and Smith, G.M., 2009. Mixed effects models and extensions in ecology with R. Gail M, Krickeberg K, Samet JM, Tsiatis A, Wong W, editors. *New York, NY: Spring Science and Business Media*.

4 Beals, E.W. (1984). Bray-Curtis ordination: an effective strategy for analysis of multivariate ecological data. *Advances in Ecological Research*, 14, 1-55.

5 Euclidean distances are actually calculated from squared differences.

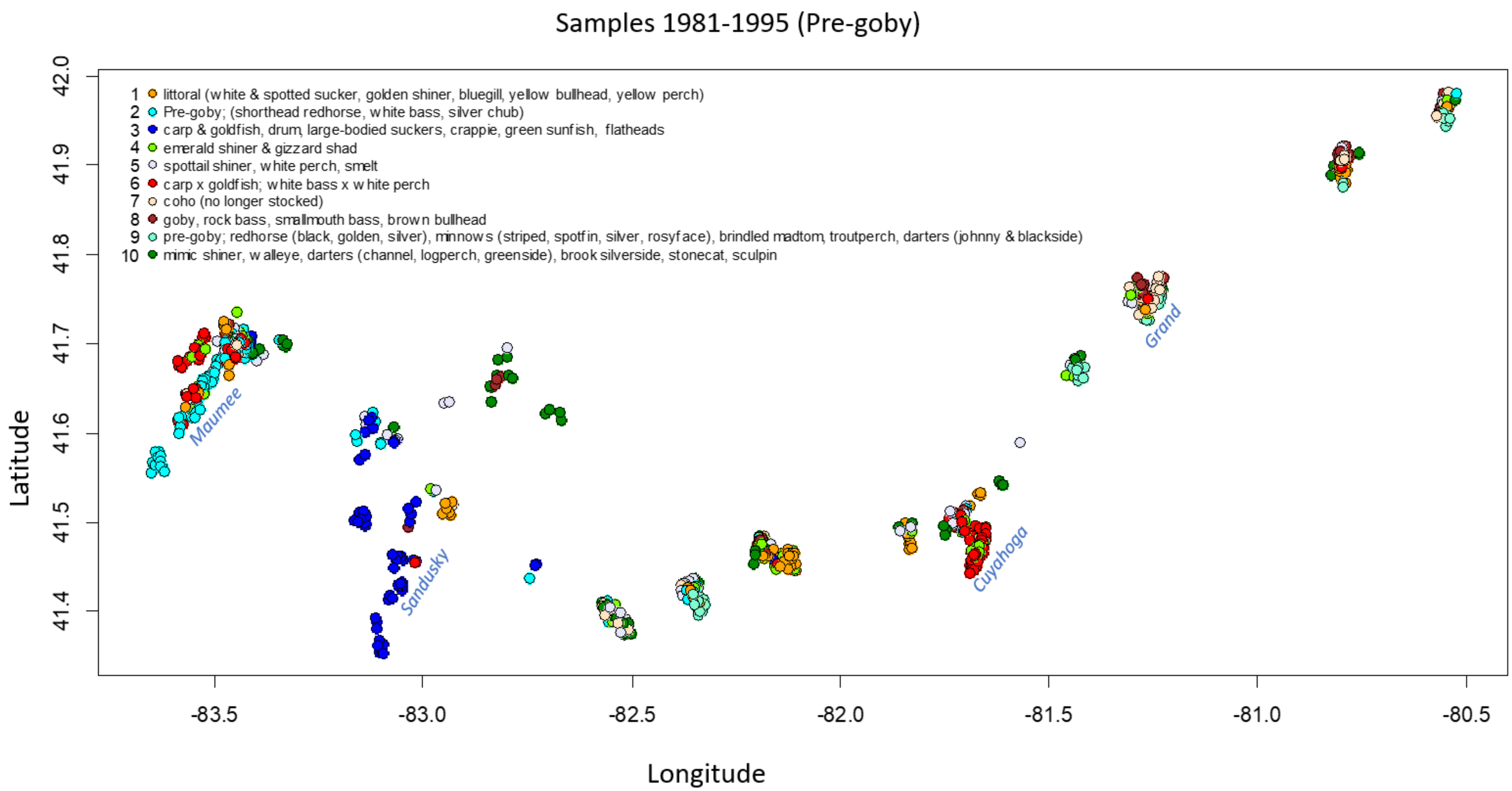

Figure G-11—Fish assemblage hierarchical cluster group of each electro-fishing sampling event in Lake Erie lacusturaries and shoreline from 1981-1995 (pre-round goby invasion).

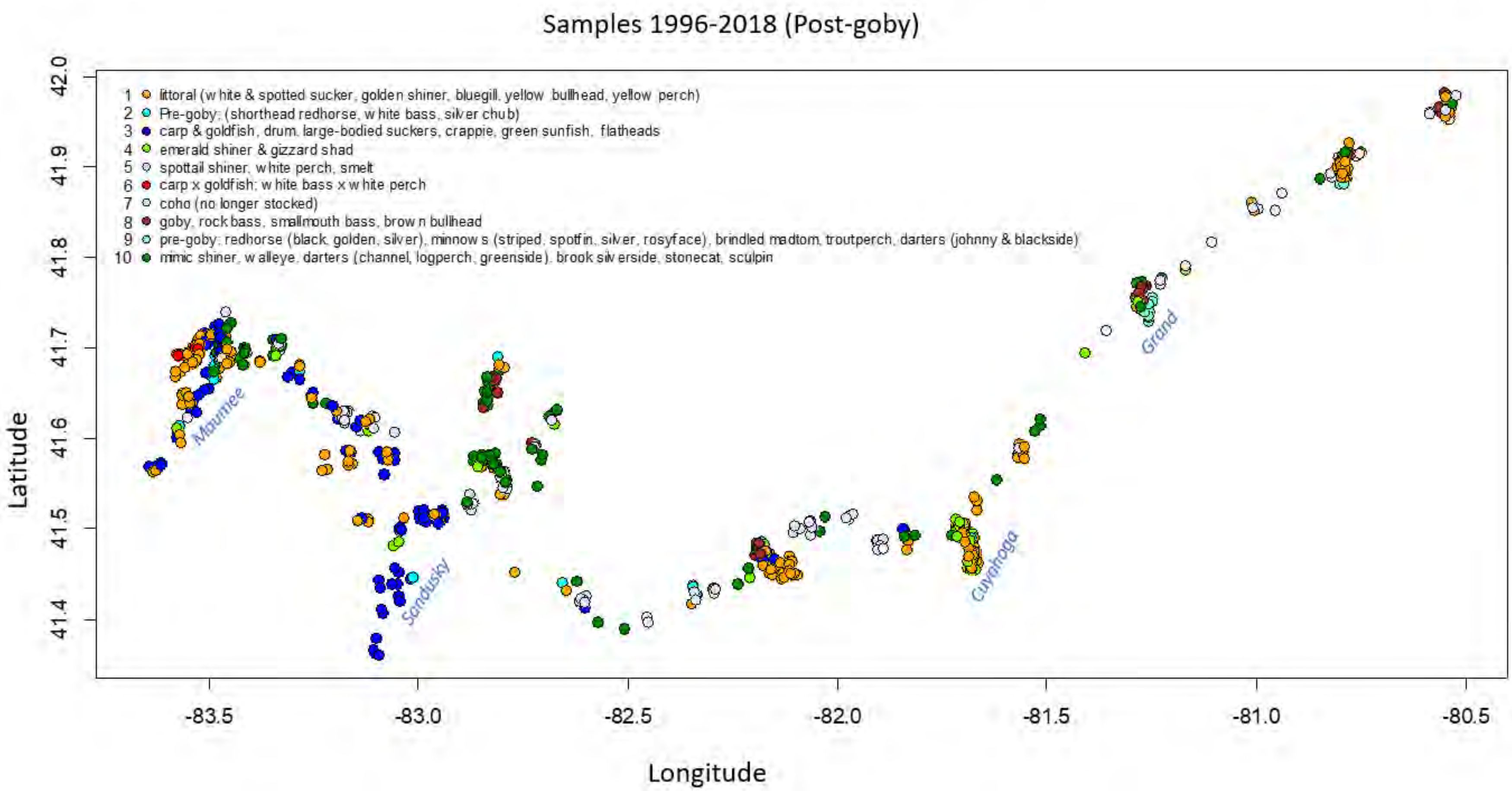

Figure G-12 — Fish assemblage hierarchical cluster group of each electro-fishing sampling event in Lake Erie lacusturaries and shoreline from 1996-2018 (post-round goby invasion).

Table G-4 — Summary of aquatic life use assessment for Ohio's WAUs1, LRAUs and LEAUs: 2002-2020 IR cycles.

IR Cycle	2002 (1991-2000)	2004 (1993-2002)	2006 (1995-2004)	2008 (1997-2006)	2010 (1999-2008)	2012 (2001-2010)	2014 (2003-2012)	2016 (2005-2014)	2018 (2007-2016)	2020 (2009-2018)
HUC11 WAUs (331)										
No. AUs Assessed (% of total)	224 (68%)	225 (68%)	212 (64%)	218 (66%)	221 (67%)	-	-	-	-	-
No. Sites Assessed	3272	3620	3785	4030	4200	-	-	-	-	-
Average AU Scores										
Full Attainment	**46.6**	**48.3**	**52.5**	**54.7**	**58.5**	-	-	-	-	-
Partial Attainment	25.2	23.6	22.6	22.4	21.2	-	-	-	-	-
Non-Attainment	28.2	28.1	24.9	22.9	20.3	-	-	-	-	-
HUC12 WAUs (1538)										
No. AUs Assessed (% of total)[2]	-	-	-	-	999 (65%)	908 (59%)	933 (61%)	983 (64%)	1,007 (65.5%)	838 (54.5%)
No. Sites Assessed	-	-	-	-	4200	3867	3876	3875	3911	3533
Average AU Score[3]	-	-	-	-	**56.7**	**57.7**	**59.2**	**61.5**	**64.2**	**64.3**
% Sites Full Attainment	-	-	-	-	55.1	57.0	57.8	59.3	61.8	61.2
% Sites Partial Attainment	-	-	-	-	20.0	21.6	22.3	20.7	19.7	19.9
% Sites Non-Attainment	-	-	-	-	24.9	21.4	19.9	20.0	18.5	19.0
LRAUs (23 rivers/38 AUs totaling 1247.54 Miles)										
No. Rivers/AUs Assessed[4]	22	21	17	16	18/30	18/31	22/37	23/38	23/38	23/38
No. Sites Assessed	422	425	374	278	265	312	332	358	370	364
No. Miles Assessed (% of total)	905 (70%)	918 (71%)	873 (68%)	850 (66%)	852 (69%)	984 (80%)	1,147 (92%)	1,216 (98%)	1,243 (99.7%)	1,243 (99.7%)
% Miles Full Attainment	**62.5**	**64.0**	**76.8**	**78.7**	**93.1**	**89.0**	**89.2**	**87.4**	**87.5**	**88.2**
% Miles Partial Attainment	23.0	21.4	15.1	13.9	5.5	7.5	6.3	8.7	8.8	8.2
% Miles Non-Attainment	14.5	14.6	8.1	7.4	1.4	3.5	4.5	3.9	3.7	3.6
LEAUs (4[5])										
No. AUs Assessed	3	3	3	3	3	3	3	3	4[5]	4
No. Sites Assessed[6]	92	111	93	49	34	23	38	45	47	35
% Sites Full Attainment	**12.0**	**18.0**	**19.4**	**10.2**	**14.7**	**30.4**	**13.2**	**13.3**	**17.0**	**35.4**[7]
% Sites Partial Attainment	13.0	14.4	16.1	22.4	17.7	30.4	34.2	31.1	25.5	22.9[7]
% Sites Non-Attainment	75.0	67.6	64.5	67.4	67.6	39.2	52.6	55.6	57.5	41.6[7]

1 WAUs for the IR 2002-2010 cycles were based on HUC11s; WAUs transitioned to HUC12s for cycles beginning with 2010.
2 2010 statistics based on direct assessment of HUC12 AUs with data collected between 2005 and 2008 (n=545) and HUC11 extrapolated assessment of HUC12 AUs with data collected between 1998 and 2004 (n=454).
3 Statistic based on the average of available AU scores with up-to-date or acceptable data, derived as explained in Section G2.2.
4 LRAUs are assessed using data back to 2003 in statistics for IR cycles 2014-2020.
5 For the 2018 IR, LEAUs were refined to distinguish the Sandusky Bay shorelines and open water as a transition area between the western and central basins, resulting in four shoreline units that were assessed for aquatic life use.
6 Data for Lake Erie shoreline sites used in the 2002-2012 IR cycles were generally collected between 1993 and 2002; for the 2014-2020 IRs, data were collected 2011-2018.
7 Percentages are calculated upon number of sampling events in full attainment, partial attainment and non-attainment. Data are not grouped by site.

Section

H

Evaluating Beneficial Use: Public Drinking Water Supply

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H1. Background

The 2020 Integrated Report (IR) is the seventh reporting cycle to include assessment of the public drinking water supply (PDWS) beneficial use. Ohio continues to look for connections between Clean Water Act and Safe Drinking Water Act (SDWA) activities and leverage the programs to clean up and protect drinking water sources. Acknowledgement of the public water supply use and identification of impaired waters provides an effective issue in which to engage the public and stakeholders in watershed-wide planning and implementation activities. Conversely, the public water systems can be effective partners in these efforts and stand to benefit through reduced treatment costs, reduced risk to human health and credits toward achieving compliance with new SDWA regulations via source water controls in the watershed.

Assessments for each public water system were completed for nitrate, pesticide and algae (cyanotoxin) indicators. Assessments included in this cycle are based on treated and raw water quality compliance data and, to a limited extent, other source water quality data available from Ohio EPA and external sources. Information used to complete assessment determinations include public water system treatment information, intake location, number and type of reservoirs and water quality data. Assessments were completed for stream sources, in-stream impounded reservoir sources and upground reservoirs with active drinking water intakes. Figure H-1 identifies Ohio watershed assessment units (WAUs), large river assessment units (LRAUs) and Lake Erie assessment units (LEAUs) that contain surface waters currently utilized as drinking water sources by a public water system. WAUs correspond to 12-digit hydrologic unit codes. Since the last reporting period, the following public water systems had intakes go inactive: ODNR West Branch (Kirwin Reservoir and West Branch Mahoning River), Fluor-B and W Portsmouth, and McClure. Any WAU associated with these public water systems that is not also associated with active intakes was not assessed.

H2. Evaluation Method

The methodology for assessing the PDWS beneficial use was first presented in the 2006 Integrated Water Quality Monitoring and Assessment Report. Updates to the methodology were included in subsequent IRs. The methodology used for this reporting cycle, including the use of an algae indicator, is described in this section. For more detail on how the method was first developed and rationale for indicator selection and exclusion, please refer to the initial methodology at ***epa.ohio.gov/portals/35/tmdl/2006IntReport/IR06_app_C_PDWSmethodology.pdf***.

Beneficial Use Designation

The PDWS use designation is defined in paragraph (B)(3) of Ohio Administrative Code (OAC) rule 3745-1-07. It applies to public waters that, with conventional treatment, will be suitable for human intake and meet federal regulations for drinking water. Although not necessarily included in rules 3745-1-08 to 3745-1-30 of the OAC, the bodies of water with one or more of the following characteristics are designated public water supply by definition:

- All publicly owned lakes and reservoirs, except for Piedmont reservoir;
- All privately owned lakes and reservoirs used as a source of public drinking water;
- All surface waters within 500 yards of an existing public water supply surface water intake; and
- All surface waters used as emergency water supplies.

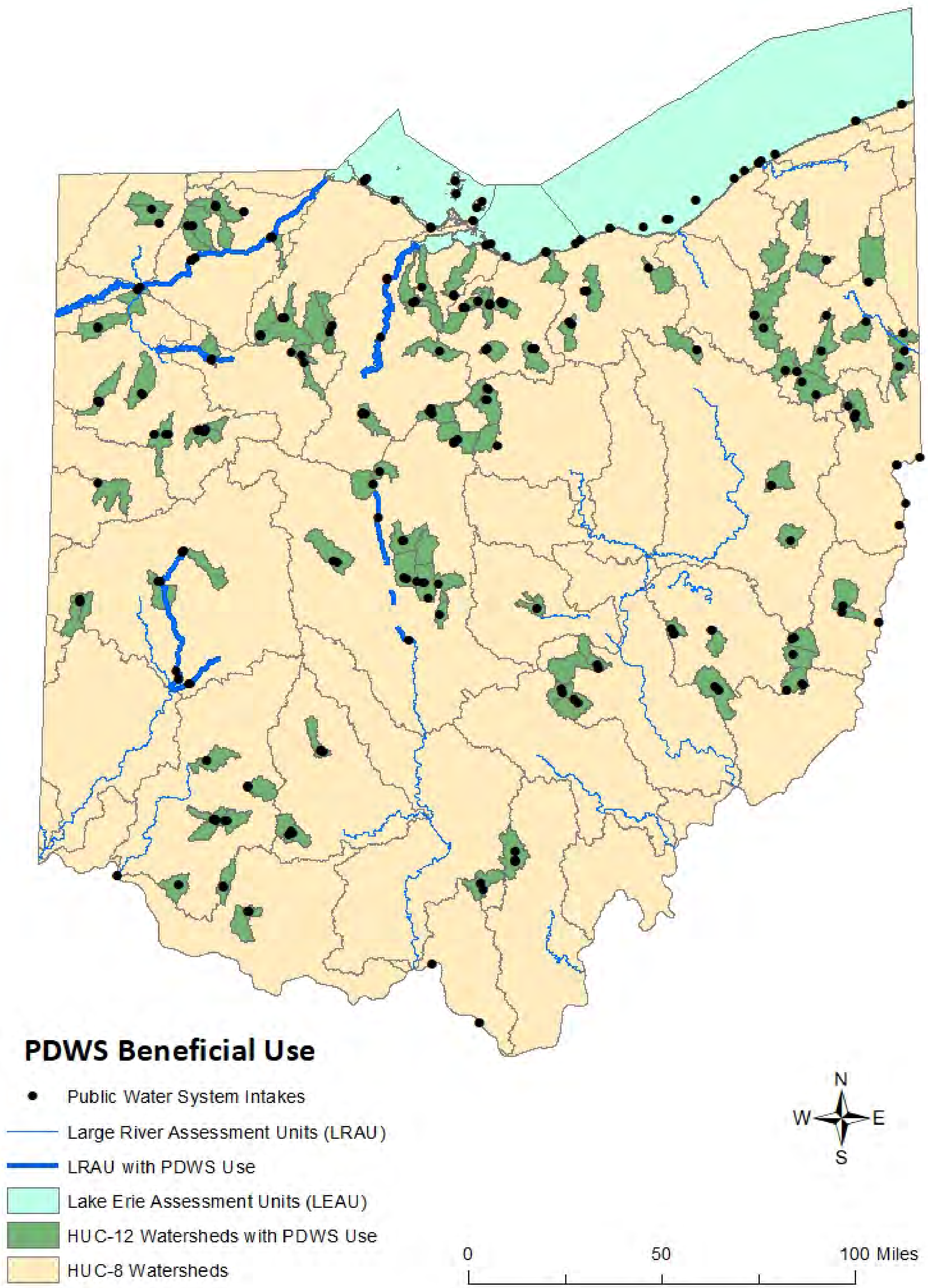

Figure H-1 — Ohio WAUs, LRAUs and LEAUs that contain at least one active surface water drinking water intake.

Ohio EPA is focusing assessment efforts and limited resources on water bodies currently serving as public drinking water sources. Water bodies with inactive drinking water intakes that are being maintained as an emergency source of drinking water will also be assessed. Assessments for waters designated with the PDWS use but not currently used as a drinking water source are considered a lower priority and will be assessed only when water quality data is available.

Attainment determinations will apply to hydrologic assessment units (AUs) as defined by Ohio EPA's Division of Surface Water (DSW). For inland rivers the assessment unit is defined as the 12-digit hydrologic unit code (HUC 12) or the large river assessment unit. LEAUs were revised in the 2018 cycle to cover all of Ohio's waters and now include seven units based on geographic location and depth (shoreline: less than or equal to three meters and open water: greater than three meters). There are 30 active public water system intakes located within six of the seven LEAUs. Although this beneficial use designation applies to a 500-yard zone surrounding the intakes, the attainment determination will be associated with the corresponding hydrologic assessment unit and factor into the 303(d) priority listing determination for impaired waters.

Water Quality Standards

Water quality standards are designed to protect source water quality to the extent that public water systems can meet the finished water SDWA standards utilizing only conventional treatment. Source water quality will be assessed though comparison of in-stream and applicable treated water quality data to numeric chemical water quality criteria for the core indicators: nitrate; pesticides and other contaminants; and *Cryptosporidium* (following criteria development). The numeric water quality criteria correspond to the maximum contaminant levels established by the SDWA or were adopted from U.S. EPA's 304(a) recommended water quality criteria. Criteria will apply as average concentrations except for nitrate. At elevated levels, nitrate can cause acute health effects and the SDWA finished water standard applies as a maximum concentration not to be exceeded. Consequently, the water quality criteria for nitrate will be applied as a maximum value. Annual time-weighted mean pesticide concentrations were calculated by taking the annual average of the quarterly averages and comparing to the water quality criteria.

An additional core indicator based on algae and associated cyanotoxins is based on the aesthetic narrative criteria for algae described in OAC rule 3745-1-07 and uses cyanotoxins as an indicator of algae impairment. The State of Ohio initially developed numeric cyanotoxin drinking water thresholds for microcystins, saxitoxins, anatoxin-a and cylindrospermopsin in 2011 and these thresholds were the initial basis for cyanotoxin indicators of impairment. The numeric cyanotoxin drinking water thresholds were updated in the 2015 State of Ohio Public Water System Harmful Algal Bloom Response Strategy and remain in use through the current version of the strategy. The PDWS beneficial use assessments are now based on comparison to the thresholds identified in the 2019 State of Ohio Public Water System Harmful Algal Bloom Response Strategy. In 2016, Ohio finalized new rules for harmful algal blooms and cyanotoxins at public water systems, including requirements for routine microcystins and cyanobacteria screening monitoring and reporting. For this report, Ohio EPA reevaluated the cyanotoxin indicators and decided to align the cyanotoxin indicators with adult drinking water threshold values for the 2020 reporting cycle. Due to this change in methodology, two WAUs listed as impaired for saxitoxins in the previous assessment cycle are now in full support and watch list for cyanotoxins indicator. Since cyanotoxin thresholds are based on acute or short-term exposures, the criteria are based on a maximum concentration not to be exceeded.

Public Drinking Water Supply Beneficial Use Cyanotoxin Indicators and Thresholds			
Microcystins (µg/L)	Anatoxin-a (µg/L)	Cylindrospermopsin (µg/L)	Saxitoxins (µg/L)
1.6	20	3.0	1.6

Attainment Determination

Each assessment will result in identification of one of three attainment categories: Impaired; Full Attainment; and Not Assessed-Insufficient Data. For AUs with multiple PDWS zones, the attainment statuses of all zones are combined and the lowest attainment status applied to determine the PDWS assessment status for the entire assessment unit. That is, the overall AU status is considered Impaired if any of the PDWS zones have an impaired attainment status. Conversely, the overall assessment status for the AU could be listed as Full Support only if sufficient data for at least the nitrate indicator was available to determine the attainment status for all PDWS zones within the AU.

AUs are further evaluated for water quality conditions placing them on a watch list. Source waters are placed on the watch list when water quality was impacted, but not at a level that indicates impairment. Waters may remain on the watch list based on historical data, if current raw water data or applicable finished water quality data are not available. While these waters are still considered in full attainment of the PDWS use, they will be targeted for additional monitoring and more frequent assessment as resources allow. Table H-1 identifies impaired and watch list water quality conditions.

Table H-1 — PDWS attainment determination.
Applies to ambient and treated water quality data from 2013 through October 2019.

Indicator	Impaired Conditions
Nitrate	☐ Two or more excursions[a] above 10.0 mg/L within the 5-year period
Pesticides	☐ Annual average exceeds WQ criteria (atrazine = 3.0 µg/L)
Other Contaminants	☐ Annual average exceeds WQ criteria
Algae: Cyanotoxins[b]	☐ Two or more excursions[a] above the state drinking water thresholds (microcystins = 1.6 µg/L) within the 5-year period
Cryptosporidium[c]	☐ Annual average exceeds WQ criterion (1.0 oocysts/L)
Indicator	**Full Attainment Conditions**
Nitrate	☐ No more than one excursion[a] above 10.0 mg/L within the 5-year period
Pesticides	☐ Annual average does not exceed the WQ criteria (atrazine = 3.0 µg/L)
Other Contaminants	☐ Annual average does not exceed the WQ criteria
Algae: Cyanotoxins	☐ No more than one excursion[a] above the state drinking water thresholds (microcystins = 1.6 µg/L, cylindrospermopsin = 3.0 µg/L, and saxitoxins = 1.6 µg/L) within the 5-year period
Cryptosporidium	☐ Annual average does not exceed the WQ criterion
Indicator	**"Watch List" Conditions** *Source waters targeted for additional monitoring and assessment*
Nitrate	☐ Maximum instantaneous value > 8 mg/L (80% of WQ criterion)
Pesticides	☐ Running quarterly average ≥ WQ criteria ☐ Maximum instantaneous value ≥ 4x WQ criteria
Other Contaminants	☐ Maximum instantaneous value ≥ WQ criteria
Algae: Cyanotoxins	☐ Maximum instantaneous value ≥ 50% of the state drinking water thresholds
Cryptosporidium	☐ Annual average ≥ 0.075 oocysts/L

[a] Excursions must be at least 30 days apart in order to capture separate or extended source water quality events.
[b] Impaired conditions based on source water detections at inland public water systems and detections at public water system intakes for Lake Erie source waters. Cyanotoxins include: microcystins, saxitoxins, anatoxin-a and cylindrospermopsin.
[c] Impaired conditions for *Cryptosporidium* are based on water quality criteria that Ohio EPA intends to develop.

Data Sources and Requirements

To capture current water quality conditions, the beneficial use will be evaluated using the most recent five years of data. The 2020 PDWS use impairment list was developed using public water system compliance monitoring treated and raw water quality data and ambient (stream and lake) water quality data from January 2013 through October 2019. Water quality data were requested and obtained from the Syngenta Crop Protection, Inc. Atrazine Monitoring Program (AMP; 2012-2018). Treated water quality data were obtained from the Safe Drinking Water Information System (SDWIS) database, which contains all SDWA compliance data submitted to the Division of Drinking and Ground Waters (DDAGW) by Ohio public water systems and their certified laboratories. Raw water quality data from samples collected near intakes were obtained from DSW's ambient monitoring database and level 3 credible data collected and submitted by level 3 qualified data collectors. Additional raw water quality data were collected by DDAGW at intake locations and cyanotoxin data were retrieved from Ohio EPA's Harmful Algal Bloom database.

Treated water quality data could only be used for the assessments if the water system did not blend with ground water, selectively pump from the stream source to an upground reservoir to avoid contamination or use a nitrate or pesticide removal treatment process. A significant number of water systems use activated carbon during the water treatment process, which precludes use of the treated pesticide data for PDWS assessments and leads to a significant number of assessments completed with nitrate and algae data only.

The following sampling guidance was followed to ensure that surface water samples are representative of the source water.

- Preferred sampling location was within the 500-yard PDWS zone or directly at the intake. Samples collected at the treatment plant raw water line were also considered representative.
- Data collected upstream from the intake beyond the 500-yard zone were utilized if there were no significant hydrologic or water quality changes between the sample location and the intake. Dams, channel modification, tributaries with significant flow or contaminant sources were assumed to significantly alter in-stream water quality and limit applicability of farther upstream sampling data.
- For PDWS lakes and reservoirs with known stratification or seasonal turnover, the preferred data collection location was either the raw water intake line or in the lake at the same depth or zone as the raw water intake screen(s). Surface sampling data collected at the intake were utilized if no other raw water data were available.

PDWS attainment determinations based on small sample sets present several challenges. The small sample set may fail to identify an exceedance of a water quality standard, resulting in a determination of attainment when in fact an area is impaired. Statistical confidence in the determination decision is also reduced. To address these concerns, the assessment looks at multiple lines of evidence including several sources of water quality data and treatment plant information. The attainment decision target sample size is 20 samples collected within the past five years. This sample count will provide sufficient power to detect exceedances of greater than or equal to 15 percent above the criterion with a Type I error of 0.15. Ohio EPA has limited resources for source water sampling, therefore attainment determinations may be concluded with a minimum of 10 samples if these samples represent the critical period when the contaminant is typically detected. Attainment decisions may also be made with less than the required sample count when there is overwhelming evidence of impairment, such as a large single sample exceedance of nitrate or microcystins (verified with a repeat sample).

Many source water contaminants occur in surface waters seasonally with maximum concentration in early spring through summer. To ensure that sampling for nitrates and pesticides accurately characterizes these seasonal fluxes, at least 50 percent of the samples are collected from March to August with at least two years represented. The critical sampling time for cyanotoxins is late spring through fall (May to November). To minimize dataset seasonal bias, any impairment determination based on exceedance of a mean water quality criterion requires a minimum of 10 samples representing at least two seasons. If a large dataset is available with sample collection skewed toward high flow events (stratified sampling program), it may be necessary to calculate time-weighted seasonal or monthly average values.

Most of the nitrate assessments were completed with sufficient samples and well over the recommended minimum sample counts. Much lower sample counts for pesticides were available and several assessments were completed with fewer than 10 samples. Use of fewer than 10 samples were allowed if the samples were collected from at least two separate years, the samples were all within the spring runoff period (typically March through June), and all results were well below (less than 50 percent) the water quality criteria. Exception to the ten-sample minimum was also allowed if the PDWS zone was in an area with minimal atrazine application, all samples were also below the criteria, and available samples were collected during the spring runoff period when occurrence is most likely.

To provide additional information within the Not Assessed reporting category 3, Insufficient Information was used to note when some water quality data were available but not enough to complete an assessment. A determination was also made to retain all impaired listings until sufficient valid data were obtained to justify delisting.

The impaired status will remain until there are five consecutive years without any excursions and sufficient raw water data are obtained. The same number of samples required to list an AU as impaired due to nitrate, pesticides or algae will be required to delist the AU.

For the 2020 assessment cycle, only the nitrate, pesticide and algae (cyanotoxin) indicators were evaluated in-depth. Other contaminants monitored by the public water systems for SDWA compliance and reported in the SDWIS database were also reviewed but no in-stream raw water data were evaluated for these contaminants. All available *Cryptosporidium* data from SDWA compliance monitoring were reviewed for this assessment cycle, but the water quality criteria have not yet been established and no impairment determinations could be made based on this parameter.

Ohio River Assessments

The Ohio River Valley Water Sanitation Commission (ORSANCO) evaluates the PDWS use for Ohio River intakes and presents assessments in the Biennial Assessment of Ohio River Water Quality Conditions Report. ORSANCO is an interstate agency that was created in 1948 to control and abate pollution in the Ohio River Basin. ORSANCO operates programs to monitor, assess and improve water quality within the basin. Consequently, Ohio EPA will not assess the PDWS use for intakes located on the Ohio River. ORSANCO's water quality standards are available at the commission's website: ***orsanco.org***.

H3. Results

Using the PDWS assessment methodology and available water quality data, results for the PDWS beneficial use are presented here for all WAUs, LRAUs and LEAUs where the PDWS use applies. Applicable water quality data were evaluated to determine an impairment status for each key indicator in each AU. To be considered assessed, sufficient data were required for only the nitrate indicator. There are 103 public water systems using surface water (excluding Ohio River intakes, purchased water systems, and multiple facilities at a water system) in 118 separate AUs. The 118 AUs with the PDWS beneficial use include the following: 103 WAUs; nine LRAUs; and six LEAUs. A summary of the nitrate, pesticide and algae (cyanotoxin) indicators for each public water system are presented in Section H4. Table H-2 provides supporting information for each of the 47 AUs listed as impaired for the PDWS beneficial use.

Nitrate Indicator. Sufficient data were available to complete nitrate evaluations for 62 (53 percent) of the 118 AUs using data primarily from Ohio EPA's compliance database and Ohio EPA watershed surveys. Of all 118 AUs, eight (seven percent) were identified as impaired and 54 (46 percent) were in full support. There was one new assessment unit identified as impaired due to nitrates this reporting cycle. Impairments included five of the nine LRAUs. Three Maumee River, one Sandusky River, and one Scioto River LRAUs remain impaired. Most of the 33 waters placed on the nitrate watch list (single detection greater than 8 mg/L) are in northwestern Ohio (Figure H-2).

Pesticide Indicator. Sufficient data were available to complete atrazine evaluations for 35 (30 percent) of the 118 PDWS AUs using data from Ohio EPA's compliance database (treated water), Ohio EPA water quality surveys and Syngenta Crop Protection, Inc.'s AMP. Five of the WAUs were impaired while the remaining 30 were in full support. There were no new assessment units identified as impaired due to pesticides. For LRAUs, five remained on the watch list from the previous report cycle and one Sandusky River LRAU was added to the watch list. A total of 24 waters were placed on the pesticide watch list because of elevated atrazine [single exceedance of four times the water quality criteria (WQC) or quarterly average greater than WQC]. These areas of elevated atrazine coincide with the predominantly agricultural land use in western and northwestern Ohio (Figure H-3).

Algae (cyanotoxin) Indicator. Starting June 1, 2016, Ohio public water systems are required to conduct routine monitoring for microcystins and cyanobacteria, greatly increasing the data available to assess the algae indicator. Sufficient data were available to list 39 AUs (33 percent) as impaired due to algae. The impairment listing includes all AUs in Lake Erie with drinking water intakes, including: Western Basin shoreline and open water; Sandusky Basin shoreline and open water; Central Basin open waters; and Island shoreline AUs. In addition, 30 WAUs and three LRAUs are assessed as impaired. An additional 24 AUs were placed on the algae watch list and one Sandusky River LRAU was added to the watch list. Microcystins are the predominant cyanotoxin impacting attainment determinations. The change in methodology described in section H2.2 resulted in removing impairment for saxitoxins at two WAUs. WAUs that are impaired or on the watch list for cyanotoxins were found distributed across Ohio virtually in every geographic region (Figure H-4).

***Cryptosporidium* Indicator.** Since Ohio EPA has not yet formalized water criteria for *Cryptosporidium*, assessment of this indicator could not be included in this report nor used for Ohio's 2016 and 2018 303(d) listings. Ohio EPA requested all available *Cryptosporidium* data from U.S. EPA and summarized the results to demonstrate how the data would be evaluated using the PDWS assessment methodology. The highest average (in oocysts/L) in any 12 consecutive months is compared to SDWA Bin classifications 1 through 4. Ohio EPA's proposed water quality criteria and watch list condition for *Cryptosporidium* correlate to these trigger concentrations for the Bins.

Cryptosporidium data are available for 115 public water systems. This dataset included samples collected to fulfill SDWA regulations that require the water systems to submit samples over a two-year period. Water systems collected between 24 to 47 samples in Round 1 of data collection which started in 2006 and was completed in 2012. Round 2 of sampling began in 2015, and all except for five public water systems have completed Round 2.

A review of available data indicates that no water systems have exceeded the 1.0 oocysts/L 12-month average. Following Round 2 monitoring, six public water systems had average concentrations between 0.075 oocysts/L and 1.0 oocysts/L. These systems are: City of Delaware (had an average less than 0.075 oocysts, but officially chose to stay in Bin 1), Newark, Greenville, Campbell, Salem, and Columbus Dublin Plant.

H4. Supplemental Information

Table H-3 provides a summary of PDWS assessment results for the nitrate, pesticide and algae indicators and is organized by assessment unit. A description of the PDWS use zone is also included.

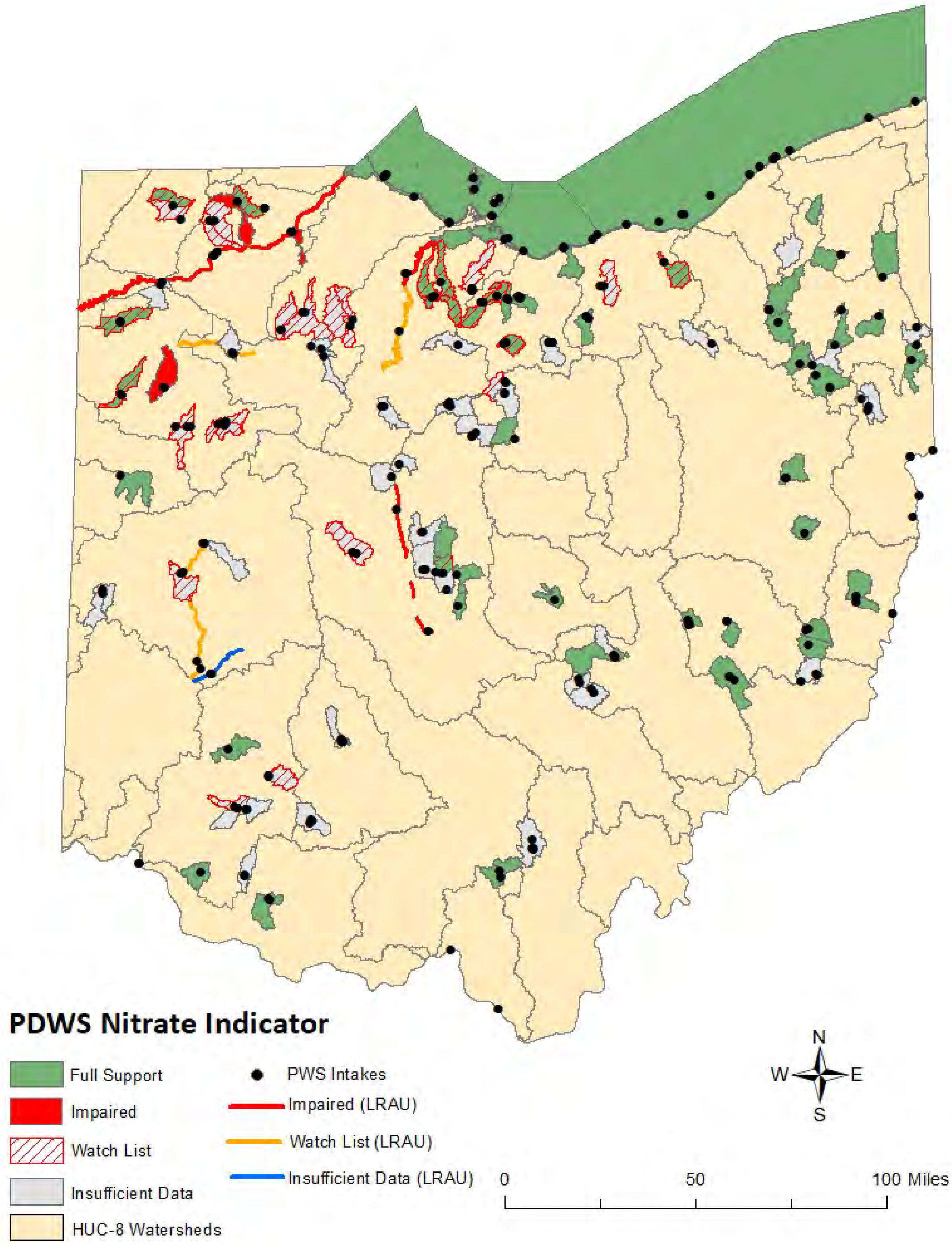

Figure H-2 — AUs with nitrate indicator results.

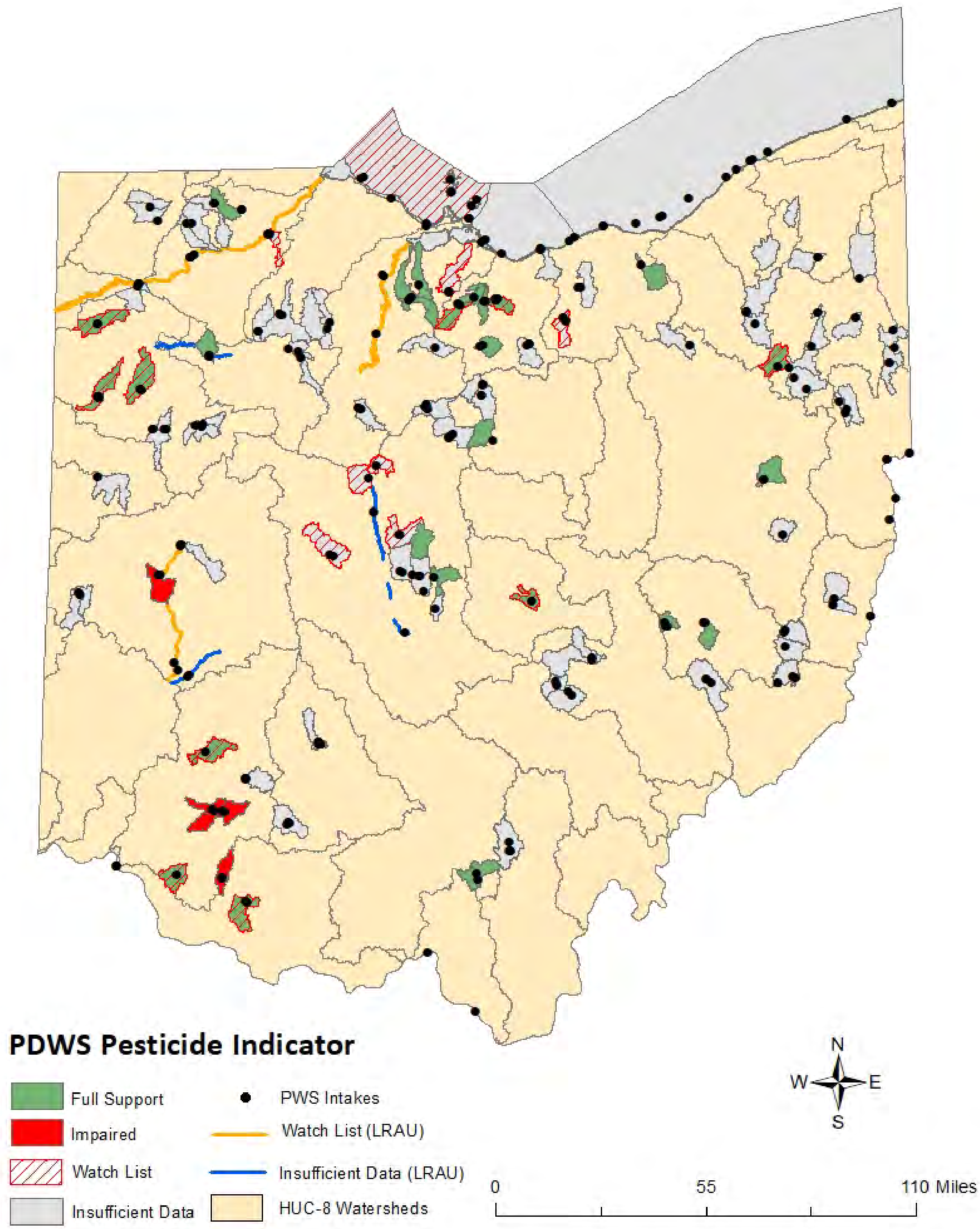

Figure H-3 — AUs with pesticide indicator results.

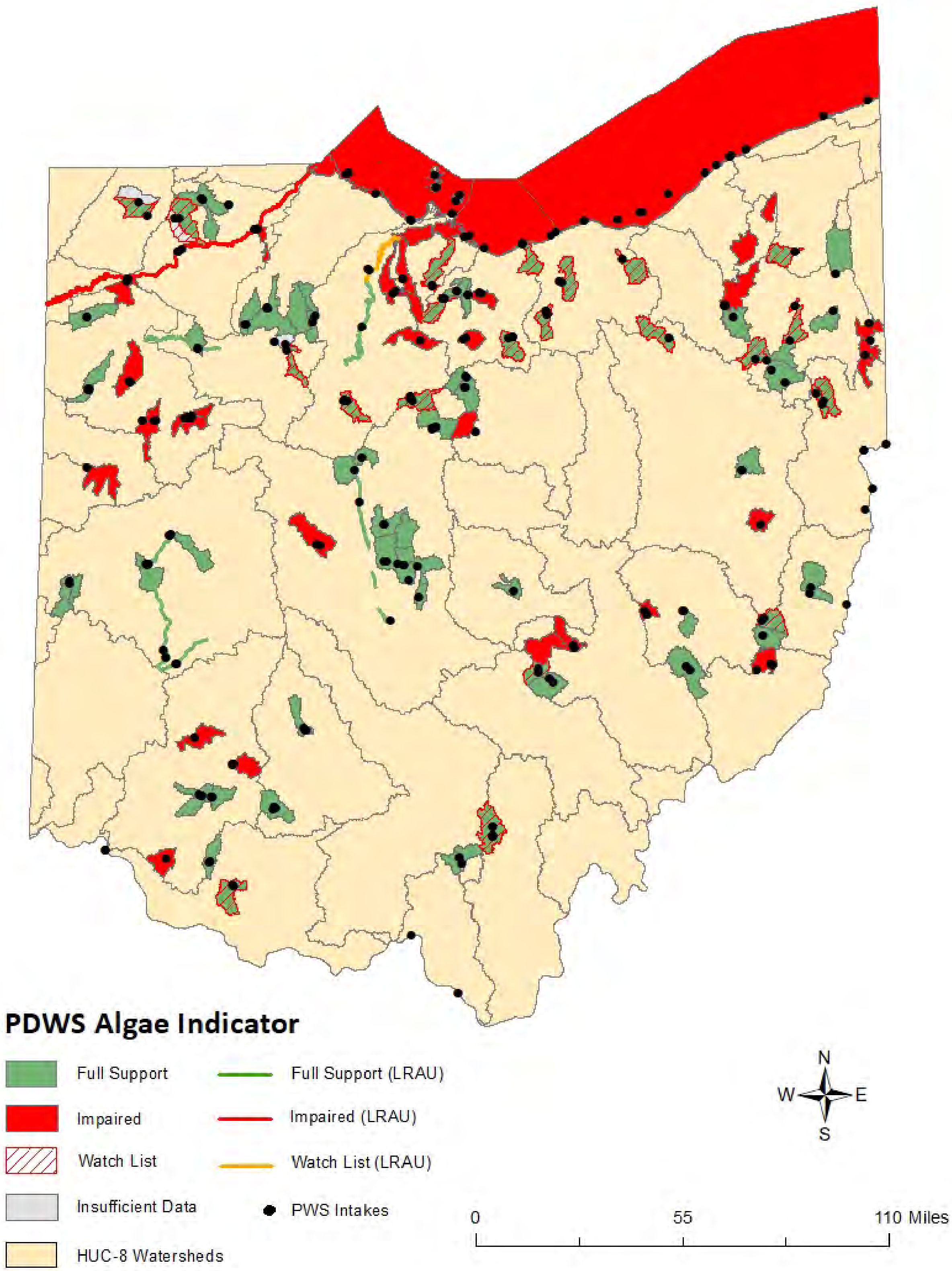

Figure H-4 — AUs with algal toxin indicator results.

Table H-2 — Waters designated as impaired for (not supporting) the PDWS beneficial use.

Assessment Unit	Cause of Impairment	Summary of Key Water Quality Data
04100005 90 01 Maumee River Mainstem (IN border to Tiffin River)	*Nitrate* One public water system had at least one excursion above the nitrate WQC and finished nitrate levels above the WQC. Original impairment listed in 2008. *Algae* One public water system had at least two source water samples above the threshold for microcystins.	The City of Defiance exceeded the nitrate WQC in finished water during three events (12/24/02-1/28/03; 6/17/03-6/19/03; and 5/15/06-5/16/06). None of the excursions occurred during the reporting period, but the impairment will remain until raw water is collected that supports delisting the assessment unit. A watch list level exceedance occurred on 1/14/13 (8.73 mg/L) and there were seven samples collected by the public water system at their intake that exceeded the WQC (>10 mg/L), indicating more data is needed to delist. The source water for the City of Defiance exceeded the microcystins threshold in 2014, 2016, and 2019 (maximum concentration 19 µg/L at Maumee River intake).
04100007 02 03 Sims Run-Auglaize River 04100007 03 05 Lost Creek 04100007 03 06 Lima Reservoir- Ottawa River 04100007 04 03 Honey Run	*Algae* One public water system had at least two source water samples above the threshold for microcystins.	The City of Lima's Metzger Reservoir exceeded the microcystins threshold two times in 2010 and once in 2012 (maximum concentration 5.3 µg/L). The City of Lima's raw water sources, including Williams Reservoir and Bresler Reservoir, had raw water microcystins detections that exceeded the threshold in 2012, 2015, and 2018. Maximum microcystins concentrations were 1400 µg/L (Williams) and 39 µg/L (Bresler).
04100007 06 04 Dry Fork-Little Auglaize River	*Nitrate* One public water system had two excursions above the Nitrate 10.0 mg/L WQC. *Algae* One public water system had at least two source water samples above the threshold for microcystins.	Nitrate samples collected from the source water for City of Delphos public water system exceeded the WQC in 2015 and 2017. Included were 15.9 mg/L on 6/10/15 and 15.6 mg/L on 12/2/17. The City of Delphos' raw water had microcystins exceeding the threshold in 2016, 2018, and 2019 (maximum concentration 19 µg/L).
04100007 12 09 Eagle Creek – Auglaize River	*Algae (New Impairment)* One public water system had at least two source water samples above the threshold for microcystins.	The City of Defiance had raw water microcystins exceeding the threshold during June and July 2019 (maximum concentration 5 µg/L at plant and 17 µg/L in Defiance WTP Reservoir).
04100009 03 02 Lower Bad Creek	*Nitrate* One public water system had two excursions above the Nitrate 10.0 mg/L WQC.	Nitrate samples collected from source water for Delta public water system exceeded WQC in 2015. Included were 17.6 mg/L on 6/11/15 and 13.4 mg/L on 7/14/15.

Assessment Unit	Cause of Impairment	Summary of Key Water Quality Data
04100009 90 01 Maumee River Mainstem (Tiffin River to Beaver Creek)	*Nitrate* One public water system had several excursions above the nitrate WQC during the 5-year period. The public water system had finished nitrate levels above the WQC and received SDWA violations. *Algae* Two public water systems had at least two raw water samples above the threshold for microcystins.	Finished water nitrate excursions occurred at Campbell's Soup in 2012 (11.3 - 12.5 mg/L), 2014 (10.6 mg/L), 2016 (10.6 – 11.3 mg/L), and 2018 (12.4 – 14.9 mg/L). Finished water sample results exceeded the 8.0 mg/L watch list threshold at Napoleon in 2012, 2013, 2014, 2015 and 2016. Campbell's Soup's Maumee River intake exceeded the microcystins threshold in 2015, 2016, 2017 and 2018 (maximum concentration 3.9 µg/L) and Napoleon exceeded the threshold in 2015, 2016, and 2018 (maximum concentration 4.0 µg/L).
04100009 90 02 Maumee River Mainstem (Beaver Creek to Maumee Bay) 04100009 06 03 Haskins Ditch – Maumee River	*Nitrate* One public water system had at least one excursion above the nitrate WQC during the 5-year period. *Algae* One public water system had at least two raw water samples above the threshold for microcystins.	Numerous Maumee River samples from 2012 to 2015 exceeded the Nitrate WQC. In addition, raw water from Bowling Green exceeded the nitrate WQC during three events in 2011 and 2012. The source water for Bowling Green public water system had microcystins detections that exceeded the threshold in 2013, 2014, 2015, and 2018 (maximum concentration in plant raw water was 2.3 µg/L in 2018, maximum concentration in Bowling Green Reservoir was 20,000 µg/L in 2014).
04100011 02 04 Raccoon Creek 04100011 12 02 Beaver Creek 04100011 12 03 Green Creek	*Algae* One public water system had numerous microcystins concentrations above the threshold.	For the City of Clyde public water system, Beaver Creek Reservoir raw water sample results for microcystins routinely exceeded the threshold in 2014 and 2015. Included was a maximum of 300 µg/L in July 2015 on Beaver Reservoir.
04100011 08 05 Middle Honey Creek	*Algae (New Impairment)* One public water system had numerous microcystins concentrations above the threshold.	Attica Village public water system had raw water microcystins detections that exceeded the threshold in 2018 and 2019 (maximum 30 µg/L).
04100011 90 02 Sandusky River Mainstem (Wolf Creek to Sandusky Bay)	*Nitrate* One public water system had an excursion above the nitrate WQC during the 5-year period in both raw and finished water. This public water system also received SDWA violations.	The City of Fremont exceeded the nitrate WQC in May 2010 (13 mg/L). In addition, Sandusky River samples exceeded the nitrate WQ criteria numerous times from 2010-2015.

Assessment Unit	Cause of Impairment	Summary of Key Water Quality Data
04100012 04 03 Walnut Creek - West Branch Huron River	*Algae* One public water system had at least two source water samples above the threshold for microcystins.	The City of Willard's raw water had microcystins exceeding the threshold on one occasion in 2015 and on multiple occasions in October and November of 2017 (maximum detection greater than 5 µg/L).
04100012 06 03 Norwalk Creek	*Algae* One public water system had at least two raw water samples above the threshold for microcystins.	The source water for Norwalk public water system, Memorial Reservoir, had microcystins detections that exceeded threshold in 2014 and 2015 (maximum concentration 22.7 µg/L in August 2014 and results greater than 5.0 µg/L in June and July 2015).
04110002 01 01 East Branch Reservoir-East Branch Cuyahoga River 04110002 01 04 Ladue Reservoir-Bridge Creek 04110002 02 03 Lake Rockwell-Cuyahoga River	*Algae* One public water system had at least two raw water samples in each assessment unit with microcystins concentrations above the threshold.	Source waters for the City of Akron had microcystins levels that exceeded the drinking water threshold in 2010, 2016, and 2017. In 2010, maximum raw water microcystins concentrations were 43 µg/L in LaDue reservoir, 3.6 µg/L in East Branch reservoir and 3.2 µg/L in Lake Rockwell. Maximum microcystins concentrations at Akron's Lake Rockwell intake were 1.3 µg/L in 2016 and 2.2 µg/L in 2017.
05030103 08 05 Headwater Yellow Creek	*Algae* One public water system had at least two source water samples above the threshold for microcystins.	Aqua Ohio Struthers source water from Lake Evans had microcystins exceeding the threshold in 2016, 2017, 2018, and 2019 (maximum concentration greater than 10 µg/L).
05030103 08 06 Burgess Run – Yellow Creek 05030103 08 07 Dry Run – Mahoning River	*Algae* One public water system had at least two source water samples above the threshold for microcystins.	The City of Campbell had source water microcystins threshold exceedances in 2016, 2017, 2018, and 2019 (maximum 4.8 µg/L).
05030201 01 01 Upper Sunfish Creek	*Algae* One public water system had at least two raw water samples above the threshold for microcystins.	Raw water sampling for the Village of Woodsfield source water from Ruble Lake and Witten Lake exceeded the microcystins threshold in 2010 and 2015. Maximum microcystins concentration on Rubel Lake in 2010 was 360 µg/L. Maximum microcystins concentration on Witten Lake in 2015 was 2.1 µg/L.

Assessment Unit	Cause of Impairment	Summary of Key Water Quality Data
05040001 15 03 Upper Little Stillwater Creek	*Algae* One public water system had at least two raw water samples above the threshold for microcystins.	The Village of Cadiz raw water sampling from Tappan Lake exceeded the microcystins threshold in 2014, 2015, 2016, 2017, and 2019. There were 94 results greater than the 1.6 µg/L threshold (maximum concentration 12 µg/L).
05040002 03 01 Headwaters Clear Fork Mohican River	*Algae* One public water system had at least two source water samples above the threshold for microcystins.	The City of Mansfield's source water from Clear Fork reservoir had microcystins exceeding the threshold in 2016 and 2018 (maximum concentration 5.6 µg/L).
05040004 04 05 Kent Run 05040004 04 07 Painter Creek-Jonathon Creek	*Algae* One public water system had at least two source water samples above the threshold for microcystins.	The City of Maysville's source water had microcystins exceeding the threshold in 2016 and 2019 (maximum concentration 1.9 µg/L).
05040005 05 01 North Crooked Creek	*Algae (New Impairment)* One public water system had at least two source water samples above the threshold for microcystins.	Source water for New Concord public water system had microcystins exceeding the threshold in 2014 and 2018 (maximum concentration 5.6 µg/L).
05060001 06 02 Middle Mill Creek	*Algae* One public water system had at least two source water samples above the threshold for microcystins.	The City of Marysville's source water had microcystins exceeding the threshold in September, October, and December 2017 (maximum concentration 3.1 µg/L).
05060001 90 01 Scioto River Mainstem (L. Scioto R. to Olentangy R.); excluding O'Shaughnessy and Griggs reservoirs	*Nitrate* One public water system had an excursion above the nitrate WQC during the 5-year period in both raw and <u>finished</u> water. This public water system also received SDWA violations.	The City of Columbus exceeded the nitrate WQC in finished drinking water from 6/8/15 through 6/17/15 (maximum 12.5 mg/L) and again from 6/17/16 through 7/1/16 (maximum 10.7 mg/L).
05080001 07 05 Garbry Creek-Great Miami River	*Pesticides* One public water system had the pesticide atrazine in source water where the annual average exceeded the WQC.	The City of Piqua uses several surface water sources and participates in Syngenta Crop Protection's AMP[1]. Swift Run Lake (impounded section of Swift Run) is one of the three drinking water sources and the atrazine annual average[2] was 3.62 µg/L in 2008. In recent years, atrazine results remained at levels of concern with several lake samples exceeding 12.0 µg/L (4x WQC; maximum concentrations include 38.5 µg/L in 2011, 17.1 µg/L in 2014, 16.1 µg/L in 2017, and 36.5 in 2018).

Assessment Unit	Cause of Impairment	Summary of Key Water Quality Data
05090201 10 01 Sterling Run	*Pesticides* One public water system had the pesticide atrazine in source water where the annual average exceeded the WQC.	The Village of Mt. Orab draws surface water from Sterling Run and participates in Syngenta Crop Protection's AMP[1]. The 2011 annual average[2] (6.2 µg/L) exceeded the WQC. In addition, single sample maximum atrazine detections were over four times the WQC in June 2011 (121 µg/L) and April 2012 (18.05 µg/L).
05090202 04 06 Lower Caesar Creek 05090202 06 04 Headwaters Cowan Creek	*Algae* One public water system had at least two source water samples above the threshold for microcystins.	The City of Wilmington's source water had microcystins exceeding the threshold in 2017 (maximum 12.8 µg/L at Caesar Creek Lake intake) and 2019 (maximum 8.1 µg/L at Caesar Creek State Park, South Beach).
05090202 07 02 Second Creek 05090202 10 05 West Fork East Fork Little Miami River 05090202 13 01 Headwaters Stonelick Creek	*Pesticides* One public water system had the pesticide atrazine in source water where the annual average exceeded the WQC.	The Village of Blanchester draws surface water from Whitacre Run, Stonelick Creek and the West Fork of the East Fork Little Miami River and participates in Syngenta Crop Protection's AMP[1]. The raw and finished water sampling locations for this monitoring program do not differentiate between the three separate source waters. In 2005, the annual average of the AMP samples was 4.63 µg/L and exceeded the WQC for atrazine in finished water. Ohio EPA conducted two sampling runs in 2008 at the three separate sources and measured elevated atrazine levels ranging between 23 µg/L and 70 µg/L. Considering the 2008 atrazine levels, Ohio EPA conservatively applied the impairment listing to all three AUs. In 2012, atrazine concentrations were greater than four times the WQC in samples collected at Stonelick Creek (102.0 µg/L) and the West Fork of the East Fork Little Miami River (89.5 µg/L) and resulting annual averages for atrazine exceeded the WQC in the source water. Finished water result of 21.7 µg/L in May 2014. The impairment listings will remain until adequate source water sampling is conducted to confirm the water source is no longer impaired.
05090202 12 03 Lucy Run-East Fork Little Miami River	*Algae* One public water system had at least two source raw water samples with microcystins concentrations above the threshold.	Multiple raw water samples collected from Clermont County public water system source water locations on Harsha Lake (East Fork Lake State Park) from 2012 to 2017 exceeded the microcystins threshold. Maximum concentration observed was 190 µg/L in June 2014.
05120101 02 04 Grand Lake-St Marys	*Algae* One public water system had at least two raw water samples with microcystins concentrations above the threshold.	The Grand Lake Saint Marys public water system intake for the City of Celina continues to be heavily impacted by microcystins. Threshold exceedances have occurred every year since the lake was first sampled in 2009, with exceedances occurring year-round in recent years. Microcystins concentrations routinely exceed 100 µg/L in the early and late summer months, with a maximum detection of 185 µg/L on 9/21/15.

Assessment Unit	Cause of Impairment	Summary of Key Water Quality Data
041202000201 Lake Erie Western Basin Shoreline (≤3m)	*Algae* Two public water systems had at least two raw water samples with microcystins concentrations above the threshold.	Carroll Township and Ottawa County had raw water samples that exceeded the microcystins threshold in 2010, 2011, 2013-2015, and 2017-2019.
041202000301 Lake Erie Western Basin Open Water (>3m)	*Algae* Four public water systems had at least two raw water samples above the threshold for microcystins.	Oregon had raw water samples that exceeded the microcystins threshold in 2010, 2011, 2013, 2014, and 2015-2019. Toledo had raw water samples that exceeded the microcystins threshold in 2010, 2011, 2013-2015, and 2017-2019. Marblehead had raw water samples that exceed the microcystins threshold in 2015 and 2017. Kelleys Island had results above the threshold from 2015, 2017, and 2018.
041202000101 Lake Erie Islands Shoreline (≤3m)	*Algae* Three public water systems had at least two raw water samples above the threshold for microcystins.	Put-In-Bay had sample results above the threshold in 2010, 2013-2015, and 2017-2019. Camp Patmos had results above the threshold in 2010, 2013-2015, and 2017-2019. Lake Erie Utilities had results above the threshold in 2014, 2015, 2018 and 2019.
041202000202 Lake Erie Sandusky Basin Shoreline (≤3 m)	*Algae* One public water system had at least two raw water samples above the threshold for microcystins.	Sandusky had raw water samples that exceeded the microcystins threshold in 2015, 2017 and 2018.
041202000302 Lake Erie Sandusky Basin Open Water (>3 m)	*Algae* Two public water systems had at least two raw water samples above the threshold for microcystins.	Huron had raw water microcystins above the threshold in 2013, 2015, 2017 and 2018. Sandusky had raw water samples that exceeded the microcystins threshold in 2015, 2017 and 2018.
041202000303 Lake Erie Central Basin Open Water (>3m)	*Algae* Three public water systems had at least two raw water samples above the threshold for microcystins.	Lake County West, Mentor, and Painesville public water systems all had raw water microcystins threshold exceedances in 2015 and 2017. Mentor and had additional detections in 2016. Ashtabula and Fairport Harbor had their first threshold exceedances in 2017.

[1] The January 2003 Atrazine Interim Reregistration Eligibility Decision and subsequent Memorandum of Agreement between U.S. EPA and the atrazine registrants, including Syngenta Crop Protection, Inc., initiated an atrazine monitoring program at select community water systems.
[2] Annual average calculated as average of the quarterly means for calendar year.

Table H-3 — Summary of PDWS assessment results for the nitrate, pesticide and algae indicators.

Assessment Unit ID	Assessment Unit Name	PDWS Zone [Public Water System(s)]	Use Support	Nitrate Indicator	Pesticide Indicator	Algae Indicator
04100005 90 01	Maumee River Mainstem (IN border to Tiffin River)	Maumee River @ RM 65.84 [Defiance]	No	Impaired	Full Support; Watch List	Impaired
04100006 03 01	Bates Creek-Tiffin River	Tiffin River @ RM 47.54 [Archbold]	Yes	Full Support; Watch List	Insufficient Data	Insufficient Data
04100006 03 03	Flat Run-Tiffin River	Archbold Upground Reservoirs [Archbold]	Unknown	Insufficient Data; Watch List	Insufficient Data	Full Support; Watch List
04100007 02 03	Sims Run-Auglaize River	Auglaize River @ RM 64.58 (Agerter Rd), Williams and Bresler Reservoirs [Lima]	No	Insufficient Data; Watch List	Insufficient Data	Impaired
04100007 03 05	Lost Creek	Lima Metzger, Ferguson, and Lost Creek Reservoirs [Lima]	No	Insufficient Data; Watch List	Insufficient Data	Impaired
04100007 03 06	Lima Reservoir-Ottawa River	Ottawa River @ RMs 42.60 (Roush Rd) and 43.45 (upstream of low-head dam at Metzger Rd) [Lima]	No	Insufficient Data; Watch List	Insufficient Data	Impaired
04100007 04 03	Honey Run	Williams and Bresler Reservoirs [Lima]	No	Insufficient Data; Watch List	Insufficient Data	Impaired
04100007 06 04	Dry Fork-Little Auglaize River	Little Auglaize River @ RM 23.40 [Delphos]	No	Impaired	Full Support; Watch List	Impaired
04100007 08 04	Lower Town Creek	Town Creek @ RM 18.35 [Van Wert]	Yes	Full Support; Watch List	Full Support; Watch List	Full Support
04100007 12 06	Big Run-Flatrock Creek	Flat Rock Creek @ RM 14.13 [Paulding]	Yes	Full Support; Watch List	Full Support; Watch List	Full Support
04100007 12 09	Eagle Creek-Auglaize River	Defiance Upground Reservoir [Defiance]	No	Insufficient Data	Insufficient Data	Impaired
04100008 02 03	Findlay Upground Reservoirs-Blanchard River	Findlay Upground Reservoirs [Findlay]	Unknown	Insufficient Data	Insufficient Data	Full Support; Watch List
04100008 02 05	City of Findlay Riverside Park-Blanchard River	Blanchard River @ RMs 58.72, 62.43 and 65.20 [Findlay]	Unknown	Insufficient Data	Insufficient Data	Insufficient Data
04100008 06 02	Pike Run-Blanchard River	Ottawa Upground Reservoirs [Ottawa Village]	Unknown	Insufficient Data	Full Support	Full Support

Assessment Unit ID	Assessment Unit Name	PDWS Zone [Public Water System(s)]	Use Support	Nitrate Indicator	Pesticide Indicator	Algae Indicator
04100008 90 01	Blanchard River Mainstem (Dukes Run to mouth)	Blanchard River @ RM 28.50 [Ottawa Village]	Unknown	Insufficient Data; Watch List	Insufficient Data	Full Support
04100009 03 02	Lower Bad Creek	Bad Creek @ RM 17.0 [Delta]	No	Impaired	Insufficient Data	Full Support
04100009 04 01	Konzen Ditch	Unnamed trib segments immediately adjacent to Wauseon Reservoir, Big Ditch Intake [Wauseon]	Unknown	Insufficient Data; Watch List	Insufficient Data	Insufficient Data; Watch List
04100009 04 02	North Turkeyfoot Creek	Stucky Ditch Intake and Reservoir [Wauseon]	Unknown	Insufficient Data; Watch List	Insufficient Data	Full Support; Watch List
04100009 06 03	Haskins Road Ditch – Maumee River	Bowling Green Upground Reservoir [Bowling Green]	No	Impaired	Insufficient Data; Watch List	Impaired
04100009 07 02	Fewless Creek-Swan Creek	Swan Creek @ RM 30.84 [Swanton]	Yes	Full Support; Watch List	Full Support	Full Support
04100009 90 01	Maumee River Mainstem (Tiffin River to Beaver Creek)	Maumee River @ RMs 45.88 and 47.10 [Campbell Soup], 47.13 [Napoleon and Wauseon]	No	Impaired	Full Support; Watch List	Impaired
04100009 90 02	Maumee River Mainstem (Beaver Creek to Maumee Bay)	Maumee River @ RMs 23.16 [Bowling Green]	No	Impaired	Insufficient Data; Watch List	Impaired
04100010 01 01	Rader Creek	Rader Creek @ RM 13.57 and Upground Reservoirs [McComb]	Unknown	Insufficient Data; Watch List	Insufficient Data	Full Support
04100010 01 03	Rocky Ford	Rocky Ford Creek @ RMs 10.66 and 11.10 and Upground Reservoirs [North Baltimore]	Unknown	Insufficient Data; Watch List	Insufficient Data	Full Support
04100010 02 02	East Branch Portage River	East Branch Portage River @ RMs 13.84 and 16.15 and Upground Reservoirs [Fostoria]	Unknown	Insufficient Data; Watch List	Insufficient Data	Full Support
04100010 02 03	South Branch Portage River	Veterans Memorial Reservoir [Fostoria]	Unknown	Insufficient Data	Insufficient Data	Full Support
04100011 01 03	Mills Creek	Snyders Ditch @ RMs 5.0 and 5.5 and Upground Reservoirs [Bellevue]	Unknown	Insufficient Data; Watch List	Insufficient Data; Watch List	Full Support; Watch List
04100011 02 04	Raccoon Creek	Raccoon Creek Upground Reservoir [Clyde]	No	Full Support; Watch List	Full Support	Impaired

Assessment Unit ID	Assessment Unit Name	PDWS Zone [Public Water System(s)]	Use Support	Nitrate Indicator	Pesticide Indicator	Algae Indicator
04100011 04 03	Headwaters Middle Sandusky River	Sandusky River @ RM 115.4 and Upground Reservoirs [Bucyrus]	Unknown	Insufficient Data	Insufficient Data	Full Support; Watch List
04100011 07 02	Town of Upper Sandusky-Sandusky River	Sandusky River @ RMs 82.9 and 83.15 and Upground Reservoirs [Upper Sandusky]	Unknown	Insufficient Data	Insufficient Data	Full Support
04100011 08 05	Middle Honey Creek	Honey Creek @ RM 28.35 and Upground Reservoirs [Attica]	No	Insufficient Data	Insufficient Data	Impaired
04100011 12 02	Beaver Creek	Beaver Creek @ RM 2.88 and Upground Reservoirs [Clyde]	No	Full Support; Watch List	Full Support	Impaired
04100011 12 03	Green Creek	Beaver Creek Upground Reservoir [Clyde]	No	Full Support; Watch List	Full Support	Impaired
04100011 90 01	Sandusky River Mainstem (Tymochtee Creek to Wolf Creek)	Sandusky River @ RM 41.08 [Tiffin-Ohio American Water]	Unknown	Insufficient Data; Watch List	Insufficient Data; Watch List	Full Support
04100011 90 02	Sandusky River Mainstem (Wolf Creek to Sandusky Bay)	Sandusky River @ RM 18.02 [Fremont]	No	Impaired	Insufficient Data; Watch List	Full Support; Watch List
04100012 01 04	New London Upground Reservoir-Vermilion River	Vermilion River @ RM 52.24 and Upground Reservoirs [New London]	Unknown	Insufficient Data	Insufficient Data	Full Support; Watch List
04100012 02 04	Mouth Vermilion River	Vermilion River @ RM 0.2 [Vermilion]	Yes	Full Support	Insufficient Data	Full Support; Watch List
04100012 04 03	Walnut Creek-West Branch Huron River	West Branch Huron River @ RM 33.8 and Upground Reservoirs [Willard]	No	Full Support; Watch List	Full Support	Impaired
04100012 05 03	Frink Run	Frink Run @ RM 4.83 and Upground Reservoir #5 [Bellevue]	Yes	Full Support; Watch List	Full Support; Watch List	Full Support; Watch List
04100012 05 06	Mouth West Branch Huron River	W. Branch Huron River @ RM 8.52 and Upground Reservoirs [Monroeville]	Yes	Full Support; Watch List	Full Support	Full Support
04100012 06 03	Norwalk Creek	Norwalk Creek @ RMs 0.11 and 4.02 [Norwalk]	No	Full Support	Full Support	Impaired
04100012 06 04	Mouth East Branch Huron River	East Branch Huron River @ RM 6.16 [Norwalk]	Yes	Full Support	Full Support	Full Support
04110001 02 02	Baldwin Creek-East Branch Rocky River	E. Branch Rocky River @ RM 5.06, Baldwin Creek @ RM 0.48, upstream boundaries of Rocky River reservation (RM 15.15) to West Branch [Berea]	Yes	Full Support; Watch List	Full Support	Full Support; Watch List

Assessment Unit ID	Assessment Unit Name	PDWS Zone [Public Water System(s)]	Use Support	Nitrate Indicator	Pesticide Indicator	Algae Indicator
04110001 05 01	Charlemont Creek	Charlemont Creek @ RM 2.97 and Upground Reservoir [Wellington]	Yes	Full Support	Insufficient Data; Watch List	Full Support; Watch List
04110001 05 06	Lower West Branch Black River	West Branch Black River @ RM 14.42 [Oberlin]	Unknown	Insufficient Data; Watch List	Insufficient Data	Full Support; Watch List
04110002 01 01	East Branch Reservoir – East Branch Cuyahoga River	East Branch Reservoir [Akron]	No	Full Support	Insufficient Data	Impaired
04110002 01 04	LaDue Reservoir-Bridge Creek	LaDue Reservoir [Akron]	No	Insufficient Data	Insufficient Data	Impaired
04110002 02 02	Feeder Canal-Breakneck Creek	Lake Hodgson (Breakneck Creek) [Ravenna]	Yes	Full Support	Insufficient Data	Full Support
04110002 02 03	Lake Rockwell-Cuyahoga River	Lake Rockwell (Cuyahoga River RM 62.0 to 57.97) [Akron]	No	Full Support	Insufficient Data	Impaired
04110004 01 02	Headwaters Grand River	Grand River @ RM 89.12 [West Farmington]	Yes	Full Support	Insufficient Data	Full Support; Watch List[1]
05030101 04 03	Stone Mill Run-Middle Fork Little Beaver Creek	Salem Reservoir [Salem]	Unknown	Insufficient Data	Insufficient Data	Full Support; Watch List
05030101 05 01	Cold Run	Cold Run @ RM 4.96, Salem Reservoir, Unnamed Tributary (Cold Run RM 4.97) @ RM 1.42 [Salem]	Unknown	Insufficient Data	Insufficient Data	Full Support; Watch List
05030103 01 03	Fish Creek-Mahoning River	Mahoning River @ RMs 83.55 [Alliance] and 91.50 [Sebring]	Yes	Full Support	Insufficient Data	Full Support
05030103 02 01	Deer Creek	Deer Creek @ RM 0.54 (Walborn Reservoir) [Alliance]	Yes	Full Support	Full Support; Watch List	Full Support; Watch List
05030103 02 04	Island Creek-Mahoning River	Berlin Lake [Mahoning Valley S.D]	Unknown	Insufficient Data	Insufficient Data	Full Support
05030103 03 06	Charley Run Creek-Mahoning River	Mahoning River @ RMs 56.47 [Newton Falls]	Yes	Full Support	Insufficient Data	Full Support; Watch List
05030103 05 02	Middle Mosquito Creek	Mosquito Creek @ RM 12.49 (Reservoir) [Warren]	Yes	Full Support	Insufficient Data	Full Support
05030103 07 03	Lower Meander Creek	Meander Creek @ RM 2.96 (Meander Cr Reservoir) [Mahoning Valley S.D.]	Yes	Full Support	Insufficient Data	Full Support
05030103 08 05	Headwaters Yellow Creek	Yellow Creek @ RM 8.40 (Lake Evans) [Struthers- Aqua Ohio]	No	Full Support	Insufficient Data	Impaired

[1] Algae Indicator updated from impaired to full support, watch list due to change in methodology (see section H2.2).

Assessment Unit ID	Assessment Unit Name	PDWS Zone [Public Water System(s)]	Use Support	Nitrate Indicator	Pesticide Indicator	Algae Indicator
05030103 08 06	Burgess Run-Yellow Creek	Yellow Creek @ RM 2.0 (Lake Hamilton) [Campbell]	No	Full Support	Insufficient Data	Impaired
05030103 08 07	Dry Run-Mahoning River	Dry Run @ RM 2.86 (Lake McKelvey) [Campbell]	No	Insufficient Data	Insufficient Data	Impaired
05030106 03 03	Cox Run-Wheeling Creek	Jug Run @ RM 3.18 (Provident Reservoir) [St. Clairesville]	Yes	Full Support	Insufficient Data	Full Support
05030106 07 03	Little McMahon Creek	Little McMahon Creek @ RM 6.6 (St. Clairesville Reservoir) [St. Clairesville]	Yes	Full Support	Insufficient Data	Full Support
05030106 09 01	North Fork Captina Creek	Unnamed trib (North Fork RM 10.0) @ RM 0.55 (Res #1 and #3) [Barnesville]	Yes	Full Support	Insufficient Data	Full Support; Watch List
05030106 09 02	South Fork Captina Creek	Slope Creek @ RM 1.85 Slope Creek Res) [Barnesville]	Yes	Full Support	Insufficient Data	Full Support
05030201 01 01	Upper Sunfish Creek	Sunfish Creek @ RM 25.50, Unnamed trib (Sunfish Creek RM 24.55) @ RM 0.15 and 0.80 [Woodsfield]	No	Insufficient Data	Insufficient Data	Impaired
05030201 09 01	Headwaters West Fork Duck Creek	Wolf Run @ RM 0.7 (Wolf Run Lake), Dog Run @ RM 1.35 (Caldwell Lake) [Caldwell]	Yes	Full Support	Insufficient Data	Full Support
05030204 01 01	Center Branch	Center Branch Rush Creek @ RM 5.45, Unnamed Tributary (Somerset Creek RM 1.84) @ RM 0.89 [Somerset]	Unknown	Insufficient Data	Insufficient Data	Full Support; Watch List
05030204 01 02	Headwaters Rush Creek	Yeager Creek (Rush Creek RM 28.46) @ RM 1.0; New Lexington Reservoir [New Lexington]	Unknown	Insufficient Data	Insufficient Data	Full Support
05040001 01 04	Wolf Creek	Wolf Creek @ RM 5.12 (Reservoir) [Barberton]	Unknown	Insufficient Data	Insufficient Data	Full Support; Watch List[1]
05040001 08 02	Pleasant Valley Run-Indian Fork	Indian Fork @ RM 3.0 and 3.7 (Atwood Lake) [MWCD Atwood Park]	Yes	Full Support	Full Support	Full Support
05040001 15 03	Upper Little Stillwater Creek	Tappan Lake [Cadiz]	No	Full Support	Insufficient Data	Impaired
05040002 01 01	Marsh Run	Marsh Run Creek @ RM 0.05 [Shelby]	Unknown	Insufficient Data; Watch List	Insufficient Data	Full Support
05040002 01 02	Headwaters Black Fork Mohican River	Black Fork River @ RMs 50.82, 53.88 [Shelby]	Unknown	Insufficient Data	Insufficient Data	Full Support

[1] Algae Indicator updated from impaired to full support, watch list due to change in methodology (see section H2.2).

Assessment Unit ID	Assessment Unit Name	PDWS Zone [Public Water System(s)]	Use Support	Nitrate Indicator	Pesticide Indicator	Algae Indicator
05040002 03 01	Headwaters Clear Fork Mohican River	Clear Fork River @ RM 30.6 (Clear Fork Reservoir) [Mansfield]	No	Full Support	Full Support	Impaired
05040004 04 05	Kent Run	Kent Run @ RM 1.3 [Maysville]	No	Insufficient Data	Insufficient Data	Impaired
05040004 04 07	Painter Creek-Jonathon Creek	Frazier's Run (Fraziers Quarry) [Maysville]	No	Full Support	Insufficient Data	Impaired
05040005 02 07	Trail Run-Wills Creek	Wills Creek (Cambridge Reservoir) [Cambridge]	Yes	Full Support	Full Support	Full Support
05040005 05 01	North Crooked Creek	North Crooked Creek [New Concord]	No	Full Support	Full Support	Impaired
05040006 02 05	Log Pond Run-North Fork Licking River	North Fork Licking River @ RM 3.0 [Newark]	Yes	Full Support	Full Support; Watch List	Full Support
05060001 03 03	City of Marion-Little Scioto River	Little Scioto River @ RM 7.1 [Marion-Ohio American Water]	Unknown	Insufficient Data	Insufficient Data; Watch List	Full Support
05060001 04 06	Glade Run-Scioto River	Scioto River @ RM 180.04 [Marion-Ohio American Water]	Unknown	Insufficient Data	Insufficient Data; Watch List	Full Support
05060001 06 02	Middle Mill Creek	Mill Creek @ RM 19.45 [Marysville]	No	Full Support; Watch List	Insufficient Data; Watch List	Impaired
05060001 08 01	Headwaters Olentangy River	Rocky Fork (Olentangy River RM 84.84) @ RM 0.6 [Galion]	Unknown	Insufficient Data	Insufficient Data	Full Support
05060001 10 07	Delaware Run-Olentangy River	Olentangy River @ RMs 31.23 and 31.02 [Delaware]	Unknown	Insufficient Data	Insufficient Data; Watch List	Full Support
05060001 11 01	Deep Run-Olentangy River	Olentangy River @ RM 18.19 [Del-Co]	Unknown	Insufficient Data	Insufficient Data	Full Support
05060001 13 08	Hoover Reservoir-Big Walnut Creek	Hoover Reservoir, Duncan Run @ RM 0.68 [Columbus]	Yes	Full Support	Full Support	Full Support
05060001 14 03	Big Run-Alum Creek	Alum Creek Reservoir [Del-Co]	Yes	Full Support	Full Support	Full Support
05060001 14 04	Alum Creek Dam-Alum Creek	Alum Creek Reservoir and Alum Creek @ RM 26.74 [Del-Co]	Yes	Full Support Watch list	Full Support	Full Support
05060001 15 02	City of Gahanna-Big Walnut Creek	Big Walnut Creek @ RM 32.64 [Columbus]	Yes	Full Support	Insufficient Data	Full Support
05060001 16 01	Westerville Reservoir-Alum Creek	Alum Creek @ RM 21.20 (@ low-head dam) [Westerville]	Unknown	Insufficient Data	Insufficient Data	Full Support
05060001 90 01	Scioto River Mainstem (L. Scioto R. to Olentangy R.); excluding O'Shaughnessy and Griggs reservoirs	Scioto River at O'Shaughnessy dam (RM 148.8) to Dublin Road WTP dam [Columbus]	No	Impaired	Insufficient Data	Full Support

Assessment Unit ID	Assessment Unit Name	PDWS Zone [Public Water System(s)]	Use Support	Nitrate Indicator	Pesticide Indicator	Algae Indicator
05060002 08 02	Buckeye Creek	Buckeye Creek/Hammertown Lake [Jackson]	Yes	Full Support	Full Support	Full Support
05060002 08 03	Horse Creek-Little Salt Creek	Jisco Lake [Jackson]	Yes	Full Support	Full Support	Full Support
05060003 01 03	Town of Washington Court House-Paint Creek	Paint Creek @ RM 71.4 [Washington Court House]	Unknown	Insufficient Data	Insufficient Data	Full Support
05060003 05 02	Clear Creek	Clear Creek (Rocky Fork) @ RM 7.4 [Hillsboro]	Unknown	Insufficient Data	Insufficient Data	Full Support
05080001 07 02	Mosquito Creek	Tawawa Creek @ RM 0.14 [Sidney]	Unknown	Insufficient Data	Insufficient Data	Full Support
05080001 07 05	Garbry Creek-Great Miami River	Piqua Hydraulic System (Swift Run Lake) and Ernst Gravel Pit [Piqua]	No	Insufficient Data; Watch List	Impaired	Full Support
05080001 11 01	Mud Creek	Mud Creek @ RM 0.88 [Greenville]	Unknown	Insufficient Data	Insufficient Data	Full Support
05080001 11 02	Bridge Creek-Greenville Creek	Greenville Creek @ RM 22.3 [Greenville]	Unknown	Insufficient Data	Insufficient Data	Full Support
05080001 90 01	Great Miami River Mainstem (Tawawa Creek to Mad River)	Great Miami River @ RMs 86.6 and 90.3 [Dayton], 118.3 [Piqua] and 130.2 [Sidney]	Unknown	Insufficient Data; Watch List	Insufficient Data; Watch List	Full Support
05080001 90 03	Mad River Mainstem (Donnels Creek to mouth)	Mad River @ RMs 5.2 and 5.6 [Dayton]	Unknown	Insufficient Data	Insufficient Data	Full Support
05090101 04 01	Headwaters Little Raccoon Creek	Little Raccoon Creek @ RM 30, Lake Rupert, Alma Lake [Wellston]	Unknown	Insufficient Data	Insufficient Data	Full Support; Watch List
05090201 08 02	Headwaters Straight Creek	Sycamore Run @ RM 0.97 (Reservoir) and Straight Creek (Lake Waynoka) [Waynoka Regional]	Yes	Full Support	Full Support; Watch List	Full Support; Watch List
05090201 10 01	Sterling Run	Sterling Run @ RM 6.47 [Mt. Orab]	No	Insufficient Data	Impaired	Full Support
05090202 04 06	Lower Caesar Creek	Caesar Creek Lake [Wilmington]	No	Full Support	Full Support; Watch List	Impaired
05090202 06 04	Headwaters Cowan Creek	Cowan Creek @ RM 11.7 [Wilmington]	No	Insufficient Data; Watch List	Insufficient Data	Impaired

Assessment Unit ID	Assessment Unit Name	PDWS Zone [Public Water System(s)]	Use Support	Nitrate Indicator	Pesticide Indicator	Algae Indicator
05090202 07 02	Second Creek	Whitacre Run @ RM 1.4 [Blanchester]	No	Insufficient Data; Watch List	Impaired	Full Support
05090202 10 05	West Fork East Fork Little Miami River	West Branch of the East Fork LMR @ RM 4.6 and Westboro Reservoir [Blanchester]	No	Insufficient Data	Impaired	Full Support
05090202 12 03	Lucy Run-East Fork Little Miami River	Harsha Lake - Impounded E. Fork LMR [Clermont County]	No	Full Support	Full Support; Watch List	Impaired
05090202 13 01	Headwaters Stonelick Creek	Stonelick Creek @ RM 23.4 [Blanchester]	No	Insufficient Data	Impaired	Full Support
05120101 02 04	Grand Lake-St Marys	Grand Lake St. Marys [Celina]	No	Full Support	Insufficient Data	Impaired
04120200 01 01	Lake Erie Islands Shoreline (≤3m)	[Camp Patmos, Lake Erie Utility Co., Put-in-Bay]	No	Full Support	Insufficient Data	Impaired
04120200 02 01	Lake Erie Western Basin Shoreline (≤3m)	[Ottawa County Regional, Carrol Water & Sewer]	No	Full Support	Insufficient Data	Impaired
04120200 02 02	Lake Erie Sandusky Basin Shoreline (≤3m)	[Sandusky, Vermillion]	No	Full Support	Insufficient Data	Impaired
04120200 03 01	Lake Erie Western Basin Open Water (>3m)	[Toledo, Oregon, Kelleys Island, Marblehead]	No	Full Support	Insufficient Data; Watch List	Impaired
04120200 03 02	Lake Erie Sandusky Basin Open Water (>3m)	[Sandusky, Huron, Vermillion, Elyria, Lorain]	No	Full Support	Insufficient Data	Impaired
04120200 03 03	Lake Erie Central Basin Open Water (>3m)	[Conneaut, Ashtabula-Ohio American Water, Lake County East, Lake County West, Painesville, Fairport Harbor, Mentor-Aqua Ohio, Cleveland, Avon Lake]	No	Full Support	Insufficient Data	Impaired

Considerations for Future Lists

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As new ideas are introduced and in the general course of progress, it is natural for evaluation and reporting of water quality conditions to evolve. Since the introduction of the Integrated Report (IR) format in 2002, methods for evaluating the recreation use, the human health use (via fish contaminants) and public drinking water supply use have been systematically added to the traditional aquatic life use reporting.

This section identifies future reporting possibilities and the status of each. The potential future changes include reporting on more types of waters (wetlands, inland lakes, Lake Erie) or reporting on specific pollutants of interest (mercury).

I1. Wetlands

Ohio EPA's IR provides information on the overall condition of Ohio's water resources and identifies those waters that are not currently meeting water quality goals (Ohio EPA, 2016). It fulfills the requirements under the Clean Water Act (CWA) to report biennially on the current condition of Ohio's regulated waters [305(b) report] and to provide a list of impaired waters [303(d) list]. Given the sheer number of National Wetland Inventory [U.S. Fish and Wildlife Service, 2006-2007 (NWI)] mapped wetlands in Ohio (n = 134,736), it is not feasible to identify individual wetlands that are impaired as part of the 303(d) list, nor is it feasible to assess every individual wetland portrayed on the NWI mapping. Given the historic losses of wetlands in the state (Dahl, 1990), it would be problematic to attempt to list any of the remaining wetlands as impaired without giving consideration for the wetlands which have been eliminated from the landscape. The 2012 version of Ohio's IR (Ohio EPA, 2012) discussed a plan for incorporating wetland information into future reports, as general 305(b) information by using five primary items:

- identify historic wetland resources using Natural Resources Conservation Service (NRCS) digital soil survey data (USDA, 2012);
- identify existing wetland resources using NWI data (U.S. Fish and Wildlife Service, 2006-2007);
- perform a preliminary off-site wetland condition assessment using a Level 1 GIS tool;
- include information on past wetland field assessments within each 12-digit hydrologic unit code (HUC) [Seaber, Kapinos and Knapp, (1987)] watershed; and
- describe and summarize watershed specific field assessment work.

The 2014 report (Ohio EPA, 2014) was Ohio EPA's first attempt at implementing this plan. In 2013, Ohio EPA's Wetland Ecology Group (WEG) completed a study focusing on the inclusion of wetland information in the Total Maximum Daily Load (TMDL) process on the Middle Scioto watershed (Gara, Harcarik and Schumacher, 2013). This study provided the framework for incorporating wetland information into this reporting process. The focus of the study was twofold: 1) conduct a probabilistic survey of wetland condition for a current TMDL project in central Ohio using Level 2 [Ohio Rapid Assessment Method for Wetlands (ORAM)(Mack, 2001)] and Level 3 [Vegetation Index of Biotic Integrity (VIBI)(Mack, 2004; Mack and Gara, 2015)] assessment tools; and 2) develop a Geographic Information System (GIS)-based Level 1 assessment tool to estimate wetland condition within this survey area. The results of the Level 1 assessment were then compared to those obtained using the more detailed Level 2 and Level 3 field assessments. The Level 1 tool that was developed for the Middle Scioto TMDL study differed slightly from the proposed tool included in the 2012 IR (Ohio EPA, 2012). This updated assessment methodology is based on close statistical relationships between the individual metrics and detailed field assessments previously conducted by the WEG. For this reason, the updated Level 1 tool was used when characterizing wetland condition within each of Ohio's HUC12 watersheds. Additional information regarding the Middle Scioto TMDL and the Statewide Level 1 assessment data can be found in previous versions of the IR (Ohio EPA 2012; Ohio EPA, 2014; Ohio EPA, 2016).

Documented High-Quality Wetlands

Ohio EPA's section 401 water quality certification and isolated wetland permitting section requires applicants that seek to discharge dredged or fill material into wetlands to coordinate with the Ohio Department of Natural Resources' (ODNR) natural heritage database (NHD) to determine whether documented high-quality wetlands, or known occurrences of rare, threatened or endangered species are present in and around proposed impact sites. Many wetlands are identified in the current version of the NHD; however, the information currently available has not been updated in more than 10 years and is primarily based on the best professional judgement of previous ODNR staff without specific criteria for inclusion.

Recognizing a need for more up-to-date information to ensure proper identification and protection of high-quality wetlands, Ohio EPA, in consultation with a workgroup of wetland experts, has developed the following criteria for identifying these kinds of wetlands:

- The area is mapped on the NWI as emergent, scrub-shrub or forested – no open water habitats were included;
- The mapped wetland must be five acres in size or larger;
- At least a portion of the wetland is within the Ducks Unlimited's conservation and recreation lands (CARL) layer (Ducks Unlimited, 2008) or otherwise known to be protected by the State or another conservation organization; and
- There is evidence of high quality functions based on existing data including, but not limited to, NHD records of threatened or endangered species (ODNR, 2016) and/or Ohio EPA has determined the wetland to be Category 3 based on an Agency-approved assessment methodology such as ORAM (Mack, 2001), VIBI (Mack and Gara, 2015), VIBI-FQ (Gara, 2013) and/or Amph-IBI (Miccachion, 2011) data.

A total of 220 wetlands that meet the above criteria were identified. NWI Polygons that abut one another were joined together as a single wetland polygon and, in a few instances, NWI polygons that are not abutting one another were combined where a high degree of hydrologic interaction is likely based on aerial imagery interpretation (OSIP 2006-2007), topography and NRCS soil survey. In these instances, it is assumed that the wetland polygons would be considered within the same hydrogeomorphic classification and would be scored within a single scoring boundary using ORAM. Of the high-quality wetlands identified, 162 (73.6 percent) have not been assessed by Ohio EPA, but are identified in the NHD to be high-quality based on the presence of at least one threatened or endangered species; 19 wetlands (8.6 percent) have been determined by Ohio EPA to be category 3 wetlands using one of the above-mentioned methods; and 39 (17.7 percent) wetlands are considered to be high-quality wetlands based on both Ohio EPA categorical assessment and because of the recorded presence of at least one threatened or endangered species. A list of high-quality wetlands is included in Table I-1.

Significant Wetland Areas

Ohio EPA also attempted to identify significant wetlands and wetland complexes. Many of these areas are included in the high-quality wetlands list described in Section I1.1 above; however, size was the main criterion used to determine whether an area should be included on the significant wetland area list. Ohio EPA analyzed NWI polygons, aerial imagery and topographic maps to identify wetlands and wetland complexes that likely have a high degree of hydrologic interaction. Generally only areas which exceed 300 acres of mapped NWI wetlands are included in this list. The lone exception is Cedar Bog (approximately 296 acres) in Champaign County. A list of significant wetland areas is included in Table I-2.

Stream and Wetland Mitigation

Research by the Ohio EPA WEG identified site selection as one of the most important factors influencing the degree of success of restoration and mitigation projects. In order to facilitate improved site selection for projects, Ohio EPA created a mapping application that includes the following:

- The location of stream and wetland mitigation projects including permittee responsible sites with environmental covenants, mitigation banks, pooled mitigation areas, and in lieu fee sites approved by Ohio EPA.
- The location of wetlands from the National Wetland Inventory categorized by wetland condition using aerial imagery by Ohio EPA.
- Potential vernal pool restoration sites, as identified by Ohio EPA.
- In stream dams as identified by Ohio Department of Natural Resources.
- Reference data layers including predominantly hydric soils, Quaternary geology, Ohio woody plant distributions, conservation and recreation lands, and USGS topographic map wetlands.

This application is available to the public and can be used to identify potential future areas for projects or monitoring.

Assessment of Riparian Areas

In 2016 and 2018, Ohio EPA collected vegetation data from reference and restored riparian areas in order to better quantify the quality of non-wetland habitats that directly interact with aquatic ecosystems. Ohio EPA proposes further monitoring of riparian areas, particularly prior to restoration activity in order to improve restoration practices and maximize water quality improvement.

Next Steps

Ohio EPA has considered conducting periodic Level 2 and Level 3 field assessments on a random selection of wetlands within targeted HUC12 watersheds on a rotating basin schedule, like what is currently being done with Ohio EPA stream assessments. Initially the assessments could focus on significant wetland areas and high-quality wetlands that lack prior assessment data. Focusing on these areas will potentially give an understanding of wetland condition within the HUC12. Issues such as property access and staff resources will dictate the number of watersheds that can be surveyed, but as the number of field assessed HUC12s increases, a better understanding of the relationship between the Level 1 and Level 2/Level 3 characterizations will be illustrated. This understanding will be critical to the continued improvements to our ability to assess the ecological condition of wetlands using remotely sensed, landscape-level GIS data. Current staffing resource issues have prevented us from expanding the ecological monitoring program to include regular watershed-scale wetland surveys at this time and in the foreseeable future.

Table I-1 — List of high-quality wetland areas.

Site Name	Reason	Owner	Owner Type	Size (Acres)
Abshire And Graves Scenic River Area	NHD	ODNR	State	20
Akron Watershed Land	Cat 3/NHD	City of Akron	Local	5,013
Aquilla Lake WA	NHD	ODNR	State	673
Aquilla Lake	Cat 3	Private	Private	410
Arcola Creek	Cat 3/NHD	Lake County Metroparks	Local	30
Area K	Cat 3	ODNR	State	20
Arthur W Youngblood Watershed Area	NHD	City of Akron	Local	36
Ashcroft Preserve	NHD	Grand River Partners, Inc.	Private	516
ATV	Cat 3	Columbus and Franklin County Metro Parks	Local	9
Aurora Sanctuary NP	NHD	Audubon Society of Greater Cleveland	NGO	44
Aurora Wetlands II	NHD	Summit County Metro Parks	Local	30
Avoca Park	NHD	Great Parks of Hamilton County	Local	19
Baker Swamp	Cat 3/NHD	The Nature Conservancy	NGO	68
Bass Lake	NHD	Western Reserve Land Conservancy	Private	149
Bass Lake Preserve	NHD	Geauga County Park District	Private	22
Bath Nature Preserve	NHD	Bath Township	Local	6
Battaglia	NHD	Portage County Park District	Local	27
Battelle Darby Creek Metro	NHD	Columbus and Franklin County Metro Parks	Local	48
Bay Point	NHD	Natural Areas Land Conservancy	NGO	13
Beach City WA	NHD	ODNR	State	27
Beaumont Scout Reservation	NHD	Boy Scouts of America	NGO	266
Beaver Creek Preserve Easement	NHD	Beavercreek Wetlands Association	NGO	104
Beaver Creek SP	NHD	ODNR	State	24
Beaver Creek WA	NHD	ODNR	State	279
Beck Fen	NHD	The Nature Conservancy	NGO	147
Bedford Reservation	NHD	Cleveland Metroparks	Local	222
Berlin Lake WA	NHD	ODNR	State	328
Betsch Fen	NHD	The Nature Conservancy	NGO	26
Big Creek Reservation	NHD	Cleveland Metroparks	Local	20
Big Island WA	NHD	ODNR	State	1,160
Big Swamp Woods	Cat 3/NHD	Cleveland Museum of Natural History	Local	83
Bradley Woods Reservation	Cat 3/NHD	Cleveland Metroparks	Local	112
Browns Lake Bog	Cat 3/NHD	The Nature Conservancy	NGO	60
Buck Creek SP	NHD	ODNR	State	63
Burton Wetlands	Cat 3/NHD	Geauga Park District	County	9
Cackley Swamp	NHD	Appalachia Ohio Alliance	NGO	307
Calamus	Cat 3	Columbus Audubon Society	NGO	9
Campbell SNP	NHD	ODNR	State	49
Canal Corridor	NHD	Stark County Parks	County	66
Cascade Valley Park	NHD	Summit County Metro Parks	County	6
Cedar Bog NP	Cat 3/NHD	Ohio Historical Society	State	244
Cedar Point National Wildlife Refuge	Cat 3/NHD	U.S. Fish & Wildlife Service	Federal	1,853
Charles Mill Lake	NHD	Muskingum Watershed Conservancy District	Local	619
Chesterfield Swamp (Gleeson Family Nature Reserve)	NHD	Morrow County Park District	County	44
City of Ravenna Park	NHD	City of Ravenna	Local	67
Clark Lake WA	NHD	ODNR	State	21
Collier SNP	Cat 3	ODNR	State	21
Conneaut Township Park	NHD	Conneaut Township	Local	64

Site Name	Reason	Owner	Owner Type	Size (Acres)
Conneaut WA	NHD	ODNR	State	24
Cooper Hollow WA	NHD	ODNR	State	94
Cooperrider/Kent Bog SNP	Cat 3/NHD	ODNR	State	82
Cranberry Bog NP	NHD	ODNR	State	13
Crystal Lake	NHD	The Nature Conservancy	NGO	25
Culberson Woods SNP	Cat 3	ODNR	State	29
Daubel	NHD	Black Swamp Conservancy	Private	109
Davenport Pond and Wetlands	NHD	Appalachia Ohio Alliance	NGO	6
Delaware WA	NHD	ODNR	State	79
Dickason Run Swamp	NHD	Ohio Valley Conservation Coalition	NGO	47
E. Frohring	NHD	Western Reserve Land Conservancy (Easement)	Private	17
Eagle Creek NP	Cat 3	ODNR	State	358
East Harbor SP	NHD	ODNR	State	124
Edge of Appalachia	NHD	Cincinnati Museum of Natural History	Local	64
Eldon Russell Park	NHD	City of Akron	Local	40
Farley Property	NHD	Geauga County Park District	County	498
Firestone Metro Park	NHD	Summit County Metro Parks	County	109
Firestone/Yeagley WA	NHD	ODNR	State	81
Fish Creek WA	NHD	ODNR	State	53
Flatiron Lake Bog	NHD	The Nature Conservancy	NGO	37
Forrest Woods Nature Preserve	Cat 3/NHD	Black Swamp Conservancy	NGO	20
Fowler Woods NP	Cat 3	ODNR	State	48
Franklin Township Marsh	NHD	Ohio Valley Conservation Coalition	NGO	8
Furnace Run Park	NHD	Summit County Metro Parks	County	15
Gallagher/Springfield Fen SNP	NHD	ODNR	State	9
Garlo Heritage Nature Preserve	NHD	Seneca County Park District	County	40
Geneva SP	NHD	ODNR	State	25
Geneva Swamp	NHD	Cleveland Museum of Natural History	Local	285
Glade Wetland	NHD	The Nature Conservancy	NGO	7
Goll Woods SNP	NHD	ODNR	State	64
Goodyear	Cat 3	ODNR	State	77
Goodyear Heights Metro Park	NHD	Summit County Metro Parks	County	25
Gott Fen NP	Cat 3/NHD	ODNR	State	49
Grand River WA	NHD	ODNR	State	1,695
Grand River Terraces	Cat 3	Cleveland Museum of Natural History	NGO	105
Gray Birch Bog	NHD	Western Reserve Land Conservancy	NGO	16
Greendale Buttonbush	Cat 3	U.S. Forest Service	Federal	9
Griggs Reservoir Park	Cat 3	City of Columbus Parks and Recreation	Local	9
Hambden Orchard WA	NHD	ODNR	State	358
Hampton Hills Metro Park	NHD	Summit County Metro Parks	County	28
Harper Valley Preserve, Inc.	NHD	Grand River Partners, Inc.	Private	19
Harris Nature Preserve 1999	NHD	Black Swamp Conservancy	Private	179
Headlands Beach SP	NHD	ODNR	State	10
Herrick Fen	Cat 3/NHD	The Nature Conservancy	NGO	48
Hertrick	NHD	Grand River Partners, Inc.	Private	6
Hess	NHD	Western Reserve Land Conservancy	NGO	122
Highland Heights Park	NHD	City of Highland Heights	Local	6
Highlandtown WA	NHD	ODNR	State	14
Hinckley Reservation	NHD	Cleveland Metroparks	Local	98
Holden Arboretum	NHD	Holden Arboretum	Private	33

Site Name	Reason	Owner	Owner Type	Size (Acres)
Honey Point WA	NHD	ODNR	State	11
I-480 Preserve	NHD	Western Reserve Land Conservancy	NGO	18
Indian Creek WA	NHD	ODNR	State	52
Irwin Prairie SNP	Cat 3/NHD	ODNR	State	213
Jackson Bog NP	NHD	ODNR	State	18
Jackson Lake SP	NHD	ODNR	State	101
Kendrick Woods NP	NHD	ODNR	State	31
Killbuck Marsh WA	Cat 3/NHD	ODNR	State	4,169
Killdeer Plains WA	Cat 3/NHD	ODNR	State	670
Kinnikinnick Fen	NHD	Ross County Park District	County	19
Kiser Lake SP	NHD	ODNR	State	23
Kitty Todd	Cat 3/NHD	The Nature Conservancy	NGO	302
Kuehnle WA	NHD	ODNR	State	12
Lake Katherine SNP	NHD	ODNR	State	40
Lake La Su An WA	NHD	ODNR	State	145
Lake Park	NHD	Coshocton City & County Park District	Local	19
Lake Rockwell	NHD	City of Akron	Local	106
Lakeshore Reservation	NHD	Lake County Metroparks	Local	6
Lawrence Woods NP	Cat 3/NHD	ODNR	State	14
Liberty/Owens Fen NP	Cat 3/NHD	ODNR	State	58
Little Portage WA	NHD	ODNR	State	281
Little Rocky Hollow NP	NHD	ODNR	State	7
Little Darby Terrace	Cat 3	ODNR	State	8
Magee Marsh WA	Cat 3/NHD	ODNR	State	1,968
Mallard Club Marsh WA	NHD	ODNR	State	389
Mantua Bog NP	NHD	ODNR	State	44
Marsh Wetlands WA/NP	Cat 3/NHD	ODNR	State	132
Maumee Bay SP	NHD	ODNR	State	160
Maumee SF	NHD	ODNR	State	260
McCracken Fen SNP	NHD	ODNR	State	52
Mentor Marsh NP	NHD	ODNR	State	798
Mercer WA	NHD	ODNR	State	48
Metzger Marsh WA	NHD	ODNR	State	703
Miami Whitewater Forest	NHD	Hamilton County Park District	County	38
Milan WA	NHD	ODNR	State	55
Mill Creek Park	NHD	Mill Creek Metroparks	County	356
Mill Hollow - Bacon Woods Park	NHD	Lorain County Metro Parks	County	370
Mill Stream Run Reservation - 1-71 Parcel	NHD	Cleveland Metroparks	Local	369
Mogadore Reservoir	NHD	City of Akron	Local	49
Mohawk Reservoir	NHD	Muskingum Watershed Conservancy District	Local	14
Morgan Swamp	Cat 3/NHD	The Nature Conservancy	NGO	589
Mosquito Creek WA	Cat 3/NHD	ODNR	State	1,431
Mud Lake Bog SNP	Cat 3/NHD	ODNR	State	26
Museum Lands	NHD	Cleveland Museum of Natural History	Local	75
Muzzy Lake (East)	NHD	City of Ravenna	Local	20
Myersville Fen NP	NHD	ODNR	State	12
North Fork Wetlands	NHD	Western Reserve Land Conservancy	Private	31
North Pond NP	Cat 3/NHD	ODNR	State	19
Northeast Ohio Wetlands, Inc.	NHD	Grand River Partners, Inc.	Private	34

Site Name	Reason	Owner	Owner Type	Size (Acres)
O'Shaughnessy Reservoir Park	Cat 3	City of Columbus	Local	12
Oak Openings Preserve Metropark	Cat 3/NHD	Metroparks of the Toledo Area	Local	23
Observatory Park	NHD	Geauga County Park District	Local	822
Old Woman Creek NERR/NP	Cat 3/NHD	ODNR	State	87
Orwell WA	NHD	ODNR	State	152
Ottawa National Wildlife Refuge	NHD	U.S. Fish & Wildlife Service	Federal	500
Oxbow Lake WA	NHD	ODNR	State	17
Pallister SNP	Cat 3/NHD	ODNR	State	61
Parkersburg WA	NHD	ODNR	State	109
Pater WA	NHD	ODNR	State	7
Pennline Bog	NHD	Cleveland Museum of Natural History	Local	199
Pickerel Creek WA	NHD	ODNR	State	832
Pipe Creek WA	NHD	ODNR	State	66
Poland Village Park	NHD	Village of Poland	Local	135
Pond Brook Conservation Area	Cat 3/NHD	Summit County Metro Parks	County	483
Portage Lakes SP	NHD	ODNR	State	249
Portage Lakes Wetlands NP	NHD	ODNR	State	26
Prairie Oaks Metropark	NHD	Columbus and Franklin County Metro Parks	Local	8
Prairie Road Fen NP	Cat 3/NHD	ODNR	State	11
Price Road Swamp	NHD	City of Akron	Local	207
Punderson SP	NHD	ODNR	State	42
Putnam Marsh	NHD	Erie Metroparks	Local	281
Pymatuning Creek Wetlands NP	NHD	ODNR	State	610
Pymatuning SP	NHD	ODNR	State	121
Ravenna Arsenal	NHD	USA	Federal	636
Ray	NHD	Geauga County Park District	Local	83
Resthaven WA	Cat 3/NHD	ODNR	State	1,096
Rocky River Reservation	NHD	Cleveland Metroparks	County	162
Rome SNP	NHD	ODNR	State	279
Rutherford	Cat 3	U.S. Forest Service	Federal	19
Salt Fork SP	NHD	ODNR	State	1,225
Salt Fork WA	NHD	ODNR	State	122
School Lands	NHD	Ravenna City School District	NGO	132
Secor Metropark	NHD	Metroparks of the Toledo Area	County	50
Seneca Lake	NHD	Muskingum Watershed Conservancy District	Local	38
Shawnee Lookout	NHD	Great Parks of Hamilton County	County	7
Shawnee SF	NHD	ODNR	State	137
Sheldon Marsh NP	Cat 3/NHD	ODNR	State	412
Shenango WA	Cat 3/NHD	ODNR	State	3,539
Showalter Bog	NHD	Portage County Park District	County	15
Silver Creek Fen	NHD	Western Reserve Land Conservancy	NGO	14
Singer Lake Bog	Cat 3/NHD	The Nature Conservancy	NGO	94
Slate Run Metropark	Cat 3	Columbus and Franklin County Metro Parks	Local	24
Spring Valley WA	NHD	ODNR	State	107
Springville Marsh NP	Cat 3/NHD	ODNR	State	233
Suawa	NHD	Grand River Partners, Inc.	Private	34
Sumner on Ridgewood	Cat 3	Concordia of Ohio (Easement)	Private	22
Swamp Cottonwood SNP	Cat 3	ODNR	State	5
Tinkers Creek NP	Cat 3/NHD	ODNR	State	473
Towner's Woods	NHD	Portage County Park District	County	16

Site Name	Reason	Owner	Owner Type	Size (Acres)
Township Lands	NHD	Oberlin College	Local	16
Triangle Lake Bog NP	NHD	ODNR	State	68
Tummonds NP	NHD	ODNR	State	135
Twinsburg Bog	NHD	Western Reserve Land Conservancy	NGO	72
Tycoon Lake WA	NHD	ODNR	State	67
Urbana Raised Bog	NHD	Champaign County Fairgrounds	County	14
USFWS Ottawa National Wildlife Refuge	NHD	U.S. Forest Service	Federal	2,391
USFWS Ottawa National Wildlife Refuge Navarre Division	NHD	U.S. Forest Service	Federal	413
Veteran's Memorial Park	NHD	Lake County Metroparks	County	27
Walnut Beach Park	NHD	City of Ashtabula	Local	63
Waterloo WA	NHD	ODNR	State	153
Wayne National Forest	Cat 3/NHD	U.S. Forest Service	Federal	856
West Branch Copperbelly Site	NHD	Boy Scouts of America	NGO	60
West Woods	NHD	Geauga County Park District	County	155
Westwinds Woods	NHD	Metroparks of the Toledo Area	Local	37
Wildlife Habitat Restoration Program Chamberlain	NHD	ODNR	State	38
Willard Marsh WA	Cat 3/NHD	ODNR	State	775
Willow Point WA	NHD	ODNR	State	299
Wills Creek Reservoir	Cat 3	Muskingum Watershed Conservancy District	Local	9
Yellow Creek SF	NHD	ODNR	State	9
Yoctangee Park and Annex	NHD	City of Chillicothe	Private	14
Zaleski SF	Cat 3/NHD	ODNR	State	726

Table I-1 Key			
HQW	High Quality Wetland	SF	State Forest
NERR	National Estuarine Research Reserve	SNP	State Nature Preserve
NGO	Non-governmental organization	SP	State Park
NHD	Natural Heritage Database	SW	Significant Wetland
NP	Nature Preserve	USFWS	U.S. Fish and Wildlife Service
NWR	National Wildlife Refuge	WA	Wildlife Area
ODNR	Ohio Department of Natural Resources	WEG	Wetland Ecology Group

Table I-2 — List of significant wetland areas.

Site Name	Size (acres)
Akron Watershed Land	6,303
Andover Township Wetlands	405
Ashtabula Wetlands	495
Atwater Wetlands	1,039
Auburn Wildlife Area	519
Bates Creek Wetland	1,008
Beach City Reservoir Wetlands	1,114
Beach City Wildlife Area	1,741
Big Island Wildlife Area /Little Scioto	1,713
Black Fork Mohican River Wetlands	1,045
Boggs Fork Wetlands	869
Bolivar Reservoir	722
Bridge Creek Wetland	604
Bristol Township Wetland	662
Cackley Swamp	413
Cambridge Wetlands	3,234
Canal Fulton Wetlands	1,152
Cedar Bog	296
Cedar Point Wildlife Area/Maumee Bay State Park	2,434
Charles Mill Lake	832
Chippewa Lake	568
Crooked Creek Wetland	990
Deacon Creek Corner Wetland	1,034
Deerfield Wetlands	851
Denmark Township Wetland	702
Dillon Wildlife Area/Dillon State Park	1,608
Dorset Wildlife Area	1,702
Dover Reservoir Wetlands	998
Eagle Creek Wildlife Area	2,181
Flatrock Creek Riparian	1,759
Fox Lake Wetlands	418
Friday Creek Wetland	1,008
Funk Bottoms Wildlife Area	2,545
Geauga Park District Rookery Wetland	636
Geneva State Park	422
Grand River Wildlife Area	11,030
Griggs Mill Creek Wetland	330
Hambden Orchard Wildlife Area	1,866
Indian Lake Inlet Wetlands	785
Jerome Fork Wetlands	399
Killbuck Creek	2,218
Killbuck Marsh Wildlife Area	5,046
Kiwanis Lake Wetlands	437
Lake Luna Wetlands	1,041
Lennox Center Wetlands	1,131
Linton Road Wetland	1,213
Little Portage River Wetlands	1,086
Magee/Metzger/Ottawa National Wildlife Refuge (West)	5,412
Marrian Road Wetland	617
Mecca Township Wetland	609
Mentor Marsh State Nature Preserve	869

Site Name	Size (acres)
Mill Creek Wetland	1,527
Mogadore Reservoir Wetlands	1,070
Monroe Center Wetlands	438
Montville Township Wetland	1,506
Morgan Swamp State Nature Preserve	747
Mosquito Creek (Warren) Wetlands	863
Mosquito Creek Wildlife Area	4,276
Moxley/Smith/Sanford/Other Private Clubs	1,211
Muskingum River (Dresden) Wetlands	1,270
New Lyme Wildlife Area	981
North Bend Road Wetlands	626
Oak Openings - Irwin Prairie	1,086
Ohio Brush Creek Wetlands	476
Orwell Wetlands	1,063
Ottawa National Wildlife Refuge (Central)/Toussaint Shooting Club/Other	3,138
Ottawa National Wildlife Refuge (Navarre)	848
Phelps Road Wetland	3,143
Plymouth Township Wetland	1,224
Pond Brook	1,230
Potter Creek Wetlands	712
Pritchard Wetlands	409
Raccoon Creek (Wellston) Wetlands	1,123
Raccoon State Forest Wetlands	749
Racoon Creek/Zaleski State Forest/Lake Hope State Park	1,374
Ray State Line Road Wetlands	480
Resthaven Wildlife Area	1,309
Richmond Center Wetland	816
Rittman Wetland	826
Rome State Nature Preserve	1,256
Salt Fork Wetlands	1,102
Sandyville Wetlands	1,648
Shedd Road Wetland	808
Sheffield Center Wetland	1,687
Sheldon's Marsh	923
Shenango Wildlife Area	4,999
Sixteen Valley Wetlands	464
Skull Fork Wetlands	468
Spring Pond Wetland	530
St. Mary's River Riparian	2,617
Stillwater Creek Wetlands	714
Symmes Creek Wetlands	1,328
Trumbull Creek Wetlands	764
Twitchell Road Wetlands	405
Upstream East Branch Reservoir	1,220
West Branch Huron River Wetlands	2,220
West Branch Mahoning River Wetland	1,162
Willard Marsh Wildlife Area	1,240
Willow Creek Wetlands	378
Willow Point	316
Wills Creek Reservoir/Conesville Coal	2,564
Windham Wetlands	897
Winous Point Shooting Club/Ottawa Shooting Club/Pickerel Creek Wildlife Area	9,358

Site Name	Size (acres)
Wolf Creek Wetlands	753
Yankee Run Wetlands	876
Champion Township Wetlands	533
Wildare Wetlands	564
Lake Cardinal Area Wetlands	359

I2. Mercury Reduction at Ohio EPA

Mercury is a persistent bioaccumulative toxic metal that is widely used in many products. Once mercury is released into the environment its toxicity, persistence and ability to travel up the food chain are important issues for human health and the environment. Ohio has a statewide health advisory for mercury from fish consumption for sensitive populations: women of childbearing age; and children 15 years old or younger (issued by the Ohio Department of Health).

U.S. EPA is allowing states to identify waters for a special 303(d) list category devoted to mercury issues (5M). While moving in this direction would be preferable as a way to focus on this important pollutant, Ohio EPA has decided that such a move is not possible for this report. At the same time, Ohio EPA is taking action to decrease mercury pollution and these efforts are summarized here.

Ohio Law

House Bill 443 was made law on Jan. 4, 2007. The law has the mercury product regulations created initially in House Bill 583 and Senate Bill 323, establishing sales bans for certain mercury products. Public and private schools through high school were not to purchase mercury, mercury compounds or mercury-measuring devices for classroom use as of April 6, 2007. Mercury thermometers and mercury-containing novelty items were not to be sold in Ohio as of Oct. 6, 2007. The sale of novelty items that have mercury cell button batteries were banned as of 2011. Mercury thermostats were not to be sold or installed as of April 6, 2008. There are exemptions to the sales bans.

Ohio Projects

Ohio EPA has worked in several areas seeking to reduce mercury emissions and increase awareness:

- identification of air sources of mercury, including identification of water bodies in the State impaired by mercury predominantly from atmospheric deposition, potential emissions sources contributing to deposition in the State and adoption of appropriate State-level programs to address in-state sources;
- identification of other potential multi-media sources of mercury, such as mercury in products and wastes and adoption of appropriate State-level programs (note that mercury-containing products may be a source of mercury to the air and other media during manufacturing, use or disposal);
- quantifying multi-media mercury reductions achieved by scrubber systems installed at Ohio power plants in response to a lawsuit filed by several northeastern states;
- adoption of statewide mercury reduction goals and targets, including percent reduction and dates of achievement, for air and other sources of mercury, as well as reduction targets for specific categories of mercury sources where possible;
- multi-media mercury monitoring, including water quality, air deposition and air emissions monitoring;

- implementation of Pollutant Minimization Programs by publicly owned treatment works with mercury variances to identify and reduce sources of mercury that discharge to their plants[1].
- investigating mercury in various types of wastewater, including:
  - primary materials industries, including primary metal production, oil refining and coal facilities;
  - facilities processing steel scrap (continuous casting and steel foundries);
  - publicly owned treatment works, which look at indirectly discharging industries through the pretreatment program and facility Pollutant Minimization Plan;
  - coal power plant wastewater from scrubbers, ash ponds and “Low Volume” wastewaters; and
  - other industries in interactive allocation segments to get an accurate accounting of mercury in the segments.
- working to control discharges from the state’s one mercury cell sodium/chlorine plant[2].
- coordination across states, where possible, such as multi-State mercury reduction programs. Ohio EPA has had representatives in several organizations that work toward this goal.

Ohio Resources

Many videos, fact sheets and presentations are available on Ohio EPA’s website that relate to mercury. These include household mercury fact sheets; an introduction to mercury issues; a guide for dealing with mercury by school administrators; an informational sheet for building awareness of mercury in schools; information about mercury in industry; and suggestions for developing a community mercury reduction program. See ***epa.ohio.gov/ocapp/p2/mercury_pbt/mercury.aspx*** for more information.

Federal Rules

In 2017, U.S. EPA finalized technology-based pretreatment standards under the Clean Water Act to reduce discharges of mercury and other metals from dental offices into municipal sewage treatment plants known as publicly owned treatment works (POTWs). Ohio EPA is responsible for ensuring the rule is implemented. The rule requires dental offices to comply with requirements based on the American Dental Association’s recommended practices, including the use of amalgam separators. Once captured by the separator, dental amalgam can be recycled. Removing mercury when it is concentrated and easy to manage, such as through low-cost amalgam separators at dental offices (average annual cost per dental office in 2016 is about $800), is a common-sense solution to managing mercury that would otherwise be released to air, land and water. You can find this rule and supporting documents at U.S. EPA’s website: ***epa.gov/eg/dental-effluent-guidelines***.

[1] The facilities track implementation of mercury reduction measures and monitor influent and effluent mercury levels. They compile reduction information and submit annual progress reports to Ohio EPA.

[2] The current consent order includes reducing fugitive air emissions that have contributed to storm water discharges of mercury. The plant will be scrubbing cell emissions with water and sending those discharges to the plant’s zero discharge process treatment system. The consent order also requires the company to track mercury mass balances through the facility and recycle where possible. This includes using collected storm water as process water make-up.

I3. Inland Lakes and Reservoirs

Ohio EPA initiated a renewed monitoring effort for inland lakes in 2008. This report assesses three beneficial uses that apply to inland lakes: recreation; public drinking water supply; and human health (via fish tissue). Ohio EPA is in the process of updating the water quality standards for inland lakes. For this Integrated Report, Ohio will use a two-tiered approach incorporating existing water quality criteria that apply to all waters of the state as well as a separate assessment that will explore the effects of systemic nutrient enrichment in the watershed and its impact on water quality, and ultimately on aquatic life in lakes and reservoirs, as a surrogate for the aquatic life beneficial use.

Background of Ohio's Inland Lake Water Quality Monitoring Program

Ohio EPA's work to assess lakes began in 1989 with a CWA Section 314 Lake Water Quality Assessment grant that supported the evaluation of 52 lakes. Various additional grants enabled the evaluation of 89 more lakes through 1995. An analysis and determination of beneficial use status for 447 public lakes (greater than five acres in surface area) was presented in Volume 3 of the 1982 through 1996 Ohio Water Resource Inventories [305(b) report]. In those reports, Ohio EPA developed a *Lake Condition Index* (LCI) using multiple metrics to characterize overall lake health which was applied to designated uses as well as general CWA fishable and swimmable goals. All lakes, with the exception of upground reservoirs, were considered EWH by rule in the earlier 305(b) reports.

After dedicated U.S. EPA funding for lakes monitoring ended, Ohio EPA monitored only 53 lakes over the next 10 years. The recently described LCI became obsolete with the passage of Ohio's Credible Data Law [House Bill 43 (amended), effective 10/21/2003]. This law requires that decisions on impairment for all surface waters (streams, lakes wetlands) be based solely on Level 3 credible data. Ohio's original LCI assessment process included a combination of Level 2 and Level 3 credible data to make impairment decisions.

Ohio EPA began researching ways to re-establish an inland lakes monitoring program in 2005. During the 2007 field season, Ohio EPA participated in the U.S. EPA-sponsored National Lakes Assessment (NLA). Ohio was assigned 19 lakes that were selected through a probability-based random selection process. The effort served as a precursor for a renewed lake sampling program in Ohio.

Status of Inland Lakes Program

In 2010 and subsequent IRs through 2018, Ohio EPA provided a proposed methodology for assessing inland lakes based on Lake Habitat (LH) use as a substitute for aquatic life use (ALU). The LH criterion were deemed overprotective of inland lakes, lacking realistic expectations of the largely artificial reservoirs in Ohio. Ohio EPA currently monitors select inland lakes using the strategy described in Section I3.2.1 below. Priority is being placed on lakes used for public drinking water or used heavily for recreation and suspected of being impaired for either of those uses. The objectives for monitoring inland lakes remain as follows:

- Track status and trends of lake quality
- Determine attainment status of beneficial uses
- Identify causes and sources of impaired uses
- Recommend actions for improving water quality in impaired lakes

A Methodology for the Assessment of Aquatic Life in Lakes

As in recent IRs, Ohio EPA has implemented a sampling strategy that focuses on evaluating the water quality conditions present in the epilimnion of lakes. The sampling target consists of an even temporal distribution of 10 sampling events collected during the summer months (multiple or single year). Details of the sampling protocol are outlined in the Inland Lakes Sampling Procedure Manual, available on Ohio EPA's webpage at: ***epa.ohio.gov/dsw/inland_lakes/index.aspx***.

The current ALU designation for all inland lakes in Ohio is exceptional warmwater habitat (EWH) except for upground reservoirs which are designated warmwater habitat (WWH). As stated earlier, the assignment of EWH and WWH to inland lakes has unclear origins giving reason to consider new standards for inland lake use designations. To evaluate lake condition using existing standards protective of aquatic life in Ohio lakes and reservoirs, the chemical parameters ammonia, dissolved oxygen, pH, total dissolved solids and various metals were analyzed. Statewide water quality outside mixing zone average (OMZA) criteria for these parameters are summarized in Table 35-1 of the Ohio water quality standards rule 3745-1-35 of the Ohio Administrative Code (***epa.ohio.gov/portals/35/rules/01-35.pdf***). Other important parameters for assessing lake condition include causative nutrient parameters (e.g. total phosphorus, total nitrogen) and biological response variables (e.g. chlorophyll-a).

For this 2020 IR, Ohio EPA has initiated a slightly modified approach to assessing lakes compared to previous Integrated Reports (IRs). First, statewide criteria are used to determine if there was any overt pollution of the lake as would be indicated by a greater than 10% exceedance of the appropriate statewide OMZA criteria for each lake (exception-outside mixing zone minimum (OMZM) for D.O.). Where criteria do not exist, a common approach to assessing relative lake condition is to compare lake water quality sampling data to regional and lake-type derived percentiles (e.g. 25^{th}) of existing lake data. Certain chemical parameters (i.e. nutrient parameters) comprise the second tier where values below the 25^{th} percentile of reference sites generally represent an acceptable condition.

Inland lake targets derived using this approach include: the 25^{th} percentile for TN and TP (as causative variables), and the 25th percentile for chlorophyll-a (Chl. a) and the upper 75^{th} percentile Secchi depth (as response variables). Data used to determine these targets were collected by Ohio EPA from Ohio inland lakes between 1989 and 2006 (Table I-3). Data for individual sites were expressed as medians prior to calculating percentiles.

A Methodology to Assess Inland Lake Water Quality in Ohio

An important distinction between assessment of aquatic life uses of rivers and streams in Ohio versus lakes is that the former relies on biological monitoring and a comparison of those results to the biological criteria as the assessment tool. Ohio does not have biological criteria that apply to lakes. As a result, the assessment methodology for the aquatic life use will rely solely on the results of chemical water quality sampling and a comparison of the results to the applicable numeric chemical criteria. This is an important difference to the weight-of-evidence approach traditionally used by Ohio EPA utilizing bio-criteria for the assessment of rivers and streams.

Methodology Preview: Inland Lakes Aquatic Life Assessment

The following protocol is intended to be used to determine the effects of toxic pollutants and nutrient enrichment on aquatic life in Ohio's inland lakes. This conceptual approach or something similar could be considered in future WQS rulemaking for inland lakes.

Parameters sampled with applicable and existing aquatic life outside mixing zone average (OMZA) WWH and EWH chemical numeric criterion:

- Comparison of the average dissolved oxygen content of the epilimnetic samples in a thermally stratified lake (or samples throughout the water column of an unstratified lake) to the OMZM WWH (4.0 mg/L) and EWH (5.0 mg/L) dissolved oxygen criteria considered protective of aquatic life (i.e. fish) in lakes. OMZM was considered more appropriate for instantaneous D.O. measurements. If more than 10 percent of the average dissolved oxygen values are below the OMZM criterion, lake conditions are stressful to aquatic life, a condition that is often associated with accelerated or unnatural nutrient enrichment (i.e., a *hypertrophic* condition) and is considered *impaired*.
- Comparison of the median pH value of the epilimnetic samples of a thermally stratified lake (or samples from throughout the water column of an unstratified lake) to the statewide OMZA pH criteria for WWH and EWH lakes. If more than 10 percent of the median pH values do not meet the OMZA criterion, lake conditions are stressful to aquatic life, and the lake is considered *impaired*.
- Comparison of individual sample concentrations for ammonia of lake samples collected, to the temperature and pH dependent OMZA numeric criterion. Lake conditions are stressful to aquatic life, and the lake is considered *impaired* if more than 10 percent of the individual samples exceed the OMZA numeric criteria.
- Comparison of individual sample concentrations for any TDS or metal parameter to the current applicable aquatic life outside mixing zone average (OMZA) numeric criterion. If more than 10 percent of the samples within an assessment period (multiple or single year) exceed the OMZA numeric criterion for metals, the lake would be considered *impaired* and placed on the 303d list requiring a TMDL study or 9-element plan to restore the lake to meet applicable WQS.

Table I-3 — Percentage of sampling events exceeding the statewide water quality criteria for the protection of aquatic life in WWH lakes.

WWH WQS statewide chemical Criteria													
Percentage of Samples Exceeding the OMZA WWH Criterion													
Lake/Reservoir	D.O. (mg/L)[1]	pH (SU)	NH3-N (mg/l)[2]	TDS Mg/L	As **µg/L**	Se **µg/L**	Cd[3]	Cr[3]	Cu[3]	Pb[3]	Ni[3]	Zn[3]	
Water Quality Standard	**<4.0**	**>6.5 <9.0**		**1500**	**150**	**5.0**							
Amicks Reservoir	10	0	0	0	0	0	0	0	0	0	0	0	
Bucyrus (Outhwaite) Reservoir	0	0	0	0	0	0	0	0	0	0	0	0	
Defiance Reservoir	0	0	0	0	0	0	0	0	0	0	0	0	
Norwalk Memorial Reservoir	0	10	0	0	0	0	0	0	0	0	0	0	
Raccoon Reservoir	0	0	0	0	0	0	0	0	30	0	0	0	
Swanton Reservoir	10	0	0	0	0	0	0	0	0	0	0	0	
Willard Reservoir	0	0	0	0	0	0	0	0	0	0	0	0	

[1] For dissolved oxygen, the OMZM (outside mixing zone minimum) criteria (4.0 mg/l) is applied since 24-hour data was not available. Dissolved oxygen criteria apply in the epilimnion of stratified lakes and throughout the water column in unstratified lakes.

[2]WQS 3745-1-35 table 35.5, OMZA 30-day average total ammonia-nitrogen criteria.

[3]Hardness dependent criteria.

Table I-4 — Percentage of sampling events exceeding the statewide water quality criteria for the protection of aquatic life in EWH lakes.

EWH WQS statewide chemical Criteria													
Percentage of Samples Exceeding the OMZA EWH Criterion													
Lake/Reservoir	D.O. (mg/L)[4]	pH (SU)	NH3-N (mg/l)[5]	TDS Mg/L	As **µg/L**	Se **µg/L**	Cd[6]	Cr[6]	Cu[6]	Pb[6]	Ni[6]	Zn[6]	
Water Quality Standard	**<5.0**	**>6.5 <9.0**		**1500**	**150**	**5.0**							
Amann Reservoir	14	0	0	0	0	0	0	0	0	0	0	0	
Attwood Reservoir	0	0	0	0	0	0	0	0	0	0	0	0	
Barberton Reservoir	0	0	0	0	0	0	0	0	0	0	0	0	
Caesar Creek Reservoir	38	0	0	0	NS	NS	NS	NS	NS	NS	NS	NS	
Lake Alma	0	0	0	0	0	0	0	0	0	0	0	0	
Lake Rupert	0	0	0	0	0	0	0	0	0	0	0	0	
Woodsfield Reservoir	60	0	0	0	0	0	0	0	5	0	0	0	

[4] For dissolved oxygen, the OMZM (outside mixing zone minimum) criteria (5.0 mg/l) is applied since 24-hour data was not available. Dissolved oxygen criteria apply in the epilimnion of stratified lakes and throughout the water column in unstratified lakes.

[5]WQS 3745-1-35 table 35.5, OMZA 30-day average total ammonia-nitrogen criteria.

[6]Hardness dependent criteria.

NS – Not sampled for those parameters

Table I-5 — Causative and response nutrient targets for Ohio inland lakes by lake type and ecoregion.

Parameter Lake type	Form[7]	Units[8]	Statewide Targets	Ecoregional Targets[9] ECBP	EOLP	HELP	IP	WAP
Chlorophyll a[10] (Response)								
Dugout lakes	T	µg/L	6.0	--	--	--	--	--
Impoundments	T	µg/L	--	14.0	14.0	14.0	14.0	6.2
Natural lakes	T	µg/L	14.0	--	--	--	--	--
Upground reservoirs	T	µg/L	6.0	--	--	--	--	--
Secchi disk transparency[10] (Response)								
Dugout lakes	--	m	2.60	--	--	--	--	--
Impoundments	--	m	--	1.19	1.19	1.19	1.19	2.16
Natural lakes	--	m	1.19	--	--	--	--	--
Upground reservoirs	--	m	2.60	--	--	--	--	--
Phosphorus[10] (Causative)								
Dugout lakes	T	µg/L	18	--	--	--	--	--
Impoundments	T	µg/L	--	34	34	34	34	14
Natural lakes	T	µg/L	34	--	--	--	--	--
Upground reservoirs	T	µg/L	18	--	--	--	--	--
Nitrogen[10] (Causative)								
Dugout lakes	T	µg/L	450	--	--	--	--	--
Impoundments	T	µg/L	--	930	740	930	688	350
Natural lakes	T	µg/L	638	--	--	--	--	--
Upground reservoirs	T	µg/L	1,225	--	--	--	--	--

[7] T = total.
[8] m = meters; mg/L = milligrams per liter (parts per million); µg/L = micrograms per liter (parts per billion); s.u. = standard units.
[9] ECBP stands for Eastern Corn Belt Plains; EOLP stands for Erie/Ontario Lake Plain; HELP stands for Huron/Erie Lake Plains; IP stands for Interior Plateau; and WAP stands for Western Allegheny Plateau.
[10] These targets apply as lake medians from May through October in the epilimnion of stratified lakes and throughout the water column in unstratified lakes.

The nutrient loading concept implies that a relationship exists between the quantity of nutrients entering a water body and its response to that nutrient input (Wetzel 2001). For this report, Ohio EPA will utilize this idea to identify a lake's nutrient status, and to define a benchmark that can be used to develop an action plan when chemical targets are exceeded. The above concept was used as an assessment tool to establish the following aquatic life use target guidelines (Table I-5):

- Response Parameters: Comparison of the median chlorophyll a concentration of the samples collected over the sample period (multiple or single season) to the applicable chlorophyll a targets for the type of lake and ecoregion in which the lake is located. High concentrations of chlorophyll a will often be reflected in a lower secchi depth or transparency reading. These response variables are used to help gauge the system response to nutrient enrichment in lakes. If median chlorophyll a concentration and secchi transparency exceed the applicable targets, these lakes are likely experiencing accelerated eutrophication (enriched) and should be managed as such.
- Causative Parameters: Total phosphorus and total nitrogen are common causative parameters that can cause accelerated nutrient enrichment in lakes. In this IR, Ohio EPA compared median total phosphorus and total nitrogen concentrations in samples collected over the sample period (multiple or single season) to the applicable causative targets for the type of lake and ecoregion in which the lake is located.

Results

Table I-6 describes the assessment status of the Aquatic Life Use designation for 14 lakes sampled by Ohio EPA in 2017-2018 based on the protocol outlined in the previous section.

Table I-6 — Application of the Aquatic Life Assessment Methodology to lakes sampled in 2017-2018.

Response and Causative Nutrient Targets				*Results - Median Values			
Lake/Reservoir	District	Ecoregion9	Lake Type	Chl. a (µg/L)	T-P (µg/L)	T-N (µg/L)	Secchi (m)
Amann Reservoir	CDO	ECBP	DPI	64	143.0	1830	0.5
Amick Reservoir	CDO	ECBP	UP	9.7	18.6	885	1.5
Attwood Reservoir	SEDO	WAP	DPI	21.0	21.0	539	1.0
Barberton Reservoir	NEDO	EOLP	DPI	37.1	54	770	0.8
Bucyrus (Outhwaite) Reservoir	NWDO	ECBP	UP	1.8	5.0	982	3.8
Caesar Creek Reservoir	SWDO	ECBP	DPI	26	22.1	1330	1.1
Defiance Reservoir	NWDO	HELP	UP	34.7	602.0	1450	0.7
Lake Alma	SEDO	WAP	DPI	5.2	9.1	455	2.3
Lake Rupert	SWDO	WAP	DPI	11.7	19.1	440	1.6
Norwalk Memorial Reservoir	NWDO	ECBP	UP	29.8	57.8	1613	0.7
Raccoon Reservoir	NWDO	HELP	UP	2.89	16.0	1230	3.0
Swanton Reservoir	NWDO	HELP	UP	13.7	36.3	3236	1.2
Willard Reservoir	NWDO	ECBP	UP	2.16	10.8	159	5.1
Woodsfield Reservoir	SEDO	WAP	DPI	11.4	20.8	501	2.1

Summary of Findings

Three Ohio reservoirs sampled during the 2017-2018 sampling season experienced D.O. exceedances: Amann Reservoir, Caesar Creek Reservoir and Woodsfield Reservoir (Table I-4). Amann Reservoir is a shallow dammed impoundment that feeds Amicks Reservoir, an upground drinking water source for the city of Galion. Woodsfield Reservoir is also a dammed impoundment used as a water supply for the City of Woodsfield in Eastern Ohio.

Amann Reservoir is enriched and experiences high temperatures during the day. Due to its physical nature and external nutrient inputs, Amann Reservoir likely develops extreme diel D.O. swings during the summer months. Although slightly deeper and more shaded, the same can be said about Woodsfield Reservoir. Algal blooms were observed by Ohio EPA DSW staff at Amann and Woodsfield Reservoirs during the 2017 sampling season.

Caesar Creek is a deep U.S. Army Corps reservoir in southwest Ohio mainly used for flood control but is also utilized as a drinking water source and for recreation. The maximum depth of Caesar Creek Reservoir approaches 100 feet. During the summer sampling period in 2018, the reservoir experienced low D.O. in the epilimnion during 38% of the sampling events. This indicates that anoxia was occurring at the bottom of the reservoir and it was severe enough that it migrated through the metalimnion, affecting available oxygen even in the epilimnion.

Based on the aquatic life assessment methods provided in this IR, Amann, Woodsfield and Caesar Creek Reservoirs are considered *impaired* due to exceedance of the EWH aquatic life D.O. criteria that applies to all waters except for upground reservoirs (Table I-4). None of the upground reservoirs experienced greater than 10% exceedances of WWH D.O. criteria during the 2017-2018 sampling seasons (Table I-3).

Raccoon Creek Reservoir, a drinking water source for the City of Clyde did exhibit a copper exceedance in 30% of the sampling events, likely an indicator of copper sulfate used for algae control. The distribution of the micronutrients (i.e. metals) in lakes is very complex and poorly understood, however ionic concentrations of micronutrients is usually very small in aerated surface waters (Wetzel 2001). Copper exceedances of greater than 10 percent reveal unnatural conditions that could adversely affect aquatic life in Ohio lakes and reservoirs.

Future Rule Development for Inland Lakes in Ohio

U.S. EPA has been working on draft 304(a) lake numeric nutrient criteria based in part on the results from the National Lakes Assessment (NLA) program. Through this study, U.S. EPA has established some ecoregional relationships regarding nutrients, in particular chlorophyll *a*. However, U.S. EPA recognizes the difficulty in assigning a one-size-fits-all approach for nutrient criteria. Currently, states are proceeding with different methods of regulating their lakes with the understanding that U.S. EPA is expected to release a draft proposal of lake nutrient criteria in January 2020. At this time, Ohio EPA would look at the appropriateness of incorporating U.S. EPA's metrics into a new inland lake assessment methodology.

I4. Future Lake Erie Monitoring and Assessment

Ohio EPA recognizes the need to develop a sustainable, long-term plan to monitor Lake Erie, both to support Ohio's water resource and to support assessment of the lake ecosystem objectives identified in the Great Lakes Water Quality Agreement (GLWQA). Long-term monitoring will need to provide data to evaluate water quality trends, assess the effectiveness of remedial and nutrient reduction programs, measure compliance with jurisdictional regulatory programs, identify emerging problems and support implementation of the remedial action plans in Ohio's four Areas of Concern (more information about Areas of Concern is available in Section C1 of this report).

Ohio EPA evaluates the results of the monitoring efforts funded by the Great Lakes Restoration Initiative (GLRI) and other funding sources. Tracking Lake Erie tributary nutrient loads at continuous nutrient load monitoring stations are part of this strategy. These stations are monitored by United States Geological Survey (USGS) and Heidelberg University's National Center for Water Quality Research (Figure I-1 and Figure I-2). With those partners and the Ohio Lake Erie Commission, Ohio EPA developed the Expanded Water Monitoring Report in October 2019 (see ***lakeerie.ohio.gov/LakeEriePlanning/OhioDomesticActionPlan2018.aspx*** to download this report and its supplemental data spreadsheet). This report shows the loading and flow weighted mean concentration results for all tributary monitoring sites back to 2008, where data is available.

Ohio EPA continues to monitor Lake Erie via its monitoring program. Monitoring plans and data summaries can be found on Ohio EPA's webpage (***epa.ohio.gov/dsw/lakeerie/index#125073721-nearshore-monitoring***). Summer chlorophyll concentrations at ambient stations on an annual basis will be one component, as will measuring physical profiles at transect locations used to track hypoxia/anoxia in the hypolimnion of the Central Basin. Mayfly and phytoplankton biological indicator data were included in Ohio EPA's 2019 Lake Erie monitoring, however electrofishing bioindicators (i.e. IBI and MIwb) were not. This is because Ohio EPA is developing new aquatic life use assessment methodology.

In 2020, Ohio EPA will participate in the National Coastal Condition Assessment. This U.S. EPA-organized survey occurs every five years covering the Nation's coastal waters. It addresses two key questions: What percent of the Nation's coastal waters are in good, fair and poor condition for key indicators of water quality, ecological health and recreation? Also, what is the relative importance of key stressors such as nutrients and contaminated sediments. Results for previous surveys are available at the following website: ***epa.gov/national-aquatic-resource-surveys/what-national-coastal-condition-assessment***

For the assessment of algae impacts and attainment of designated uses in relation to algae, Ohio EPA continues to collaborate with universities and other agencies to determine appropriate monitoring locations, frequencies and parameters, as well as how that data collection can be sustained. Researchers from the University of Toledo, Bowling Green State University and The Ohio State University/Stone Laboratory continue to collect supplemental data that Ohio EPA will use to evaluate algae impacts. Algal bloom remote sensed/satellite data as interpreted by the National Oceanic and Atmospheric Administration (NOAA) will also continue to be used by Ohio EPA for assessment purposes, as detailed in Section F.4 of this report.

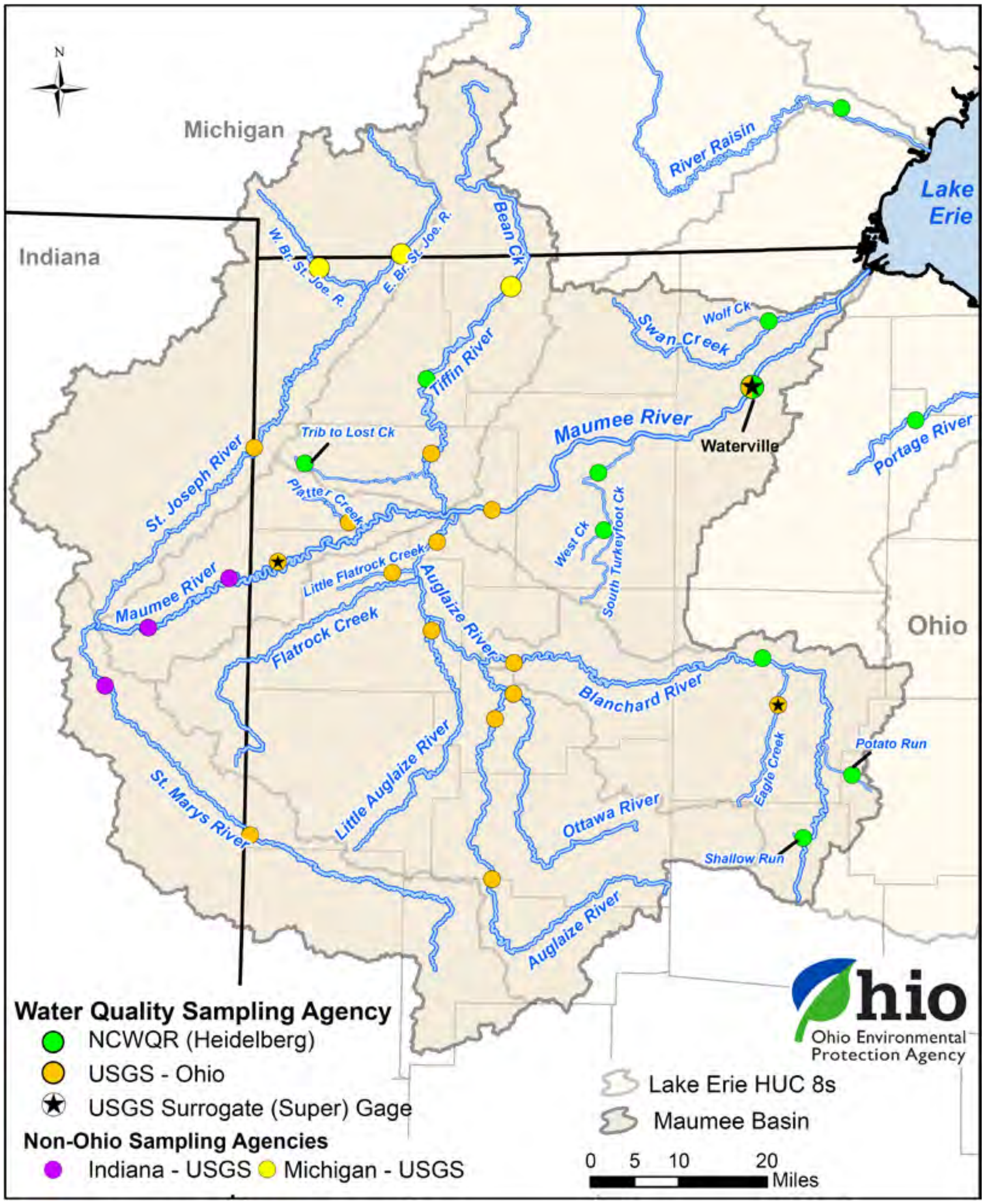

Figure I-1 — Western Lake Erie Basin tributary nutrient load monitoring sites by sampling agency.

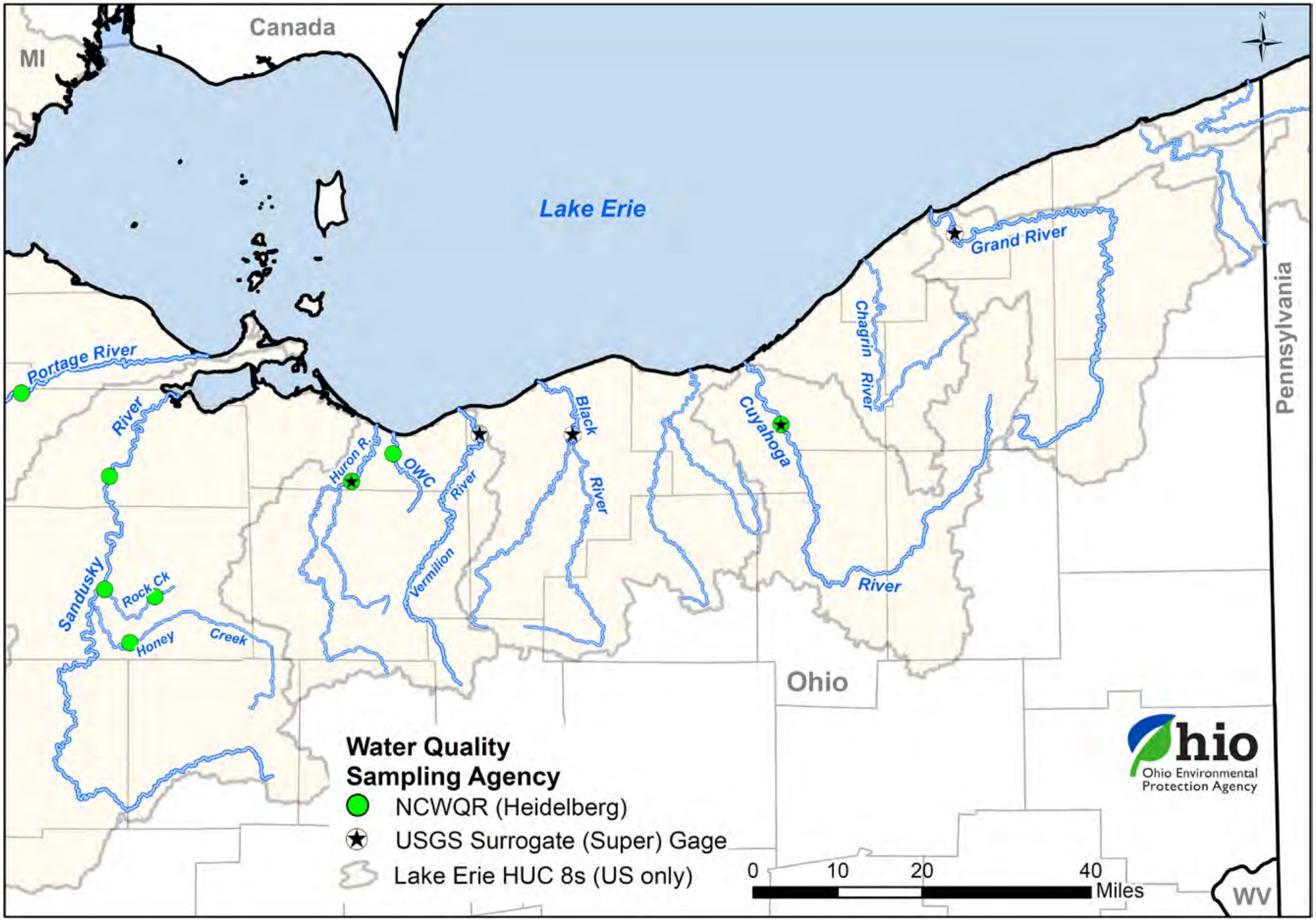

Figure I-2 — Sandusky Bay and Central Lake Erie Basin tributary nutrient load monitoring sites by sampling agency.

Methodology Preview: Lake Erie Aquatic Life Use Assessment Methodology Developments

The Ohio State University's Ohio Sea Grant College Program has agreed to assist Ohio EPA in leading a panel of experts to advise the state on the development of aquatic life use metrics for Lake Erie. This includes developing the state's first set of metrics to be applied to the three open water assessment units and redefining metrics for the four shoreline assessment units. At the publishing of this IR, this effort has just begun.

Section

J

Addressing Waters Not Meeting Water Quality Goals

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The federal Clean Water Act (CWA) requires that states identify waters not meeting water quality goals and then prioritize them for action to restore their beneficial uses[1]. The resulting list of prioritized impaired waters is known as the 303(d) list. Ohio's 2020 303(d) list is available on Ohio EPA's webpage at: ***epa.ohio.gov/dsw/tmdl/OhioIntegratedReport#123145265-2020*** .

Ohio made substantial changes to its listing process in 2010 (see Sections A and J in the *2010 Integrated Report* [Ohio EPA, 2010]); Ohio's *2012 Integrated Report* and 303(d) list (Ohio EPA, 2012) contained relatively few changes compared to the major adjustments made in 2010. A significant change to the 2014 report included the addition of a new indicator (algae) to the public drinking water supply (PDWS) use. The 2016 report contained changes in how the information was organized and what data sets were used (for instance, 2015 data was included for both recreation and PDWS uses) and was amended to include new open water assessment units for Lake Erie and a new recreation assessment methodology based upon algae. In 2018, the most significant changes were to the recreation use assessments and definition of Lake Erie Assessment Units (increased from six to seven units). The assessment based on bacteria was updated to comply with the revised *E. coli* WQS which include a 90-day geometric mean and statistical threshold value (see Sections F1-F3). In addition, an assessment method for recreation based on algae for the western basin of Lake Erie was added in Section F4. The 2020 report marks the first time Ohio EPA is utilizing U.S. EPA's Assessment, Total Maximum Daily Load (TMDL) Tracking and Implementation System (ATTAINS) for report preparation and submittal. The majority of the revisions to the report narrative and format are related to the transition to ATTAINS. Assessment methods for recreation based on algae for the Sandusky and central basin open water and shoreline units are included in Section F4.

This section outlines the listing framework, lays out the prioritizing and delisting processes and results and reports on the status of Ohio total maximum daily load (TMDL) efforts including schedules for future TMDLs in Ohio.

J1. Ohio's 303(d) Listing Framework

The process of listing involves assigning a condition status (a category) for each of four beneficial uses for each assessment unit (AU). Data requirements, descriptions of available data, assessment methodologies and results were discussed and reported by individual beneficial use in Sections E, F, G and H.

In 2010, Ohio modified the five-category listing structure suggested by U.S. EPA to accommodate listing by beneficial use and introduced subcategories to give more information about the status of each water. In 2012, one additional subcategory - t - was added to aid reporting the status of AUs relative to approved TMDLs and data availability. In 2014, the "t" subcategory was altered slightly and a new category - d - was added to better reflect circumstances encountered as Ohio EPA revisits watersheds having approved TMDLs. In 2016, a new subcategory in Category 5 (5-alternative or 5-alt) was added to report on alternative restoration approaches for CWA 303(d) listed waters. Such waters will still require TMDLs until water quality standards are achieved. Ohio does not have any AUs listed under 5-alt in this report but anticipates using this subcategory in the future. In 2018, a new subcategory "p" was added under Category 5 to track which impairments are based on threatened status, primarily for nutrients.

Ohio is modifying state subcategories in 2020 by discontinuing the following: d, h, i, n, p, t, and x. With the transition to ATTAINS, it is apparent the information conveyed by these subcategories is either captured in the database through other means or is no longer useful in reporting out information on water quality. For example, alternative plans required for the use of the category 5-alt are uploaded into ATTAINS and

[1] Beneficial uses include aquatic life, human health (fish contaminants), recreation and public drinking water supply.

associated with the AU, triggering the 5-alt listing. Table J-1 summarizes the categories and subcategories used in this report.

Also, in 2010, Ohio began listing by beneficial use within each AU and reporting on a smaller AU size. Watershed AUs shifted from an average size of 130 square miles to 27 square miles. Under the old system, an impairment of one beneficial use caused the AU to be Category 5 (impaired) regardless of the status of other uses. ATTAINS allows the listing by beneficial use and within each beneficial use, a listing of the specific parameters (or causes) which provides more specific and detailed information regarding AUs.

Table J-1 — Category definitions for the 2020 Integrated Report and 303(d) list.

Category		Subcategory	
1	Use attaining		
2	Available data indicate some uses attaining		
3	Use attainment unknown		
4	Impaired; TMDL not needed	A	TMDL complete
		B	Other required control measures will result in attainment of use
		C	Not a pollutant
5	Impaired; TMDL needed		

J2. Prioritizing the Impaired Waters: the 303(d) List

As previously stated, the impaired waters are identified and assigned a category by individual beneficial use in Sections E, F, G and H. After waters are identified as impaired and it is determined that a TMDL is required, the waters are prioritized to produce the 303(d) list. As part of the transition to ATTAINS, Ohio EPA is modifying how impaired waters are prioritized for TMDL development. This is explained in the Inland Waters subsection below.

Lake Erie Shoreline and Open Waters

Ohio EPA is assigning a high priority to Lake Erie's western basin shoreline, western basin open water, and islands shoreline assessment units for impairments of public drinking water supply and recreation uses due to algae (see Figure J-1 below for a map of Lake Erie's assessment units). Ohio EPA is committed to work diligently with stakeholders in the development of a Maumee Watershed nutrient TMDL to address these impairments in Lake Erie and committed to provide a TMDL deliverable to U.S. EPA within two to three years.

Lake Erie's Sandusky basin shoreline, Sandusky basin open water, and central basin open water assessment units impairments for public drinking water supply use due to algae are assigned a medium priority. Ohio EPA continues to work with researchers to collect additional algae data, and work with the Great Lakes Water Quality Agreement's (GLWQA) Annex 4 – Nutrients team to determine loading influences from the western units and central basin algal bloom dynamics before beginning TMDL efforts.

Lake Erie aquatic life use assessment methodology for the shoreline assessment units is under review and under development for the open water assessment units. Lake-wide metrics are needed before Ohio EPA can proceed with a TMDL. Therefore, a medium priority is assigned to the causes of shoreline impairments.

Lake Erie recreation use assessment for bacteria (*E. coli*) requires additional data collection in the western, Sandusky, and central basin open water assessment units before Ohio EPA can proceed with a use determination and potential TMDL actions. Understanding the scope of this use in the open water units will allow the state to more completely understand this impairment. Therefore, a medium priority is assigned to the shoreline impairments.

Lake Erie human health (fish tissue) use impairment by PCBs is due to legacy contamination and there are few, if any, new sources. The GLWQA's Annex 1 – Areas of Concern (AOC) program, Annex 3 – Chemicals of Mutual Concern, U.S. Army Corps of Engineers and Port Authority dredge management activities include on-going efforts to remove PCBs from the Lake Erie ecosystem. The PCB impairments in all seven Lake Erie assessment units are assigned a medium priority for TMDL development. Ohio EPA may pursue an alternative restoration plan (5-alt plan) to address these impairments.

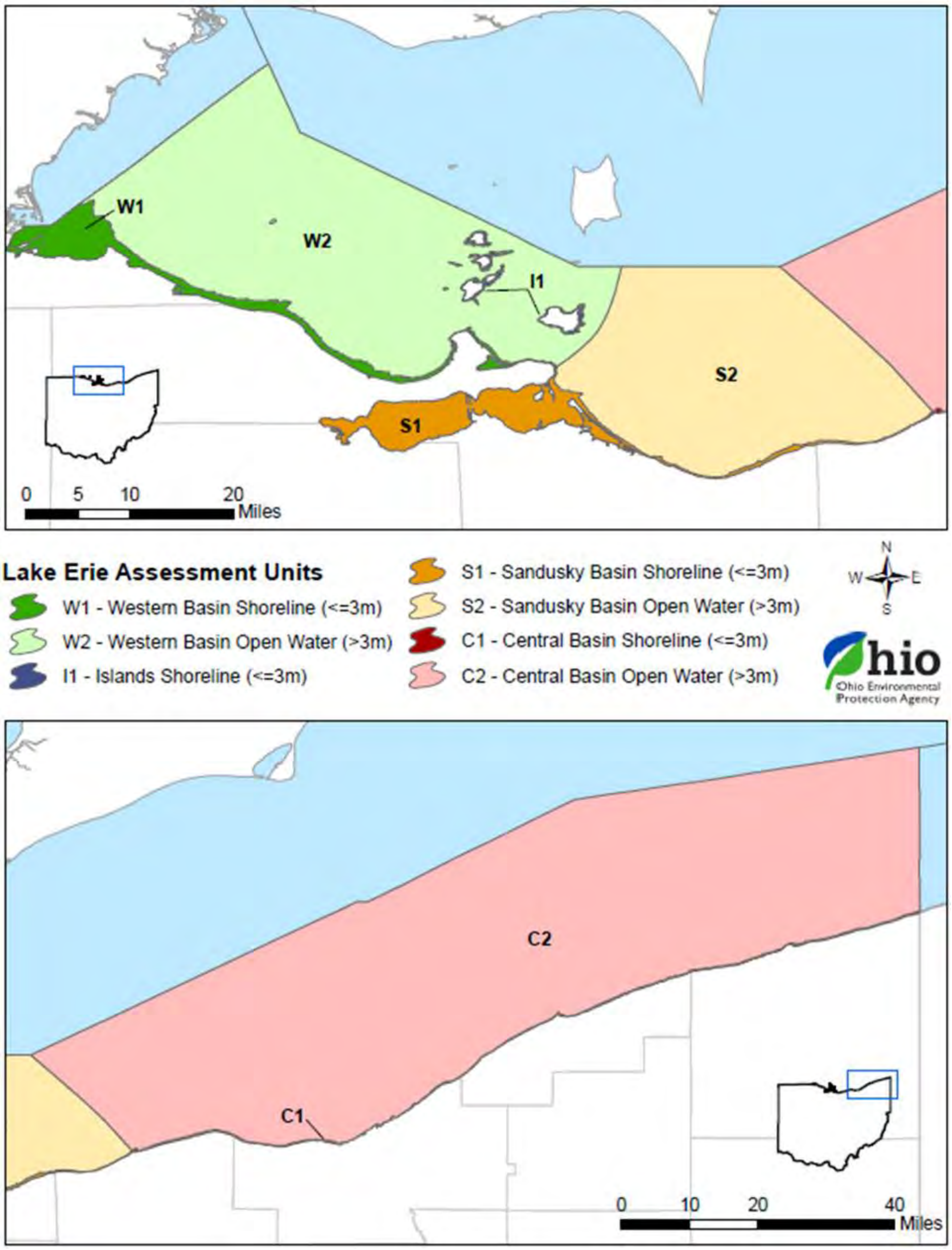

Figure J-1 Map of Lake Erie Assessment Units

Up until now, Ohio has sought to pursue the needed nutrient reductions through the GLWQA. The GLWQA is a commitment between the United States and Canada to restore and protect waters of the Great Lakes. It was first signed in 1972 and updated in 2012. There are ten Annexes to the agreement, each focusing on a specific issue. The focus of Annex 4 is nutrients. Through this Annex, the United States and Canada agreed to:

- By 2016, develop binational substance objectives for phosphorus concentrations, loading targets, and loading allocations for Lake Erie;
- By 2018, develop binational phosphorus reduction strategies and domestic action plans to meet the objectives for phosphorus concentrations and loading targets in Lake Erie;
- Assess, develop, and implement programs to reduce phosphorus loadings from urban, rural, industrial and agricultural sources. This will include proven best management practices, along with new approaches and technologies;
- Identify priority watersheds that contribute significantly to local algae development, and develop and implement management plans to achieve phosphorus load reduction targets and controls; and
- Undertake and share research, monitoring and modeling necessary to establish, report on and assess the management of phosphorus and other nutrients and improve the understanding of relevant issues associated with nutrients and excessive algal blooms. (***binational.net/annexes/a4/***)

Modeling conducted as part of the Annex 4 process has shown that that spring loading of phosphorus from the Maumee River is the determining factor in addressing harmful algal blooms and that there should be a reduction of 40 percent in spring (March-July) loads of both total and dissolved phosphorus from the Maumee River 90% of the time. Using 2008 as a baseline spring loading season, a 40 percent reduction to the Maumee River equates to a target spring load of 860 metric tons per year of total phosphorus and 186 metric tons per year of soluble reactive phosphorus. This goal is intended to limit the formation of harmful algal blooms in nine years out of 10.

While the GLWQA has certain inherent advantages towards ensuring a coordinated approach towards nutrient reduction by all affected Great Lake States and Canada, the State of Ohio recognizes the TMDL requirements under Section 303 of the CWA as another important tool towards addressing the State's water quality goals and that these two efforts do not need to be mutually exclusive. Since our 2018 Integrated Report, Ohio EPA has been working on a methodology to distribute the Annex 4 spring target total phosphorus load from the Maumee River watershed to the smaller watershed level throughout the entire basin. This effort fits together pieces of the puzzle obtained from Annex 4 Objectives and Targets Task Team Final Report, *Recommended Phosphorus Loading Targets for Lake Erie* (2015), Ohio EPA's methodology and assessment of Ohio's Lake Erie western basin for recreation impairment due to algae (2018 Integrated Report), Ohio EPA's *Nutrient Mass Balance Study for Ohio's Major Rivers*, and U.S. EPA's *Methodology for Connecting Annex 4 Water Quality Targets with TMDLs in the Maumee River Basin*. Ohio EPA now has the necessary technical pieces to develop a Maumee Watershed TMDL report.

One key recent initiative that deserves special mention is Governor DeWine's H2Ohio Plan. H2Ohio was unveiled on November 13, 2019 by Ohio Governor Mike DeWine and is a comprehensive, data-driven water quality plan to reduce harmful algal blooms, improve wastewater infrastructure, and prevent lead contamination. The H2Ohio plan aims to achieve a 40% reduction in phosphorus runoff into the Lake Erie basin and is focused in targeted solutions to help reduce phosphorus runoff and prevent algal blooms through:

- increased implementation of agricultural best practices;
- the creation of wetlands;
- improvements in wastewater infrastructure; and
- replacing failing home septic systems.

Under Ohio's 2019 budget bill (HB 166), the Ohio General Assembly authorized $172 million in state funding to support water quality improvements in the Lake Erie basin and other areas of the state under the plan. It is the intent to request additional state funding from the General Assembly in forthcoming budget proposals to support the long-term objectives of H2Ohio in improving water quality in the Lake Erie basin and in other areas of the state.

The H2Ohio plan was developed with input from a broad coalition of agriculture, education, research, conservation, and environmental partners. H2Ohio will be led by the Ohio Department of Agriculture, Ohio Department of Natural Resources, Ohio EPA, and Lake Erie Commission with support from the Ohio Agricultural Conservation Initiative, Ohio Farm Bureau, U.S. Department of Agriculture, and others.

To that end, with the issuance of this draft Integrated Report, Ohio EPA is proposing to move forward with a Maumee Watershed TMDL to reduce excessive phosphorus loadings thereby harmonizing our obligations under the GLWA and the CWA. H2Ohio will serve as a key piece towards efforts to address non-point sources of pollution, which are the predominant source of the phosphorus loadings the Lake Erie from the Maumee Watershed.

Ohio River

Ohio River Valley Water Sanitation Commission (ORSANCO) has lead responsibility for the multi-jurisdictional Ohio River water quality as outlined in Section D2. Ohio EPA is actively participating in TMDLs for tributaries and mainstem sections of the Ohio River. U.S. EPA, ORSANCO and ORSANCO member states are currently working on an Ohio River Bacteria TMDL. Additional information on Ohio River TMDL's can be found on ORSANCO's website at: ***orsanco.org/programs/bacteria-tmdl/*** .

Inland Waters

In previous reports, AUs were assigned priority points via a weighted system for each of the beneficial use designation categories and then summed for total numeric priority points by AU. See Section J2 of the 2018 report for more information. Ohio is now using U.S. EPA's ATTAINS database for inland waters listing. In ATTAINS the term "parameter" replaces what Ohio has traditionally called a "cause" of impairment. ATTAINS requires Ohio to assign a narrative priority value of high, medium or low for each parameter within any beneficial use designation in an AU. Since each parameter receives its own priority, an AU can now have multiple, variable priorities assigned. Utilizing priority in this way clarifies the intent of the exercise, the states are required to assign priority to each pollutant/AU combination for TMDL development.

For the 2020 report, Ohio is assigning TMDL priority to parameters based upon the expected TMDL development schedule for the next two years. The parameters contained within those TMDLs are assigned high priority for those AUs on the schedule. Low priority is assigned to parameters for which TMDL development might not be the most effective tool to address the water quality impairment. For example, legacy contamination being addressed through remediation under the Superfund Program is assigned a low priority. Other parameters are assigned medium priority for TMDL development at this time. Again, this does not have any relevance to the degree of water body impairment or importance as a human health or water quality concern. For the next two years Ohio EPA is dedicated to addressing the TMDL development backlog and may revise priority assignment in future IRs to consider a wider range of considerations in setting TMDL development goals.

Near-Term Priorities for Ohio EPA

Ohio is facing increasing problems with cyanobacteria blooms in inland lakes, including development of HABs in source waters. Many public water systems are experiencing increased treatment costs to manage the extra carbon load and cyanotoxins at their intake. The smaller conventional systems will have difficulty treating water for these problems and the expense will be very high to upgrade those plants.

In the *2014 Integrated Report*, Ohio listed waters impaired by algal toxins for the first time. In the 2016 report, more waters are listed, especially lakes and reservoirs. To emphasize protection of the public drinking water supply beneficial use from HABs, Ohio is making inland lakes used for public water supply a focus for the next several years for improving water quality through TMDLs or other approaches.

Based on a review of the inland lakes or reservoirs that were listed as impaired or on the Watch List for algae indicators in the 2014 Integrated Report, as well as the more recent data collected for algae at PDWS with intakes in inland lakes or reservoirs that led to the 303(d) listing in the 2016 report, the following inland lakes were chosen as Ohio's priorities for the next few years:

- Tappan Lake in Harrison county (upper Little Stillwater Creek)
- W.H. Harsha Lake in Clermont County (Lucy Run - East Fork Little Miami River)
- Clyde/Beaver Creek Reservoir in Seneca County (Beaver Creek, Green Creek)

The impairments (or watch list parameters) cited include nitrate, pesticides and algae indicators. Where there is a TMDL developed, it is older and/or does not include the stream reaches that most impact the lake/reservoir. In most cases, there are active local parties interested and/or there is a sizable population served by these sources. Ohio EPA considers reducing nutrients causing eutrophication (primarily phosphorus as the TMDL parameter) to be the priority for the inland lake efforts. However, the cause of impairment in more than one area also includes pesticides and/or nitrates, so other pollutants may be added to the TMDL or alternative plan. These waters were listed on the 303(d) Priority list in Section L4 of the 2018 report as follows (greater the priority point values means greater the priority):

			2018 IR Category				
AU Number	AU Name	Sq. Mi. in Ohio	Human Health	Recreation	Aquatic Life	PDW Supply	Priority Points
05040001 15 03	Upper Little Stillwater Creek	29.72	1	1	3	5	5
05090202 12 03	Lucy Run-East Fork Little Miami River	32.48	1	1	5	5	7
04100011 12 02	Beaver Creek	29.3	3i	4Ah	4A	5	5
04100011 12 03	Green Creek	30.78	1	5	4A	5	9

While these AUs did not have the highest priority points, the AUs with higher priority points that included a PDWS impairment already had a TMDL under development or were likely to be addressed through other means such as the Great Lakes Water Quality Agreement Annex 4 nutrient reduction efforts discussed in J3.

Tappan Lake

The following outlines key features of Tappan Lake:

- Stillwater Creek basin – primarily forest with mining influences.
- 2,350 acres of water surface.
- Provides drinking water to the Village of Cadiz (pop. ~ 3,350).
- Lake is operated by the U.S. Army Corp of Engineers. It is a multipurpose project for flood reduction, recreation and fish and wildlife enhancement.
- Assessed by Ohio EPA in 2012-2013 and did not meet the draft lake habitat use criteria.
- *2014 Integrated Report* listed the lake as impaired for PDWS based on algae indicators (microcystin).
- Figure J-2 shows a map of the lake's watershed that includes its stream assessment sites.

2018 IR Update

The Tappan Lake Nutrient Reduction Initiative (TLNRI) was formed at the end of 2017 by the Muskingum Watershed Conservancy District and the Village of Cadiz. TLNRI's goal is to eliminate the presence of harmful algal blooms and their resultant water-borne toxins in Tappan Lake within the next decade. The TLNRI has outlined the following steps toward achieving their goal:

- Phase 1: Comprehensive study of existing water quality data for the watershed and identification of gaps (year one)
- Phase 2: Collection of data to fill gaps, evaluation and selection of remedial actions for the watershed (years two through four)
- Phase 3: Implementation of action plan for the watershed (years five through 10)

Ohio EPA is an active partner in the initiative and will provide support through participation in the four subgroups. The Stillwater Creek watershed is a high priority project for either a TMDL or an alternative plan. The Agency will continue to participate in the TLNRI efforts and determine which approach is most appropriate as that work unfolds.

2020 IR Update

Phase 1 of the TLNRI has been completed. Existing water quality data for the watershed are available on the following webpage for review and analysis: ***watersheddata.com/map/map.aspx?WaterShed=TL1***. The TLNRI is currently in phase 2.

In addition, Ohio EPA has completed step three in the TMDL development process for the Stillwater Creek watershed. The draft Loading Analysis Plan (LAP) was released for public comment on October 22, 2019. The final LAP is available here: ***epa.ohio.gov/dsw/tmdl/MuskingumRiver#120886319-supplemental-information***. Although the LAP does not address impairments in Tappan Lake, it does provide a road map to addressing water quality impairments in the upstream watershed. Ohio EPA's Division of Surface Water and Division of Drinking and Ground Waters are collaborating to determine if the Village of Cadiz's source water protection plan and harmful algal bloom cyanotoxin general plan can be the foundation for an alternative restoration plan and meet the requirements of U.S. EPA's Category 5-alt guidance.

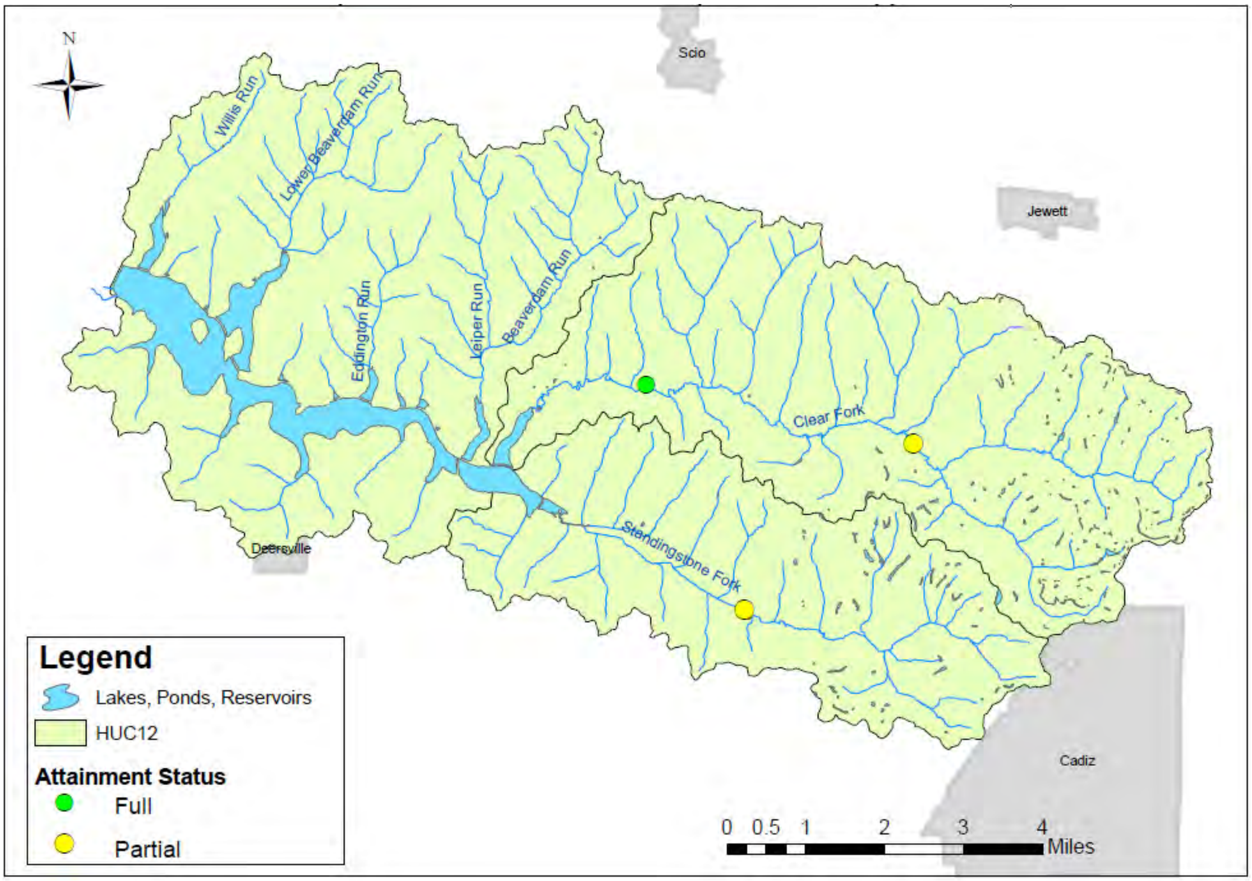

Figure J-2 — Watershed upstream from Tappan Lake and attainment status of sites from 2012 Stillwater River survey.

William H. Harsha Lake

The following outlines key features of Harsha Lake:

- Located in the East Fork of the Little Miami River watershed – largely agriculture and forest with some urban influence.
- 2,160 acres of water surface.
- Lake is operated by the U.S. Army Corp of Engineers and is a multipurpose project for flood reduction, water supply, recreation and wildlife habitat.
- *2014 Integrated Report* listed the lake as impaired for PDWS based on algae indicators (microcystin) and placed it on the watch list for atrazine.
- Figure J-3 shows a map of the lake's watershed that includes its stream assessment sites.

From the *Ohio EPA East Fork Little Miami River Technical Support Document, 2014*:

- Clermont County operates a community public water system that serves a population of approximately 117,097 people. The water supply sells water to the village of Batavia, village of Williamsburg and New Richmond Robin-Grays water system. Clermont County operates two ground water plants and one surface water plant. The BMW surface water plant draws water from an intake structure on Harsha (East Fork) Lake. The system's treatment capacity is approximately 27.5 million gallons per day, but current average production is 12.5 million gallons per day.
- There are several environmental organizations active in the East Fork Little Miami River watershed. The oldest of these is Little Miami Incorporated (LMI) which has been active for 45

years. Most of LMI's activities have involved the purchase of conservation easements or property purchases in the riparian zone of the river. Clermont County and SWCDs in Clermont, Brown, Highland and Clinton counties formed the East Fork Watershed Collaborative to take advantage of ODNR's Watershed Coordinator Program.

- Several research projects have been initiated in the East Fork watershed and Harsha Lake by U.S. EPA's National Exposure Research Laboratory in Cincinnati and the U. S. Army Corps of Engineers. Among other topics research and monitoring are examining HABs and nutrients, impacts on the Clermont County water intake, carbon sequestration, methane release, nutrient trading, environmental tipping points and fish population genetics. Currently, seven different projects are conducting monitoring in Harsha Lake.

2018 IR Update

The East Fork Watershed Cooperative, formed in 2001, continues to be active in addressing water quality issues in the East Fork Little Miami River watershed. The Cooperative is in the process of updating watershed action plans into Nine Element Nonpoint Source Implementation Strategy Plans. The first updated plan for the Fivemile Creek HUC 12, approved by Ohio EPA on July 31, 2017, is located upstream of Harsha Lake. The East Fork Little Miami River watershed is a high priority TMDL project for TMDL development. The Agency plans to initiate the next steps in the TMDL development process by the 2020 IR.

2020 IR Update

Ohio EPA is in the process of drafting step three in the TMDL development process for the East Fork Little Miami River watershed and Harsha Lake. The plan will be available here:
epa.ohio.gov/dsw/tmdl/LittleMiamiRiver#118225928-supplemental-information

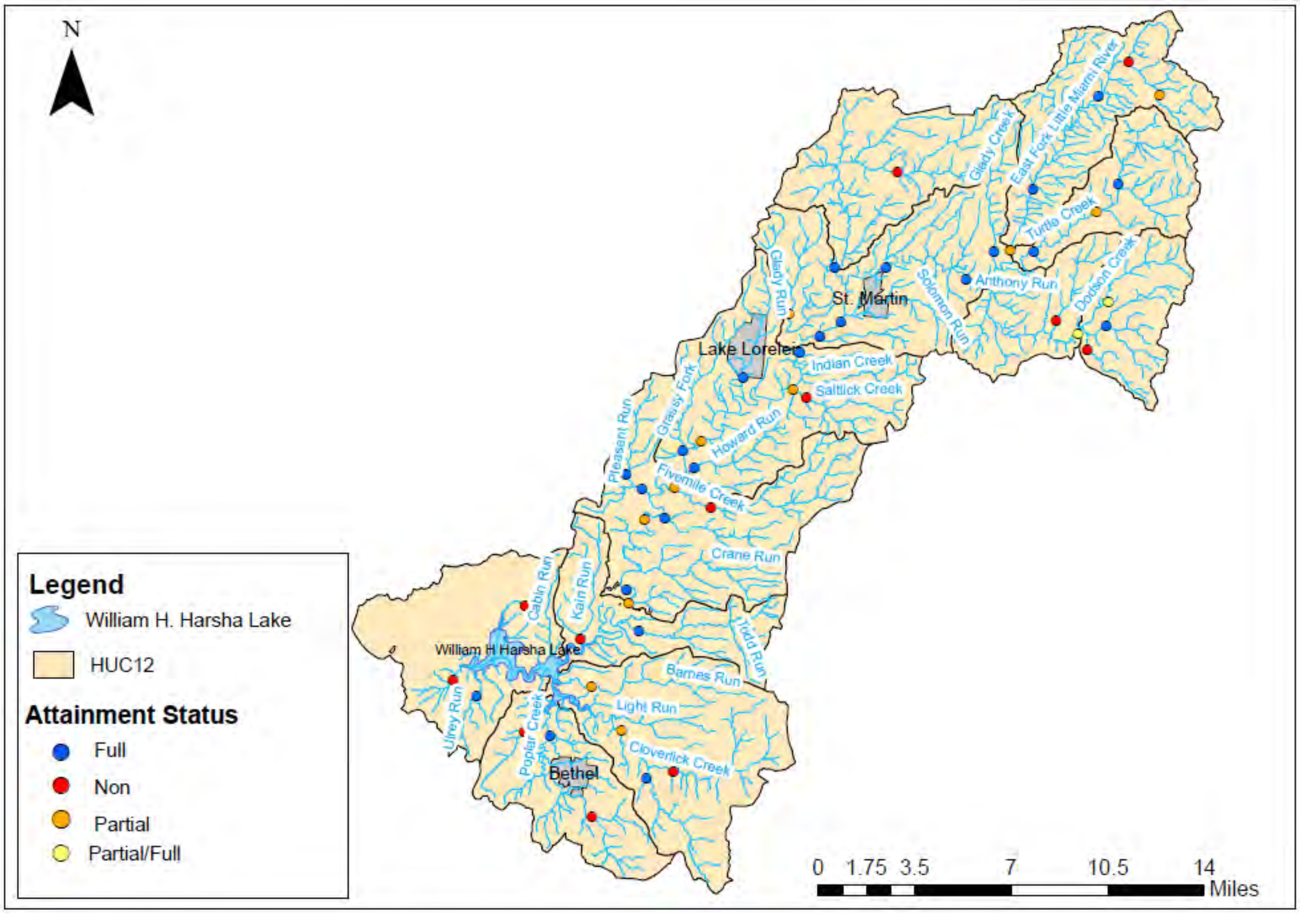

Figure J-3 — Watershed upstream from Harsha Lake and the attainment status of sites from the 2012 East Fork Little Miami River survey.

Clyde/Beaver Creek Reservoir (up-ground)

The following outlines key features of Clyde/Beaver Creek Reservoir:

- Sandusky river watershed - primarily agricultural land use above reservoir.
- 110 acres of water surface.
- Provides drinking water to the City of Clyde (pop. ~6,320).
- Reservoir was assessed by Ohio EPA in 2009-2010 and did not meet the draft lake habitat use criteria.
- *2014 Integrated Report* placed the lake on the watch list for PDWS use based on algae indicators (microcystin) and nitrates. In the *2016 Integrated Report* it was listed as impaired for PDWS use based on algae indicators.
- The Raccoon Creek reservoir that also serves the City of Clyde is filled with water from Beaver Creek. The Raccoon creek reservoir was listed in the 2014 IR as impaired for PDWS based on algae indicators (microcystin).
- A TMDL for the lower Sandusky River was completed by Ohio EPA and approved by U.S. EPA but did not set specific loads for Beaver Creek since the stream was not listed as impaired.
- Figure J-4 shows a map of the reservoir's watershed that includes its stream assessment sites.

2018 IR Update

Sampling of Raccoon Creek reservoir was completed in 2016 and 2017 as part of Ohio EPA's inland lakes sampling program. The results of this sampling will be included in the 2020 IR and will be used to direct the next steps in the restoration process for this watershed.

2020 IR Update

The results of Raccoon Creek reservoir sampling can be found in Section I.3 of this report. Since June 2016, all of the City of Clyde public water supply compliance microcystins data have been non-detect at the raw and finished water sample points.

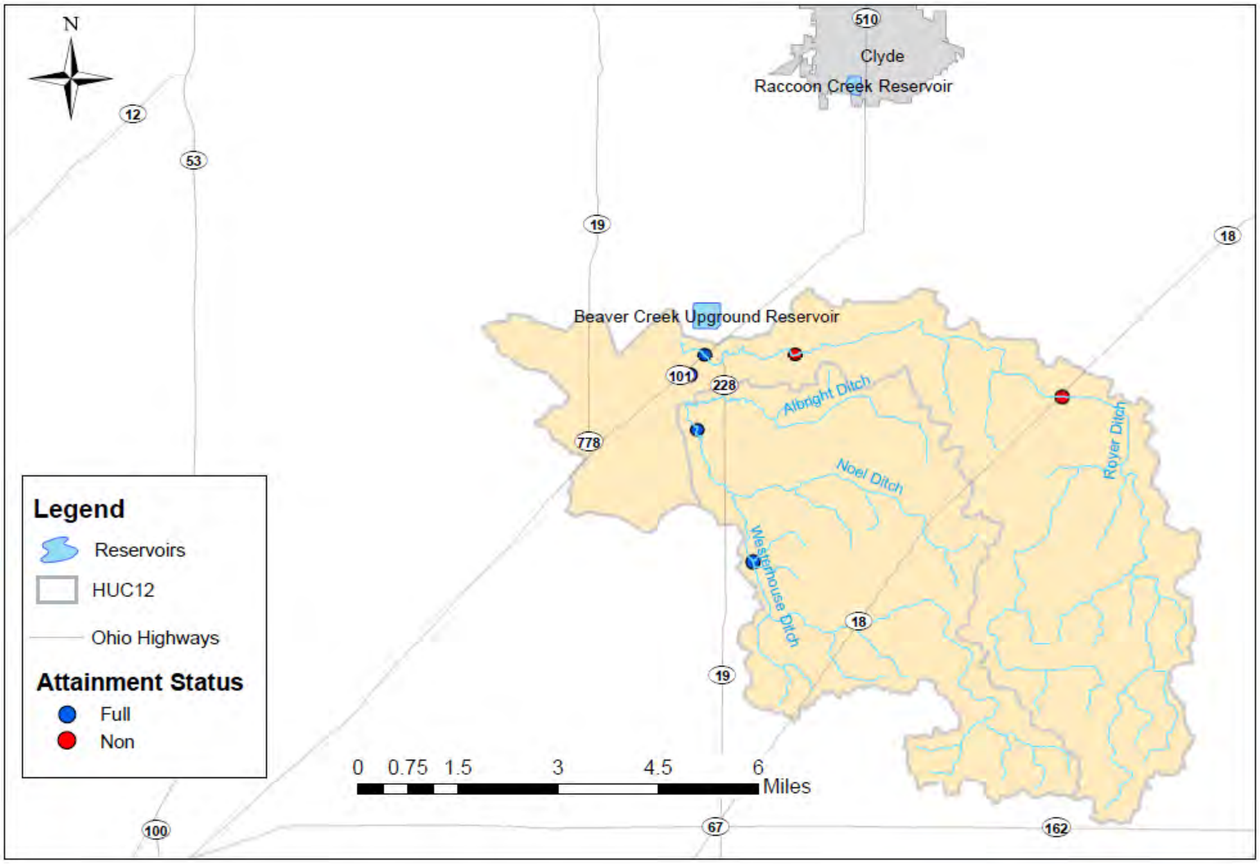

Figure J-4 — Watershed contributing to Beaver Creek Reservoir and the attainment status of sites sampled in 2009.

J3. Addressing Nutrients in Lake Erie

Currently, there are many parallel planning and management efforts ongoing at the state, federal and binational level addressing nutrient delivery reduction to Lake Erie. Effective lake management and coordinated implementation are needed to address the Western Basin of Lake Erie algal blooms and the Central Basin hypoxia issues, requiring a multi-state and binational effort.

In addition to the Maumee Watershed TMDL and H2Ohio Plan implementation discussed in Section J2 above, Ohio will continue to work to address its contribution to the problems in Lake Erie through activities including:

- GLWQA efforts, including Annex 4 - Nutrients
- Ohio Domestic Action Plan
- TMDLs for Lake Erie Watershed

Great Lakes Water Quality Agreement

Binationally, the U.S. and Canada are working together under the GLWQA to develop nutrient reduction strategies; and create and implement action plans to meet the targets. Annex 4 of the 2012 GLWQA specifically addresses nutrients in the Great Lakes and contains short-term requirements specific for Lake Erie. The U.S. and Canada formally adopted new phosphorus targets for the western and central basins of Lake Erie in February 2016. These targets have been incorporated into Ohio's Domestic Action Plan and are the goals for all the state's efforts to reduce phosphorus loading to the lake.

Annex 2 of the GLWQA provides the framework for long-term binational management of the lake. A comprehensive LAMP has been developed for Lake Erie and is the binational platform where whole lake management plans are developed, implemented and tracked. Ohio is a key partner in the binational partnership. For example, Annex 2 calls for creation of a new nearshore framework and the binational partnership will be responsible for implementing the framework and reporting on progress. It is also expected that the nutrient targets from Annex 4 will be incorporated in the next version of the lake-wide management plans. Working through the binational partnership is critical for developing a coordinated approach with consistent reporting across the borders.

Ohio's Domestic Action Plan for Lake Erie

The State of Ohio's Domestic Action Plan expanded upon the *Collaborative Implementation Plan* (see below) and was submitted to U.S. EPA on Feb. 7, 2018. The commitment to meet the Collaborative Agreement phosphorus reduction goals of 20 percent by 2020 and 40 percent by 2025 was also incorporated into this plan. The plan is not intended to static but to be revised following the adaptive management philosophy. An updated DAP version 1.1 was submitted to U.S. EPA on August 31, 2018. The State is currently working on another update with a draft released for public comment in January 2020. New action items included in the draft focus on:

- Establishing science-based priorities for agricultural best management practices and state programs to support H2Ohio efforts to encourage farmers to implement scientifically backed best practices;
- The importance of wetland restoration and outlining ODNR efforts to create, restore, and enhance wetlands for nutrient reduction as part of H2Ohio;
- Updated actions for communities including H2Ohio support for home sewage treatment system remediation;
- Integrating the role of watershed planning at the local level for siting projects to reduce nutrients efficiently, including a distribution of the load reduction throughout the Maumee River watershed based on an augmentation to Ohio EPA's Nutrient Mass Balance method (***lakeerie.ohio.gov/LakeEriePlanning/OhioDomesticActionPlan2018.aspx***).

Lake Erie Collaborative Agreement

The Lake Erie Collaborative Agreement was another state/province led-initiative; it was signed in June 2015 by Ohio, Michigan and Ontario (***cglslgp.org/media/1590/western-basin-of-lake-erie-collaborative-agreement-6-13-15.pdf***). The three parties in the agreement are supportive of the binational Annex 4 effort but recognize that immediate actions can be implemented at the state and provincial levels. In order to get a head start on the Annex 4 process and hasten efforts to improve water quality in Lake Erie, Ohio released a draft *Collaborative Implementation Plan* in June 2016. One of the goals spelled out in the Collaborative Agreement was to reduce nutrient levels going into Lake Erie by 40 percent. The other was to develop a strategic plan to manage dredge material to ensure it complies with the state's commitment to stop open lake disposal of dredge material into Lake Erie by 2020. The GLWQA does not contain timeframes for implementation and restoration goals, but Ohio is working to meet the Collaborative Agreement phosphorus reduction goals of 20 percent by 2020 and 40 percent by 2025.

TMDLs for Lake Erie Watershed

TMDLs are conducted by the state or federal governments as required under the CWA for waters that have been formally identified as impaired. TMDLs use monitoring and modeling to identify where load reductions and restoration actions are needed. Ohio EPA plans to continue utilizing this tool to target implementation in Ohio's Lake Erie watersheds.

Ohio has completed TMDL reports for 22 of 32 project areas (watersheds) draining to Lake Erie and work on the remaining 10 watersheds is underway by Ohio EPA. All of these TMDLs employ the State's narrative water quality (WQ) criteria for nutrients and algae and have established phosphorus targets and methods to address near-field impacts on rivers and streams.

Throughout 2017 and 2018, Ohio worked with U.S. EPA, Tetratech (a contractor), Indiana and Michigan to develop a method for setting load reduction goals for the smaller tributaries to Lake Erie (for example, the tributaries to the Maumee river) and evaluate whether the tributary TMDLs will provide the load reductions needed to protect the lake. This project identified that local, near-field nutrient TMDLs do limit nutrients, however just for specific localized impaired areas. Since these TMDLs were only developed to address the near-field impairments, allocating for additional nutrient reductions to address Lake Erie's algal blooms were outside the scope of these projects. The report concluded that the near-field impairments (and TMDLs) were not abundant enough to meet Lake Erie's nutrient reduction goals. The project's report did suggest Maumee River sub-basin targets that sum up to meet the Annex 4 loading goals (***epa.gov/tmdl/methodology-connecting-annex-4-water-quality-targets-tmdls-maumee-river-basin***). Some results from this project have been used for the 2020 draft Domestic Action Plan's load reduction distribution work and will be used to help develop the methods of Ohio EPA's Maumee Watershed TMDL as mentioned above in Section J2.

Ohio-based Nutrient Reduction Efforts

Recognizing that Ohio's watersheds provide a significant amount of nutrients to Lake Erie and that its communities are bearing the brunt of algal bloom impacts, Ohio launched a series of initiatives at the state level beginning in 2010 and has expanded the scope and scale of implementation, developed a statewide strategy, targeted funding and undertaken legislative action to address the problem. Most recently, as noted in Section J2 above, Governor Mike DeWine unveiled the H2Ohio Plan, a comprehensive, data-driven water quality plan to reduce harmful algal blooms, improve wastewater infrastructure, and prevent lead contamination. Under Ohio House Bill 166, the Ohio General Assembly authorized $172 million to support water quality improvements in the Lake Erie basin and other areas of the state. Initial funding for best management practices to prevent nutrient runoff from farms will be in the Maumee River watershed.

As part of the more than $3 billion Ohio has previously invested comprehensively in the Lake Erie watershed, more than $150 million was made available starting in 2014 to help to public water systems keep drinking water safe and wastewater facilities reduce the amount of phosphorus they discharge into the Lake Erie watershed. In addition, Ohio targeted millions of dollars to support local health departments to find and fix faulty residential septic systems that are contributing nutrients to Ohio waters.

The following is a list of several state-led and statewide water quality improvement activities previously identified in past Integrated Reports.

- GLRI Demonstration and Nutrient Reduction Projects — For example, nine grants totaling more than $13.9 million were awarded to Ohio. Highlights include: installation of the first two saturated buffers installed in Ohio; installation of approximately 70 controlled drainage structures; development of 52 whole farm conservation plans; planting of more than 9,000 acres of cover crops; installation and planting of 50 acres of reconstructed or restored wetlands; restoration of 3,500 linear feet of stream and 500 feet of streambank stabilization; installation of 4,400 feet of two-stage ditches; installation of rain gardens and vegetated infiltration basins in the Toledo area; and completion of 29 storm water, wetland and stream restoration projects in Cuyahoga County.
- Ohio Clean Lakes Initiative — The Ohio General Assembly provided more than $3.5 million for projects to reduce nutrient runoff in the Western Lake Erie Basin.
- Healthy Lake Erie Initiative — The Ohio General Assembly provided $10 million to the Healthy Lake Erie Initiative to reduce the open lake placement of dredge material into Lake Erie. These sediments often contain high levels of nutrients or other contaminants so finding alternative use or disposal options is a priority.
- Ohio EPA's *NPS Management Plan* - Agency's guiding document that outlines recommended strategies, goals and objectives for controlling nonpoint sources of water quality impairment. The Plan was most recently updated in 2014 and identifies specific management activities to be implemented by Ohio EPA's NPS management program. The most current version of Ohio's *NPS Management Plan* is available at ***epa.ohio.gov/Portals/35/nps/NPS_Mgmt_Plan.pdf***.
- Statewide Nutrient Reduction Strategy — Ohio's environmental, agricultural and natural resource agencies worked together to create a statewide strategy to reduce nutrient loading to streams and lakes, including Lake Erie. The strategy was submitted to U.S. EPA Region 5 in 2013. Ohio EPA updated the strategy in 2015 to address gaps identified through U.S. EPA's review. The strategy and more information about the effort are available at ***epa.ohio.gov/dsw/wqs/NutrientReduction.aspx***.
- Ohio Senate Bill 1 — This bill, effective July 3, 2015, requires major public-owned treatment works (POTWs) to conduct technical and financial capability studies to achieve 1.0 mg/L total phosphorus; establishes regulations for fertilizer or manure application for persons in the western basin[2]; designates the director of Ohio EPA as coordinator of harmful algae management and response and requires the director to implement actions that protect against cyanobacteria in the western basin and public water supplies; prohibits the director of Ohio EPA from issuing permits for sludge management that allow placement of sewage sludge on frozen ground; and prohibits the deposit of dredged material in Lake Erie on or after July 1, 2020, with some exceptions.
- Ohio Senate Bill 150 — This bill, effective Aug. 21, 2014, requires, among other things, that beginning Sept. 31, 2017, fertilizer applicators must be certified and educated on the handling and application of fertilizer; and authorizes a person who owns or operates agricultural land to develop a voluntary nutrient management plan or request that one be developed for him or her.
- Ohio HB 64 — This bill, effective June 30, 2015, required the development of a biennial report by spring 2016 on mass loading of nutrients delivered to Lake Erie and the Ohio River from Ohio's

[2] "Western basin" is defined in this Senate Bill as consisting of the following 11 watersheds: Ottawa watershed, HUC 04100001; River Raisin watershed, HUC 04100002; St. Joseph watershed, HUC 04100003; St. Mary's watershed, HUC 04100004; Upper Maumee watershed, HUC 04100005; Tiffin watershed, HUC 04100006; Auglaize watershed, HUC 04100007; Blanchard watershed, HUC 04100008; Lower Maumee watershed, HUC 04100009; Cedar-Portage watershed, HUC 04100010; and Sandusky watershed, HUC 04100011.

point and nonpoint sources. A summary of the bill is available at ***legislature.ohio.gov/legislation/legislation-summary?id=GA131-HB-64***.

- Directors' Agricultural Nutrients and Water Quality Working Group — This is a collaborative working group that consists of participants from Ohio EPA, ODA and ODNR. The group's report contains several recommendations to be implemented during the next several years. For example, the report recommends ways for farmers to better manage fertilizers and animal manure and provides the state with the means to assist farmers in the development of nutrient management plans and to exert more regulatory authority over the farmers who are not following the rules. The report is available at ***agri.ohio.gov/topnews/waterquality/docs/FINAL_REPORT_03-09-12.pdf***.
- Ohio Lake Erie Phosphorus Task Force Phase 2 — The Task Force, which includes participants from Ohio EPA, ODA and ODNR, originally met back in 2009 and was brought back together in 2012 to build on its previous work and make recommendations for improving water quality in the Lake Erie watershed. The taskforce finalized the latest report in 2014 and it is available at ***lakeerie.ohio.gov/Portals/0/Reports/Task_Force_Report_October_2013.pdf***.
- Ohio Point Source and Urban Runoff Workgroup — Businesses, municipalities and Ohio EPA came together to initiate the Point Source and Urban Runoff Workgroup in 2012 to identify actions that can be taken immediately to reduce phosphorus loadings from WWTPs, industrial discharges and urban storm water. The group's full report is available at ***epa.ohio.gov/portals/35/documents/point_source_workgroup_report.pdf***.

J4. Summary of Results

The consolidated results of the 2020 analysis are shown in Table J-2 and Table J-3.

Table J-2 — Summary of results for human health, recreation and public drinking water supply beneficial uses

	Human Health (fish tissue)	Recreation	Public Drinking Water Supply
Not being used for PDWS	-	-	1435
Attains	242	159	32
Insufficient information	56	38	35
Not assessed	810	170	-
Impaired	430	1171	36
Total watersheds considered	**1538**	**1538**	**1538**
Not being used for PDWS	-	-	29
Attains	6	3	0
Insufficient information	0	1	
Not assessed	0	2	4
Impaired	32	32	5
Total large rivers considered	**38**	**38**	**38**
Not being used for PDWS	-	-	1
Attains	0	0	0
Insufficient information	0	0	
Not assessed	0	2	0
Impaired	7	5	6
Total Lake Erie considered	**7**	**7**	**7**

Table J-3 — Summary of results for aquatic life beneficial use

Aquatic Life Use	Attains	Insufficient Information	Not assessed	Impaired
Watershed Assessment Units				
Warmwater Habitat	437	21	71	818
Exceptional Warmwater Habitat	151	2	12	92
Modified Warmwater Habitat – Channel Modification	83	6	1	95
Modified Warmwater Habitat – Mine Effected	3			6
Modified Warmwater Habitat - Impounded	4			3
Limited Resource Waters	11	1	4	30
Coldwater Habitat	130	2	1	35
Exceptional Warmwater Habitat/Coldwater Habitat	53		1	8
Warmwater Habitat/Coldwater Habitat				2
Warmwater Habitat/Seasonal Salmonid Habitat				1
Seasonal Salmonid Habitat	1			
Large River Assessment Units				
Warmwater Habitat	12			18
Exceptional Warmwater Habitat	9			5
Modified Warmwater Habitat - Impounded	3			2
Limited Resource Waters	1			
Seasonal Salmonid Habitat	1			
Lake Erie Assessment Units				
Exceptional Warmwater Habitat			3	4

J5. Changes for the 2020 303(d) List

Federal regulations require a demonstration of good cause for not including water bodies on the Section 303(d) list that were included on previous 303(d) lists (40 CFR 130.7(b)(6)(iv)). Over time, U.S. EPA has modified the wording of reasons for delisting in guidance (U.S. EPA 2005, 2006, 2009, 2011, 2013) to be used in preparing this report. Ohio is delisting 343 parameters based on one of these reasons:

- Applicable WQS attained, due to restoration activities
- Applicable WQS attained; based on new data
- Applicable WQS attained; original basis for listing was incorrect
- Clarification of listing cause
- Not caused by a pollutant (4c)
- Not specified

Table J-4 summarizes the parameters removed from the 2020 303(d) list.

Table J-4 — Parameters delisted and delisting reason

Assessment Unit	Assessment Unit Name	Parameter Name	Delisting Reason
OH041000010308	Sibley Creek-Ottawa River	Habitat alterations	Not caused by a pollutant (4c)
OH041000030301	Nettle Creek	Habitat alterations	Not caused by a pollutant (4c)
OH041000030303	Eagle Creek	Habitat alterations	Not caused by a pollutant (4c)
OH041000040102	Center Branch	Habitat alterations	Not caused by a pollutant (4c)
OH041000040103	East Branch	Habitat alterations	Not caused by a pollutant (4c)
OH041000040104	Kopp Creek	Habitat alterations	Not caused by a pollutant (4c)
OH041000040106	Fourmile Creek-Saint Marys River	Habitat alterations	Not caused by a pollutant (4c)
OH041000040202	Eightmile Creek	Flow regime modification	Applicable WQS attained; original basis for listing was incorrect

Assessment Unit	Assessment Unit Name	Parameter Name	Delisting Reason
OH041000040204	Twelvemile Creek	Alteration in stream-side or littoral vegetative covers	Not caused by a pollutant (4c)
OH041000040301	Little Black Creek	Alteration in stream-side or littoral vegetative covers	Not caused by a pollutant (4c)
OH041000040303	Yankee Run-Saint Marys River	Alteration in stream-side or littoral vegetative covers	Not caused by a pollutant (4c)
OH041000050204	Gordon Creek	Habitat alterations	Not caused by a pollutant (4c)
OH041000050208	Snooks Run-Maumee River	Flow regime modification	Applicable WQS attained; original basis for listing was incorrect
OH041000060204	Mill Creek	Fish passage barrier	Not caused by a pollutant (4c)
OH041000070102	Blackhoof Creek	Habitat alterations	Not caused by a pollutant (4c)
OH041000070105	Dry Run-Auglaize River	Habitat alterations	Not caused by a pollutant (4c)
OH041000070306	Lima Reservoir-Ottawa River	Other anthropogenic substrate alterations	Not caused by a pollutant (4c)
OH041000070306	Lima Reservoir-Ottawa River	Habitat alterations	Not caused by a pollutant (4c)
OH041000070402	Dug Run-Ottawa River	Fish passage barrier	Not caused by a pollutant (4c)
OH041000071205	Wildcat Creek-Flatrock Creek	Habitat alterations	Not caused by a pollutant (4c)
OH041000071207	Little Flatrock Creek	Habitat alterations	Not caused by a pollutant (4c)
OH041000090701	Ai Creek	Habitat alterations	Applicable WQS attained; based on new data
OH041000090701	Ai Creek	Nitrate/nitrite (nitrite + nitrate as N)	Applicable WQS attained; based on new data
OH041000090701	Ai Creek	Phosphorus, total	Applicable WQS attained; based on new data
OH041000090702	Fewless Creek-Swan Creek	Physical substrate habitat alterations	Applicable WQS attained; based on new data
OH041000090702	Fewless Creek-Swan Creek	Sulfate	Applicable WQS attained; based on new data
OH041000090702	Fewless Creek-Swan Creek	Habitat alterations	Applicable WQS attained; based on new data
OH041000090702	Fewless Creek-Swan Creek	Nitrate/nitrite (nitrite + nitrate as N)	Applicable WQS attained; based on new data
OH041000090703	Gale Run-Swan Creek	Habitat alterations	Applicable WQS attained; based on new data
OH041000090703	Gale Run-Swan Creek	Nitrate/nitrite (nitrite + nitrate as N)	Applicable WQS attained; based on new data
OH041000090703	Gale Run-Swan Creek	Sedimentation/siltation	Applicable WQS attained; based on new data
OH041000090802	Lower Blue Creek	Aluminum	Applicable WQS attained; based on new data
OH041000090802	Lower Blue Creek	Chromium in sediment	Applicable WQS attained; based on new data
OH041000090802	Lower Blue Creek	Copper in sediment	Not specified
OH041000090802	Lower Blue Creek	Habitat alterations	Not specified
OH041000090802	Lower Blue Creek	Mercury in sediment	Applicable WQS attained; based on new data
OH041000090802	Lower Blue Creek	Nitrate/nitrite (nitrite + nitrate as N)	Applicable WQS attained; based on new data

Assessment Unit	Assessment Unit Name	Parameter Name	Delisting Reason
OH041000090802	Lower Blue Creek	Sedimentation/siltation	Applicable WQS attained; based on new data
OH041000090803	Wolf Creek	Aluminum	Applicable WQS attained; based on new data
OH041000090803	Wolf Creek	Habitat alterations	Not specified
OH041000090803	Wolf Creek	Polycyclic aromatic hydrocarbons (PAHs) (aquatic ecosystems)	Applicable WQS attained; based on new data
OH041000090803	Wolf Creek	Sedimentation/siltation	Applicable WQS attained; based on new data
OH041000090804	Heilman Ditch-Swan Creek	Lead	Applicable WQS attained; based on new data
OH041000090804	Heilman Ditch-Swan Creek	Copper	Applicable WQS attained; based on new data
OH041000090804	Heilman Ditch-Swan Creek	Dieldrin	Applicable WQS attained; based on new data
OH041000090904	Delaware Creek-Maumee River	Sedimentation/siltation	Applicable WQS attained; original basis for listing was incorrect
OH041000090904	Delaware Creek-Maumee River	Nitrate/nitrite (nitrite + nitrate as N)	Applicable WQS attained; based on new data
OH041000090904	Delaware Creek-Maumee River	Phosphorus, total	Applicable WQS attained; based on new data
OH041000090904	Delaware Creek-Maumee River	Flow regime modification	Applicable WQS attained; based on new data
OH041000100301	North Branch Portage River	Habitat alterations	Not caused by a pollutant (4c)
OH041000100602	Packer Creek	Habitat alterations	Applicable WQS attained; based on new data
OH041000100603	Lower Toussaint Creek	Organic enrichment	Applicable WQS attained; based on new data
OH041000100603	Lower Toussaint Creek	Cause unknown	Clarification of listing cause
OH041000100603	Lower Toussaint Creek	Habitat alterations	Applicable WQS attained; based on new data
OH041000100701	Turtle Creek-Frontal Lake Erie	Total dissolved solids (TDS)	Applicable WQS attained; based on new data
OH041000100703	Cedar Creek-Frontal Lake Erie	Phosphorus, total	Applicable WQS attained; based on new data
OH041000100703	Cedar Creek-Frontal Lake Erie	Ammonia	Applicable WQS attained; based on new data
OH041000100703	Cedar Creek-Frontal Lake Erie	Organic enrichment	Applicable WQS attained; based on new data
OH041000100703	Cedar Creek-Frontal Lake Erie	Dissolved oxygen	Applicable WQS attained; based on new data
OH041000100705	Berger Ditch	Organic enrichment	Applicable WQS attained; based on new data
OH041000100705	Berger Ditch	Phosphorus, total	Not specified
OH041000110204	Racoon Creek-Frontal Sandusky Bay	Habitat alterations	Not caused by a pollutant (4c)
OH041000110703	Negro Run	Habitat alterations	Not caused by a pollutant (4c)
OH041000110903	Greasy Run-Sycamore Creek	Habitat alterations	Not caused by a pollutant (4c)
OH041000110905	Mile Run-Sandusky River	Habitat alterations	Not caused by a pollutant (4c)
OH041000111101	Rock Creek	Habitat alterations	Not caused by a pollutant (4c)
OH041000120101	Clear Creek-Vermilion River	Habitat alterations	Not caused by a pollutant (4c)

Assessment Unit	Assessment Unit Name	Parameter Name	Delisting Reason
OH041000120104	New London Upground Reservoir-Vermilion River	Habitat alterations	Not caused by a pollutant (4c)
OH041000120105	Indian Creek-Vermilion River	Habitat alterations	Not caused by a pollutant (4c)
OH041000120301	Sugar Creek-Frontal Lake Erie	Habitat alterations	Not caused by a pollutant (4c)
OH041000120504	Seymour Creek	Habitat alterations	Not caused by a pollutant (4c)
OH041000120505	Town of Kimball	Habitat alterations	Applicable WQS attained; original basis for listing was incorrect
OH041000120505	Town of Kimball	Cause unknown	Applicable WQS attained; original basis for listing was incorrect
OH041100010102	North Branch West Branch Rocky River	Habitat alterations	Not caused by a pollutant (4c)
OH041100010103	Headwaters West Branch Rocky River	Habitat alterations	Not caused by a pollutant (4c)
OH041100010107	Plum Creek	Habitat alterations	Not caused by a pollutant (4c)
OH041100010107	Plum Creek	Fish passage barrier	Not caused by a pollutant (4c)
OH041100010202	Baldwin Creek-East Branch Rocky River	Fish passage barrier	Not caused by a pollutant (4c)
OH041100010202	Baldwin Creek-East Branch Rocky River	Sedimentation/siltation	Not caused by a pollutant (4c)
OH041100010203	Rocky River	Fish passage barrier	Not caused by a pollutant (4c)
OH041100010601	French Creek	Habitat alterations	Not caused by a pollutant (4c)
OH041100010603	Heider Ditch-Frontal Lake Erie	Habitat alterations	Not caused by a pollutant (4c)
OH041100010703	Quarry Creek-Frontal Lake Erie	Habitat alterations	Not caused by a pollutant (4c)
OH041100020101	East Branch Reservoir-East Branch Cuyahoga River	Habitat alterations	Applicable WQS attained; based on new data
OH041100020101	East Branch Reservoir-East Branch Cuyahoga River	Natural limits	Applicable WQS attained; based on new data
OH041100020101	East Branch Reservoir-East Branch Cuyahoga River	Organic enrichment	Applicable WQS attained; based on new data
OH041100020101	East Branch Reservoir-East Branch Cuyahoga River	Siltation	Applicable WQS attained; based on new data
OH041100020101	East Branch Reservoir-East Branch Cuyahoga River	Flow regime modification	Applicable WQS attained; based on new data
OH041100020102	West Branch Cuyahoga River	Flow regime modification	Applicable WQS attained; based on new data
OH041100020102	West Branch Cuyahoga River	Habitat alterations	Applicable WQS attained; based on new data
OH041100020102	West Branch Cuyahoga River	Natural limits	Applicable WQS attained; based on new data
OH041100020102	West Branch Cuyahoga River	Organic enrichment	Applicable WQS attained; based on new data
OH041100020102	West Branch Cuyahoga River	Siltation	Applicable WQS attained; based on new data
OH041100020104	Ladue Reservoir-Bridge Creek	Flow regime modification	Applicable WQS attained; based on new data
OH041100020104	Ladue Reservoir-Bridge Creek	PCBs in fish tissue	Applicable WQS attained; original basis for listing was incorrect
OH041100020104	Ladue Reservoir-Bridge Creek	Siltation	Applicable WQS attained; based on new data
OH041100020104	Ladue Reservoir-Bridge Creek	Habitat alterations	Applicable WQS attained; based on new data

Assessment Unit	Assessment Unit Name	Parameter Name	Delisting Reason
OH041100020104	Ladue Reservoir-Bridge Creek	Organic enrichment	Applicable WQS attained; based on new data
OH041100020106	Sawyer Brook-Cuyahoga River	Habitat alterations	Applicable WQS attained; based on new data
OH041100020106	Sawyer Brook-Cuyahoga River	Natural limits	Applicable WQS attained; based on new data
OH041100020106	Sawyer Brook-Cuyahoga River	Flow regime modification	Applicable WQS attained; based on new data
OH041100020106	Sawyer Brook-Cuyahoga River	Organic enrichment	Applicable WQS attained; based on new data
OH041100020106	Sawyer Brook-Cuyahoga River	Siltation	Applicable WQS attained; based on new data
OH041100020201	Potter Creek-Breakneck Creek	Habitat alterations	Not caused by a pollutant (4c)
OH041100020202	Feeder Canal-Breakneck Creek	Habitat alterations	Not caused by a pollutant (4c)
OH041100020302	Mogadore Reservoir-Little Cuyahoga River	Habitat alterations	Not caused by a pollutant (4c)
OH041100020402	Yellow Creek	Habitat alterations	Not caused by a pollutant (4c)
OH041100020403	Furnace Run	Sedimentation/siltation	Applicable WQS attained; based on new data
OH041100020403	Furnace Run	Physical substrate habitat alterations	Applicable WQS attained; based on new data
OH041100020403	Furnace Run	Flow regime modification	Applicable WQS attained; based on new data
OH041100020403	Furnace Run	Total dissolved solids (TDS)	Applicable WQS attained; based on new data
OH041100020501	Pond Brook	Habitat alterations	Not caused by a pollutant (4c)
OH041100020502	Headwaters Tinkers Creek	Habitat alterations	Not caused by a pollutant (4c)
OH041100020503	Headwaters Chippewa Creek	Flow regime modification	Applicable WQS attained; based on new data
OH041100020503	Headwaters Chippewa Creek	Organic enrichment	Applicable WQS attained; based on new data
OH041100020503	Headwaters Chippewa Creek	Natural limits	Applicable WQS attained; based on new data
OH041100020503	Headwaters Chippewa Creek	Nutrients	Applicable WQS attained; based on new data
OH041100020503	Headwaters Chippewa Creek	Oil and grease	Applicable WQS attained; based on new data
OH041100020503	Headwaters Chippewa Creek	Habitat alterations	Applicable WQS attained; based on new data
OH041100020504	Town of Twinsburg-Tinkers Creek	Habitat alterations	Not caused by a pollutant (4c)
OH041100020505	Willow Lake-Cuyahoga River	Habitat alterations	Applicable WQS attained; based on new data
OH041100020505	Willow Lake-Cuyahoga River	Flow regime modification	Applicable WQS attained; based on new data
OH041100020505	Willow Lake-Cuyahoga River	Natural limits	Applicable WQS attained; based on new data
OH041100020505	Willow Lake-Cuyahoga River	Nutrients	Applicable WQS attained; based on new data
OH041100020505	Willow Lake-Cuyahoga River	Cause unknown	Applicable WQS attained; based on new data
OH041100020505	Willow Lake-Cuyahoga River	Oil and grease	Applicable WQS attained; based on new data

Assessment Unit	Assessment Unit Name	Parameter Name	Delisting Reason
OH041100020505	Willow Lake-Cuyahoga River	Organic enrichment	Applicable WQS attained; based on new data
OH041100020602	Village of Independence-Cuyahoga River	Escherichia coli (*e. Coli*)	Applicable WQS attained; based on new data
OH041100030105	Lower Ashtabula River	Alteration in stream-side or littoral vegetative covers	Not caused by a pollutant (4c)
OH041100030105	Lower Ashtabula River	Habitat alterations	Not caused by a pollutant (4c)
OH041100030203	Arcola Creek	Habitat alterations	Not caused by a pollutant (4c)
OH041100030302	Headwaters Aurora Branch	Fish passage barrier	Not caused by a pollutant (4c)
OH041100030402	Griswold Creek-Chagrin River	Alteration in stream-side or littoral vegetative covers	Not caused by a pollutant (4c)
OH041100030503	Euclid Creek	Habitat alterations	Not caused by a pollutant (4c)
OH041100030504	Doan Brook-Frontal Lake Erie	Habitat alterations	Not caused by a pollutant (4c)
OH041201010703	Town of North Kingsville-Frontal Lake Erie	Habitat alterations	Not caused by a pollutant (4c)
OH050301010401	East Branch Middle Fork Little Beaver Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050301010403	Stone Mill Run-Middle Fork Little Beaver Creek	Pesticides	Not specified
OH050301010601	Longs Run	Habitat alterations	Not caused by a pollutant (4c)
OH050301010602	Honey Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050301010605	Headwaters Bull Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050301010606	Leslie Run-Bull Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050301010804	Hollow Rock Run-Yellow Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050301011103	Carpenter Run-Ohio River	Habitat alterations	Not caused by a pollutant (4c)
OH050301020602	Little Yankee Run	Habitat alterations	Not caused by a pollutant (4c)
OH050301030503	Lower Mosquito Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050301030503	Lower Mosquito Creek	Pollutants in urban storm water	Applicable WQS attained; original basis for listing was incorrect
OH050301030601	Duck Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050301030602	Mud Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050301030602	Mud Creek	Fish passage barrier	Not caused by a pollutant (4c)
OH050301030703	Lower Meander Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050301030704	Squaw Creek	Alteration in stream-side or littoral vegetative covers	Not caused by a pollutant (4c)
OH050301030704	Squaw Creek	Fish passage barrier	Not caused by a pollutant (4c)
OH050301030801	Headwaters Mill Creek	Fish passage barrier	Not caused by a pollutant (4c)
OH050301030805	Headwaters Yellow Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050301030806	Burgess Run-Yellow Creek	Fish passage barrier	Not caused by a pollutant (4c)
OH050301030809	Coffee Run-Mahoning River	Fish passage barrier	Not caused by a pollutant (4c)
OH050302010804	Paw Paw Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050302020201	Headwaters West Branch Shade River	Manganese	Clarification of listing cause
OH050302020202	Kingsbury Creek	Manganese	Clarification of listing cause
OH050302020205	Walker Run-West Branch Shade River	Manganese	Clarification of listing cause
OH050302020404	Forked Run-Ohio River	Natural limits	Applicable WQS attained; original basis for listing was incorrect
OH050302020702	Mud Fork	Habitat alterations	Not caused by a pollutant (4c)
OH050302020902	Campaign Creek	Manganese	Clarification of listing cause

Assessment Unit	Assessment Unit Name	Parameter Name	Delisting Reason
OH050302040103	Clark Run-Rush Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050302040405	Buck Run-Hocking River	Cause unknown	Applicable WQS attained; based on new data
OH050400010102	Pigeon Creek	Natural limits	Applicable WQS attained; based on new data
OH050400010102	Pigeon Creek	Habitat alterations	Applicable WQS attained; based on new data
OH050400010102	Pigeon Creek	Organic enrichment	Applicable WQS attained; based on new data
OH050400010102	Pigeon Creek	Siltation	Applicable WQS attained; based on new data
OH050400010102	Pigeon Creek	Flow regime modification	Applicable WQS attained; based on new data
OH050400010105	Portage Lakes-Tuscarawas River	Cause unknown	Applicable WQS attained; original basis for listing was incorrect
OH050400010202	Hubbard Creek-Chippewa Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050400010301	Pancake Creek-Tuscarawas River	Habitat alterations	Not caused by a pollutant (4c)
OH050400010301	Pancake Creek-Tuscarawas River	Hexachlorobenzene	Applicable WQS attained; based on new data
OH050400010302	Nimisila Reservoir-Nimisila Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050400010309	West Sippo Creek-Tuscarawas River	Cause unknown	Clarification of listing cause
OH050400010501	Swartz Ditch-Middle Branch Nimishillen Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050400010505	Sherrick Run-Nimishillen Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050400010506	Town of East Sparta-Nimishillen Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050400010701	Headwaters Upper Conotton Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050400010801	Cold Spring Run-Indian Fork	Habitat alterations	Not caused by a pollutant (4c)
OH050400010802	Pleasant Valley Run-Indian Fork	Ammonia	Applicable WQS attained; original basis for listing was incorrect
OH050400010804	Huff Run	Specific conductivity	Clarification of listing cause
OH050400010805	Dog Run-Conotton Creek	Specific conductivity	Clarification of listing cause
OH050400010901	Little Sugar Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050400010902	Town of Smithville-Sugar Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050400010903	North Fork Sugar Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050400010904	Town of Brewster-Sugar Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050400011203	Wolf Creek-Tuscarawas River	Siltation	Applicable WQS attained; original basis for listing was incorrect
OH050400011203	Wolf Creek-Tuscarawas River	Metals	Applicable WQS attained; original basis for listing was incorrect
OH050400011203	Wolf Creek-Tuscarawas River	Ph	Applicable WQS attained; original basis for listing was incorrect
OH050400011301	Spencer Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050400011505	Lower Little Stillwater Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050400011603	Weaver Run-Stillwater Creek	Aluminum	Applicable WQS attained; original basis for listing was incorrect
OH050400011604	Town of Uhrichsville-Stillwater Creek	Habitat alterations	Not caused by a pollutant (4c)

Assessment Unit	Assessment Unit Name	Parameter Name	Delisting Reason
OH050400011604	Town of Uhrichsville-Stillwater Creek	Dissolved oxygen	Applicable WQS attained; original basis for listing was incorrect
OH050400011702	Oldtown Creek	Flow regime modification	Applicable WQS attained; based on new data
OH050400011702	Oldtown Creek	Habitat alterations	Applicable WQS attained; based on new data
OH050400011702	Oldtown Creek	Organic enrichment	Applicable WQS attained; based on new data
OH050400011702	Oldtown Creek	Siltation	Not specified
OH050400011703	Beaverdam Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050400011903	White Eyes Creek	Ammonia	Applicable WQS attained; based on new data
OH050400011903	White Eyes Creek	Cause unknown	Applicable WQS attained; based on new data
OH050400011903	White Eyes Creek	Nutrients	Applicable WQS attained; based on new data
OH050400011904	Morgan Run-Tuscarawas River	Nutrients	Applicable WQS attained; original basis for listing was incorrect
OH050400011904	Morgan Run-Tuscarawas River	Cause unknown	Applicable WQS attained; original basis for listing was incorrect
OH050400011904	Morgan Run-Tuscarawas River	Ammonia	Applicable WQS attained; original basis for listing was incorrect
OH050400020102	Headwaters Black Fork Mohican River	Habitat alterations	Not caused by a pollutant (4c)
OH050400020105	Shipp Creek-Black Fork Mohican River	Habitat alterations	Not caused by a pollutant (4c)
OH050400020201	Village of Pavonia-Black Fork Mohican River	Habitat alterations	Not caused by a pollutant (4c)
OH050400020203	Headwaters Rocky Fork	Habitat alterations	Not caused by a pollutant (4c)
OH050400020303	Town of Lexington-Clear Fork Mohican River	Habitat alterations	Not caused by a pollutant (4c)
OH050400020702	Mohicanville Dam-Lake Fork Mohican River	Habitat alterations	Not caused by a pollutant (4c)
OH050400020802	Town of Perrysville-Black Fork Mohican River	PCBs in fish tissue	Applicable WQS attained; original basis for listing was incorrect
OH050400020803	Big Run-Black Fork Mohican River	PCBs in fish tissue	Applicable WQS attained; original basis for listing was incorrect
OH050400030304	Delano Run-Kokosing River	PCBs in fish tissue	Applicable WQS attained; based on new data
OH050400030601	Little Apple Creek	Habitat alterations	Applicable WQS attained; original basis for listing was incorrect
OH050400030604	Jennings Ditch-Killbuck Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050400030705	Shrimplin Creek-Killbuck Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050400040102	Winding Fork	Habitat alterations	Not caused by a pollutant (4c)
OH050400040103	Brushy Fork	Habitat alterations	Not caused by a pollutant (4c)
OH050400040201	Black Run-Wakatomika Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050400040202	Mill Fork	Habitat alterations	Not caused by a pollutant (4c)
OH050400040203	Little Wakatomika Creek	Habitat alterations	Not caused by a pollutant (4c)

Assessment Unit	Assessment Unit Name	Parameter Name	Delisting Reason
OH050400040204	Town of Frazeysburg-Wakatomika Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050400040801	Brush Creek	Fish passage barrier	Not caused by a pollutant (4c)
OH050400040803	Duncan Run-Muskingum River	Physical substrate habitat alterations	Not caused by a pollutant (4c)
OH050400040902	Headwaters South Branch Wolf Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050400040903	Plumb Run-South Branch Wolf Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050400041105	Congress Run-Muskingum River	Habitat alterations	Not caused by a pollutant (4c)
OH050400050102	Beaver Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050400050202	Headwaters Collins Fork	Specific conductivity	Clarification of listing cause
OH050400050205	Crane Run-Buffalo Fork	Specific conductivity	Clarification of listing cause
OH050400050207	Trail Run-Wills Creek	Sedimentation/siltation	Applicable WQS attained; original basis for listing was incorrect
OH050400050402	Headwaters Salt Fork	Habitat alterations	Not caused by a pollutant (4c)
OH050400050502	Headwaters Crooked Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050400050502	Headwaters Crooked Creek	Sedimentation/siltation	Applicable WQS attained; original basis for listing was incorrect
OH050400050602	Twomile Run-Wills Creek	Sedimentation/siltation	Not caused by a pollutant (4c)
OH050400060101	Otter Fork Licking River	Habitat alterations	Not caused by a pollutant (4c)
OH050400060302	Lobdell Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050600010102	Headwaters Scioto River	Habitat alterations	Not caused by a pollutant (4c)
OH050600010202	McDonald Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050600010203	Dudley Run-Rush Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050600010301	Rock Fork	Habitat alterations	Not caused by a pollutant (4c)
OH050600010302	Headwaters Little Scioto River	Habitat alterations	Not caused by a pollutant (4c)
OH050600010303	City of Marion-Little Scioto River	Habitat alterations	Not caused by a pollutant (4c)
OH050600010304	Honey Creek-Little Scioto River	Habitat alterations	Not caused by a pollutant (4c)
OH050600010404	Wildcat Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050600010504	Fulton Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050600010602	Middle Mill Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050600011203	Indian Run	Habitat alterations	Not caused by a pollutant (4c)
OH050600011502	City of Gahanna-Big Walnut Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050600011504	Town of Brice-Blacklick Creek	Alteration in stream-side or littoral vegetative covers	Not caused by a pollutant (4c)
OH050600011704	Sycamore Creek	Total dissolved solids (TDS)	Applicable WQS attained; based on new data
OH050600012002	Proctor Run-Treacle Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050600012004	Spring Fork	Habitat alterations	Not caused by a pollutant (4c)
OH050600012005	Barron Creek-Little Darby Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050600012302	Kian Run-Scioto River	Habitat alterations	Not caused by a pollutant (4c)
OH050600012303	Grant Run-Scioto River	Fish passage barrier	Not caused by a pollutant (4c)
OH050600020406	Blackwater Creek-Scioto River	Habitat alterations	Not caused by a pollutant (4c)
OH050600021406	Beech Fork-South Fork Scioto Brush Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050600021503	Jaybird Branch-Scioto Brush Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050600030301	Wilson Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050800011101	Mud Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050800011805	Rock Run-Mad River	Habitat alterations	Not caused by a pollutant (4c)
OH050800012004	Pleasant Run-Honey Creek	Physical substrate habitat alterations	Not caused by a pollutant (4c)

Assessment Unit	Assessment Unit Name	Parameter Name	Delisting Reason
OH050800020602	Little Four Mile Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050800020604	Acton Lake Dam-Four Mile Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050800020704	Dicks Creek	Physical substrate habitat alterations	Not caused by a pollutant (4c)
OH050800030808	Howard Creek-Dry Fork Whitewater River	Dissolved oxygen	Applicable WQS attained; based on new data
OH050800030808	Howard Creek-Dry Fork Whitewater River	Nutrients	Applicable WQS attained; based on new data
OH050901010202	West Branch Raccoon Creek	Coarse sediment	Applicable WQS attained; original basis for listing was incorrect
OH050901010203	Brushy Fork	Alteration in stream-side or littoral vegetative covers	Applicable WQS attained; original basis for listing was incorrect
OH050901010203	Brushy Fork	Coarse sediment	Applicable WQS attained; original basis for listing was incorrect
OH050901010204	Twomile Run-Raccoon Creek	Alteration in stream-side or littoral vegetative covers	Applicable WQS attained; original basis for listing was incorrect
OH050901010204	Twomile Run-Raccoon Creek	Coarse sediment	Applicable WQS attained; original basis for listing was incorrect
OH050901010205	Town of Zaleski-Raccoon Creek	Coarse sediment	Applicable WQS attained; original basis for listing was incorrect
OH050901010301	Hewett Fork	Coarse sediment	Applicable WQS attained; original basis for listing was incorrect
OH050901010301	Hewett Fork	Alteration in stream-side or littoral vegetative covers	Not caused by a pollutant (4c)
OH050901010302	Headwaters Elk Fork	Coarse sediment	Applicable WQS attained; original basis for listing was incorrect
OH050901010303	Flat Run-Elk Fork	Coarse sediment	Applicable WQS attained; original basis for listing was incorrect
OH050901010304	Flat Run-Raccoon Creek	Coarse sediment	Applicable WQS attained; original basis for listing was incorrect
OH050901010304	Flat Run-Raccoon Creek	Alteration in stream-side or littoral vegetative covers	Not caused by a pollutant (4c)
OH050901010401	Headwaters Little Raccoon Creek	Coarse sediment	Applicable WQS attained; original basis for listing was incorrect
OH050901010402	Dickason Run	Coarse sediment	Applicable WQS attained; original basis for listing was incorrect
OH050901010403	Meadow Run-Little Raccoon Creek	Aluminum	Applicable WQS attained, due to restoration activities

Assessment Unit	Assessment Unit Name	Parameter Name	Delisting Reason
OH050901010403	Meadow Run-Little Raccoon Creek	Coarse sediment	Applicable WQS attained; original basis for listing was incorrect
OH050901010403	Meadow Run-Little Raccoon Creek	Nutrients	Applicable WQS attained, due to restoration activities
OH050901010403	Meadow Run-Little Raccoon Creek	Organic enrichment	Applicable WQS attained, due to restoration activities
OH050901010403	Meadow Run-Little Raccoon Creek	Ph	Applicable WQS attained, due to restoration activities
OH050901010403	Meadow Run-Little Raccoon Creek	Iron	Applicable WQS attained, due to restoration activities
OH050901010403	Meadow Run-Little Raccoon Creek	Nickel	Applicable WQS attained, due to restoration activities
OH050901010403	Meadow Run-Little Raccoon Creek	Salinity/total dissolved solids/chlorides	Applicable WQS attained, due to restoration activities
OH050901010403	Meadow Run-Little Raccoon Creek	Sedimentation/siltation	Applicable WQS attained, due to restoration activities
OH050901010403	Meadow Run-Little Raccoon Creek	Habitat alterations	Applicable WQS attained, due to restoration activities
OH050901010403	Meadow Run-Little Raccoon Creek	Metals	Applicable WQS attained, due to restoration activities
OH050901010403	Meadow Run-Little Raccoon Creek	Thermal modifications	Applicable WQS attained, due to restoration activities
OH050901010404	Deer Creek-Little Raccoon Creek	Coarse sediment	Applicable WQS attained; original basis for listing was incorrect
OH050901010502	Strongs Run	Coarse sediment	Applicable WQS attained; original basis for listing was incorrect
OH050901010503	Flatlick Run-Raccoon Creek	Coarse sediment	Applicable WQS attained; original basis for listing was incorrect
OH050901010504	Robinson Run-Raccoon Creek	Coarse sediment	Applicable WQS attained; original basis for listing was incorrect
OH050901010605	Claylick Run-Raccoon Creek	Coarse sediment	Applicable WQS attained; original basis for listing was incorrect
OH050901010802	Black Fork	Fish passage barrier	Applicable WQS attained; original basis for listing was incorrect
OH050902010303	Baker Fork	Habitat alterations	Not caused by a pollutant (4c)
OH050902010701	Headwaters West Fork Eagle Creek	Phosphorus, total	Applicable WQS attained; original basis for listing was incorrect
OH050902020102	North Fork Little Miami River	Habitat alterations	Not caused by a pollutant (4c)
OH050902020201	North Fork Massies Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050902020301	Headwaters Anderson Fork	Fish passage barrier	Not caused by a pollutant (4c)
OH050902020301	Headwaters Anderson Fork	Habitat alterations	Not caused by a pollutant (4c)
OH050902021003	Headwaters Dodson Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050902021005	West Fork East Fork Little Miami River	Habitat alterations	Not caused by a pollutant (4c)
OH050902021006	Glady Creek-East Fork Little Miami River	Habitat alterations	Not caused by a pollutant (4c)

Assessment Unit	Assessment Unit Name	Parameter Name	Delisting Reason
OH050902021101	Solomon Run-East Fork Little Miami River	Habitat alterations	Not caused by a pollutant (4c)
OH050902021102	Fivemile Creek-East Fork Little Miami River	Habitat alterations	Not caused by a pollutant (4c)
OH050902021305	Salt Run-East Fork Little Miami River	Habitat alterations	Not caused by a pollutant (4c)
OH050902021401	Sycamore Creek	Fish passage barrier	Not caused by a pollutant (4c)
OH050902021401	Sycamore Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050902021404	Duck Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050902030102	West Fork Mill Creek	Habitat alterations	Not caused by a pollutant (4c)
OH050902030202	Dry Creek-Ohio River	Habitat alterations	Not caused by a pollutant (4c)
OH051201010101	Headwaters Wabash River	Habitat alterations	Not caused by a pollutant (4c)
OH051201010102	Stoney Creek-Wabash River	Habitat alterations	Not caused by a pollutant (4c)
OH051201010103	Toti Creek-Wabash River	Habitat alterations	Not caused by a pollutant (4c)
OH051201010501	Hickory Branch-Wabash River	Habitat alterations	Not caused by a pollutant (4c)
OH051201030101	Little Mississinewa River	Habitat alterations	Not caused by a pollutant (4c)
OH051201030102	Gray Branch-Mississinewa River	Habitat alterations	Not caused by a pollutant (4c)
OH051201030103	Jordan Creek-Mississinewa River	Habitat alterations	Not caused by a pollutant (4c)
OHLE041202000101	Lake Erie Islands Shoreline (<=3m)	Habitat alterations	Not caused by a pollutant (4c)
OHLE041202000202	Lake Erie Sandusky Basin Shoreline (<=3m)	Habitat alterations	Not caused by a pollutant (4c)
OHLE041202000203	Lake Erie Central Basin Shoreline (<=3m)	Habitat alterations	Not caused by a pollutant (4c)
OHLR041000099002	Maumee River Mainstem (Beaver Creek to Maumee Bay)	Habitat alterations	Not caused by a pollutant (4c)
OHLR041100029001	Cuyahoga River Mainstem (Brandywine Cr. to mouth); including old channel	Habitat alterations	Not caused by a pollutant (4c)
OHLR041100029001	Cuyahoga River Mainstem (Brandywine Cr. to mouth); including old channel	Ammonia	Applicable WQS attained; based on new data
OHLR041100029001	Cuyahoga River Mainstem (Brandywine Cr. to mouth); including old channel	Organic enrichment	Applicable WQS attained; based on new data
OHLR041100029001	Cuyahoga River Mainstem (Brandywine Cr. to mouth); including old channel	Pollutants in urban storm water	Applicable WQS attained; based on new data
OHLR041100029001	Cuyahoga River Mainstem (Brandywine Cr. to mouth); including old channel	Toxicity	Not specified
OHLR050301039001	Mahoning River Mainstem (Eagle Creek to Pennsylvania Border)	Habitat alterations	Not caused by a pollutant (4c)
OHLR050301039001	Mahoning River Mainstem (Eagle Creek to Pennsylvania Border)	Sedimentation/siltation	Not caused by a pollutant (4c)
OHLR050400019003	Tuscarawas River Mainstem (Stillwater Creek to Muskingum River)	Hexachlorobenzene	Applicable WQS attained; based on new data
OHLR050600019001	Scioto River Mainstem (L. Scioto R. to Olentangy R.); excluding O'Shaughnessy and Griggs reservoirs	Habitat alterations	Not caused by a pollutant (4c)
OHLR050800019001	Great Miami River Mainstem (Tawawa Creek to Mad River)	Habitat alterations	Not caused by a pollutant (4c)
OHLR050800019002	Stillwater River Mainstem (Greenville Creek to mouth)	Sedimentation/siltation	Applicable WQS attained; original basis for listing was incorrect

J6. Schedule for TMDL Work

Once waters are assessed and the impaired waters are prioritized, the next step is to determine a schedule to address the monitoring needs of all waters and restoration needs (including TMDLs) of the impaired ones. Various factors must be considered, including Ohio's ongoing TMDL work; the process identified to do TMDLs; the monitoring strategy; and the resources available for the work.

Over the past few years, TMDL projects transitioned from the old HUC 11-scale watersheds to the new, smaller HUC 12-scale watersheds. Through 2009, TMDLs were completed using the HUC 11-scale AUs. Projects submitted for approval after April 1, 2010, reflect the new HUC 12-size units.

Ohio TMDL Status

Ohio EPA is currently working on numerous projects in various stages of TMDL development. Ohio EPA has approved TMDL reports in about 50 project areas. As of 2017, Ohio has assessed all our significant watershed areas using our current survey approach. Table J-5 summarizes Ohio TMDL reports approved by U.S. EPA at the 11-digit HUC level. Table J-6 summarizes Ohio TMDL reports approved by U.S. EPA at the 12-digit HUC level. It must be noted that the 2015 Ohio Supreme Court decision resulted in a delay of TMDLs submitted for approval by Ohio EPA, as discussed in Section C of this report.

Long-Term Schedules for Monitoring and TMDLs

Ohio's rotating basin approach provides a foundation for scheduling monitoring and TMDL projects. The assessment methodology allows that, generally, aquatic life use monitoring data up to 10 years old may be considered in judging AUs, so it follows that each AU must be monitored at least once every 10 years to maintain coverage. However, resources to maintain this pace are no longer available — cycling through the entire basin rotation would take about 20 years at current resource levels. The delays caused by the 2015 Ohio Supreme Court Decision[3] and the workload resulting from the legislative changes to the process have also resulted in a larger backlog of TMDL reports. Fewer new assessments were conducted in 2018 and 2019.

In early 2019, Ohio EPA began the process of updating the aquatic life monitoring strategy with goal of cycling through the basin rotation faster with current resources. Staff devised an updated strategy consisting of a two-pronged approach. The first prong of the approach reconfigures project areas into 37 watershed groupings as depicted in Figure J-1. These project areas will be assessed through the rotating basin approach approximately every 12 years. The second prong of the approach introduces a method to better estimate statewide water quality trends through probabilistic surveys. Ohio EPA held an outreach event in July 2019 to solicit feedback on the strategy. The Agency continues to review comments submitted by stakeholders. As such, the Agency is only including scheduled water quality monitoring for the next two years in this report.

[3] March 2015 in Fairfield Cty. Bd. of Commrs. v. Nally, 143 Ohio St. 3d 93, 2015-Ohio-991, the Ohio Supreme Court determined that "A TMDL established by Ohio EPA pursuant to the Clean Water Act is a rule that is subject to the requirements of R.C. Chapter 119, the Ohio Administrative Procedure Act."

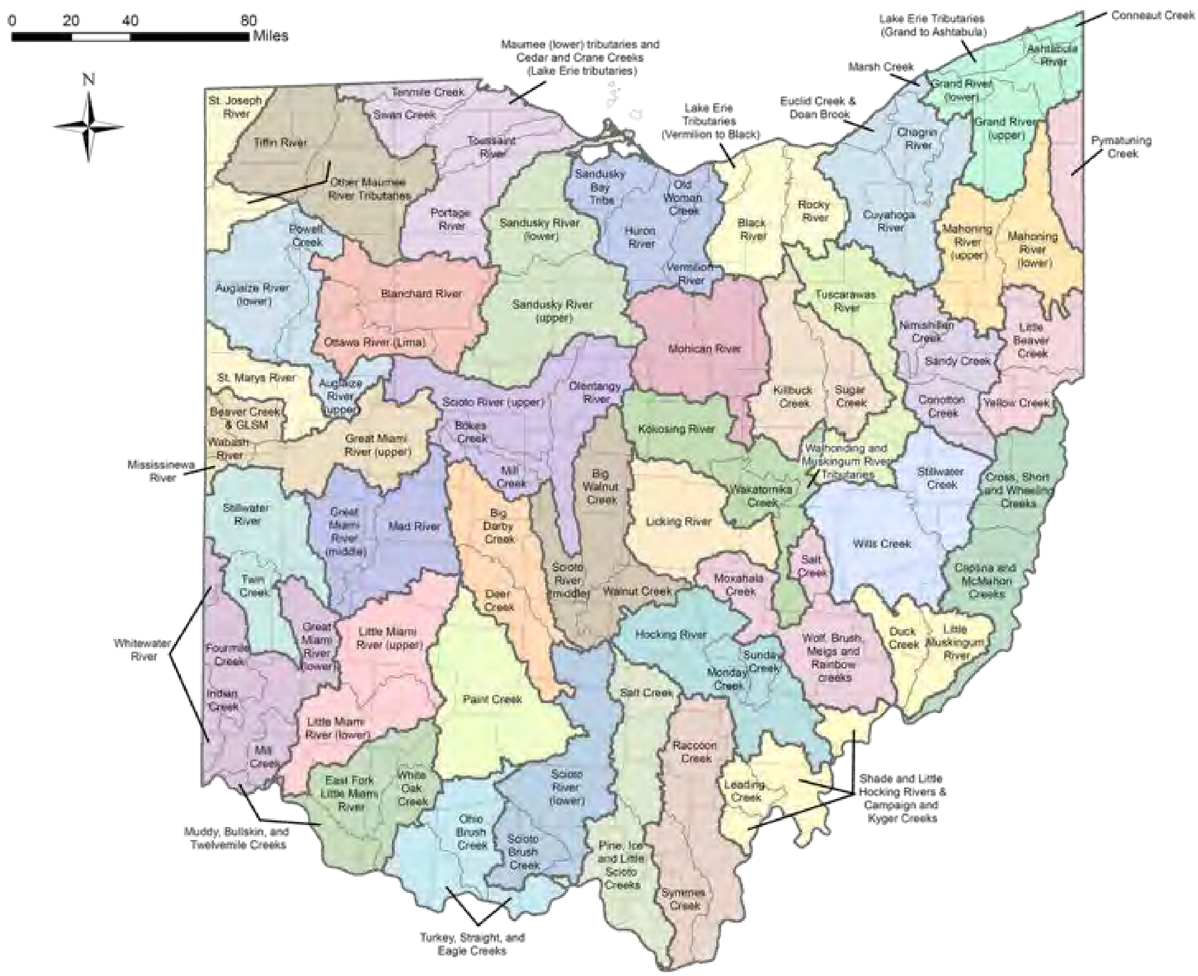

Figure J-1 — New Rotating Basin Project Areas.

2020 Monitoring

In 2020, Ohio EPA will be conducting water quality monitoring in all 23 large rivers throughout the state (38 large river assessment units) and the new Beaver Creek, Grand Lake St. Marys, Mississinewa River, Wabash River and upper Great Miami River watersheds project area.

2021 Monitoring

In 2021, Ohio EPA will be monitoring the following new project areas: Sandusky River (upper and lower); Pymatuning Creek, Little Beaver Creek and Yellow Creek; Hocking River, Sunday Creek and Monday Creek; middle Great Miami River and Mad River.

Short-Term Schedule for TMDL Development

Ohio EPA evaluated the pending TMDL projects and plans to focus on the following projects during the next two years, which are indicated in Table J-7, Table J-8 and Table J-9. Because Ohio's TMDL process begins with a watershed assessment, all TMDLs to be completed in the next two years are already well in progress. In addition, the Agency is committed to restoring water quality and will be exploring other alternatives to this end in both the short- and long-term, as outlined in the 303(d) Vision discussion in Section C7 of this report.

Table J-5 — Ohio TMDLs[4] approved by U.S. EPA at the 11-digit hydrologic unit scale.

AU Code	AU Name	U.S. EPA Approval Date	Pollutants Allocated, per U.S. EPA[5]
04110002 020	Cuyahoga River (below Black Brook to below Breakneck Creek)	10/11/2000	dissolved oxygen
04110002 030	Cuyahoga River (below Breakneck Creek to below Little Cuyahoga River)		
04110001 070	Rocky River (below West Br. to Lake Erie [including East Br.] and Lake Erie tribs [above Porter Cr to above Cuyahoga R]): Plum Creek	12/04/2001	phosphorus, nitrogen
05090202 010	Little Miami River (headwaters to above Massies Creek)	07/02/2002 05/13/2003	phosphorus, sediment
05090202 020	Little Miami River (above Massies Creek to below Beaver Creek)		
05090202 030	Little Miami River (below Beaver Creek of above Caesar Creek)		
05090202 040	Anderson Fork Caesar Creek		
05090202 050	Caesar Creek (except Anderson Fork)		
05060001 060	Bokes Creek (Scioto River above Bokes Creek to above Mill Creek)	09/27/2002 07/31/2003	phosphorus, sediment
05040001 100	Sugar Creek (headwaters to above Middle Fork Sugar Creek)	11/20/2002 07/08/2003	phosphorus, nitrogen, sediment
05040001 110	South Fork Sugar Creek		
05040001 120	Sugar Creek (upstream Middle Fork to mouth)		
05090101 020	Raccoon Creek (headwaters to above Hewett Fork)	3/20/2003	pH (acid), metals
05090101 030	Raccoon Creek (above Hewett Fork to below Elk Fork)		
05060001 070	Mill Creek (Scioto River basin)	9/02/2003	CBOD, ammonia, phosphorus, sediment, aldrin, d- BHC, dieldrin, endosulfan, endrin, heptachlor
05030201 110	East Fork Duck Creek	9/23/2003	TSS, aluminum, iron, manganese, BOD, ammonia
05030201 120	Duck Creek (except East Fork)		
04110002 040	Cuyahoga River (below Little Cuyahoga River to below Brandywine Creek)	9/26/2003	fecal coliform, phosphorus
04110002 050	Cuyahoga River (below Brandywine Creek to below Tinkers Creek)		
04110002 060	Cuyahoga River (below Tinkers Creek to Lake Erie)		
04110002	Cuyahoga River (mainstem)		
05080001 090	Stillwater River (headwaters to above Swamp Creek)	06/15/2004	nitrates, phosphorus
05080001 100	Stillwater River (above Swamp Creek to above Greenville Creek)		
05080001 110	Greenville Creek (headwaters to below West Branch)		
05080001 120	Greenville Creek (below West Branch to Stillwater River)		
05080001 130	Stillwater River (below Greenville Creek to above Ludlow Creek)		
05080001 140	Stillwater River (above Ludlow Creek to Great Miami River)		
05080001	Stillwater River (mainstem)		
04100007 010	Auglaize River (headwaters to below Pusheta Creek)	09/23/2004	

4 One or more AUs may be included in a TMDL report; the determination is made on a project-by-project basis, at the discretion of Ohio EPA.

5 The TMDL goal is restoration of the designated use through the attainment of applicable criteria. Pollutants listed here were specifically recognized in U.S. EPA decision documents. TMDL reports typically include such parameters for targeting, pollutant load characterization and measuring interim progress and may explore other indicators of watershed condition.

AU Code	AU Name	U.S. EPA Approval Date	Pollutants Allocated, per U.S. EPA[5]
04100007 020	Auglaize River (below Pusheta Creek to above Jennings Creek)		ammonia, phosphorus, pathogens, sediment
04100007 060	Auglaize River (above Jennings Creek to above Little Auglaize River)		
04110002 010	Cuyahoga River (headwaters to below Black Brook)	09/27/2004	phosphorus, sediment
04100011 020	Sandusky River (headwaters to above Broken Sword Creek)	09/30/2004	phosphorus, pathogens, sediment
04100011 030	Broken Sword Creek		
04100011 040	Sandusky River (below Broken Sword Creek to above Tymochtee Creek)		
04100011 050	Tymochtee Creek (headwaters to below Warpole Creek)		
04100011 060	Tymochtee Creek (downstream Warpole Creek to Sandusky River)		
04100011 070	Sandusky River (below Tymochtee Creek to above Honey Creek)		
04100011 080	Honey Creek		
05090203 010	Mill Creek	04/26/2005	phosphorus, nitrogen
04100012 040	Lake Erie Tributaries (below Huron River to above Vermilion River) [Old Woman and Chappel Creeks]	08/31/2005	nutrients, siltation, habitat alteration
05030204 060	Monday Creek	09/22/2005	pH, metals, sediment
05060001 130	Big Walnut Creek (headwaters to Hoover Dam)	09/26/2005	nutrients (phosphorus), pathogens, siltation, organic enrichment, flow, habitat alteration
05060001 140	Big Walnut Creek (below Hoover Dam to above Alum Creek)		
05060001 150	Alum Creek (headwaters to Alum Creek Dam)		
05060001 160	Big Walnut Creek (above Alum Creek [except above Alum Creek Dam] to Scioto River)		
04110003 010 (partial)	Lake Erie Tributaries (East of Cuyahoga River to West of Grand River; excluding Chagrin River) [Euclid Creek]	09/27/2005	nutrients (phosphorus), organic enrichment, habitat alteration
04100012 010	West Branch Huron River (headwaters to above Slate Run)	09/28/2005	nutrients (phosphorus), siltation, organic enrichment, flow, habitat alteration
04100012 020	West Branch Huron River (above Slate Run to above East Branch Huron River)		
04100012 030	Huron River (above East Branch to Lake Erie) and Lake Erie Tributaries (below Sawmill Creek to below Huron River)		
05030101 070	Middle Fork Little Beaver Creek	09/28/2005	nutrients (phosphorus), pathogens, siltation, organic enrichment, flow, habitat alteration, unionized ammonia
05030101 080	West Fork Little Beaver Creek		
05030101 090	Little Beaver Creek (downstream Middle and West Forks to mouth)		
05030204 070	Sunday Creek	03/31/2006	sediment, bacteria, acidity
05060001 190	Big Darby Creek (headwaters to below Sugar Run)	03/31/2006 10/27/2009	phosphorus, bacteria, sediment
05060001 200	Big Darby Creek (below Sugar Run to above Little Darby Creek)		
05060001 210	Little Darby Creek		
05060001 220	Big Darby Creek (below Little Darby Creek to Scioto River)		
04100010 020	Toussaint Creek	09/22/2006	phosphorus
05040004 020	Wakatomika Creek (headwaters to downstream Brushy Fork)	09/28/2006	bacteria, manganese, iron, aluminum, total dissolved solids, alkalinity
05040004 030	Wakatomika Creek (downstream Brushy Fork to mouth)		

AU Code	AU Name	U.S. EPA Approval Date	Pollutants Allocated, per U.S. EPA[5]
05040001 100	Sugar Creek (headwaters to above Middle Fork Sugar Creek)	05/08/2007	bacteria
05040001 110	South Fork Sugar Creek		
05040001 120	Sugar Creek (upstream Middle Fork to mouth)		
04110003 020	Chagrin River (headwaters to downstream Aurora Branch)	07/10/2007	nutrients (phosphorus and nitrate), bacteria, total suspended solids
04110003 030	Chagrin River (downstream Aurora Branch to mouth)		
05060001 090	Olentangy River (headwaters to downstream Flat Run)	09/19/2007	nutrients (phosphorus), bacteria, total suspended solids
05060001 100	Whetstone Creek		
05060001 110	Olentangy River (downstream Flat Run to downstream Delaware Run); excluding Whetstone Creek		
05060001 120	Olentangy River (downstream Delaware Run to mouth)		
05120101 020	Beaver Creek (Grand Lake St. Marys and tributaries)	09/28/2007	nutrients (phosphorus and nitrate), bacteria
05120101 030	Beaver Creek (downstream Grand Lake St. Marys Dam to mouth)		
05030202 090	Leading Creek	1/9/2008	total dissolved solids, total suspended solids, chlorides
04110001 020	West Branch Black River (headwaters to Black River)	8/20/2008	phosphorus, nitrate, bacteria, total suspended solids
04110001 030	East Branch Black River (headwaters to below Coon Creek)		
04110001 040	East Branch Black River (below Coon Creek to Black River)		
04110001 050	Black River (below East Branch to Lake Erie) and Lake Erie tribs (below Black R. to above Porter Cr)		
05040001 050	Nimishillen Creek	9/25/2008 12/16/2009	sediment, bacteria, phosphorus
04100007 110	Powell Creek	6/18/2009	phosphorus, nitrate-nitrogen, total suspended solids, biological oxygen
04100008 010	Blanchard River (headwaters to downstream Potato Run)	7/2/2009	phosphorus, bacteria, sediment
04100008 020	Blanchard River (downstream Potato Run to upstream Eagle Creek)		
04100008 030	Blanchard River (upstream Eagle Creek to upstream Ottawa Creek)		
04100008 040	Blanchard River (upstream Ottawa Creek to upstream Riley Creek); excluding Blanchard R.		
04100008 050	Riley Creek		
04100008 060	Blanchard River (downstream Riley Creek to mouth); excluding Blanchard R. mainstem		
04100008	Blanchard River (mainstem)		
05060002 070	Salt Creek (headwaters to upstream Queer Creek)	8/12/2009	sediment (bedload), habitat
05060002 080	Middle Fork Salt Creek		
05060002 090	Salt Lick Creek (excluding Middle Fork)		
05060002 100	Salt Creek (upstream Queer Creek to mouth); excluding Little Salt Creek and Middle Fork Salt Creek		
05040001 010	Tuscarawas River (headwaters to downstream Wolf Creek)	9/15/2009	fecal coliform, sediment, phosphorus
05040001 020	Chippewa Creek		
05040001 030	Tuscarawas River (downstream Wolf Creek to downstream Sippo Creek); excluding Chippewa Creek		
05040001 090	Tuscarawas River (downstream Sippo Creek to upstream Sugar Creek); excluding Tuscarawas R. mainstem		

AU Code	AU Name	U.S. EPA Approval Date	Pollutants Allocated, per U.S. EPA[5]
05040001 130	Tuscarawas River (downstream Sugar Cr. to upstream Stillwater Cr.); excluding Tuscarawas R. mainstem		
05040001 180	Tuscarawas River (downstream Stillwater Cr. to upstream Evans Cr.); excluding Tuscarawas R. mainstem		
05040001 190	Tuscarawas River (upstream Evans Creek to mouth); excluding Tuscarawas R. mainstem		
05040001	Tuscarawas River (mainstem)		
05030204 010	Hocking River (headwaters to Enterprise); excluding Rush Creek and Clear Creek	9/25/2009	fecal coliform, total phosphorus, sediment (bedload)
05030204 020	Rush Creek (headwaters to upstream Little Rush Creek)		
05030204 030	Rush Creek (upstream Little Rush Creek to mouth)		
05030204 040	Clear Creek		
05030204 050	Hocking River (Enterprise to upstream Monday Creek); excluding Hocking R. mainstem dst. Duck Creek		
05030204 080	Hocking River (downstream Monday Creek to Athens/RM 33.1); excluding Hocking R. mainstem		
05030204 090	Federal Creek		
05030204 100	Hocking River (downstream Athens/RM 33.1 to mouth); excluding Federal Creek and Hocking R. mainstem		
05030204	Hocking River (mainstem)		
04100009 070	Swan Creek (headwaters to above Blue Creek)	1/6/2010	*E. coli*, total phosphorus, nitrate- nitrogen, total suspended solids, total aluminum, total copper, ammonia, total dissolved solids, dieldrin, strontium, benzo(a)pyrene
04100009 080	Swan Creek (above Blue Creek to Maumee River)	10/25/2010	
05080001 150	Mad River (headwaters to below Kings Creek)	1/26/2010	fecal coliform, sediment (bedload), nitrate
05080001 160	Mad River (below Kings Creek to below Chapman Creek)		
05080001 170	Buck Creek		
05080001 180	Mad River (below Chapman Cr. to above Mud Cr. [except Buck Cr.])		
05080001 190	Mad River (above Mud Cr. to Great Miami River)		
05080002 030	Twin Creek (headwaters to above Bantas Fork)	3/4/2010	fecal coliform, sediment
05080002 040	Twin Creek (above Bantas Fork to Great Miami River)		
05030101 100	Ohio River (downstream Little Beaver Cr to upstream Yellow Creek) (Little Yellow Cr)	3/18/2010	fecal coliform, total phosphorus
05030101 180	Yellow Creek (headwaters to upstream Town Fork)		
05030101 190	Yellow creek (upstream Town Fork to mouth)		
05060001 170	Walnut Creek (headwaters to below Sycamore Creek)	5/4/2010	fecal coliform, sediment
05060001 180	Walnut Creek (below Sycamore Creek to Scioto River)		

Table J-6 —Ohio TMDLs[6] approved by U.S. EPA at the 12-digit hydrologic unit scale.

AU Code	AU Name	U.S. EPA Approval Date	Pollutants Allocated, per U.S. EPA[7]
05080001 09 01 – 06	Headwaters Stillwater River	9/8/2009[8]	phosphorus
05080001 10 01 – 04	Headwaters Greenville Creek		
05080001 11 01 – 03	Mud Creek-Greenville Creek		
05080001 12 01 – 05	Swamp Creek-Stillwater River		
05080001 13 01 – 03	Painter Creek-Stillwater River		
05080001 14 01 – 06	Ludlow Creek-Stillwater River		
05080001 90 02	Stillwater River Mainstem (Greenville Creek to mouth)		
05090201 09 01 – 04	Headwaters White Oak Creek	2/25/2010	fecal coliform, ammonia, total phosphorus, habitat/ total suspended solids, dissolved oxygen, nitrate + nitrite, atrazine
05090201 10 01 – 03	Sterling Run-White Oak Creek		
05090202 06 01 – 06	Headwaters Todd Fork	3/28/2011	*E. coli*, total phosphorus, chemical oxygen demand, sediment, total suspended solids, carbonaceous biochemical oxygen demand
05090202 07 01 – 04	East Fork Todd Fork-Todd Fork		
05090202 08 01 – 04	Turtle Creek-Little Miami River		
05090202 09 01 – 03	O'Bannon Creek-Little Miami River		
05090202 14 01 – 06	Sycamore Creek-Little Miami River		
05090202 90 01	Little Miami River Mainstem (Caesar Creek to O'Bannon Creek)		
05090202 90 02	Little Miami River Mainstem (O'Bannon Creek to Ohio River)		
05040004 06 01 – 06	Salt Creek (Muskingum River watershed)	6/6/2011	*E. coli*
05030103 01 01 – 03	Headwaters Mahoning River	9/28/2011 10/19/2011	*E. coli*, sediment, phosphorus
05030101 02 01 – 04	Deer Creek-Mahoning River		
05030101 03 01 – 06	West Branch Mahoning River-Mahoning River		
05030101 04 01 – 06	Eagle Creek-Mahoning River		
04100010 01 01 – 04	Rocky Ford-Middle Branch Portage River	9/30/2011	*E. coli*, total phosphorus, carbonaceous biochemical oxygen demand, sediment
04100010 02 01 – 05	South Branch Portage River-Middle Branch Portage River		
04100010 03 01 – 02	Upper Portage River		
04100010 04 01 – 02	Middle Portage River		
04100010 05 01 – 02	Lower Portage River-Frontal Lake Erie		
05060002 14 01 – 06	South Fork Scioto Brush Creek	9/30/2011	*E. coli*, phosphorus
05060002 15 01 – 07	Scioto Brush Creek		
05080001 01 01 – 03	Headwaters Great Miami River	3/26/2012	*E. coli*, sediment, nutrients, total dissolved solids
05080001 02 01 – 04	Muchinippi Creek		
05080001 03 01 – 06	Bokengehalas Creek-Great Miami River		
05080001 04 01 – 06	Stoney Creek-Great Miami River		
05080001 05 01 – 03	Headwaters Loramie Creek		
05080001 06 01 – 04	Turtle Creek-Loramie Creek		
04110004 04 01 – 03	Griggs Creek-Mill Creek	4/12/2012	*E. coli*, phosphorus, flow regime
04110004 06 01 – 07	Big Creek-Grand River		

[6] One or more AUs may be included in a TMDL report. The determination is made on a project-by-project basis, at the discretion of Ohio EPA.
[7] The TMDL goal is restoration of the designated use through the attainment of applicable criteria; pollutants listed here were specifically recognized in U.S. EPA decision documents. TMDL reports typically include such parameters for targeting, pollutant load characterization and measuring interim progress and may explore other indicators of watershed condition.
[8] The TMDL was revised for one pollutant.

AU Code	AU Name	U.S. EPA Approval Date	Pollutants Allocated, per U.S. EPA[7]
05060003 01 01 – 03	Headwaters Paint Creek	9/18/2012	*E. coli*, sediment
05060003 02 01 – 02	Sugar Creek		
05060003 03 01 – 05	Headwaters Rattlesnake Creek		
05060003 04 01 – 07	Lees Creek-Rattlesnake Creek		
05060003 05 01 – 05	Rocky Fork		
05060003 06 01 – 03	Indian Creek-Paint Creek		
05060003 07 01 – 04	Buckskin Creek-Paint Creek		
05060003 08 01 – 05	Headwaters North Fork Paint Creek		
05060003 09 01 – 04	Little Creek-North Fork Paint Creek		
05060003 10 01 – 03	Ralston Run-Paint Creek		
05060003 90 01	Paint Creek Mainstem (Paint Creek Lake dam to mouth)		
04100010 07 01 – 06	Cedar Creek-Frontal Lake Erie	9/25/2012	total phosphorus, nitrate + nitrite, ammonia, total suspended solids, *E. coli*
04100009 09 01 – 04	Grassy Creek-Maumee River		
04110004 01 01 – 06	Headwaters Grand River	4/10/2013	*E. coli,* total phosphorus, total kjeldahl nitrogen, ammonia, total dissolved solids,
04110004 02 01 – 03	Rock Creek		
04110004 03 01 – 05	Phelps Creek-Grand River		
04110004 05 01 – 02	Three Brothers Creek-Grand River		
05040004 04 01 – 07	Jonathan Creek	7/10/2013	*E. coli*, acidity
05040004 05 01 – 04	Moxahala Creek		
04100007 03 01 – 06	Upper Ottawa River Mid	4/15/2014	*E. coli,* total phosphorus, sediment
04100007 04 01 – 06	Middle Ottawa River		
04100007 05 01 – 03	Lower Ottawa River		
04100011 01 01 – 03	Lower Sandusky	8/11/2014	*E. coli,* total phosphorus, total suspended solids, nitrate+nitrite
04100011 01 02 – 05	Pickeral Creek-Frontal Sandusky Bay		
04100011 10 01 – 04	Wolf Creek		
04100011 11 01 – 05	Rock Creek - Sandusky River		
04100011 90 01 – 02	Sandusky Mainsteam (Tymochtee Creek to Sandusky Bay)		
04100011 12 01 – 03	Green Creek		
04100011 13 01 – 03	Muskellunge Creek-Sandusky River		
04100011 14 01 – 05	Muddy Creek-Frontal Sandusky Bay		

Table J-7 — Short-term schedule for TMDL development – High priority TMDLs in Lake Erie assessment units

Lake Erie Assessment Unit	Assessment Unit Name	Use Name	Parameter	Parameter Attainment Status	TMDL Priority Ranking
OHLE041202000101	Lake Erie Islands Shoreline (<=3m)	Recreation - Bathing Waters	Algae	Not meeting criteria	High
OHLE041202000101	Lake Erie Islands Shoreline (<=3m)	Water Supply - Public Drinking	Algae	Not meeting criteria	High
OHLE041202000201	Lake Erie Western Basin Shoreline (<=3m)	Recreation - Bathing Waters	Algae	Not meeting criteria	High
OHLE041202000201	Lake Erie Western Basin Shoreline (<=3m)	Water Supply - Public Drinking	Algae	Not meeting criteria	High
OHLE041202000301	Lake Erie Western Basin Open Water (>3m)	Recreation - Bathing Waters	Algae	Not meeting criteria	High
OHLE041202000301	Lake Erie Western Basin Open Water (>3m)	Water Supply - Public Drinking	Algae	Not meeting criteria	High

Table J-8 — Short-term schedule for TMDL development – High priority aquatic life use TMDLs in watershed assessment units

Watershed Assessment Unit	Watershed Assessment Unit Name	Parameter	Parameter Attainment Status	TMDL Priority Ranking
OH041000030204	Lake Da Su An-West Branch Saint Joseph River	Nutrients	Not meeting criteria	High
OH041000030303	Eagle Creek	Nutrients	Not meeting criteria	High
OH041100010301	East Fork of East Branch Black River	Sedimentation/Siltation	Not meeting criteria	High
OH041100010303	Coon Creek-East Branch Black River	Sedimentation/Siltation	Not meeting criteria	High
OH041100010403	Willow Creek	Organic Enrichment	Not meeting criteria	High
OH041100010403	Willow Creek	Sedimentation/Siltation	Not meeting criteria	High
OH041100010403	Willow Creek	Nutrients	Not meeting criteria	High
OH041100010404	Jackson Ditch-East Branch Black River	Sedimentation/Siltation	Not meeting criteria	High
OH041100010501	Charlemont Creek	Nutrient/Eutrophication Biological Indicators	Not meeting criteria	High
OH041100010502	Upper West Branch Black River	Sedimentation/Siltation	Not meeting criteria	High
OH041100010503	Wellington Creek	Nutrients	Not meeting criteria	High
OH041100010504	Middle West Branch Black River	Sedimentation/Siltation	Not meeting criteria	High
OH041100010505	Plum Creek	Sedimentation/Siltation	Not meeting criteria	High
OH041100010506	Lower West Branch Black River	Sedimentation/Siltation	Not meeting criteria	High
OH041100010506	Lower West Branch Black River	Nutrients	Not meeting criteria	High
OH041100010601	French Creek	Nutrient/Eutrophication Biological Indicators	Not meeting criteria	High
OH041100010602	Black River	Specific Conductivity	Not meeting criteria	High
OH041100010602	Black River	Nutrients	Not meeting criteria	High

Table J-9 — Short-term schedule for TMDL development – High priority recreation use TMDLs in watershed assessment units

Watershed Assessment Unit	Watershed Assessment Unit Name	Parameter	Parameter Attainment Status	TMDL Priority Ranking
OH041000010301	Shantee Creek	*E. coli*	Not meeting criteria	High
OH041000010302	Halfway Creek	*E. coli*	Not meeting criteria	High
OH041000010303	Prairie Ditch	*E. coli*	Not meeting criteria	High
OH041000010304	Headwaters Tenmile Creek	*E. coli*	Not meeting criteria	High
OH041000010305	North Tenmile Creek	*E. coli*	Not meeting criteria	High
OH041000010306	Tenmile Creek	*E. coli*	Not meeting criteria	High
OH041000010307	Heldman Ditch-Ottawa River	*E. coli*	Not meeting criteria	High
OH041000010308	Sibley Creek-Ottawa River	*E. coli*	Not meeting criteria	High
OH041000020304	Little Bear Creek-Bear Creek	*E. coli*	Not meeting criteria	High
OH041000030106	Clear Fork-East Branch Saint Joseph River	*E. coli*	Not meeting criteria	High
OH041000030204	Lake Da Su An-West Branch Saint Joseph River	*E. coli*	Not meeting criteria	High
OH041000030301	Nettle Creek	*E. coli*	Not meeting criteria	High
OH041000030302	Cogsworth Cemetary-Saint Joseph River	*E. coli*	Not meeting criteria	High
OH041000030303	Eagle Creek	*E. coli*	Not meeting criteria	High
OH041000030304	Village of Montpelier-Saint Joseph River	*E. coli*	Not meeting criteria	High
OH041000030305	Bear Creek	*E. coli*	Not meeting criteria	High
OH041000030306	West Buffalo Cemetary-Saint Joseph River	*E. coli*	Not meeting criteria	High
OH041000030402	Headwaters Fish Creek	*E. coli*	Not meeting criteria	High
OH041000030406	Cornell Ditch-Fish Creek	*E. coli*	Not meeting criteria	High
OH041000030501	Bluff Run-Saint Joseph River	*E. coli*	Not meeting criteria	High
OH041000030502	Big Run	*E. coli*	Not meeting criteria	High
OH041000030503	Russell Run-Saint Joseph River	*E. coli*	Not meeting criteria	High
OH041000030505	Willow Run-Saint Joseph River	*E. coli*	Not meeting criteria	High
OH041000040101	Muddy Creek	*E. coli*	Not meeting criteria	High
OH041000040102	Center Branch	*E. coli*	Not meeting criteria	High
OH041000040103	East Branch	*E. coli*	Not meeting criteria	High
OH041000040104	Kopp Creek	*E. coli*	Not meeting criteria	High
OH041000040105	Sixmile Creek	*E. coli*	Not meeting criteria	High
OH041000040106	Fourmile Creek-Saint Marys River	*E. coli*	Not meeting criteria	High
OH041000040201	Hussey Creek	*E. coli*	Not meeting criteria	High
OH041000040203	Blierdofer Ditch	*E. coli*	Not meeting criteria	High
OH041000040204	Twelvemile Creek	*E. coli*	Not meeting criteria	High
OH041000040205	Prairie Creek-Saint Marys River	*E. coli*	Not meeting criteria	High
OH041000040301	Little Black Creek	*E. coli*	Not meeting criteria	High
OH041000040302	Black Creek	*E. coli*	Not meeting criteria	High
OH041000040303	Yankee Run-Saint Marys River	*E. coli*	Not meeting criteria	High
OH041000040304	Duck Creek	*E. coli*	Not meeting criteria	High
OH041000040305	Town of Willshire-Saint Marys River	*E. coli*	Not meeting criteria	High
OH041000040401	Twentyseven Mile Creek	*E. coli*	Not meeting criteria	High
OH041000070204	Sixmile Creek-Auglaize River	*E. coli*	Not meeting criteria	High
OH041000070601	Kyle Prairie Creek	*E. coli*	Not meeting criteria	High
OH041000070602	Long Prairie Creek-Little Auglaize River	*E. coli*	Not meeting criteria	High
OH041000070603	Wolf Ditch-Little Auglaize River	*E. coli*	Not meeting criteria	High
OH041000070604	Dry Fork-Little Auglaize River	*E. coli*	Not meeting criteria	High
OH041000070701	Hagerman Creek	*E. coli*	Not meeting criteria	High
OH041000070702	West Branch Prairie Creek	*E. coli*	Not meeting criteria	High
OH041000070802	Upper Town Creek	*E. coli*	Not meeting criteria	High

Watershed Assessment Unit	Watershed Assessment Unit Name	Parameter	Parameter Attainment Status	TMDL Priority Ranking
OH041000070803	Maddox Creek	*E. coli*	Not meeting criteria	High
OH041000070804	Lower Town Creek	*E. coli*	Not meeting criteria	High
OH041000071001	Upper Prairie Creek	*E. coli*	Not meeting criteria	High
OH041000071002	Upper Blue Creek	*E. coli*	Not meeting criteria	High
OH041000071003	Middle Blue Creek	*E. coli*	Not meeting criteria	High
OH041000071004	Lower Blue Creek	*E. coli*	Not meeting criteria	High
OH041000071005	Town of Charloe-Auglaize River	*E. coli*	Not meeting criteria	High
OH041000071103	Lower Powell Creek	*E. coli*	Not meeting criteria	High
OH041000071201	Headwaters Flatrock Creek	*E. coli*	Not meeting criteria	High
OH041000071205	Wildcat Creek-Flatrock Creek	*E. coli*	Not meeting criteria	High
OH041000071206	Big Run-Flatrock Creek	*E. coli*	Not meeting criteria	High
OH041000071207	Little Flatrock Creek	*E. coli*	Not meeting criteria	High
OH041000071208	Sixmile Creek	*E. coli*	Not meeting criteria	High
OH041000071209	Eagle Creek-Auglaize River	*E. coli*	Not meeting criteria	High
OH041000110103	Mills Creek	*E. coli*	Not meeting criteria	High
OH041000110806	Lower Honey Creek	*E. coli*	Not meeting criteria	High
OH041000111203	Flag Run-Green Creek	*E. coli*	Not meeting criteria	High
OH041000111403	Little Muddy Creek	*E. coli*	Not meeting criteria	High
OH041000120103	Southwest Branch Vermilion River	*E. coli*	Not meeting criteria	High
OH041000120204	Town of Vermilion-Vermilion River	*E. coli*	Not meeting criteria	High
OH041000120304	Old Woman Creek	*E. coli*	Not meeting criteria	High
OH041100010301	East Fork of East Branch Black River	*E. coli*	Not meeting criteria	High
OH041100010302	Headwaters West Fork East Branch Black River	*E. coli*	Not meeting criteria	High
OH041100010303	Coon Creek-East Branch Black River	*E. coli*	Not meeting criteria	High
OH041100010401	Town of Litchfield-East Branch Black River	*E. coli*	Not meeting criteria	High
OH041100010402	Salt Creek-East Branch Black River	*E. coli*	Not meeting criteria	High
OH041100010403	Willow Creek	*E. coli*	Not meeting criteria	High
OH041100010404	Jackson Ditch-East Branch Black River	*E. coli*	Not meeting criteria	High
OH041100010501	Charlemont Creek	*E. coli*	Not meeting criteria	High
OH041100010502	Upper West Branch Black River	*E. coli*	Not meeting criteria	High
OH041100010503	Wellington Creek	*E. coli*	Not meeting criteria	High
OH041100010504	Middle West Branch Black River	*E. coli*	Not meeting criteria	High
OH041100010505	Plum Creek	*E. coli*	Not meeting criteria	High
OH041100010506	Lower West Branch Black River	*E. coli*	Not meeting criteria	High
OH041100010601	French Creek	*E. coli*	Not meeting criteria	High
OH041100010602	Black River	*E. coli*	Not meeting criteria	High
OH041100010603	Heider Ditch-Frontal Lake Erie	*E. coli*	Not meeting criteria	High
OH041100020106	Sawyer Brook-Cuyahoga River	*E. coli*	Not meeting criteria	High
OH041100020201	Potter Creek-Breakneck Creek	*E. coli*	Not meeting criteria	High
OH041100020202	Feeder Canal-Breakneck Creek	*E. coli*	Not meeting criteria	High
OH041100020203	Lake Rockwell-Cuyahoga River	*E. coli*	Not meeting criteria	High
OH041100030101	East Branch Ashtabula River	*E. coli*	Not meeting criteria	High
OH041100030102	West Branch Ashtabula River	*E. coli*	Not meeting criteria	High
OH041100030103	Upper Ashtabula River	*E. coli*	Not meeting criteria	High
OH041100030104	Middle Ashtabula River	*E. coli*	Not meeting criteria	High
OH041100030105	Lower Ashtabula River	*E. coli*	Not meeting criteria	High
OH050301010401	East Branch Middle Fork Little Beaver Creek	*E. coli*	Not meeting criteria	High
OH050301010404	Lisbon Creek-Middle Fork Little Beaver Creek	*E. coli*	Not meeting criteria	High
OH050301010502	Headwaters West Fork Little Beaver Creek	*E. coli*	Not meeting criteria	High

Watershed Assessment Unit	Watershed Assessment Unit Name	Parameter	Parameter Attainment Status	TMDL Priority Ranking
OH050301010504	Patterson Creek-West Fork Little Beaver Creek	*E. coli*	Not meeting criteria	High
OH050301010602	Honey Creek	*E. coli*	Not meeting criteria	High
OH050301010605	Headwaters Bull Creek	*E. coli*	Not meeting criteria	High
OH050301010606	Leslie Run-Bull Creek	*E. coli*	Not meeting criteria	High
OH050301010610	Bieler Run-Little Beaver Creek	*E. coli*	Not meeting criteria	High
OH050301010703	Upper North Fork	*E. coli*	Not meeting criteria	High
OH050301010801	Town Fork	*E. coli*	Not meeting criteria	High
OH050301010803	Salt Run-North Fork Yellow Creek	*E. coli*	Not meeting criteria	High
OH050301010804	Hollow Rock Run-Yellow Creek	*E. coli*	Not meeting criteria	High
OH050301011001	Upper Cross Creek	*E. coli*	Not meeting criteria	High
OH050301011002	Salem Creek	*E. coli*	Not meeting criteria	High
OH050301011003	Middle Cross Creek	*E. coli*	Not meeting criteria	High
OH050301011004	McIntyre Creek	*E. coli*	Not meeting criteria	High
OH050301011005	Lower Cross Creek	*E. coli*	Not meeting criteria	High
OH050301020104	Frontal Pymatuning Reservoir	*E. coli*	Not meeting criteria	High
OH050301020301	Headwaters Pymatuning Creek	*E. coli*	Not meeting criteria	High
OH050301020302	Sugar Creek-Pymatuning Creek	*E. coli*	Not meeting criteria	High
OH050301020303	Stratton Creek-Pymatuning Creek	*E. coli*	Not meeting criteria	High
OH050301020304	Booth Run-Pymatuning Creek	*E. coli*	Not meeting criteria	High
OH050301020601	Yankee Run	*E. coli*	Not meeting criteria	High
OH050301020602	Little Yankee Run	*E. coli*	Not meeting criteria	High
OH050301030501	Upper Mosquito Creek	*E. coli*	Not meeting criteria	High
OH050301030502	Middle Mosquito Creek	*E. coli*	Not meeting criteria	High
OH050301030503	Lower Mosquito Creek	*E. coli*	Not meeting criteria	High
OH050301030601	Duck Creek	*E. coli*	Not meeting criteria	High
OH050301030602	Mud Creek	*E. coli*	Not meeting criteria	High
OH050301030603	City of Warren-Mahoning River	*E. coli*	Not meeting criteria	High
OH050301030701	Upper Meander Creek	*E. coli*	Not meeting criteria	High
OH050301030702	Middle Meander Creek	*E. coli*	Not meeting criteria	High
OH050301030705	Little Squaw Creek-Mahoning River	*E. coli*	Not meeting criteria	High
OH050301030801	Headwaters Mill Creek	*E. coli*	Not meeting criteria	High
OH050301030802	Indian Run	*E. coli*	Not meeting criteria	High
OH050301030803	Andersons Run-Mill Creek	*E. coli*	Not meeting criteria	High
OH050301030804	Crab Creek	*E. coli*	Not meeting criteria	High
OH050301030805	Headwaters Yellow Creek	*E. coli*	Not meeting criteria	High
OH050301030806	Burgess Run-Yellow Creek	*E. coli*	Not meeting criteria	High
OH050301030807	Dry Run-Mahoning River	*E. coli*	Not meeting criteria	High
OH050301060202	Middle Fork Short Creek	*E. coli*	Not meeting criteria	High
OH050301060204	Piney Fork	*E. coli*	Not meeting criteria	High
OH050301060205	Perrin Run-Short Creek	*E. coli*	Not meeting criteria	High
OH050301060207	Dry Fork-Short Creek	*E. coli*	Not meeting criteria	High
OH050301060301	Crabapple Creek	*E. coli*	Not meeting criteria	High
OH050301060303	Cox Run-Wheeling Creek	*E. coli*	Not meeting criteria	High
OH050301060304	Flat Run-Wheeling Creek	*E. coli*	Not meeting criteria	High
OH050301060702	Upper McMahon Creek	*E. coli*	Not meeting criteria	High
OH050301060901	North Fork Captina Creek	*E. coli*	Not meeting criteria	High
OH050301060902	South Fork Captina Creek	*E. coli*	Not meeting criteria	High
OH050301060903	Bend Fork	*E. coli*	Not meeting criteria	High
OH050301060904	Piney Creek-Captina Creek	*E. coli*	Not meeting criteria	High

Watershed Assessment Unit	Watershed Assessment Unit Name	Parameter	Parameter Attainment Status	TMDL Priority Ranking
OH050301061201	Rush Run	*E. coli*	Not meeting criteria	High
OH050301061202	Salt Run-Ohio River	*E. coli*	Not meeting criteria	High
OH050301061204	Glenns Run-Ohio River	*E. coli*	Not meeting criteria	High
OH050302010103	Middle Sunfish Creek	*E. coli*	Not meeting criteria	High
OH050302010901	Headwaters West Fork Duck Creek	*E. coli*	Not meeting criteria	High
OH050302011006	Mill Creek-Ohio River	*E. coli*	Not meeting criteria	High
OH050302011009	Cow Creek-Ohio River	*E. coli*	Not meeting criteria	High
OH050302020102	Mile Run-Ohio River	*E. coli*	Not meeting criteria	High
OH050302020103	Headwaters Little Hocking River	*E. coli*	Not meeting criteria	High
OH050302020104	West Branch Little Hocking River	*E. coli*	Not meeting criteria	High
OH050302020105	Little West Branch Little Hocking River-Little Hocking River	*E. coli*	Not meeting criteria	High
OH050302020106	Sandy Creek-Ohio River	*E. coli*	Not meeting criteria	High
OH050302020201	Headwaters West Branch Shade River	*E. coli*	Not meeting criteria	High
OH050302020202	Kingsbury Creek	*E. coli*	Not meeting criteria	High
OH050302020203	Headwaters Middle Branch Shade River	*E. coli*	Not meeting criteria	High
OH050302020204	Elk Run-Middle Branch Shade River	*E. coli*	Not meeting criteria	High
OH050302020205	Walker Run-West Branch Shade River	*E. coli*	Not meeting criteria	High
OH050302020301	Horse Cave Creek	*E. coli*	Not meeting criteria	High
OH050302020302	Headwaters East Branch Shade River	*E. coli*	Not meeting criteria	High
OH050302020303	Big Run-East Branch Shade River	*E. coli*	Not meeting criteria	High
OH050302020304	Spruce Creek-Shade River	*E. coli*	Not meeting criteria	High
OH050302020701	Headwaters Leading Creek	*E. coli*	Not meeting criteria	High
OH050302020704	Little Leading Creek	*E. coli*	Not meeting criteria	High
OH050302020706	Parker Run-Leading Creek	*E. coli*	Not meeting criteria	High
OH050302020802	Groundhog Creek-Ohio River	*E. coli*	Not meeting criteria	High
OH050302020803	Oldtown Creek-Ohio River	*E. coli*	Not meeting criteria	High
OH050302020804	West Creek-Ohio River	*E. coli*	Not meeting criteria	High
OH050302020901	Kyger Creek	*E. coli*	Not meeting criteria	High
OH050302020902	Campaign Creek	*E. coli*	Not meeting criteria	High
OH050302040102	Headwaters Rush Creek	*E. coli*	Not meeting criteria	High
OH050302040301	Headwaters Clear Creek	*E. coli*	Not meeting criteria	High
OH050302040302	Mouth Clear Creek	*E. coli*	Not meeting criteria	High
OH050302040501	Little Monday Creek	*E. coli*	Not meeting criteria	High
OH050302040502	Lost Run-Monday Creek	*E. coli*	Not meeting criteria	High
OH050302040503	Snow Fork	*E. coli*	Not meeting criteria	High
OH050302040504	Kitchen Run-Monday Creek	*E. coli*	Not meeting criteria	High
OH050302041001	Willow Creek-Hocking River	*E. coli*	Not meeting criteria	High
OH050400010401	Conser Run	*E. coli*	Not meeting criteria	High
OH050400010402	Middle Branch Sandy Creek	*E. coli*	Not meeting criteria	High
OH050400010403	Pipes Fork-Still Fork	*E. coli*	Not meeting criteria	High
OH050400010404	Muddy Fork	*E. coli*	Not meeting criteria	High
OH050400010405	Reeds Run-Still Fork	*E. coli*	Not meeting criteria	High
OH050400010406	Headwaters Sandy Creek	*E. coli*	Not meeting criteria	High
OH050400010601	Hugle Run	*E. coli*	Not meeting criteria	High
OH050400010602	Pipe Run	*E. coli*	Not meeting criteria	High
OH050400010603	Black Run	*E. coli*	Not meeting criteria	High
OH050400010604	Little Sandy Creek	*E. coli*	Not meeting criteria	High
OH050400010605	Armstrong Run-Sandy Creek	*E. coli*	Not meeting criteria	High
OH050400010606	Indian Run-Sandy Creek	*E. coli*	Not meeting criteria	High

Watershed Assessment Unit	Watershed Assessment Unit Name	Parameter	Parameter Attainment Status	TMDL Priority Ranking
OH050400011301	Spencer Creek	*E. coli*	Not meeting criteria	High
OH050400011302	Headwaters Stillwater Creek	*E. coli*	Not meeting criteria	High
OH050400011303	Boggs Fork	*E. coli*	Not meeting criteria	High
OH050400011401	Skull Fork	*E. coli*	Not meeting criteria	High
OH050400011402	Brushy Fork	*E. coli*	Not meeting criteria	High
OH050400011403	Craborchard Creek-Stillwater Creek	*E. coli*	Not meeting criteria	High
OH050400011501	Clear Fork	*E. coli*	Not meeting criteria	High
OH050400011502	Standingstone Fork	*E. coli*	Not meeting criteria	High
OH050400011601	Laurel Creek	*E. coli*	Not meeting criteria	High
OH050400011602	Crooked Creek	*E. coli*	Not meeting criteria	High
OH050400011604	Town of Uhrichsville-Stillwater Creek	*E. coli*	Not meeting criteria	High
OH050400030101	Headwaters North Branch Kokosing River	*E. coli*	Not meeting criteria	High
OH050400030102	East Branch Kokosing River	*E. coli*	Not meeting criteria	High
OH050400030201	Headwaters Kokosing River	*E. coli*	Not meeting criteria	High
OH050400030202	Mile Run-Kokosing River	*E. coli*	Not meeting criteria	High
OH050400030203	Granny Creek-Kokosing River	*E. coli*	Not meeting criteria	High
OH050400030302	Armstrong Run-Kokosing River	*E. coli*	Not meeting criteria	High
OH050400030304	Delano Run-Kokosing River	*E. coli*	Not meeting criteria	High
OH050400030305	Little Schenck Creek	*E. coli*	Not meeting criteria	High
OH050400030306	Schenck Creek	*E. coli*	Not meeting criteria	High
OH050400030307	Indianfield Run-Kokosing River	*E. coli*	Not meeting criteria	High
OH050400030401	Little Jelloway Creek	*E. coli*	Not meeting criteria	High
OH050400030402	Jelloway Creek	*E. coli*	Not meeting criteria	High
OH050400030501	Headwaters Killbuck Creek	*E. coli*	Not meeting criteria	High
OH050400030503	Rathburn Run-Little Killbuck Creek	*E. coli*	Not meeting criteria	High
OH050400030504	Cedar Run-Killbuck Creek	*E. coli*	Not meeting criteria	High
OH050400030505	Clear Creek-Killbuck Creek	*E. coli*	Not meeting criteria	High
OH050400030601	Little Apple Creek	*E. coli*	Not meeting criteria	High
OH050400030602	Apple Creek	*E. coli*	Not meeting criteria	High
OH050400030603	Shreve Creek	*E. coli*	Not meeting criteria	High
OH050400030604	Jennings Ditch-Killbuck Creek	*E. coli*	Not meeting criteria	High
OH050400030605	North Branch Salt Creek	*E. coli*	Not meeting criteria	High
OH050400030606	Salt Creek	*E. coli*	Not meeting criteria	High
OH050400030607	Tea Run-Killbuck Creek	*E. coli*	Not meeting criteria	High
OH050400030701	Paint Creek	*E. coli*	Not meeting criteria	High
OH050400030702	Martins Creek	*E. coli*	Not meeting criteria	High
OH050400030703	Honey Run-Killbuck Creek	*E. coli*	Not meeting criteria	High
OH050400030704	Black Creek	*E. coli*	Not meeting criteria	High
OH050400030705	Shrimplin Creek-Killbuck Creek	*E. coli*	Not meeting criteria	High
OH050400030801	Wolf Creek	*E. coli*	Not meeting criteria	High
OH050400030802	Headwaters Doughty Creek	*E. coli*	Not meeting criteria	High
OH050400030803	Bucks Run-Doughty Creek	*E. coli*	Not meeting criteria	High
OH050400030804	Big Run-Killbuck Creek	*E. coli*	Not meeting criteria	High
OH050400030805	Bucklew Run-Killbuck Creek	*E. coli*	Not meeting criteria	High
OH050400030901	Mohawk Creek	*E. coli*	Not meeting criteria	High
OH050400030902	Dutch Run-Walhonding River	*E. coli*	Not meeting criteria	High
OH050400030903	Beaver Run	*E. coli*	Not meeting criteria	High
OH050400030904	Simmons Run	*E. coli*	Not meeting criteria	High
OH050400030905	Darling Run-Walhonding River	*E. coli*	Not meeting criteria	High
OH050400030906	Headwaters Mill Creek	*E. coli*	Not meeting criteria	High

Watershed Assessment Unit	Watershed Assessment Unit Name	Parameter	Parameter Attainment Status	TMDL Priority Ranking
OH050400030907	Spoon Creek-Mill Creek	*E. coli*	Not meeting criteria	High
OH050400030908	Crooked Creek-Walhonding River	*E. coli*	Not meeting criteria	High
OH050400040302	Village of Adams Mills-Muskingum River	*E. coli*	Not meeting criteria	High
OH050400040303	North Branch Symmes Creek	*E. coli*	Not meeting criteria	High
OH050400040304	South Branch Symmes Creek-Symmes Creek	*E. coli*	Not meeting criteria	High
OH050400040305	Blount Run-Muskingum River	*E. coli*	Not meeting criteria	High
OH050400040704	Fourmile Run-Meigs Creek	*E. coli*	Not meeting criteria	High
OH050400040801	Brush Creek	*E. coli*	Not meeting criteria	High
OH050400040802	Flat Run-Muskingum River	*E. coli*	Not meeting criteria	High
OH050400040803	Duncan Run-Muskingum River	*E. coli*	Not meeting criteria	High
OH050400040804	Island Run	*E. coli*	Not meeting criteria	High
OH050400040807	Bald Eagle Run	*E. coli*	Not meeting criteria	High
OH050400040808	Bell Creek-Muskingum River	*E. coli*	Not meeting criteria	High
OH050400040901	South West Branch Wolf Creek	*E. coli*	Not meeting criteria	High
OH050400040902	Headwaters South Branch Wolf Creek	*E. coli*	Not meeting criteria	High
OH050400040903	Plumb Run-South Branch Wolf Creek	*E. coli*	Not meeting criteria	High
OH050400041001	Headwaters West Branch Wolf Creek	*E. coli*	Not meeting criteria	High
OH050400041002	Aldridge Run-West Branch Wolf Creek	*E. coli*	Not meeting criteria	High
OH050400041003	Coal Run	*E. coli*	Not meeting criteria	High
OH050400041004	Hayward Run-Wolf Creek	*E. coli*	Not meeting criteria	High
OH050400041101	Headwaters Olive Green Creek	*E. coli*	Not meeting criteria	High
OH050400041102	Keith Fork	*E. coli*	Not meeting criteria	High
OH050400041103	Little Olive Green Creek	*E. coli*	Not meeting criteria	High
OH050400041104	Reasoners Run-Olive Green Creek	*E. coli*	Not meeting criteria	High
OH050400041202	Rainbow Creek	*E. coli*	Not meeting criteria	High
OH050400041203	Cat Creek-Muskingum River	*E. coli*	Not meeting criteria	High
OH050400041204	Devol Run-Muskingum River	*E. coli*	Not meeting criteria	High
OH050400060101	Otter Fork Licking River	*E. coli*	Not meeting criteria	High
OH050400060102	Headwaters North Fork Licking River	*E. coli*	Not meeting criteria	High
OH050400060103	Sycamore Creek	*E. coli*	Not meeting criteria	High
OH050400060104	Vance Creek-North Fork Licking River	*E. coli*	Not meeting criteria	High
OH050400060201	Lake Fork Licking River	*E. coli*	Not meeting criteria	High
OH050400060202	Clear Fork Licking River	*E. coli*	Not meeting criteria	High
OH050400060204	Dry Creek	*E. coli*	Not meeting criteria	High
OH050400060205	Log Pond Run-North Fork Licking River	*E. coli*	Not meeting criteria	High
OH050400060301	Headwaters Raccoon Creek	*E. coli*	Not meeting criteria	High
OH050400060302	Lobdell Creek	*E. coli*	Not meeting criteria	High
OH050400060303	Moots Run-Raccoon Creek	*E. coli*	Not meeting criteria	High
OH050400060304	Salt Run-Raccoon Creek	*E. coli*	Not meeting criteria	High
OH050400060401	Muddy Fork	*E. coli*	Not meeting criteria	High
OH050400060402	Headwaters South Fork Licking River	*E. coli*	Not meeting criteria	High
OH050400060403	Buckeye Lake	*E. coli*	Not meeting criteria	High
OH050400060404	Buckeye Lake Reservoir Feeder	*E. coli*	Not meeting criteria	High
OH050400060405	Town of Kirkersville-South Fork Licking River	*E. coli*	Not meeting criteria	High
OH050400060406	Bell Run-South Fork Licking River	*E. coli*	Not meeting criteria	High
OH050400060407	Ramp Creek	*E. coli*	Not meeting criteria	High
OH050400060408	Dutch Fork	*E. coli*	Not meeting criteria	High
OH050400060409	Beaver Run-South Fork Licking River	*E. coli*	Not meeting criteria	High
OH050400060501	Claylick Creek	*E. coli*	Not meeting criteria	High
OH050400060502	Lost Run	*E. coli*	Not meeting criteria	High

Watershed Assessment Unit	Watershed Assessment Unit Name	Parameter	Parameter Attainment Status	TMDL Priority Ranking
OH050400060503	Rocky Fork	*E. coli*	Not meeting criteria	High
OH050400060601	Brushy Fork	*E. coli*	Not meeting criteria	High
OH050400060602	Big Run	*E. coli*	Not meeting criteria	High
OH050400060603	Dillon Lake-Licking River	*E. coli*	Not meeting criteria	High
OH050400060604	Timber Run-Licking River	*E. coli*	Not meeting criteria	High
OH050600010701	Headwaters Bokes Creek	*E. coli*	Not meeting criteria	High
OH050600010702	Brush Run-Bokes Creek	*E. coli*	Not meeting criteria	High
OH050600010703	Smith Run-Bokes Creek	*E. coli*	Not meeting criteria	High
OH050600010704	Moors Run-Scioto River	*E. coli*	Not meeting criteria	High
OH050600011201	Eversole Run	*E. coli*	Not meeting criteria	High
OH050600011203	Indian Run	*E. coli*	Not meeting criteria	High
OH050600011204	Hayden Run-Scioto River	*E. coli*	Not meeting criteria	High
OH050600011205	Dry Run-Scioto River	*E. coli*	Not meeting criteria	High
OH050600011802	Tussing Ditch-Walnut Creek	*E. coli*	Not meeting criteria	High
OH050600011804	Little Walnut Creek	*E. coli*	Not meeting criteria	High
OH050600011806	Mud Run-Walnut Creek	*E. coli*	Not meeting criteria	High
OH050600012102	Silver Ditch-Big Darby Creek	*E. coli*	Not meeting criteria	High
OH050600012201	Hellbranch Run	*E. coli*	Not meeting criteria	High
OH050600012202	Gay Run-Big Darby Creek	*E. coli*	Not meeting criteria	High
OH050600012203	Greenbrier Creek-Big Darby Creek	*E. coli*	Not meeting criteria	High
OH050600012204	Lizard Run-Big Darby Creek	*E. coli*	Not meeting criteria	High
OH050600012301	Scioto Big Run	*E. coli*	Not meeting criteria	High
OH050600012302	Kian Run-Scioto River	*E. coli*	Not meeting criteria	High
OH050600012303	Grant Run-Scioto River	*E. coli*	Not meeting criteria	High
OH050600012304	Grove Run-Scioto River	*E. coli*	Not meeting criteria	High
OH050600012305	Dry Run	*E. coli*	Not meeting criteria	High
OH050600020101	Headwaters Deer Creek	*E. coli*	Not meeting criteria	High
OH050600020102	Richmond Ditch-Deer Creek	*E. coli*	Not meeting criteria	High
OH050600020103	Glade Run	*E. coli*	Not meeting criteria	High
OH050600020104	Walnut Run	*E. coli*	Not meeting criteria	High
OH050600020105	Oak Run	*E. coli*	Not meeting criteria	High
OH050600020106	Turkey Run-Deer Creek	*E. coli*	Not meeting criteria	High
OH050600020201	South Fork Bradford Creek-Bradford Creek	*E. coli*	Not meeting criteria	High
OH050600020202	Sugar Run	*E. coli*	Not meeting criteria	High
OH050600020203	Opossum Run	*E. coli*	Not meeting criteria	High
OH050600020204	Town of Mount Sterling-Deer Creek	*E. coli*	Not meeting criteria	High
OH050600020205	Deer Creek Lake-Deer Creek	*E. coli*	Not meeting criteria	High
OH050600020206	Buskirk Creek	*E. coli*	Not meeting criteria	High
OH050600020207	Dear Creek Dam-Deer Creek	*E. coli*	Not meeting criteria	High
OH050600020301	Dry Run	*E. coli*	Not meeting criteria	High
OH050600020302	Hay Run	*E. coli*	Not meeting criteria	High
OH050600020303	Waugh Creek	*E. coli*	Not meeting criteria	High
OH050600020304	State Run-Deer Creek	*E. coli*	Not meeting criteria	High
OH050600020401	Hargus Creek	*E. coli*	Not meeting criteria	High
OH050600020402	Yellowbud Creek	*E. coli*	Not meeting criteria	High
OH050600020403	Lick Run-Scioto River	*E. coli*	Not meeting criteria	High
OH050600020404	Congo Creek	*E. coli*	Not meeting criteria	High
OH050600020405	Scippo Creek	*E. coli*	Not meeting criteria	High
OH050600020406	Blackwater Creek-Scioto River	*E. coli*	Not meeting criteria	High
OH050600020501	Kinnikinnick Creek	*E. coli*	Not meeting criteria	High

Watershed Assessment Unit	Watershed Assessment Unit Name	Parameter	Parameter Attainment Status	TMDL Priority Ranking
OH050600020502	Dry Run-Scioto River	*E. coli*	Not meeting criteria	High
OH050600020503	Lick Run-Scioto River	*E. coli*	Not meeting criteria	High
OH050600020601	Beech Fork	*E. coli*	Not meeting criteria	High
OH050600020602	Headwaters Salt Creek	*E. coli*	Not meeting criteria	High
OH050600020603	Laurel Run	*E. coli*	Not meeting criteria	High
OH050600020604	Pine Creek	*E. coli*	Not meeting criteria	High
OH050600020605	Blue Creek-Salt Creek	*E. coli*	Not meeting criteria	High
OH050600020701	Pigeon Creek	*E. coli*	Not meeting criteria	High
OH050600020702	Middle Fork Salt Creek	*E. coli*	Not meeting criteria	High
OH050600020801	Headwaters Little Salt Creek	*E. coli*	Not meeting criteria	High
OH050600020803	Horse Creek-Little Salt Creek	*E. coli*	Not meeting criteria	High
OH050600020804	Pigeon Creek	*E. coli*	Not meeting criteria	High
OH050600020901	East Fork Queer Creek	*E. coli*	Not meeting criteria	High
OH050600020902	Queer Creek	*E. coli*	Not meeting criteria	High
OH050600020904	Pike Run	*E. coli*	Not meeting criteria	High
OH050600020905	Village of Eagle Mills-Salt Creek	*E. coli*	Not meeting criteria	High
OH050600020906	Poe Run-Salt Creek	*E. coli*	Not meeting criteria	High
OH050600021001	Indian Creek	*E. coli*	Not meeting criteria	High
OH050600021002	Dry Run	*E. coli*	Not meeting criteria	High
OH050600021003	Headwaters Walnut Creek	*E. coli*	Not meeting criteria	High
OH050600021004	Lick Run-Walnut Creek	*E. coli*	Not meeting criteria	High
OH050600021101	Carrs Run	*E. coli*	Not meeting criteria	High
OH050600021102	Left Fork Crooked Creek	*E. coli*	Not meeting criteria	High
OH050600021103	Crooked Creek	*E. coli*	Not meeting criteria	High
OH050600021105	Meadow Run-Scioto River	*E. coli*	Not meeting criteria	High
OH050600021201	Headwaters Sunfish Creek	*E. coli*	Not meeting criteria	High
OH050600021204	Grassy Fork-Sunfish Creek	*E. coli*	Not meeting criteria	High
OH050600021205	Chenoweth Fork	*E. coli*	Not meeting criteria	High
OH050600021206	Leeth Creek-Sunfish Creek	*E. coli*	Not meeting criteria	High
OH050600021302	Headwaters Big Beaver Creek	*E. coli*	Not meeting criteria	High
OH050600021303	Little Beaver Creek-Big Beaver Creek	*E. coli*	Not meeting criteria	High
OH050600021601	Camp Creek	*E. coli*	Not meeting criteria	High
OH050600021603	Bear Creek-Scioto River	*E. coli*	Not meeting criteria	High
OH050600021604	Pond Creek	*E. coli*	Not meeting criteria	High
OH050800010406	Turkeyfoot Creek-Great Miami River	*E. coli*	Not meeting criteria	High
OH050800010701	Leatherwood Creek	*E. coli*	Not meeting criteria	High
OH050800010702	Mosquito Creek	*E. coli*	Not meeting criteria	High
OH050800010703	Brush Creek-Great Miami River	*E. coli*	Not meeting criteria	High
OH050800010704	Rush Creek	*E. coli*	Not meeting criteria	High
OH050800010802	Headwaters Lost Creek	*E. coli*	Not meeting criteria	High
OH050800010901	South Fork Stillwater River	*E. coli*	Not meeting criteria	High
OH050800010903	North Fork Stillwater River	*E. coli*	Not meeting criteria	High
OH050800010904	Boyd Creek	*E. coli*	Not meeting criteria	High
OH050800010905	Woodington Run-Stillwater River	*E. coli*	Not meeting criteria	High
OH050800010906	Town of Beamsville-Stillwater River	*E. coli*	Not meeting criteria	High
OH050800011001	Dismal Creek	*E. coli*	Not meeting criteria	High
OH050800011002	Kraut Creek	*E. coli*	Not meeting criteria	High
OH050800011003	West Branch Greenville Creek	*E. coli*	Not meeting criteria	High
OH050800011004	Headwaters Greenville Creek	*E. coli*	Not meeting criteria	High
OH050800011101	Mud Creek	*E. coli*	Not meeting criteria	High

Watershed Assessment Unit	Watershed Assessment Unit Name	Parameter	Parameter Attainment Status	TMDL Priority Ranking
OH050800011102	Bridge Creek-Greenville Creek	*E. coli*	Not meeting criteria	High
OH050800011103	Dividing Branch-Greenville Creek	*E. coli*	Not meeting criteria	High
OH050800011201	Indian Creek	*E. coli*	Not meeting criteria	High
OH050800011202	Swamp Creek	*E. coli*	Not meeting criteria	High
OH050800011203	Trotters Creek	*E. coli*	Not meeting criteria	High
OH050800011204	Harris Creek	*E. coli*	Not meeting criteria	High
OH050800011205	Town of Covington-Stillwater River	*E. coli*	Not meeting criteria	High
OH050800011301	Little Painter Creek	*E. coli*	Not meeting criteria	High
OH050800011302	Painter Creek	*E. coli*	Not meeting criteria	High
OH050800011401	Brush Creek	*E. coli*	Not meeting criteria	High
OH050800011402	Ludlow Creek	*E. coli*	Not meeting criteria	High
OH050800011403	Brush Creek	*E. coli*	Not meeting criteria	High
OH050800011404	Jones Run-Stillwater River	*E. coli*	Not meeting criteria	High
OH050800011405	Mill Creek-Stillwater River	*E. coli*	Not meeting criteria	High
OH050800011504	Glady Creek-Mad River	*E. coli*	Not meeting criteria	High
OH050800011607	Bogles Run-Mad River	*E. coli*	Not meeting criteria	High
OH050800011802	Pondy Creek-Mad River	*E. coli*	Not meeting criteria	High
OH050800011903	Huffman Dam-Mad River	*E. coli*	Not meeting criteria	High
OH050800012001	East Fork Honey Creek	*E. coli*	Not meeting criteria	High
OH050800012002	West Fork Honey Creek	*E. coli*	Not meeting criteria	High
OH050800012003	Indian Creek	*E. coli*	Not meeting criteria	High
OH050800012004	Pleasant Run-Honey Creek	*E. coli*	Not meeting criteria	High
OH050800012005	Poplar Creek-Great Miami River	*E. coli*	Not meeting criteria	High
OH050800020101	North Branch Wolf Creek	*E. coli*	Not meeting criteria	High
OH050800020102	Headwaters Wolf Creek	*E. coli*	Not meeting criteria	High
OH050800020103	Dry Run-Wolf Creek	*E. coli*	Not meeting criteria	High
OH050800020104	Holes Creek	*E. coli*	Not meeting criteria	High
OH050800020201	Millers Fork	*E. coli*	Not meeting criteria	High
OH050800020202	Headwaters Twin Creek	*E. coli*	Not meeting criteria	High
OH050800020304	Town of Gratis-Twin Creek	*E. coli*	Not meeting criteria	High
OH050800020305	Little Twin Creek	*E. coli*	Not meeting criteria	High
OH050800020401	Headwaters Bear Creek	*E. coli*	Not meeting criteria	High
OH050800020403	Clear Creek	*E. coli*	Not meeting criteria	High
OH050800020502	Paint Creek	*E. coli*	Not meeting criteria	High
OH050800020503	Beasley Run-Sevenmile Creek	*E. coli*	Not meeting criteria	High
OH050800020602	Little Four Mile Creek	*E. coli*	Not meeting criteria	High
OH050800020604	Acton Lake Dam-Four Mile Creek	*E. coli*	Not meeting criteria	High
OH050800020605	Cotton Run-Four Mile Creek	*E. coli*	Not meeting criteria	High
OH050800020704	Dicks Creek	*E. coli*	Not meeting criteria	High
OH050800020803	Beals Run-Indian Creek	*E. coli*	Not meeting criteria	High
OH050800020901	Pleasant Run	*E. coli*	Not meeting criteria	High
OH050800020905	Taylor Creek	*E. coli*	Not meeting criteria	High
OH050901030101	Solida Creek-Ohio River	*E. coli*	Not meeting criteria	High
OH050901030103	Ice Creek	*E. coli*	Not meeting criteria	High
OH050901030106	Ginat Creek	*E. coli*	Not meeting criteria	High
OH050901030107	Grays Branch-Ohio River	*E. coli*	Not meeting criteria	High
OH050901030201	Hales Creek	*E. coli*	Not meeting criteria	High
OH050901030203	Little Pine Creek	*E. coli*	Not meeting criteria	High
OH050901030204	Howard Run-Pine Creek	*E. coli*	Not meeting criteria	High
OH050901030501	Headwaters Little Scioto River	*E. coli*	Not meeting criteria	High

Watershed Assessment Unit	Watershed Assessment Unit Name	Parameter	Parameter Attainment Status	TMDL Priority Ranking
OH050901030502	Sugarcamp Creek	*E. coli*	Not meeting criteria	High
OH050901030504	McDowell Creek-Little Scioto River	*E. coli*	Not meeting criteria	High
OH050901030601	Headwaters Rocky Fork	*E. coli*	Not meeting criteria	High
OH050901030602	Long Run	*E. coli*	Not meeting criteria	High
OH050901030603	McConnel Creek-Rocky Fork	*E. coli*	Not meeting criteria	High
OH050901030604	Frederick Creek	*E. coli*	Not meeting criteria	High
OH050901030606	Munn Run-Ohio River	*E. coli*	Not meeting criteria	High
OH050902010302	Elk Run	*E. coli*	Not meeting criteria	High
OH050902010303	Baker Fork	*E. coli*	Not meeting criteria	High
OH050902010505	Beasley Fork	*E. coli*	Not meeting criteria	High
OH050902010904	Flat Run-North Fork Whiteoak Creek	*E. coli*	Not meeting criteria	High
OH050902011003	Big Run-Whiteoak Creek	*E. coli*	Not meeting criteria	High
OH050902011104	Bullskin Creek	*E. coli*	Not meeting criteria	High
OH050902011106	Bear Creek-Ohio River	*E. coli*	Not meeting criteria	High
OH050902011204	Ferguson Run-Twelvemile Creek	*E. coli*	Not meeting criteria	High
OH050902011206	Tenmile Creek	*E. coli*	Not meeting criteria	High
OH050902011208	Ninemile Creek-Ohio River	*E. coli*	Not meeting criteria	High
OH050902020101	Headwaters Little Miami River	*E. coli*	Not meeting criteria	High
OH050902020102	North Fork Little Miami River	*E. coli*	Not meeting criteria	High
OH050902020103	Buffenbarger Cemetery-Little Miami River	*E. coli*	Not meeting criteria	High
OH050902020104	Yellow Springs Creek-Little Miami River	*E. coli*	Not meeting criteria	High
OH050902020201	North Fork Massies Creek	*E. coli*	Not meeting criteria	High
OH050902020202	South Fork Massies Creek	*E. coli*	Not meeting criteria	High
OH050902020203	Massies Creek	*E. coli*	Not meeting criteria	High
OH050902020204	Little Beaver Creek	*E. coli*	Not meeting criteria	High
OH050902020205	Beaver Creek	*E. coli*	Not meeting criteria	High
OH050902020206	Shawnee Creek-Little Miami River	*E. coli*	Not meeting criteria	High
OH050902020301	Headwaters Anderson Fork	*E. coli*	Not meeting criteria	High
OH050902020302	Painters Run-Anderson Fork	*E. coli*	Not meeting criteria	High
OH050902020303	Mouth Anderson Fork	*E. coli*	Not meeting criteria	High
OH050902020401	North Branch Caesar Creek	*E. coli*	Not meeting criteria	High
OH050902020402	Upper Caesar Creek	*E. coli*	Not meeting criteria	High
OH050902020403	South Branch Caesar Creek	*E. coli*	Not meeting criteria	High
OH050902020501	Sugar Creek	*E. coli*	Not meeting criteria	High
OH050902020502	Town of Bellbrook-Little Miami River	*E. coli*	Not meeting criteria	High
OH050902020503	Glady Run	*E. coli*	Not meeting criteria	High
OH050902020504	Newman Run-Little Miami River	*E. coli*	Not meeting criteria	High
OH050902020902	O'Bannon Creek	*E. coli*	Not meeting criteria	High
OH050902020903	Salt Run-Little Miami River	*E. coli*	Not meeting criteria	High
OH050902021001	Turtle Creek	*E. coli*	Not meeting criteria	High
OH050902021002	Headwaters East Fork Little Miami River	*E. coli*	Not meeting criteria	High
OH050902021004	Anthony Run-Dodson Creek	*E. coli*	Not meeting criteria	High
OH050902021005	West Fork East Fork Little Miami River	*E. coli*	Not meeting criteria	High
OH050902021006	Glady Creek-East Fork Little Miami River	*E. coli*	Not meeting criteria	High
OH050902021101	Solomon Run-East Fork Little Miami River	*E. coli*	Not meeting criteria	High
OH050902021102	Fivemile Creek-East Fork Little Miami River	*E. coli*	Not meeting criteria	High
OH050902021202	Cloverlick Creek	*E. coli*	Not meeting criteria	High
OH050902021204	Backbone Creek-East Fork Little Miami River	*E. coli*	Not meeting criteria	High
OH050902021303	Moores Fork-Stonelick Creek	*E. coli*	Not meeting criteria	High
OH050902021304	Lick Fork-Stonelick Creek	*E. coli*	Not meeting criteria	High

Watershed Assessment Unit	Watershed Assessment Unit Name	Parameter	Parameter Attainment Status	TMDL Priority Ranking
OH050902021305	Salt Run-East Fork Little Miami River	*E. coli*	Not meeting criteria	High
OH050902021401	Sycamore Creek	*E. coli*	Not meeting criteria	High
OH050902030101	East Fork Mill Creek-Mill Creek	*E. coli*	Not meeting criteria	High
OH050902030103	Sharon Creek-Mill Creek	*E. coli*	Not meeting criteria	High
OH050902030203	Muddy Creek	*E. coli*	Not meeting criteria	High

Section

K

Category 4B Demonstrations

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Ohio EPA uses the 4B alternative in conjunction with total maximum daily loads (TMDLs) to efficiently address water quality impairments. Because Ohio EPA typically completes TMDLs on a watershed basis, it makes sense to include discussion of 4B demonstrations in TMDL reports as approval of a TMDL is sought, then to report on progress in integrated reports. As new 4B demonstrations accumulate, they will be collected into future integrated reports. Progress on individual 4B projects will be reported in subsequent integrated reports until the impairment is resolved or until a decision is made that the 4B will not be sufficient to address the impairment and a TMDL is scheduled.

K1. Category 4B Demonstrations Contained in Approved Ohio TMDLs to Date

This section presents the 4B discussions as they appeared in the respective TMDL reports, with updates on status. Text that is not original to this report appears with a border to the left; plans and dates are not changed from the original, so some text may appear to be outdated. The table below shows the locations of the original 4B demonstrations as included with TMDL reports and where updates are included in this report.

Name of Watershed	WAU	Location of 4B in TMDL Report	Date of TMDL Approval	4B Status
Big Run-WhiteOak Creek	OH050902011003	Appendix H	2/25/2010	Closed
Lesley Run-Twin Creek	OH050800020205	Appendix B	3/4/2010	On-going
Sycamore Creek	OH050600011704	Appendix B	5/4/2010	Closed
Brandywine Creek - Great Miami River	OH050800010306	Appendix E	3/26/2012	On-going

Projects included in the 2012 Integrated Report

After completion of the *2010 Integrated Report* and before completion of the *2014 Integrated Report*, Ohio submitted three 4B alternatives as part of approved TMDLs: Town Run (White Oak Creek Watershed TMDL Report); Twin Creek (Twin Creek Watershed TMDL Report); and Sycamore Creek (Walnut Creek Watershed TMDL Report). Together with TMDLs approved for other impairments to the aquatic life use, the 4B work should bring the streams into attainment with water quality standards.

Town Run (Big Run - White Oak Creek Watershed)

Impairment of biological water quality standards and high ammonia concentrations have been measured in Town Run, a tributary to White Oak Creek at river mile (RM) 6.95. Town Run is a high gradient bedrock substrate headwater stream that is fed by ground water. The City of Georgetown WWTP discharges to Town Run at RM 0.80. The biological impairment and high ammonia concentrations are resulting from the Georgetown WWTP effluent discharge. Ohio EPA proposes that this impairment be handled through a category 4B alternative instead of a total maximum daily load (TMDL). Further details are discussed below. Additional information is available in the main text of the TMDL and in the biological and water quality study publication.

Ohio EPA is addressing the phosphorus and nitrate-nitrite impairments via a TMDL analysis expected to be completed in 2009.

Identification of segment and statement of problem causing the impairment

Ohio EPA measured the water quality in the White Oak Creek watershed in 2006, collecting biological, chemical and physical data. The following paragraph from Ohio EPA's water quality report summarizes the problems observed in Town Run:

"Biological sampling in Town Run (RM 0.9 in 2008) found a marginally good community of macroinvertebrates and a reproducing population of the cold water indicator two-lined salamander upstream from the Georgetown WWTP discharge (RM 0.80). Downstream from the WWTP discharge (RM 0.7 in 2008) the macroinvertebrate community was very poor and there was no observed reproduction of the two-lined salamander. High concentrations of Ammonia-N (median of 3.24 mg/L), Phosphorus-T (median of 3.04 mg/L), and Nitrate-Nitrite-N (median of 6.39 mg/L) were recorded downstream from the WWTP discharge in 2006." (***epa.ohio.gov/portals/35/documents/WhiteOakCreekTSD2006.pdf***, p. 9)

During Ohio EPA's water quality survey of the White Oak Creek watershed in 2006, five sets of chemical samples were collected at sites upstream and downstream of the Georgetown WWTP. Upstream of the WWTP, the median value for ammonia was 0.05 mg/L. Downstream of the WWTP, the ammonia value was 3.24 mg/L. The median ammonia value of the Georgetown WWTP effluent was 4.07 mg/L.

Biological impact was significant, resulting in a listing on the 303(d) list. Upstream of the WWTP, Town Run is fully attaining the Aquatic Life Use, but downstream of the WWTP the use is not attained.

Description of pollution controls and how they will achieve water quality standards

Town Run is effluent-dominated downstream from the Georgetown WWTP. The drainage area upstream of the WWTP discharge is only 1.3 square miles.

The median flow of the Georgetown WWTP from 2002-2006 was 0.47 million gallons per day (MGD) with 23.8 percent (420/1764) of the flow dates being over the facility's design capacity of 0.80 MGD.

The critical period for ammonia in such an effluent-dominated stream is late summer when ambient temperatures are highest and stream flows are lowest. Calculating a load to meet water quality standards during the summer is protective of other time periods. A winter load is calculated to meet the needs of Ohio EPA's permitting program.

By reducing the effluent concentration of ammonia from Georgetown, water quality standards for ammonia and the Aquatic Life Use in Town Run are expected to be met.

The nonpoint source load is zero because of the limited drainage area above the WWTP's discharge point. At the critical condition, no upstream flow would be expected.

Loadings for point sources can be calculated using a mass-balance equation. In this case, since upstream flow equals zero, the allocation for the Georgetown WWTP is equal to the water quality standards (WQS). The ammonia WQS for exceptional warmwater habitat (EWH)/coldwater habitat (CWH) is 0.6 mg/L during summer and 1.93 mg/L during winter.

Thus, the load allocated to the Georgetown WWTP = (WQS) x (Effluent flow) x (conversion factor):

> Summer: 0.6 mg/L x 0.8 MGD x (factor) = 1.82 kg/day
> Winter: 1.93 mg/L x 0.8 MGD x (factor) = 5.85 kg/day

An estimate or projection of the time when WQS will be met

After the Georgetown WWTP meets the new ammonia permit limit (by November 2014), the ammonia limit should be met. The water body is expected to respond to the load reduction, but recovery will not be instantaneous. Ohio EPA will monitor the stream for recovery.

Schedule for implementing pollution controls

The Georgetown NPDES permit expires on February 28, 2010. Prior to that date, Ohio EPA will issue a new permit with a 30-day average limit on effluent ammonia of 0.6 mg/L (summer) and 1.93 mg/L (winter).

Officials at the Georgetown WWTP have contracted with an engineering firm and they have produced a plan to upgrade the WWTP to achieve compliance with the new ammonia limits. The WWTP upgrade will be completed by November 2014.

Ohio EPA will monitor Georgetown's progress toward meeting the permit limits by following up on the construction activity and reviewing monthly effluent reports.

Monitoring plan to track effectiveness of pollution controls

As a part of its NPDES permit, the Georgetown WWTP measures and reports ammonia concentrations in its effluent and in Town Run upstream and downstream of its discharge point. The sampling will be conducted twice per week and reported monthly. The facility's monthly discharge monitoring reports are reviewed by permit staff in Ohio EPA's Southwest District Office. Ohio EPA staff will also conduct facility inspections approximately annually.

After the Georgetown ammonia reductions have been in place for at least one year, Ohio EPA will revisit the area to determine if progress toward meeting the Aquatic Life Use is being made. This work would follow Ohio EPA's protocol for sampling the aquatic biology and chemistry.

Commitment to revise pollution controls, as necessary

The SWDO surface water manager will initiate a reexamination of the implementation strategy if significant progress is not being made by the end of the next NPDES permit cycle for Georgetown.

Ohio EPA will report on the progress of any approved 4B in future 303(d) lists.

First Report on Town Run 4B Demonstration (*2012 Integrated Report*)

A permit was issued to the Georgetown WWTP effective on September 1, 2010. Final effluent limitations for ammonia are 0.60 mg/L (summer monthly average) and 1.76 mg/L (winter monthly average). Those limits must be met beginning on September 1, 2014.

Second Report on Town Run 4B Demonstration (*2014 Integrated Report*)

The Georgetown WWTP is under construction in fall 2013 to make improvements to meet the new nitrogen-ammonia and total phosphorus limits. The upgrade is scheduled to be completed by September 1, 2014, but upgrades are currently ahead of schedule. Follow-up sampling will take place in 2015 or 2016, so results will likely be available for the 2018 Integrated Report.

Third Report on Town Run 4B Demonstration (*2016 Integrated Report*)

The Georgetown WWTP did not complete its scheduled upgrades by September 1, 2014, due to contractor issues. The WWTP upgrades were completed on July 1, 2015, and all treatment improvements should help meet the nitrogen-ammonia and total phosphorus limits. Follow up sampling will take place in 2016.

Fourth Report on Town Run 4B Demonstration (*2018 Integrated Report*)

The Georgetown WWTP experienced some violations of the phosphorus and ammonia limits of their permit during 2015-2016. These violations occurred because of either high flows; high influent concentrations of phosphorus due to sludge dewatering; and/or learning curve on the adjustment of the ferric chloride feed to these factors. The below table details the violations for phosphorous and ammonia that have occurred since the NPDES permit effective date of November 1, 2015. The facility has been in compliance with the permit limits from September 2016 to September 2017. Ohio EPA conducted follow up sampling in Town Run in 2016. The results indicate the stream is still impaired and are being evaluated for further restoration actions.

Violations for phosphorus and ammonia since 11/1/2015 (effective date)

Reporting Period	Parameter	Limit Type	Limit	Reported Value	Violation Date
Jul 2015	Phosphorus, Total (P)	30D Qty	4.2 kg/day	4.25711 kg/day	7/1/2015
Jul 2015	Phosphorus, Total (P)	7D Qty	6.3 kg/day	6.67065 kg/day	7/22/2015
Aug 2015	Nitrogen, Ammonia (NH3)	7D Conc	0.90 mg/L	0.94333 mg/L	8/15/2015
Sep 2015	Phosphorus, Total (P)	30D Conc	1.0 mg/L	1.0475 mg/L	9/1/2015
Sep 2015	Phosphorus, Total (P)	7D Conc	1.5 mg/L	1.8 mg/L	9/22/2015
Dec 2015	Phosphorus, Total (P)	7D Qty	6.3 kg/day	6.7105 kg/day	12/1/2015
Jul 2016	Nitrogen, Ammonia (NH3)	7D Qty	3.8 kg/day	4.4491 kg/day	7/22/2016
Jul 2016	Phosphorus, Total (P)	7D Qty	6.3 kg/day	6.41985 kg/day	7/22/2016
Aug 2016	Phosphorus, Total (P)	7D Qty	6.3 kg/day	7.42163 kg/day	8/15/2016

Fifth Report on Town Run 4B Demonstration (*2020 Integrated Report*)

The Georgetown WWTP is still experiencing some periodic violations of the phosphorus and ammonia limits of their permit during 2018-2019. Some violations were due to an extended cold spell and extreme cold limiting the effectiveness of nitrifying bacteria. Others were due to heavy rains causing high flows. The results of the 2016 survey indicate that the stream is no longer impaired by ammonia. At, this time the 4B demonstration for ammonia can be closed out.

Violations for phosphorus and ammonia October 2017- May 2019

Reporting Period	Parameter	Limit Type	Limit	Reported Value	Violation Date
January 2018	Nitrogen, Ammonia (NH3)	7D Conc	2.64 mg/L	2.74667	1/8/2018
January 2018	Nitrogen, Ammonia (NH3)	30D Conc	1.76 mg/L	1.90917	1/1/2018
February 2018	Nitrogen, Ammonia (NH3)	7D Qty	11.0 kg/day	13.5025	2/8/2018
February 2018	Nitrogen, Ammonia (NH3)	7D Qty	11.0kg/day	13.4247	2/15/2018
February 2018	Nitrogen, Ammonia (NH3)	30D Qty	7.4 kg/day	10.0353	2/1/2018
November 2018	Phosphorus, Total (P)	7D Qty	6.3 kg/day	7.10785	11/1/2018
May 2019	Phosphorus, Total (P)	30D Conc	1.0 mg/L	1.0075	5/1/2019

Lesley Run - Twin Creek

The main stem of Twin Creek (in assessment unit 05080002 030) was identified as impaired by total phosphorus during the field sampling in 2005; organic enrichment was later added to the list of causes upon further investigation in the summer of 2009. Upstream of the WWTP in the City of Lewisburg, the stream was in attainment of its aquatic life use. Downstream of the treatment plant, the aquatic life in the stream was partially supporting the use. The City of Lewisburg WWTP discharges to Twin Creek at river mile (RM) 35.2. No impairment to Twin Creek upstream of Lewisburg or downstream at RM 33.6 was found. The biological impairment (between the WWTP and RM 33.6) is resulting from the Lewisburg WWTP effluent discharge. Ohio EPA proposes that this impairment be handled through a category 4B alternative instead of a total maximum daily load (TMDL). Further details are discussed below. Additional information is available in the main text of the TMDL and in the forthcoming biological and water quality study publication.

Identification of segment and statement of problem causing the impairment

An Invertebrate Community Index (ICI) of 38 was garnered at RM 34.9, which was below the Exceptional Warmwater Habitat (EWH) criterion. In 2005, excessive phosphorus due to either the Lewisburg WWTP, herbicide runoff from an upstream municipal park, or contaminated storm water was considered potential contributors to this impairment. However, new information obtained during an inspection of the Lewisburg WWTP in September 2009 revealed that biological solids were being discharged directly into Twin Creek from the wastewater plant. Gray and brown sewage sludge was observed in Twin Creek from Lewisburg's outfall downstream to at least the Salem Road Bridge, with thick algal mats coating the heaviest deposits. Black anoxic muck was also observed under many of the substrates. Because of these new findings, it is apparent that nutrient enrichment was a secondary cause of impairment to Twin Creek at RM 34.9. Organic enrichment attributable to improper solids management at the Lewisburg WWTP is now considered the primary cause of impairment to the macroinvertebrate community at RM 34.9.

Further information regarding the 2005 findings is available in the Biological and Water Quality Study of Twin Creek and Select Tributaries 2005, available on Ohio EPA web site (***epa.ohio.gov/portals/35/documents/TwinCreek2007TSD.pdf***). This report will be amended to reflect the 2009 observations.

Ohio EPA included nutrient enrichment for this assessment unit in the *2008 Integrated Report* (303(d) list), available at (***epa.ohio.gov/dsw/tmdl/2008IntReport/2008OhioIntegratedReport.aspx***). The *2010 Integrated Report* will add organic enrichment as an impairment cause for this assessment unit.

The primary issue with the Lewisburg WWTP is that biological solids or sludge is making its way into the stream resulting in the stream conditions described above. Sludge in the creek will contribute nutrients (phosphorus) and bacteria as well as smothering the substrate. Biological solids are largely made up of sewage treatment micro-organisms, living and dead. Micro-organisms contain phosphorus compounds (e.g., nucleic acids, ADP, ATP). Biosolids from WWTPs are frequently used as an agricultural soil amendment with some fertilizer value. Lewisburg's 2008 annual sewage sludge report included the following analyses results (on a dry weight basis): TKN = 35,000 mg/kg; NH_3-N = 8590 mg/kg; and phosphorus = 15,900 mg/kg.

This information demonstrates there is a nutrient content to Lewisburg's sludge.

In September 2009 there appeared to be both structural and operational problems. Clarified water was overflowing only portions of the clarifier weirs; this may have been caused by the weirs not being level and sections of the weir being clogged with algae. The net result was that the clarifiers were being short circuited. Compounding the problem was the fact that Lewisburg was not wasting sufficient amounts of sludge from the clarifiers to the sludge digesters. This resulted in old sludge denitrifying and floating to the surface of the clarifiers, which was then discharged to Twin Creek. Plant operating logs also documented difficulty in balancing flow between the two clarifiers during rain, which compromised clarifier performance still further. The appearance of the aeration tanks indicated that the mixed liquor suspended solids were being maintained at higher levels than necessary and that the biological solids in the tank were old.

Description of pollution controls and how they will achieve water quality standards

The Village of Lewisburg operates a sewer collection system and a wastewater treatment facility that handles domestic and industrial sewage for a population of about 1,800. The Lewisburg WWTP holds a NPDES permit (1PB00019*HD).

Lewisburg has been reporting substantial compliance with its NPDES effluent limits over the life of the current permit. Ohio EPA now believes that compositing effluent samples using multiple grab samples (as allowed by the NPDES permit) did not provide a true reflection of effluent quality. Recent inspections have also revealed quality control issues with the sampling and analyses, casting doubt on the reported effluent data.

Lewisburg has been required in inspection reports and Notices of Violation to take actions to eliminate the problems resulting in discharge of solids to Twin Creek. The Village has since utilized the assistance of Ohio EPA's Compliance Assistance Unit and has engaged an engineering firm that is reviewing plant operations.

Lewisburg began implementing changes recommended by Ohio EPA's Compliance Assistance Unit in November 2009.

Ohio EPA anticipates that the operational problems contributing to the discharge of solids can be resolved well before the NPDES permit is renewed in April 2010. Ohio EPA NPDES permits staff from the Southwest District office will closely monitor operational changes.

The draft renewal of the Lewisburg WWTP NPDES permit, (scheduled for issuance April 1, 2010) contains additional requirements that will address the impairment in Twin Creek downstream of the WWTP discharge. Ohio EPA intends to revisit the Twin Creek sampling sites in Lewisburg in September 2011. If the operational improvements have been properly implemented and yet the ICI at RM 34.9 cannot be demonstrated to comply with EWH criteria due to organic enrichment from the WWTP, Lewisburg will be required by a modification to its NPDES permit to comply with a schedule that leads to compliance with an initial total phosphorus limit of 1.0 mg/L by April 2015.

A complicating factor is that Preble County, at the request of the Village of Lewisburg, cleared bank vegetation and removed gravel bars and woody debris from the creek in the vicinity of RM 34.9 during the summer of 2009. This work was done to protect the Knapke Lane bridge pier and reduce bank erosion. It is unlikely that the target ICI score can be attained at that location unless the creek habitat is restored.

A loading analysis to address the organic enrichment impairment is not necessary given the scope of the operational problems at the Lewisburg WWTP and the ability of the facility to correct the problem.

Although it is difficult to predict how much of the secondary nutrient enrichment problem is associated with the operational problems, a simple analysis of chemical data provides guidance on point source loading.

The 2005 data collected in Twin Creek by Ohio EPA show a significant change in total phosphorus concentration at the WWTP's entry into the stream. The median in-stream concentration of total phosphorus upstream of Lewisburg's outfall was 0.038 mg/L. The median in-stream concentration downstream of Lewisburg was 0.239 mg/L. The exceptional warmwater habitat (EWH) in-stream target from *Association Between Nutrients, Habitat, and the Aquatic Biota of Ohio Rivers and Streams* is 0.08 mg/L (***epa.ohio.gov/portals/35/documents/assoc_load.pdf***).

A simple loading analysis using the five sets of samples collected in 2005 yields the following total phosphorus loads:

Stream capacity (based on 0.08 mg/L target) = 1.303 kg/d Margin of safety (5 percent) = 0.065 kg/d

Load allocation (from nonpoint sources) = 0.856 kg/d Wasteload allocation (Lewisburg WWTP) = 0.382 kg/d

A wasteload allocation of 0.382 kg/d equates to an effluent concentration of 0.39 mg/L total phosphorus at the WWTP's design flow. The 95th percentile of effluent total phosphorus reported by Lewisburg over the current permit is 3.69 mg/L, although there is uncertainty because of concerns with laboratory practices.

Ohio EPA intends to apply an initial phosphorus limit of 1.0 mg/L that would be triggered if fixing the WWTP's operational problems fails to result in attainment of WQS. While the loading analysis results indicate that this limit will not meet the phosphorus target concentration, it does represent a significant (approximately 72 percent) reduction in phosphorus load from the Lewisburg WWTP. This limit should provide enough in-stream nutrient reduction to improve aquatic life while imposing achievable NPDES limits. Any further reduction in effluent limits should be evaluated after this limit is being attained and an evaluation of the biological condition of the stream has been completed.

An estimate or projection of the time when WQS will be met

The next NPDES permit for Lewisburg's WWTP will be issued in 2010. Ohio EPA anticipates that Lewisburg will be able to eliminate the discharge of biosolids to the creek before the permit is renewed. This will significantly reduce the solids and nutrient load to the creek. Ohio EPA expects that the stream will respond to improved operation within two years of making the changes.

Ohio EPA proposes to measure the ICI at RM 34.9 by September 2011. If the ICI does not comply with EWH criterion due to organic enrichment at that time Lewisburg will be given three years to come into compliance with a permit limit for TP of 1.0 mg/L (that is, by April 2015).

Schedule for implementing pollution controls

Any compliance schedule placed in the NPDES permit will allow three years (2012-2015) to implement new controls to reduce TP in effluent if the ICI score is not in attainment by September 2011. It is expected that operational improvements to reduce organic enrichment and, if needed, effluent controls to reduce TP, will sufficiently improve water quality within five years such that the macroinvertebrate community will be able to recover to full attainment.

Monitoring plan to track effectiveness of pollution controls

The City of Lewisburg WWTP is required to submit monthly Discharge Monitoring Reports for effluent quality from the WWTP and upstream and downstream of its discharge point.

The renewed permit will require 24-hour flow composited effluent sampling at Lewisburg, which will provide a much-improved picture of effluent quality. The operations assistance provided by Ohio EPA to the WWTP will include attention to quality control issues so that concerns with past facility monitoring will be resolved.

Following Ohio EPA's Permit Guidance, at upstream and downstream stations, pH, dissolved oxygen and temperature will be monitored once per month year-round. Total phosphorus, bacteria and ammonia–nitrogen will be added to both upstream and downstream stations at a frequency of once per month during the summer season.

The facility's monthly discharge monitoring reports are reviewed by permit staff in Ohio EPA's Southwest District Office. Ohio EPA staff will also conduct unannounced facility inspections at least twice annually until all identified operational and process changes have been completed.

After the Lewisburg operational improvements have been in place for at least one year, Ohio EPA will return to monitor Twin Creek at RM 34.9 by September 2011 to determine if progress toward meeting the Aquatic Life Use is being made. This work would follow Ohio EPA's protocol for sampling the aquatic biology and chemistry. If sufficient progress is not being made, Ohio EPA will evaluate the options available under NPDES authority, including additional operations assistance and enforcement.

Ohio EPA will report progress in its integrated report until the impairment has been eliminated.

Commitment to revise pollution controls, as necessary

The SWDO surface water manager will initiate a reexamination of the implementation strategy if significant progress is not being made by the end of the next NPDES permit cycle for Lewisburg.

Ohio EPA will report on the progress of any approved 4B in future 303(d) lists.

First Report on Twin Creek 4B Demonstration (*2012 Integrated Report*)

Addressing organic solids issues at the Lewisburg WWTP has proven more difficult than originally anticipated. Ohio EPA is continuing to work with the WWTP to address compliance issues.

Second Report on Twin Creek 4B Demonstration (*2014 Integrated Report*)

A permit to install for WWTP improvements was approved on July 10, 2013. The approved upgrades include a fine spiral screen and continuously backwashed tertiary filters. The Village has been awarded Ohio Public Works Commission funding for completion of the project. The expected date of completion of construction is July 2014. The improvements are expected to reduce the solids being discharged from the treatment plant and therefore the associated organic enrichment, which is expected in turn to result in attainment of the designated aquatic life use.

Third Report on Twin Creek 4B Demonstration (*2016 Integrated Report*)

The following upgrades have been completed and are on-line:

- A new fine spiral screen;
- Upgrade of the existing circular aeration tanks to a zoned system to support biological nutrient removal (BNR) processes;
- All new mechanical equipment installed in the existing clarifiers;
- Addition of tertiary moving bed sand filters;
- Ultraviolet (UV) disinfection upgrade;
- New generator;
- Sludge pumping upgrades for both the return activated sludge (RAS) and waste activated sludge (WAS); and
- Sludge storage improvements.

Operators are trying to optimize the WWTP operations with small changes such as fine bubble diffusers in the sludge holding tank. There have been challenges trying to meet the 1 mg/L total phosphorus limit. Ohio EPA's Compliance Assistance Unit (CAU) has assisted with the operations at the plant. Other TMDL requirements were incorporated into the facility's NPDES permit when the permit was modified in April 2015.

Fourth Report on Twin Creek 4B Demonstration (*2018 Integrated Report*)

During the timeframe of January 1, 2016, through September 19, 2017, Lewisburg WWTP has been operating at an average of 106.7 percent of the designed flow rate. The average Phosphorus, Total (P) for 2016 was 1.26 mg/L and the average for 2017 (to date 9/19/17) is 1.12 mg/L. Improvements have been made, but the Lewisburg WWTP is still inconsistent in compliance for Phosphorus, Total (P).

Through the NPDES permit, Ohio EPA has given the Village of Lewisburg until March 1, 2020, to complete further necessary improvements for complying with the total phosphorus limit. Ohio EPA follow-up monitoring in Twin Creek should not proceed until construction of the additional improvements have been completed.

Fifth Report on Twin Creek 4B Demonstration (*2020 Integrated Report*)

Lewisburg WWTP performed a pilot study in 2017 to determine if chemical or biological phosphorus removal would be more effective at the plant. Results showed chemical removal was most effective, and in August 2018 a permit to install was approved to add a chemical feed system at Lewisburg WWTP to meet permit limits for phosphorus. The Lewisburg WWTP NPDES permit is up for renewal in 2020. No phosphorus violations were reported from October 2017 to May 2019.

Sycamore Creek (Walnut Creek Watershed)

Problem causing the impairment.

Ohio EPA measured the water quality in the Walnut Creek watershed in 2005, collecting biological, chemical and physical data. Impairment of biological water quality standards (OAC 3745-1-07) was measured at six sites on Sycamore Creek, a tributary to Walnut Creek.

Three sites in Sycamore Creek met the biological criteria and three did not. The most upstream site (river mile (RM) 12.2) was impaired due to organic enrichment (probably due to septic systems), and then two sites (RMs 9.6 and 4.7) met the criteria. The next two sites (RM 4.18 (Hill Road) and 2.6 (Busey Road) partially met the criteria. The stream recovered to fully meet the criteria at the most downstream site (RM 0.2).

The City of Pickerington WWTP discharges to Sycamore Creek at RM 4.35. No impairment to Sycamore Creek immediately upstream of Pickerington or downstream of RM 2.6 was measured. The biological impairment is resulting from the Pickerington WWTP effluent discharge.

The site at RM 4.18 only partially met the WWH biological criteria. The fish community was in very good condition while qualitative invertebrate sampling revealed a low-to-fair community. This is likely caused by the proximity of the Pickerington WWTP to this sampling station and documented chronic toxicity of effluent to *Ceriodaphnia* (Ohio EPA, 2006, Bioassay Report 06-3447-C). Both fish and invertebrate communities improved at Sycamore Creek sites downstream of RM 4.18.

The chemical water quality criterion for total dissolved solids (1500 mg/L) was exceeded in Sycamore Creek downstream of the Pickerington WWTP (2110, 1950, 1710 mg/L).

Link between the source of the problem and the specific listed impairments

High total dissolved solids (TDS) concentrations result from the Pickerington WWTP discharge. The WWTP accepts a waste stream from the Pickerington water treatment facility which uses a Zeolite process to treat drinking water. This process creates a wastewater high in dissolved solids which the WWTP does not effectively treat. This high dissolved solids waste gets passed through the WWTP and into Sycamore Creek.

Bioassay testing results on the Pickerington effluent and mixing zone have confirmed TDS-related impairment to the invertebrate community as well by demonstrating negative effects (immotility, death) to *Ceriodaphnia*. Mayfly populations found downstream of the WWTP are impaired revealing only 2 mayfly taxa (compared with 8 found upstream of the discharge point) plus a variety of TDS tolerant and facultative invertebrates as well. The two sites upstream and the site at the mouth were in full attainment of WWH biological standards with moderately good (qualitative assessments at RM 9.6 and 4.7) to exceptional (ICI=50 at RM 0.2) communities of invertebrates.

Low fish MIWB scores found at RM 2.6 provide further evidence of a problem with excessive TDS in-stream contributing to reduced numbers of fish.

Further information regarding the 2005 findings is available in the Biological and Water Quality Study of Walnut Creek and Select Tributaries 2005, available on Ohio EPA web site (***epa.ohio.gov/portals/35/documents/WalnutCreek2005TSD.pdf***).

Ohio EPA included total dissolved solids for this assessment unit in the *2008 Integrated Report* (303(d) list), available at (***epa.ohio.gov/dsw/tmdl/2008IntReport/2008OhioIntegratedReport.aspx***).

Description of pollution controls and how they will achieve water quality standards

The City of Pickerington operates a sewer collection system and a wastewater treatment facility and is regulated under a NPDES permit (4PB00017*LD).

The existing Pickerington wastewater plant has an average daily design flow of 1.6 MGD. Pickerington is expanding its wastewater plant to an average design flow of 3.2 MGD to accommodate new development within its service area. Along with other improvements, for solids handling the City will construct two new aerobic digesters and new sludge drying beds for storage.

The permit requires the development of a method to control discharges of elevated dissolved solids. Both interim and final effluent concentrations of dissolved solids are present in the permit (calculated by wasteload allocation) which should serve to ameliorate the violations of the WQS in Sycamore Creek (see the NPDES permit fact sheet for the Pickerington WWTP: ***wwwapp.epa.ohio.gov/dsw/permits/permit_list.php***).

Point and nonpoint source loadings that will achieve water quality standards.

The allowable loading is based on the beneficial uses assigned to the receiving waterbody in OAC 3745-1. Dischargers are allocated pollutant loadings/concentrations based on the Ohio Water Quality Standards (OAC 3745-1). TDS was allocated using the mass-balance method, using the following general equation:

Discharger WLA = [(downstream flow x WQS) - (upstream flow x background concentration)] / discharge flow.

See the permit fact sheet (***wwwapp.epa.ohio.gov/dsw/permits/permit_list.php***) for details.

The continuous discharge from the WWTP into Sycamore Creek at low stream flows during the summer represent the critical condition for the aquatic ecosystem. The WLA calculation accounts for the nonpoint source load in the equation. See the permit fact sheet (***wwwapp.epa.ohio.gov/dsw/permits/permit_list.php***) for details.

All loads in kg/d	Existing WWTP Flow	Expanded WWTP Flow
TMDL	11,022	20,433
LA	666	666
WLA	10,356	19,767

An estimate or projection of the time when WQS will be met

The NPDES permit requires the City of Pickerington to meet the final effluent limitations in the permit within 25 months of the effective date of the permit (in 2010). WQS should be met soon after as macroinvertebrates can recover quickly (6 months to a year) once the stressor is removed.

Schedule for implementing pollution controls

Reference the NPDES permit fact sheet for scheduling information (***wwwapp.epa.ohio.gov/dsw/permits/permit_list.php***).

Monitoring plan to track effectiveness of pollution controls

The City of Pickerington WWTP is required to submit monthly Discharge Monitoring Reports for effluent quality from the WWTP and upstream and downstream of its discharge point.

The permit requires 24-hour composite sampling for TDS of the WWTP effluent, to be completed three times per week year-round. In addition, the WWTP will collect an ambient grab sample for TDS at sites both upstream and downstream of the discharge into Sycamore Creek; they will use a laboratory of their choice.

The facility's monthly discharge monitoring reports are reviewed by permit staff in Ohio EPA's Central District Office. Ohio EPA staff will also conduct unannounced facility inspections until all identified operational and process changes have been completed.

Water chemistry and macroinvertebrate community health will be monitored following the construction and new plant start up. After the Pickerington WWTP improvements have been in place for at least one year, Ohio EPA will return to monitor Sycamore Creek to determine if progress toward meeting the Aquatic Life Use is being made. This work would follow Ohio EPA's protocol for sampling the aquatic biology and chemistry. If sufficient progress is not being made, Ohio EPA will evaluate the options available under NPDES authority, including operations assistance and enforcement.

Ohio EPA will report progress in its integrated report until the impairment has been eliminated.

Future monitoring

City of Pickerington (far field monitoring for TDS in the NPDES permit, analysis by a laboratory of their choice) and Ohio EPA DSW, CDO WQ (chemistry, with analysis by Ohio EPA DES) and EAS (macroinvertebrates).

Cost estimates

Five work days for two people to sample chemistry, 1 work day for two people to do qualitative macroinvertebrate monitoring, and the associated standard lab costs for TDS samples.

Analysis of the results and annual reporting

Ohio EPA, CDO, DSW WQ staff will examine both data from Ohio EPA sampling and that generated by Pickerington. EAS macroinvertebrate staff will analyze their own data. Ohio EPA CDO staff will complete the reporting necessary for this 4B demonstration.

Revising the implementation strategy and corresponding pollution controls

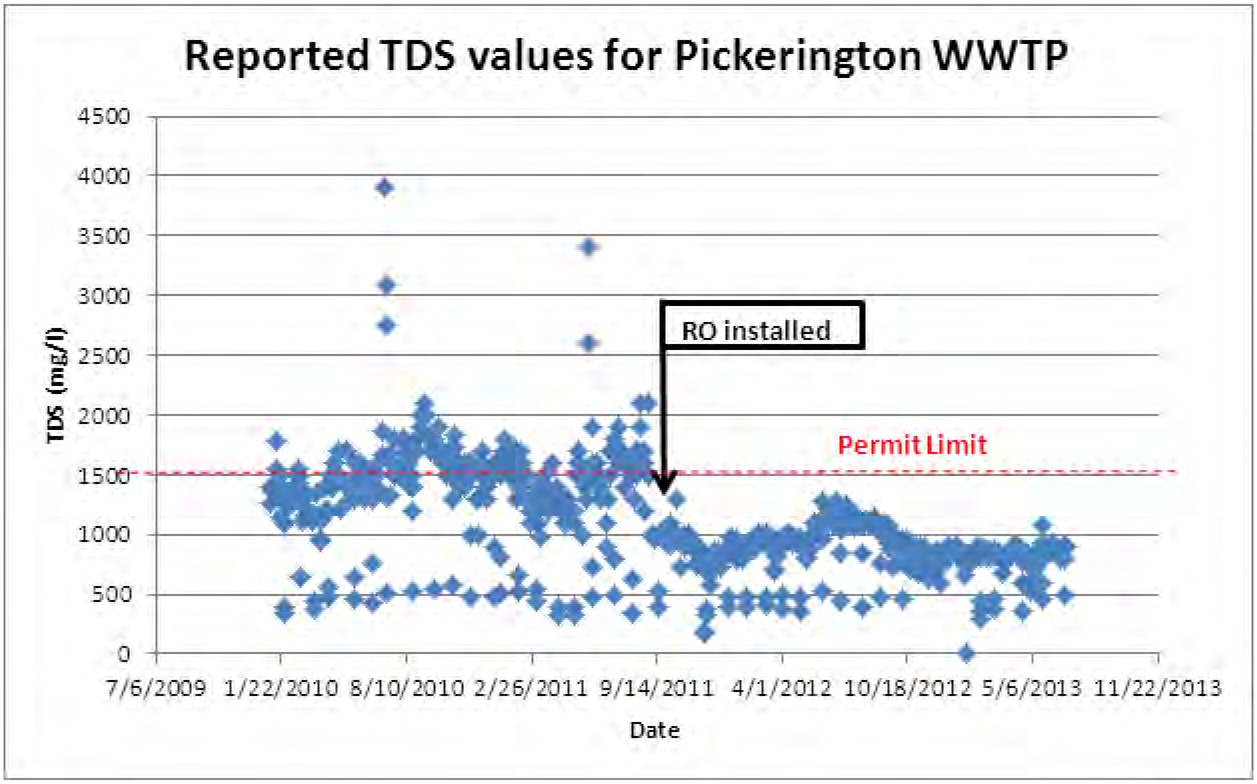
The CDO surface water manager will initiate a reexamination of the implementation strategy if significant progress is not being made by the end of the next NPDES permit cycle for Pickerington.

First Report on Sycamore Creek 4B Demonstration (*2012 Integrated Report*)

The City of Pickerington replaced their ion exchange water treatment plant with a reverse osmosis water treatment plant in order to address the NPDES TDS effluent limit violations at their WWTP. Very soon after the new plant began operating, Pickerington returned to compliance with the NPDES permit conditions implementing the water quality criterion for TDS. Ohio EPA expects this to eliminate any impairment in Sycamore Creek.

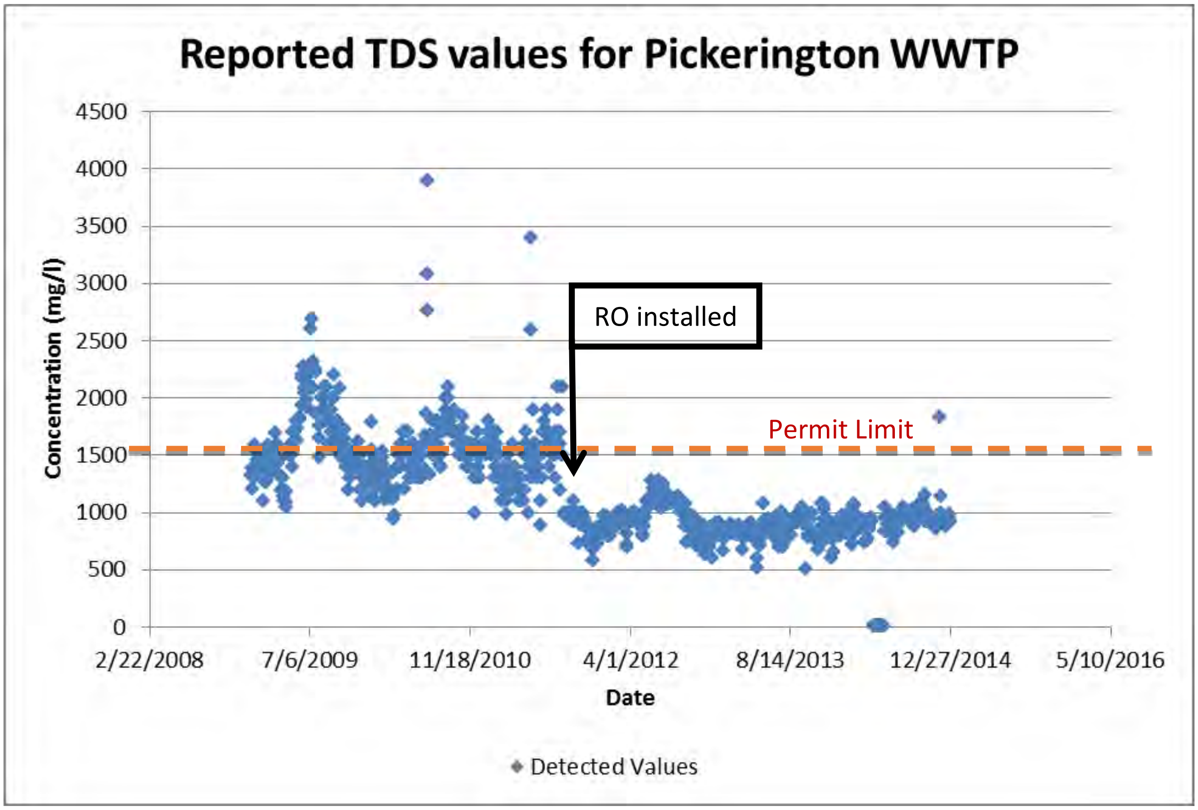
Second Report on Sycamore Creek 4B Demonstration (*2014 Integrated Report*)

Sycamore Creek has not been reevaluated for aquatic life use support since the *2012 Integrated Report*. However, the facility has not reported any TDS violations since the reverse osmosis system was put in place (see figure below).



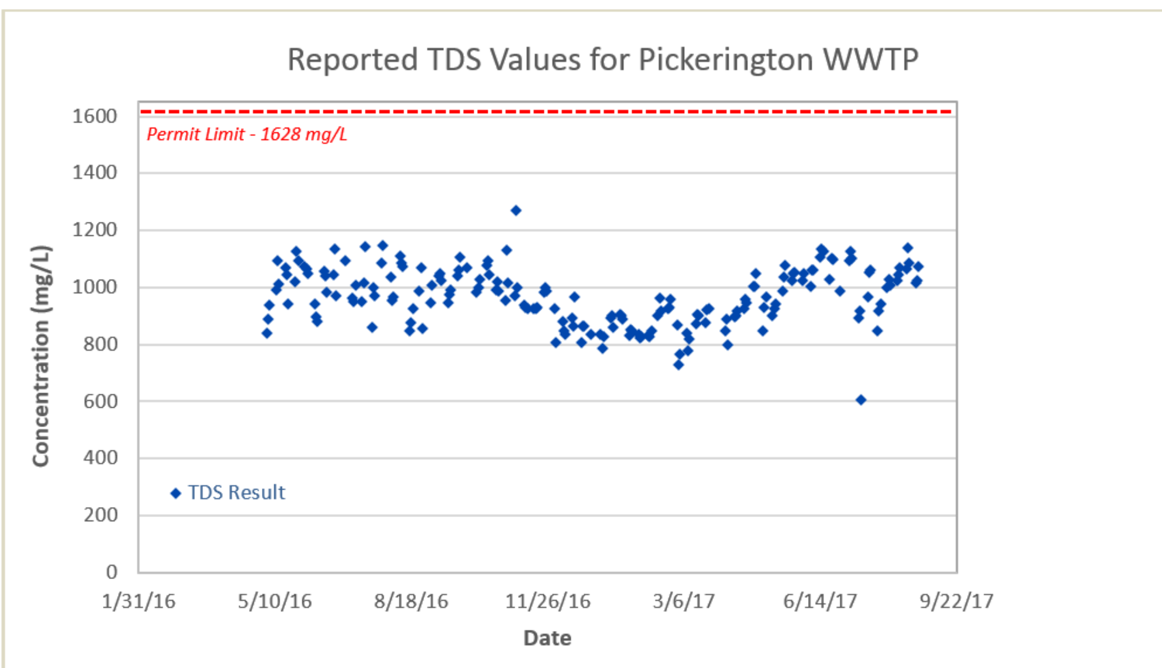
Third Report on Sycamore Creek 4B Demonstration (*2016 Integrated Report*)

Sycamore Creek has not been reevaluated for aquatic life use support since the *2012 Integrated Report*. However, the facility has not reported any TDS violations since the reverse osmosis (RO) system was put in place (see figure below). Pickerington's permit limit for TDS is 1,628 mg/L. On November 24, 2014, an exceedance of the permit limit for TDS was detected; however, the limit is based on a monthly average, which for November was approximately 1022 mg/L, well below the established limit. Therefore, compliance with the permit was maintained.



Fourth Report on Sycamore Creek 4B Demonstration (*2018 Integrated Report*)

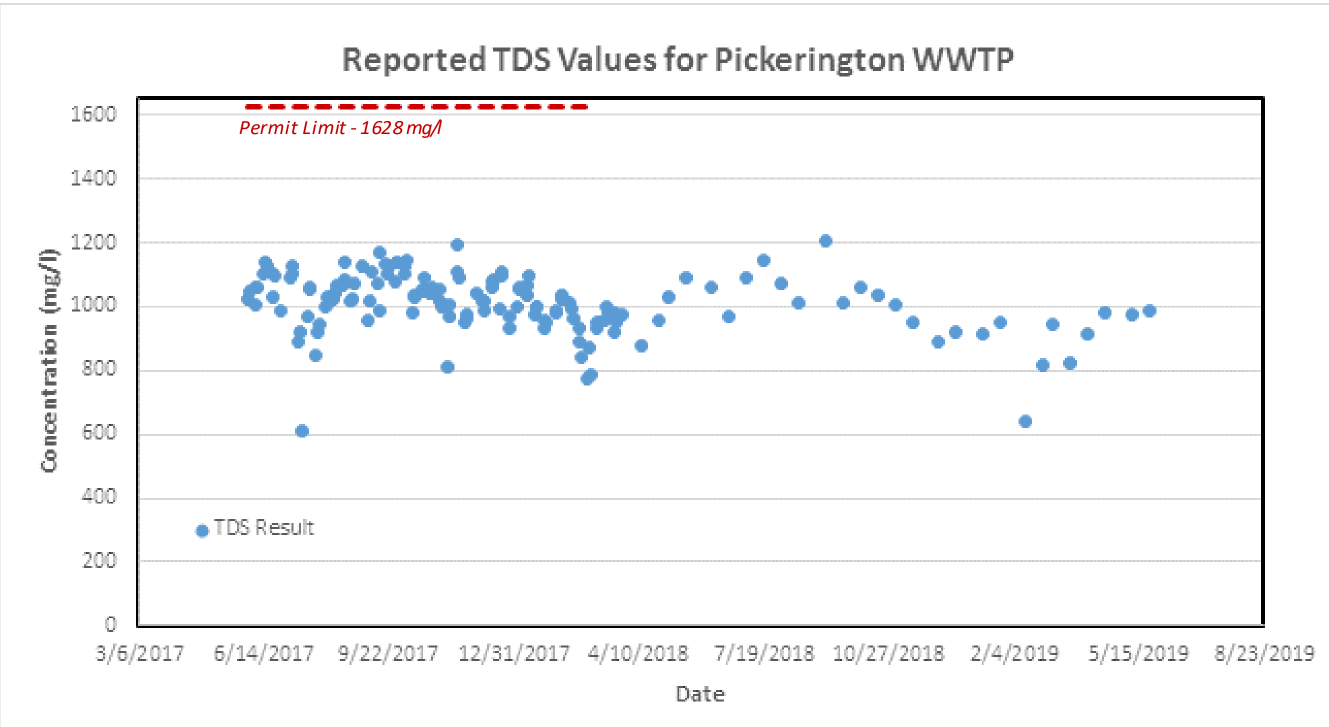
Since the Third Report on Sycamore Creek 4B Demonstration (*2016 Integrated Report*), there has been no exceedances of the Pickerington WWTP NPDES permit limit for total dissolved solids (TDS). Pickerington's permit limit for TDS is 1,628 mg/L. The mean concentration for TDS from May 2016 to September 2017 is 968 mg/L. Compliance with the permit is being maintained. Follow up monitoring by Ohio EPA is anticipated for the 2019 field season.



Fifth Report on Sycamore Creek 4B Demonstration (*2020 Integrated Report*)

Since the fourth report on Sycamore Creek 4B demonstration (2018 Integrated Report) there have been no exceedance of the Pickerington WWTP NPDES permit limit for TDS for the permit that expired in March 2017. The permit renewal effective in April 2018 contained monitor only conditions for TDS. The mean concentration for TDS from June 2016 to May 2019 is 1009 mg/l. TDS concentrations continue to be maintained at levels necessary to protect water quality for that parameter.

In the summer of 2019, Ohio EPA staff conducted a water quality study of Sycamore Creek to update the 4B characterization and aquatic life use attainment status. Additional details on the 2019 Sycamore Creek study may be found at ***epa.ohio.gov/Portals/35/lakeerie/Sycamore_Ck_QAPP_Final.pdf***. The results of the study indicate that Sycamore Creek is now in full attainment as demonstrated in the following table. This closes out the 4B demonstration for TDS.

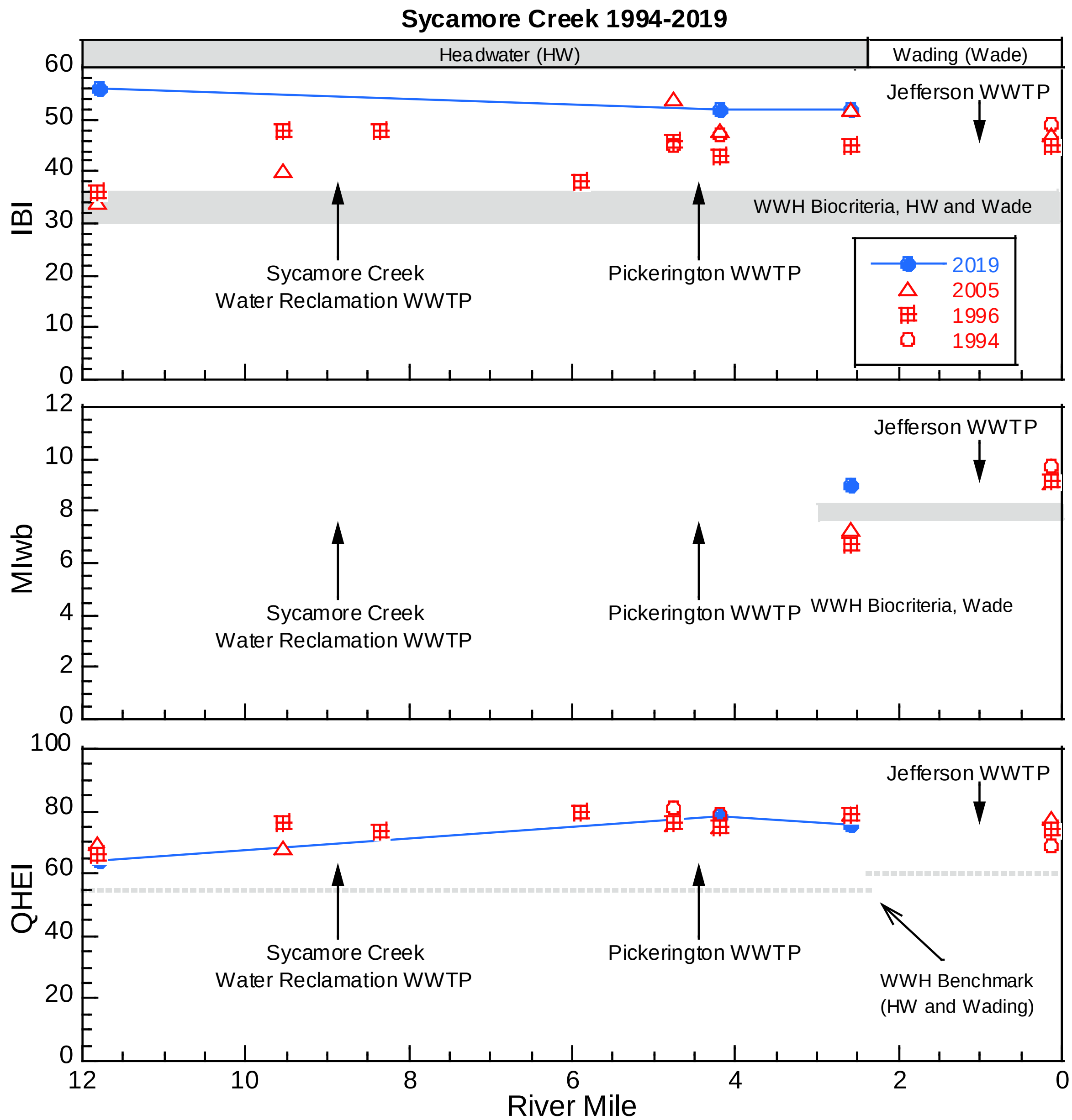


Aquatic Life Use Attainment, Sycamore Creek, 1996-2019

Station	Station Name	HUC12	RM	DA	Attain	IBI	MIWB	ICI	QHEI
Sycamore Creek 2019 (02-085-000)									
Eastern Corn Belt Plain Ecoregion (ECBP)									
V08W64	AT ST. RT. 204	05060001 17 04	11.81	4.7	Full	56	NA	G	64.3
V08S29	DST. PICKERINGTON WWTP @ HILL RD. (LOWER)	05060001 17 04	4.18	19.4	Full	52	NA	G	78.5
V08S28	DST. PICKERINGTON @ BUSEY RD.	05060001 17 04	2.60	20.5	Full	52	9.0	48	75.5
2005									
V08W64	AT ST. RT. 204	05060001 17 04	11.81	4.7	Non	34*	NA	F*	69.5
V08S41	NE OF PICKERINGTON @ REFUGEE RD.	05060001 17 04	9.55	8.7	Full	40	NA	MG	68.5
V08S30	UPST. PICKERINGTON WWTP @ HILL RD. (UPPER)	05060001 17 04	4.75	17.3	Full	54	NA	MG	76.0
V08S29	DST. PICKERINGTON WWTP @ HILL RD. (LOWER)	05060001 17 04	4.18	19.4	Partial	48	NA	LF*	75.0
V08S28	DST. PICKERINGTON @ BUSEY RD.	05060001 17 04	2.60	20.5	Partial	52	7.3*	36	79.0
V08S39	NEAR MOUTH @ BENADUM RD.	05060001 17 04	0.13	23.5	Full	47	9.1	50	77.5
1996									
V08W64	AT ST. RT. 204	05060001 17 06	11.8	4.7	Full	36ns	NA	MGns	66.5
V08S41	NE OF PICKERINGTON @ REFUGEE RD.	05060001 17 07	9.55	8.7	Full	48	NA	G	76.5
V08W63	AT STEMEN RD.	05060001 17 08	8.36	9.7	Full	48	NA	VG	73.5
200209	AT PICKERINGTON, DST SR 256	05060001 12 06	5.9	14.8	Full	38ns	NA	VG	79.5
V08S30	UPST. PICKERINGTON WWTP @ HILL RD. (UPPER)	05060001 17 10	4.75	17.3	Full	46	NA	44	76.5
V08S29	DST. PICKERINGTON WWTP @ HILL RD. (LOWER)	05060001 17 11	4.18	19.4	Full	43	NA	36	75.0
V08S28	DST. PICKERINGTON @ BUSEY RD.	05060001 17 12	2.6	20.5	Partial	45	6.7*	42	79.0
V08S39	NEAR MOUTH @ BENADUM RD.	05060001 17 13	0.13	23.5	Full	45	9.2	40	74.5

ns - Nonsignificant departure from prescribed biocriterion (≤4 IBI or ICI units or ≤0.5 MIwb units)
* - Significant departure from prescribed biocriterion (>4 IBI or ICI units or >0.5 MIwb units)
ICI narrative equivalents: E - exceptional, VG - very good, G - good, MG - marginally good, F - fair (low and high), Poor - P, and VP - very poor.

Ecoregion Biocriteria: Eastern Corn Belt Plain (ECBP)			
Index - Site Type	EWH	WWH	MWH
IBI - Headwater/Wading	50	40	24
MIwb - Wading	9.4	8.3	6.2
ICI	46	36	22



Projects included in the 2014 Integrated Report

After completion of the *2012 Integrated Report* and before completion of the *2016 Integrated Report*, Ohio submitted one 4B alternative as part of an approved TMDL: Great Miami River (upper) watershed TMDL Report. Together with TMDLs approved for other impairments to the aquatic life use, the 4B work should bring the river into attainment with water quality standards.

Brandywine Creek - Great Miami River (Great Miami River (upper) Watershed)

Ohio EPA is clarifying in the 2020 IR that this 4B demonstration applies to impairments in WAU OH050800010306 Brandywine Creek – Great Miami River.

During the 2008 field survey, Ohio EPA identified that the Great Miami River at river mile 158.15 was partially supporting its warmwater habitat aquatic life use. Identified causes of impairment included habitat alteration, siltation, flow alteration, and organic enrichment/dissolved oxygen (DO). Ohio EPA proposes that the organic enrichment/DO cause of impairment be handled through a category 4B alternative instead of a total maximum daily load (TMDL). Further details are discussed below.

Additional information is available in the main text of the TMDL report and in the biological and water quality study publication (***epa.ohio.gov/portals/35/documents/Upper_GMR_TSD_2008.pdf***).

Identification of segment and statement of problem causing the impairment

The Great Miami River upstream of the WWTP is in partial attainment of its aquatic life use because of habitat alteration, siltation, flow alteration, and organic enrichment/DO. Organic enrichment/DO is partially attributed to an upstream WWTP at RM 158.15 – Indian Lake/Logan County (OH0036641).

Other sources include Indian Lake overflow of warm water in summer months and sediment from Cherokee Mans Run. Downstream of the WWTP, the river is sluggish from the effects of the low head dam impoundment in Quincy. This sluggish water is not allowing effective re-aeration of river water, which exacerbates the DO stresses caused by nutrient enrichment and sewage solids from the Logan County Indian Lake WWTP. The result is partial attainment downstream at Notestine Road (RM 153.45). Proper treatment of wastewater will help to alleviate the impacts to this stressed section of the Great Miami River.

The Logan County Indian Lake Sanitary Sewer District has an Infiltration/Inflow (I/I) problem in the collection system. Hydraulic surges during storm events overwhelm the collection and treatment systems causing a secondary treatment bypass. The result is the discharge of undertreated sewage with ammonia and solids entering the Great Miami River at RM 158.15, contributing to partial attainment due to low macroinvertebrate performance at Notestine Road (RM 153.45).

Description of pollution controls and how they will achieve water quality standards

On March 6, 2009 the Logan County Board of Commissioners was issued a NPDES permit number 1PK00002*KD for the discharge of treated wastewater to the Great Miami River. This permit includes a compliance schedule for the elimination of a secondary treatment system bypass. This bypass allows for the discharge of primary treated wastewater to go directly to the Great Miami River. The bypass contributes to additional organic and nutrient loadings to the river. The permit compliance schedule address both phase 1 and phase 2 projects designed to eliminate secondary treatment system bypasses at the plant. The phase 1 projects also will address several collection system overflows. The schedule requires completion of phase 1 projects by no later than July 1, 2011. The phase 2 projects are scheduled for completion by no later than July 1, 2016. On June 26, 2007 Permit to Install (PTI) 597728 was issued to the Logan County Water Pollution Control District. This PTI includes the following upgrades: a new 24” force main and lift station in the slough area; new influent fine screens; a new equalization tank (1.55 million gallons); conversion of existing primary clarifiers to equalization (0.5 million gallons); a new UV disinfection system; conversion of the anaerobic digesters to aerobic digester; and the addition of a new belt press and septage receiving station. The majority of the phase 1 projects were competed in early 2010. With the completion of this work the number of bypasses and collection system overflows has been reduced significantly. This will result in a reduction of loadings to the Great Miami River. With the completion of the phase 2 upgrades, all discharges from the plant will need to meet the water quality standards. This should eliminate any water quality impacts downstream resulting from treatment plant discharges.

Aquatic life use was assessed during the summer of 2008 while the WWTP facility was undergoing construction improvements (entitled Phase I). To address one of the causes of impairment, discharge monitoring report (DMR) data and a violations history from this facility were explored for any recognizable changes in performance before and after completion of Phase I. Other causes and sources of impairment (i.e., siltation, habitat alteration) are addressed in the TMDL project report under loading development.

Phase I construction was completed in late December 2009. The quantitative analysis contained herein contrasts the Indian Lake WWTP performance prior to (January 2005 to December 2009) and following (January 2010 to May 2011) completion of Phase I construction. To summarize, the comparison shows the following changes:

- Reduction in nutrient concentrations for final outfall (station 001) based on review of total phosphorus, ammonia, and nitrite/nitrate effluent data;
- Increase in influent (station 601) concentration of carbonaceous BOD (CBOD) and total suspended solids (TSS);
- Decrease in TSS spikes from final outfall (station 001);
- Reduction in number of bypass occurrences around secondary treatment (station 602); and
- Reduction in number of limit violations (TSS, ammonia, and pH) for final outfall (station 001).

While the improvements in effluent quality and WWTP operations are clearly manifest in 2010, they are somewhat confounded in 2011 due to anomalous meteorological and hydrological conditions within February through May. The upper GMR basin received considerable rainfall and experienced correspondingly high stream flow during late winter to mid spring 2011. Figure E-1 shows a frequency distribution of flow magnitude by percent exceedance for the GMR at Sidney OH for a record of over 25 years of daily flow. This gage is located 28 miles (river miles) downstream of the WWTP outfall. Flows during this period were consistently in the high percentile of non-exceedance. Flow produced from these rain events were exceeded 15 percent or lower over time (or *not* exceeded 85 percent or higher over time). Hence, some of unexpected results (discussed below by topic) following completion of Phase I construction can be explained by these anomalous high flows experienced within the WWTP collection area.

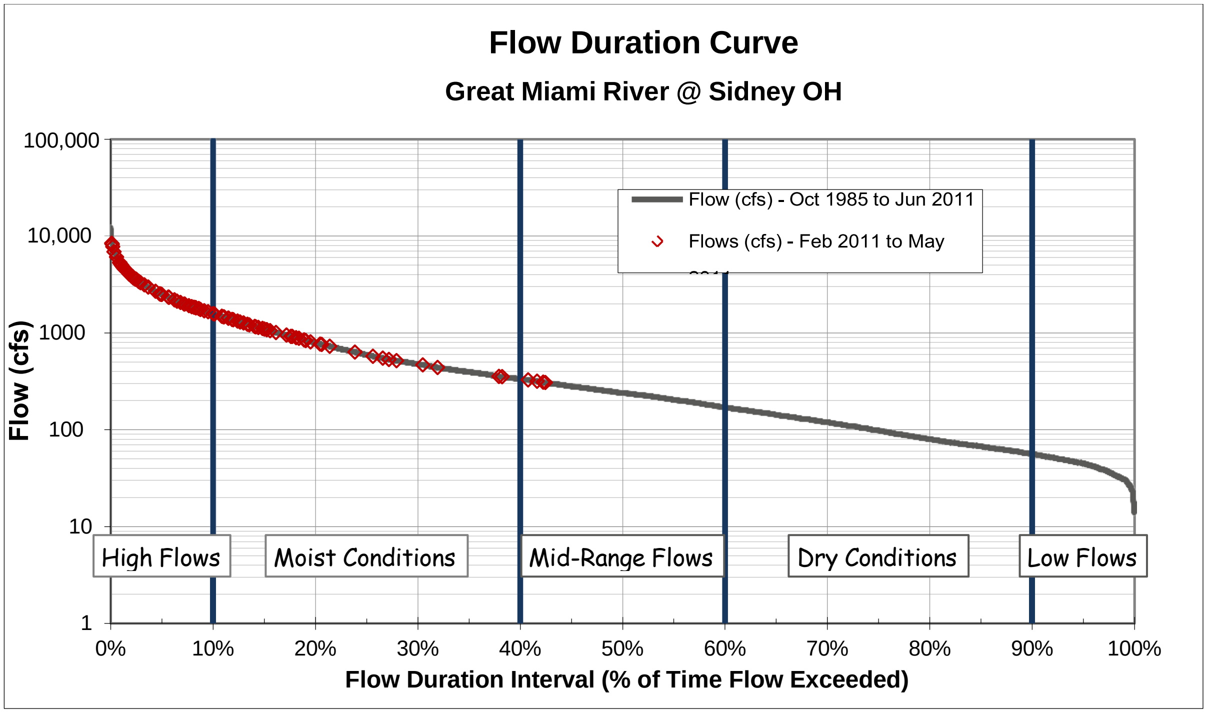


Figure E-1 Flow duration curve for data collected at USGS automatic gauge 03261500 (Great Miami River at Sidney OH) for the period October 1985 through June 2011. Flows during 2011 that occurred between February 16 and May 31 are highlighted in red. All values reported as average daily flow in cubic feet per second (cfs).

Nutrient Loading (Station 001)

When examining loadings for total phosphorus and ammonia from the final outfall, there is a progressive decline from 2005 to 2010 for both summer season (Figure E-2) and annual (Figure E-3) compilations. However, mean daily loadings increased in 2011 (annual compilation) for total phosphorus but not for ammonia (Figure E-3). For nitrite and nitrate effluent loadings, there was no consistent decline in magnitude; though for the 2009 and 2010 summer season, magnitudes were considerably lower than in the previous four years (2005-2008) (Figure E-2). This decline was also apparent for annual nitrite and nitrate loadings – 2009 to 2011 was noticeably lower than in the 2005- 2008 period (Figure E-3).

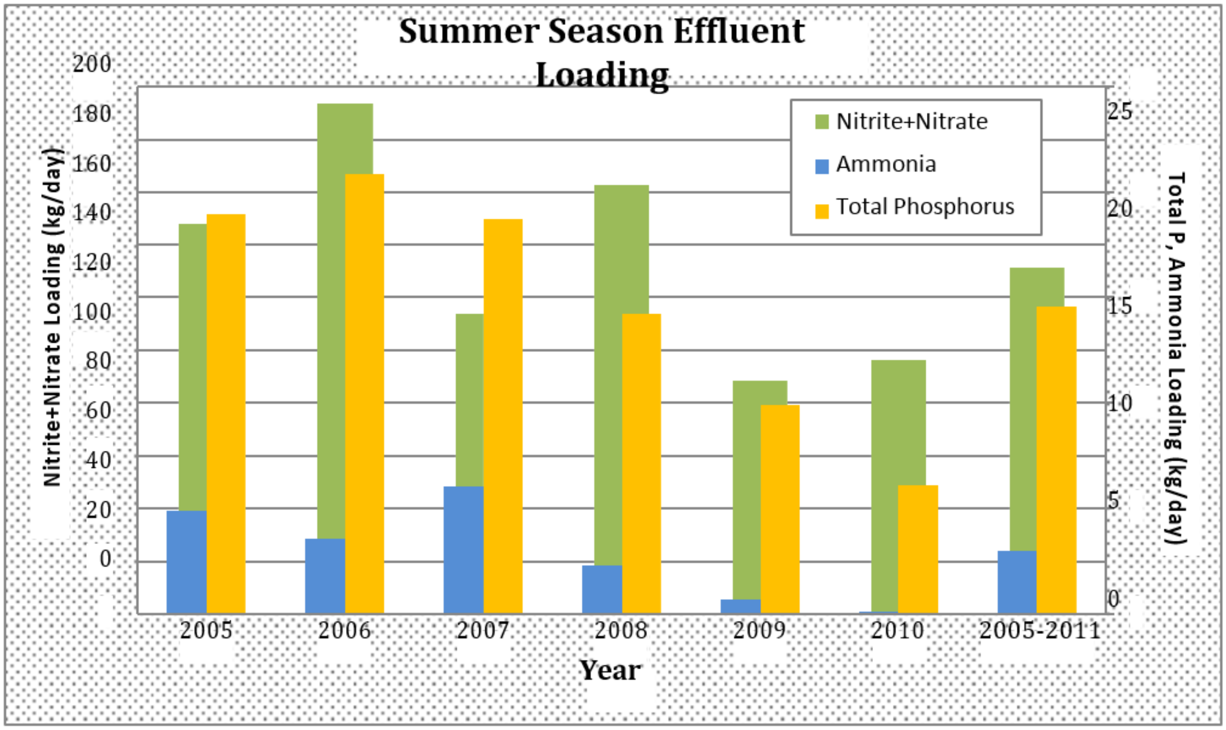


Figure E-2 — Mean loading (in kg/day) of total phosphorus, ammonia, and nitrite+nitrate by year for summer season (June to September) observations for Station 001 (final outfall) of Indian Lake WWTP. The overall seven- year summer season mean loading is also shown.

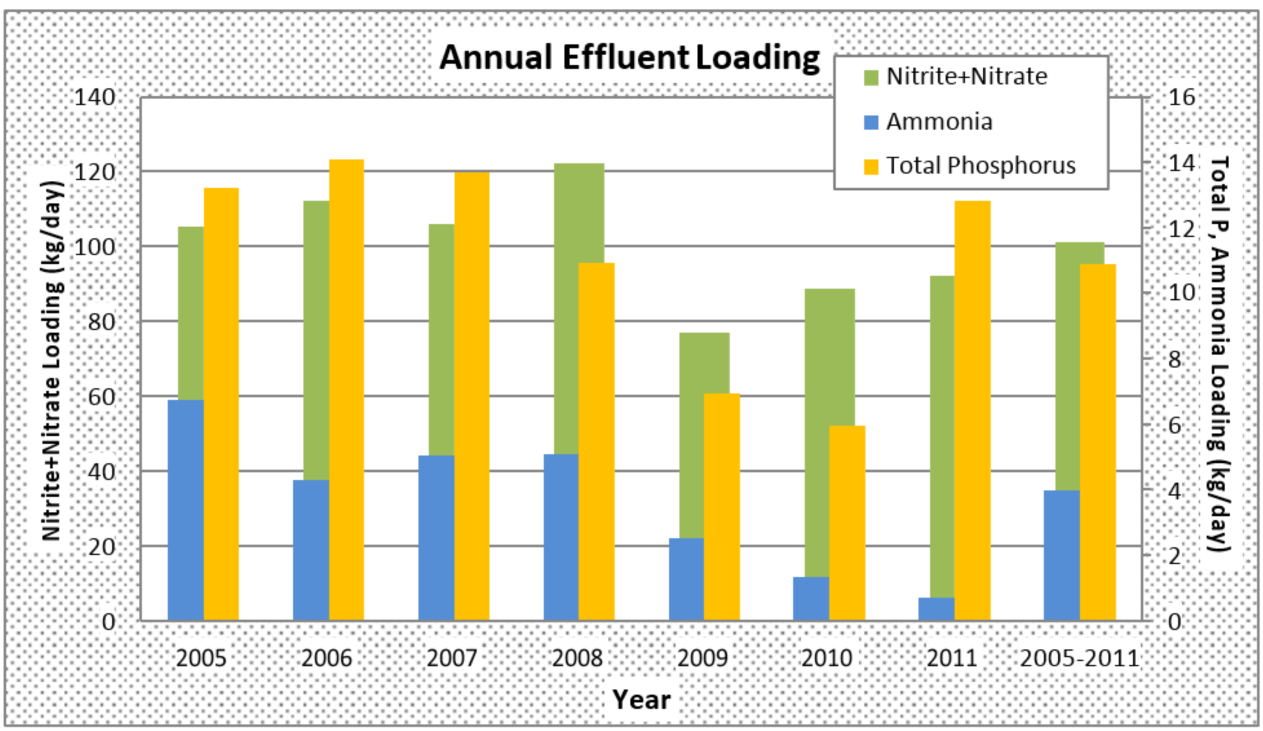


Figure E-3 — Mean loading (in kg/day) of total phosphorus, ammonia, and nitrite+nitrate by year for annual (January to December) observations for Station 001 (final outfall) of Indian Lake WWTP. The overall seven-year annual mean loading is also shown.

Influent Concentration (Station 601)

Concentrations of 5-day carbonaceous BOD (CBOD5) and total suspended solids (TSS) were examined for the influent station (station 601) to Indian Lake WWTP. Figure E-4 (summer) and Figure E-5 (annual) are included to show mean concentrations by year and overall for both CBOD5 and TSS. The overall (2005-2011) mean concentration is shown as a seven-year “normal”. Concentrations of influent TSS increased markedly in 2009, and subsequently in 2010 and 2011, to reflect improved changes in septage receiving (from HSTS). A reconfigured influent screening system changed the location of influent monitoring to now measure 100 percent of incoming septage.

The increased concentration seen in 2010 (summer and annual) and 2011 (annual only) compared to the 2005-2008 period can further be explained by completion of Phase I improvements on the wastewater *collection system*. The resultant increase in concentration for both of these parameters suggests improved capture of waste from the collection system – there is less dilution flow from I/I problems and reduced storm water overflow from a slough area into the wastewater stream.

The increasing multi-year trend in influent concentration for both TSS and CBOD5 are further supported by Figure E-6 and Figure E-7, respectively, which show a time series with a 60-day running average and a large gain in the spring of 2009.

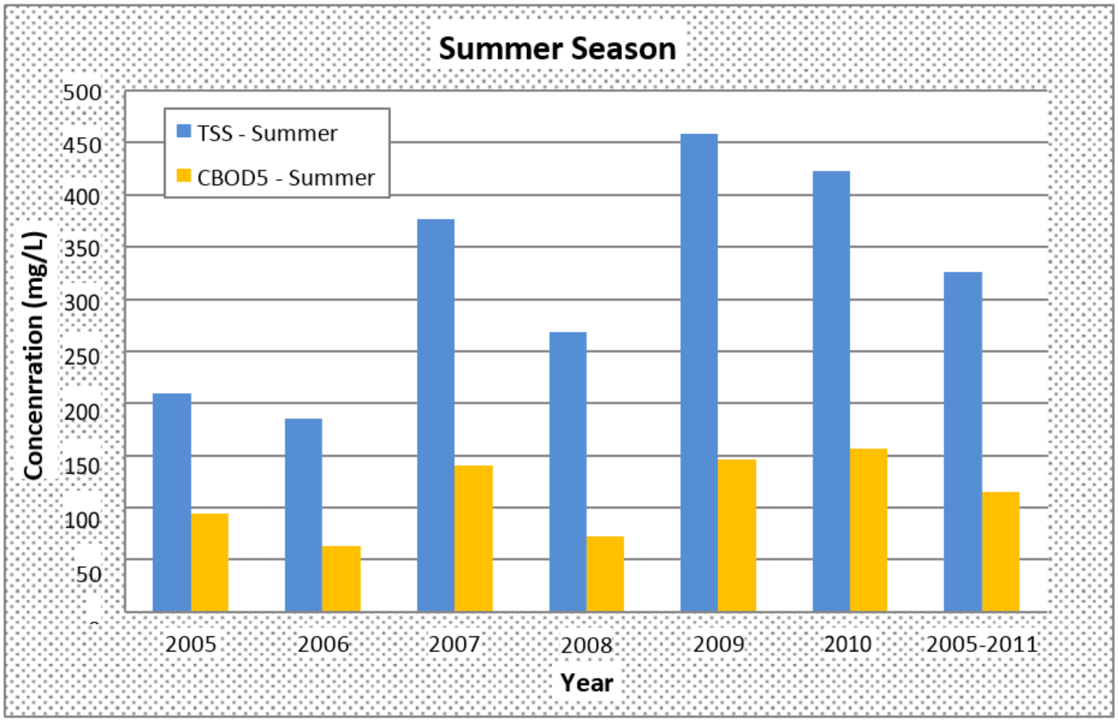


Figure E-4 — Mean concentration (in mg/L) of CBOD 5-day and TSS by year for summer season (June to September) observations for Station 601 (influent) of Indian Lake WWTP. The overall seven-year summer season mean concentration is also shown.

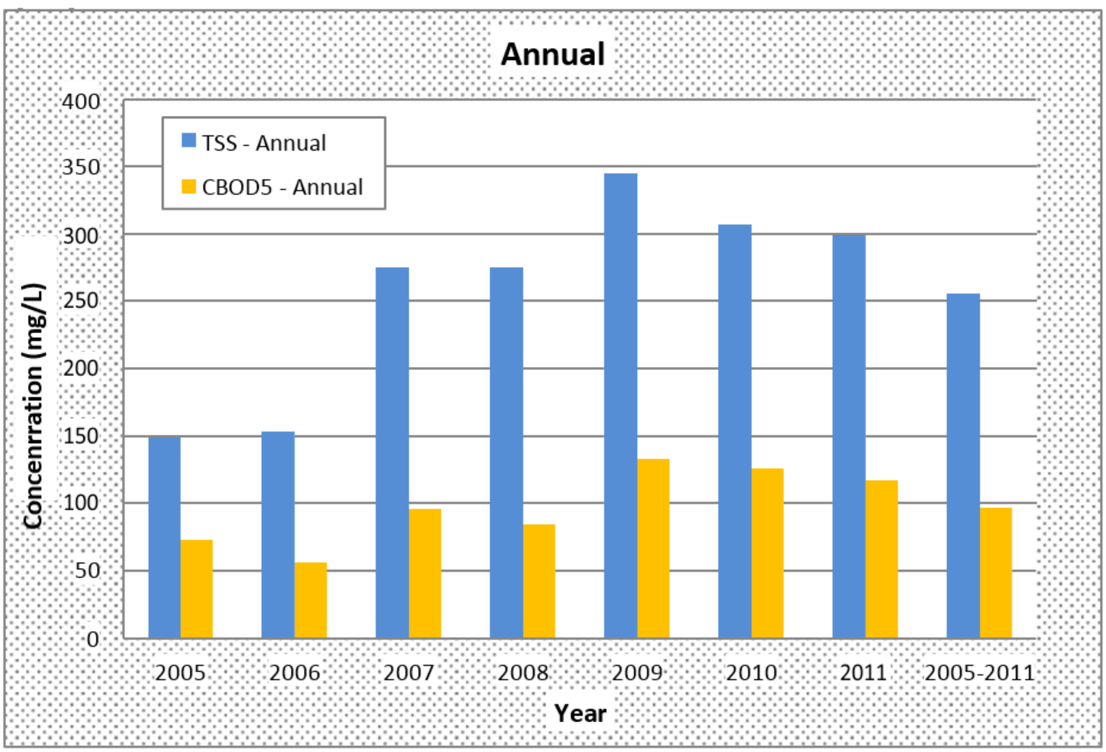


Figure E-5 — Mean concentration (in mg/L) of CBOD 5-day and TSS by year for annual (January to December) observations for Station 601 (influent) of Indian Lake WWTP. The overall seven-year annual mean concentration is also shown.

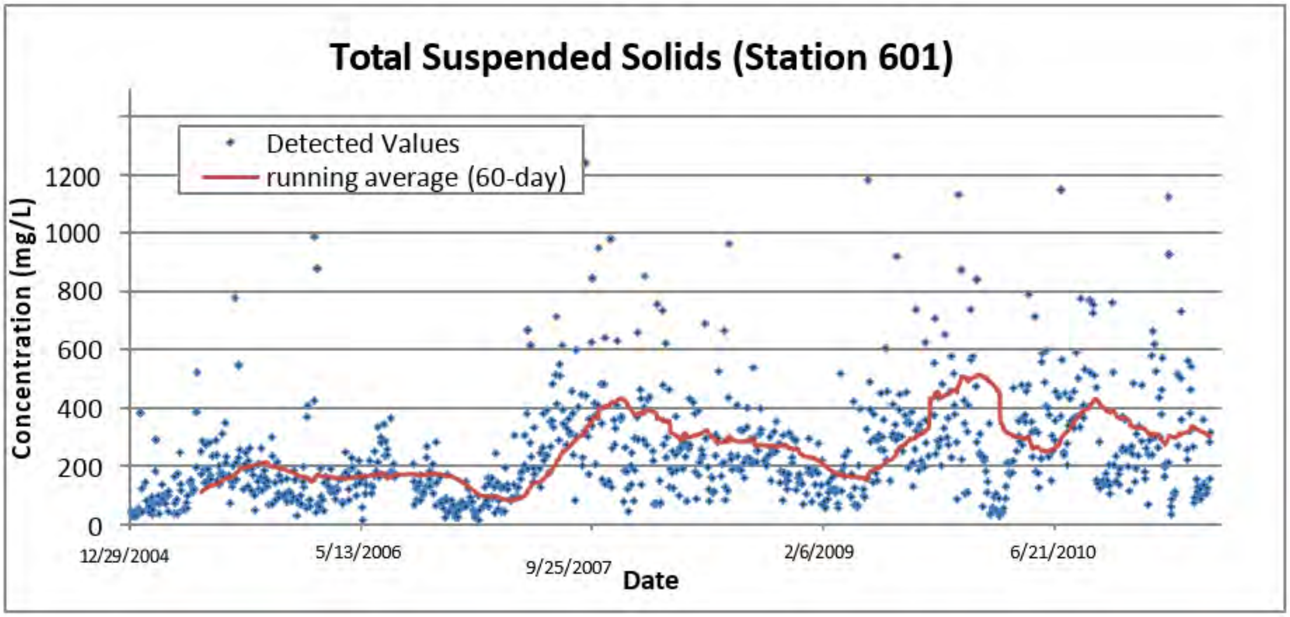


Figure E-6 — Time series of TSS from January 2005 to May 2011 for station 601 for Indian Lake WWTP. A 60-day running average was also computed and overlaid (solid red line) on the individual observations.

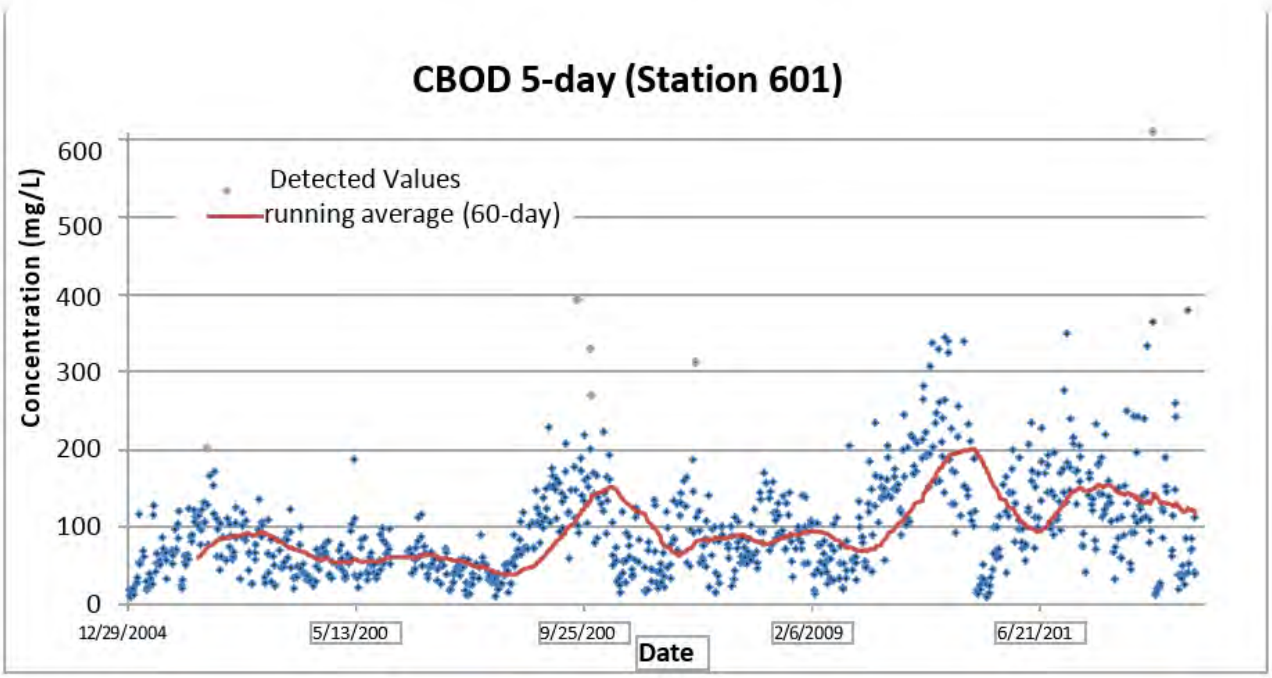


Figure E-7 — Time series of CBOD5 from January 2005 to May 2011 for station 601 for Indian Lake WWTP. A 60- day running average was also computed and overlaid (solid red line) on the individual observations.

Total Suspended Solids – Peak Events (Station 001)

A peak event is a high loading event and is defined here as a daily TSS load that exceeds 500 kg/day. The TSS permit limit for station 001 for this facility is 522 kg/day (weekly or average criterion). There were 34 of these events between 2005 and 2009 (Figure E-8). Performance following Phase I completion showed no high loading events for all 2010, and for those that occurred in 2011 – 6 of 7 events occurred in early March 2011.

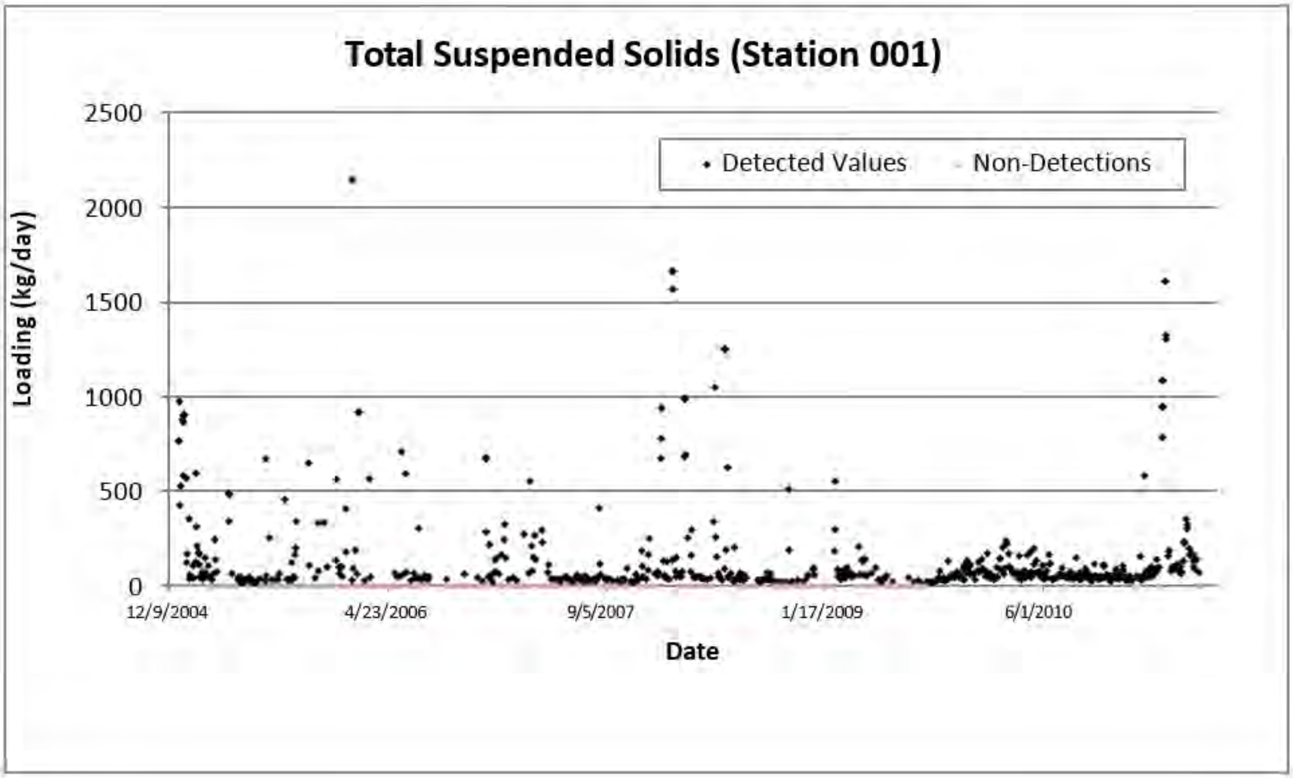


Figure E-8 — Time series of daily total suspended solid loads (kg/day) for Indian Lake WWTP for station 001 for the period January 2005 to May 2011.

Bypass Occurrence (Station 602)

Indian Lake WWTP bypass information such as number of occurrences per year and total and average volume of flow per year was examined and showed a marked decrease once Phase I was completed (Table E-1). A bypass event avoids secondary wastewater treatment and poses potentially significant harm to the receiving water. However, once into 2011 the number of bypass occurrences increased to 11 but all 11 events occurred after 2/17/2011 when the GMR basin, and corresponding WWTP collection area, experienced high percentile flood flows (Figure E-1). DMR data was only available to 5/27/2011 which is still within this identified high flow period. The sharp increase in 2011 also reflects the treatment plant's elimination of several bypasses *within the collection system*. Thus, all the flow that enters the system now makes it completely to the plant. The new expanded equalization system at the WWTP, as part of Phase I construction, will help capture more material before it is bypassed *at the plant*.

Table E-1 Summary of bypass information for Indian Lake WWTP (station 602) for the period 8/1/2006 to 5/26/2011.

Year	Number of Occurrences	Total Volume (MG)	Avg Volume per Occurrence (MG)
2006	9	22.4	2.49
2007	20	72.8	3.64
2008	22	84.8	3.85
2009	22	29.7	1.35
2010	6	12.1	2.02
2011 (5 months)	11	179.6	16.3

Limit Violations (Station 001)

A review of violations of permit limits for Indian Lake WWTP was made and is summarized in Table E-2 below. Both concentration and loading limit violations were considered and for both average (monthly) and maximum (weekly) statistical periods. While found in the review, violations for total chlorine residual were omitted because of insignificance to the impairment cause (DO/organic enrichment).

Since completion of Phase I, there was a considerable reduction in number of violations (Table E-2). The four TSS violation events that occurred after Phase I completion all occurred in early March 2011.

Table E-2 — Summary of limit violations for Indian Lake WWTP (station 001) for the period January 2005 to May 2011. Violations for total chlorine residual are omitted.

	Number of Limit Violations	
Parameter (code)	2005 - 2009	2010 - May 2011
TSS (00530)	8	4
pH (61942)	1	0
ammonia (00610)	7	0

Conclusion

The partial impairment of aquatic-life use that exists at RM 153.45 (Notestine Rd) of the GMR (12-digit HUC 05080001-03-02) is caused by multiple stressors and sources. While the predominant stresses are habitat alteration and siltation – a low gradient river system choked by sediment, a secondary stress is organic enrichment and low DO produced by an upstream POTW. The Agency aquatic-life use assessment was conducted and completed in 2008 but the POTW was in the midst of constructing improvements to minimize their bypass (of secondary treatment) occurrence and volume. The first phase (Phase I) of construction was completed in late December 2009. The above analysis described effluent quality and behavior by comparing results prior to and following this completion date. Though WWTP performance was confounded by high flows in early 2011 (February through May), 2010 performance was considerably better than that observed in the prior four years (2005-2008). Phase II construction will begin soon and address treatment levels needed to meet permit and water quality standards. The goal is that completion of Phase I and Phase II construction will, with high likelihood, remove the stressor of impairment associated with organic enrichment and low dissolved oxygen.

An estimate or projection of the time when WQS will be met

The June 2011 NPDES permit Part I, C-Schedule of Compliance paragraph f, gives April 1, 2017 as the date the Indian Lake Water Pollution Control Facility wastewater works will attain final compliance. Re-evaluation of biological water quality standards shall begin no earlier than the field season of 2018.

Schedule for implementing pollution controls

On July 13, 2011, the Logan County Board of Commissioners were issued NPDES number 1PK00002*LD. This permit contains a compliance schedule for completion of phase 2 projects that will address secondary treatment system bypassing at the plant. The permit schedule includes the following compliance dates:

- Submit an approvable “No Feasible Alternatives Analysis by no later than October 1, 2012.
- Submit a general plan for upgrades design to eliminate the secondary bypass by no later than April 1, 2013.
- Submit a Permit to Install for treatment system upgrades by no later than April 1, 2014.
- Complete treatment system upgrades by no later than July 1, 2016.
- Attain final compliance with NPDES permit limits and conditions by no later than April 1, 2017.

With the completion of the phase 2 projects, the Logan County Water Pollution Control District Indian Lake plant should be in compliance with their NPDES permit conditions, thus eliminating any effluent- derived water quality impacts downstream.

Monitoring plan to track effectiveness of pollution controls

As part of their NPDES permit, Indian Lake Water Pollution Control Facility wastewater works measures and reports plant bypasses at station 602 monthly. In addition, outfall 001 will report TSS, $cBOD_5$, phosphorus, ammonia and nitrate/nitrite discharges to the Great Miami River monthly. Sampling is done three times a week for TSS, $CBOD_5$, and NH_3. Phosphorus and NO_2/NO_3 will be sampled once a week. SSO discharges will be reported within 24 hours of the occurrence. The facility’s monthly discharge monitoring reports are reviewed by permit staff in Ohio EPA’s Southwest District Office. Inspection of the facility will be done every two years starting in 2012.

No earlier than the field season of 2018, Ohio EPA will sample the impaired section of Great Miami River (RM 153.45, Notestine Rd.) for chemistry, fish and macroinvertebrates. The chemistry will be sampled at one location and five sampling events will be completed. The fish will be sampled at one location with two passes each. The macroinvertebrates will be evaluated on one sampling event. This work will follow Ohio EPA’s protocol for sampling the aquatic biology and chemistry. The sampling will take place during the summer/fall sampling season with analysis by Ohio EPA’s laboratory and reporting to Southwest District Office.

Commitment to revise pollution controls, as necessary

The SWDO surface water manager will initiate a reexamination of the implementation strategy if significant progress is not being made by the end of the next NPDES permit cycle for Indian Lake.

Ohio EPA will report on the progress of any approved 4B in future 303(d) lists.

First Report on Great Miami River 4B Demonstration (*2014 Integrated Report*)

The facility completed a Phase One study / upgrade ($ 10,000,000) in 2011. Phase One projects included new influent screens, two MGD in equalization, a new express force main and lift station, and upgrades to the solids handling systems (belt press and septage receiving). The sewer district reported seven SSOs and several secondary bypasses in 2013.

In addition, the sewer district has hired two consultants to work on aspects of the project. The district has begun a Capacity Management Operations and Maintenance program to oversee the collection system. New sewer use regulations have been implemented. In 2012 the district installed rain gauges and 18 flow meters. A model of the sewer is being developed. As part of the phase 2 work, the district is looking at treatment plant alternatives, maximizing existing treatment systems, and high rate treatment. The district is on schedule to meet the next deadline.

Second Report on Great Miami River 4B Demonstration (*2016 Integrated Report*)

The Indian Lake Water Pollution Control District operates a 4.6 MGD WWTP that discharges directly to the Great Miami River. The plant serves the surrounding lake community as well as the communities of Lakeview, Russells Point, Belle Center and Huntsville. Excessive I/I into the collection system has contributed to collection system bypasses and blending at the plant (blended flows are screened and disinfected before recombining with the final effluent).

In response the district performed a No Feasible Alternatives Analysis (2006) of both the collection and treatment systems. An adaptive management approach was selected. A two-phase schedule was developed. Phase I work was completed in 2010. This phase included upgrades to the influent pump station; construction of new equalization basins (1.5 million gallons); installation of UV disinfection; updates to the bio solids dewatering equipment; and construction of a new pump station and force main was added to the Slough area.

As part of the Phase II work, the district is working on expansion of peak secondary and disinfection treatment capacities (peak 6.0 MGD plus). A PTI application for UV system upgrades was submitted in September 2014. The district is upgrading the final clarifier weirs, baffles and mechanisms to allow for treatment of peak flows. With the completion of this work the amount of flow that receives complete secondary treatment will be significantly increased.

The schedule for implementation of the No Feasible Alternatives Analysis Phase II projects has been inserted in the district's NPDES permit. As part of an adaptive approach the district is evaluating the effectiveness of infiltration removal verses additional treatment. The district believes if I/I into the system can be reduced by 30 percent, elimination of all wet weather overflows and bypasses will occur. The NPDES permit schedule includes the following dates:

- Study (model) and complete enough I/I projects to get to a 10 percent I/I reduction. (September 1, 2021)
- Study (model) and complete enough I/I projects to get to a 20 percent I/I reduction. (September 1, 2027)
- Study (model) and complete enough I/I projects to get to a 30 percent I/I reduction. (September 1, 2032)

With the completion of the various projects the impacts to the receiving stream should be diminished. Through the adaptive approach the district will be able to evaluate and prioritize projects that will provide the biggest improvements in the shortest time.

Third Report on Great Miami River 4B Demonstration (*2018 Integrated Report*)

On Sept. 1, 2016, construction was completed on the WWTP upgrade that included: new aeration blowers; final clarifier drives, launders, collectors and weirs; UV disinfection up to 6 MGD; and influent monitoring. This upgrade was part of the Logan County's Phase II work. Since construction was completed, the Logan County Commissioners have reported ten dissolved oxygen violations. They attributed these violations to short-term operational/equipment issues rather than infrastructure deficiencies.

Reporting Period	Parameter	Limit Type	Limit	Reported Value	Violation Date
November 2016	Dissolved Oxygen	1D Conc	5.0	3.4	11/10/2016
November 2016	Dissolved Oxygen	1D Conc	5.0	4.9	11/28/2016
April 2017	Dissolved Oxygen	1D Conc	5.0	4.5	4/12/2017
May 2017	Dissolved Oxygen	1D Conc	5.0	4.6	5/22/2017
July 2017	Dissolved Oxygen	1D Conc	5.0	4.5	7/5/2017
July 2017	Dissolved Oxygen	1D Conc	5.0	4.3	7/10/2017
July 2017	pH, Minimum	1D Conc	6.5	6.19	7/6/2017
July 2017	E. coli	7D Conc	284	840.046	7/8/2017
August 2017	Dissolved Oxygen	1D Conc	5.0	4.7	8/2/2017
August 2017	Dissolved Oxygen	1D Conc	5.0	3.7	8/3/2017
August 2017	Dissolved Oxygen	1D Conc	5.0	4.7	8/16/2017
August 2017	Dissolved Oxygen	1D Conc	5.0	4.9	8/23/2017

In accordance with the NPDES permit compliance schedule, the county is still on track for eliminating wet weather overflows and bypasses through an adaptive, inflow and infiltration reduction approach.

Fourth Report on Great Miami River 4B Demonstration (*2020 Integrated Report*)

The Indian Lake Water Pollution Control District has continued to work on limiting wet weather overflows and bypasses. In 2018, the District worked on I/I issues, sealing manholes and conducting enforcement actions which included termination of service if abatement wasn't performed. Approximately 18 portable sewer flow meters and 6 rain gauges have been deployed thought out the district to help contractors develop hydraulic models so areas can be identified to devote I/I reduction resources. The District has also started evaluating flows from satellite collection systems which are believed to have I/I issues. No dissolved oxygen violations have been reported since November 2017.

Reporting Period	Parameter	Limit Type	Limit	Reported Value	Violation Date
September 2017	Dissolved Oxygen	1D Conc	5.0	4.8	9/5/2017
September 2017	Dissolved Oxygen	1D Conc	5.0	4.4	9/21/2017
October 2017	Dissolved Oxygen	1D Conc	5.0	4.4	10/27/2017
October 2017	pH, Minimum	1D Conc	6.5	6.49	10/12/2017
November 2017	Dissolved Oxygen	1D Conc	5.0	4.6	11/29/2017
June 2018	E. coli	7D Conc	284	1507.53	6/22/2018
March 2019	Total Suspended Solids	7D Qty	783	852.639	3/8/2019

An Overview of Ground Water Quality in Ohio

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Figures

Tables

L1. Introduction

Section L summarizes water quality assessment data for Ohio's major aquifers based on information requested in U.S. EPA's *2006 Integrated Reports Guidance* (U.S. EPA 2005) and the *1997 Guidelines for Preparation of the Comprehensive State Water Quality Assessments* (U.S. EPA 1997).

Ground water protection programs for Ohio are briefly summarized in Section L2 as required by Section 106(e) of the Clean Water Act. Programs to monitor, evaluate and protect ground water resources are implemented by various state, federal and local agencies. Ohio EPA is the designated agency for monitoring and evaluating ground water quality and assessing ground water contamination problems. Within Ohio EPA, these functions are shared among the Divisions of Drinking and Ground Waters (DDAGW), Materials and Waste Management (DMWM), Environmental Response and Revitalization (DERR), and Surface Water (DSW). Short program descriptions are provided with links to program-based web pages to provide the most current information.

Ohio's three major aquifer types are described briefly in Section L3. Where possible, the water quality data are associated with major aquifer types. The aquifer descriptions allow the reader to associate water quality with geologic settings.

Section L4 summarizes major sources of ground water contamination in Ohio. These data were obtained from various sources including:

- Potential contaminant sources inventoried as part of Ohio EPA – DDAGW's Source Water Assessment and Protection (SWAP) program;
- Underground injection control sites identified in Ohio EPA – DDAGW and Ohio Department of Natural Resources (ODNR) – Division of Oil and Gas Resource Management databases;
- Leaking and formerly leaking underground storage tanks from Ohio Department of Commerce – Division of Fire Marshal's Bureau of Underground Storage Tank Regulations (BUSTR) databases;
- Federal databases listing Department of Development/Department of Energy (DOD/DOE) facilities and National Priorities List/Comprehensive Environmental Response, Compensation and Liability Act (NPL/CERCLA) sites; and
- Resource Conservation and Recovery Act (RCRA) Corrective Action sites with ground water contamination in Ohio obtained from the U.S. EPA RCRA Info Database.

In many instances, these data are not associated with the geologic setting of the impacted aquifer, so statewide summaries are provided.

Section L5 summarizes ground water quality by parameter within Ohio's major aquifers. Two primary data sets are used in this analysis: the drinking water compliance data for public water systems; and the Ambient Ground Water Quality Monitoring Program (AGWQMP) data. The public water system compliance data represents treated (post-processing) water distributed to the public. AGWQMP is an Ohio EPA - DDAGW program created to monitor raw (untreated) ground water. The goal is to collect, maintain and analyze raw ground water quality data to measure long-term changes in the water quality of major aquifer systems. Since Ohio does not have statewide ground water quality standards, comparisons to primary maximum contaminant levels (MCLs), secondary maximum contaminant levels (SMCLs), health advisory levels (HALs), action levels (lead and copper) and drinking water health advisory levels were applied.

Section L6 presents conclusions and recommendations for future direction concerning statewide ground water monitoring and protection of Ohio's major aquifers.

L2. Ohio's Ground Water Protection Programs

State Coordinating Committee on Ground Water — The State Coordinating Committee on Ground Water (SCCGW) was created in 1992 by the directors of the state agencies that have ground water program responsibilities. The purpose is to promote and guide the implementation of coordinated, comprehensive and effective ground water protection and management programs for Ohio. The SCCGW is composed of ground water technical or management staff from seven state agencies, two federal agencies and The Ohio State University Extension office. Information about the SCCGW bi-monthly meetings and meeting summaries are available on the SCCGW website: ***epa.ohio.gov/ddagw/SCCGW.aspx***.

Ohio Ground Water Protection Programs — Programs to monitor, evaluate and protect ground water resources in Ohio are administered by federal, state and local agencies. Ohio EPA is the designated state ground water quality management agency. The ODNR - Division of Water Resources is responsible for evaluation of the quantity of ground water resources. Ground water-related activities at the state level are also conducted by the Ohio Departments of Agriculture, Commerce (Division of State Fire Marshal), Health and Transportation. The United States Geological Survey (USGS), Ohio Water Science Center, contributes to these efforts with water resource research. Table L-1 (based on Table 5-2, U.S. EPA 305(b) Guidelines, 1997) summarizes agencies responsible for administering the various ground water programs in Ohio.

Program Websites

ODA - Ohio Department of Agriculture

- Pesticide Regulation Program — ***https://agri.ohio.gov/wps/portal/gov/oda/divisions/plant-health/pesticides/pesticide-regulation***
- Fertilizer Regulation Program — ***https://agri.ohio.gov/wps/portal/gov/oda/divisions/plant-health/fertilizers/fertilizer-regulation***
- Livestock Environmental Permitting Program — ***https://agri.ohio.gov/wps/portal/gov/oda/divisions/livestock-environmental-permitting***

ODH - Ohio Department of Health

- Private Water Systems — ***https://odh.ohio.gov/wps/portal/gov/odh/know-our-programs/sewage-treatment-systems/resources-and-education/res-ssinstruct***
- Sewage Treatment Systems Program — ***https://odh.ohio.gov/wps/portal/gov/odh/know-our-programs/sewage-treatment-systems/resources-and-education/res-ssinstruct***

ODNR - Ohio Department of Natural Resources (*ohiodnr.gov/*)

- Division of Water Resources — ***water.ohiodnr.gov/***
- Division of Mineral Resources — ***minerals.ohiodnr.gov/***
- Division of Oil and Gas Resources — ***oilandgas.ohiodnr.gov/***
- Division of Geologic Survey — ***geosurvey.ohiodnr.gov/***

Ohio EPA - Ohio Environmental Protection Agency (*epa.ohio.gov*)

- Division of Drinking and Ground Waters — ***epa.ohio.gov/ddagw/***
- Division of Surface Water — ***epa.ohio.gov/dsw/***
- Division of Environmental and Financial Assistance — ***epa.ohio.gov/defa/***
- Office of Compliance Assistance and Pollution Prevention — ***epa.ohio.gov/ocapp/***
- Division of Materials and Waste Management — ***epa.ohio.gov/dmwm/***
- Division of Environmental Response and Revitalization — ***epa.ohio.gov/derr/***

OWRC – Ohio Water Resource Council (*epa.ohio.gov/dsw/owrc.aspx*)

SCCGW – State Coordinating Committee on Ground Water (*epa.ohio.gov/ddagw/SCCGW.aspx*)

SFM/BUSTR – State Fire Marshal/Bureau of Underground Storage Tank Regulations (com.ohio.gov/fire/)

Table L-1 — Summary of Ohio ground water protection programs.

Programs or Activities	State Activity	Implementation Status*	Responsible Agency
Active SARA Title III Program	✓	E	Ohio EPA – DERR
Ambient Ground Water Monitoring Program	✓	E	Ohio EPA – DDAGW
Aquifer vulnerability assessment	✓	CE	ODNR – DWR
Aquifer mapping	✓	CE	ODNR – DWR
Aquifer characterization	✓	CE	ODNR – DWR
Ground water best management practices	✓	E	ODNR; ODA
Ground water legislation	✓	UR[a]	All Agencies
Ground water classification	✓	E [b]	Ohio EPA; ODNR
Ground water quality standards (program specific)	✓	E [c]	Ohio EPA
Ground water quality investigations	✓	CE	Ohio EPA DDAGW
Interagency coordination for ground water protection initiatives	✓	E	SCCGW
Nonpoint source controls	✓	CE	ODA; Ohio EPA; ODNR
Pesticide State Management Plan	✓	E [d]	ODA
Pollution Prevention Program	✓	E	Ohio EPA – DEFA (OCAPP)
Resource Conservation and Recovery Act (RCRA) Primacy	✓	E	Ohio EPA – DERR
Source Water Assessment Program	✓	E	Ohio EPA – DDAGW
State Property Clean-up Programs	✓	E	Ohio EPA – DERR
Susceptibility assessment for drinking water/wellhead protection	✓	E	Ohio EPA – DDAGW
State septic system regulations	✓	E [e]	ODH; Ohio EPA
Underground storage tank installation requirements	✓	E	SFM/BUSTR
Underground Storage Tank Remediation Fund	✓	E [f]	SFM/BUSTR
Underground Storage Tank Permit Program	✓	E	SFM/BUSTR
Underground Injection Control Program	✓	E [g]	Ohio EPA – DDAGW ODNR – DMRM
Well abandonment regulations	✓	E [h]	ODNR; Ohio EPA – DDAGW; ODH
Wellhead Protection Program (EPA-approved)	✓	E [i]	Ohio EPA – DDAGW
Well installation regulations	✓	E [j]	Ohio EPA; ODH

*** Table Notes: E** – Established; **CE** – Continuing Effort; **UD** – Under Development; **UR** – Under Revision

[a] Rules are required to be reviewed every five years by state statute.

[b] Established through program-specific classifications.

[c] Standards are program-specific.

[d] ODA received cooperative commitment from other Ohio agencies for the Generic Pesticide Management Plan. The requirement for Specific Pesticide Management Plan was dropped.

[e] The updated Household Sewage Treatment Systems Rules became effective on Jan. 1, 2015 (Ohio Revised Code (ORC) Chapter 3718 and Ohio Administrative Code Chapter 3701-29). Larger systems are regulated by Ohio EPA under separate regulations.

[f] Remediation funds are available from the Petroleum Underground Storage Tank Release Compensation Fund

[g] Ohio EPA regulates Class I and V injection wells; ODNR regulates Class II and III injection wells.

[h] Revised guidance for sealing wells was completed March 2015 by SCCGW workgroup: Regulations and Technical Guidance for Sealing Unused Water Wells and Boreholes

[i] Wellhead Protection Program has evolved to the Source Water Protection Program.

[j] Technical Guidance for Well Construction and Ground Water Protection prepared by SCCGW (2000). Private Water System rules (OAC 3701-28) are in the process of being updated. Water Well Standards (OAC 3745-7) for public water systems were last revised in 2016.

L3. Ohio's Major Aquifers

Introduction

Ohio has abundant surface and ground water resources. Average rainfall ranges between 30 and 44 inches/year (increasing from northwest to southeast), which drives healthy stream flows. Infiltration of a small portion of this rainfall (3-16 inches) recharges the aquifers and keeps the streams flowing between rains. Ohio's aquifers can be divided into three major types as illustrated in Figure L-1. The sand and gravel buried valley aquifers (in blue) are distributed through the state. The valleys filled by these sands and gravels are cut into sandstone and shale in the eastern half of the state (in tans) and into carbonate aquifers (in greens) in the western half. The buried valley aquifers are productive aquifers. The sandstone and carbonate aquifers generally provide sufficient production for water wells except where dominated by shale, as in southwest and southeast Ohio. An Ohio EPA report, *Major Aquifers in Ohio and Associated Water Quality* (2015), provides more detailed descriptions of these aquifers.

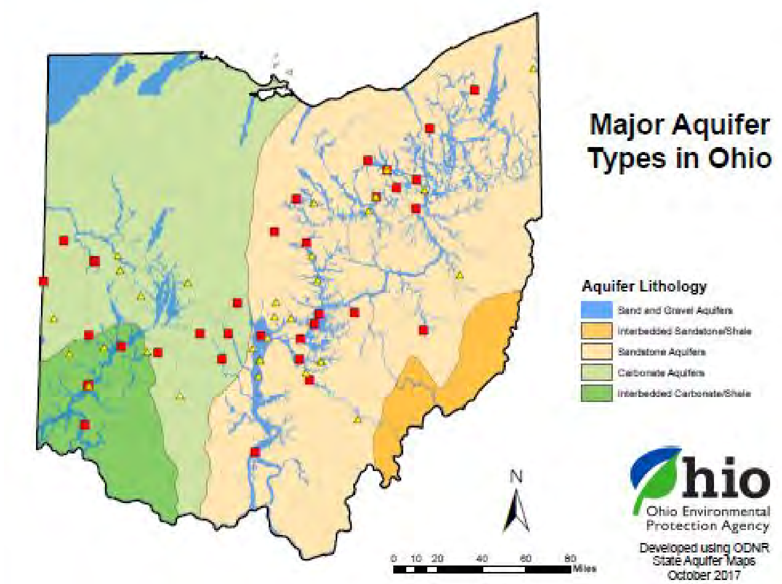

*Figure L-1 — Aquifer Types in Ohio modified from ODNR Glacial and Bedrock Aquifer Maps (ODNR, 2000; **water.ohiodnr.gov/maps/statewide-aquifer-maps**).*

Characterizing Aquifers

In a continuing effort to characterize ground water quality for the professional/technical community and the public, Ohio EPA-DDAGW is writing technical reports and fact sheets on the distribution of specific parameters in Ohio. The goal of the technical reports is to provide water quality information from the major aquifers, indicate areas with elevated concentrations and identify geologic and geochemical controls. This information is useful for assessing local ground water quality, water resource planning and evaluating areas where specific water treatment may be necessary. A series of parallel fact sheets targeted for the public provide basic information on the distribution of the selected parameters in ground water. The information in the fact sheets is presented in a less technical format, addresses health effects, outlines treatment options and provides links to additional information.

Table L-2 — Ground water contamination summary.

Hydrogeologic Setting: Statewide Data Reporting Period: As of August 2019

Source Type	Number of sites	Number of sites that are listed and/or have confirmed releases	Number of sites with confirmed ground water contamination	Contaminants
NPL - U.S. EPA	38 proposed	30	30	Mostly VOCs and heavy metals; also, SVOCs, PCBs, PAHs and others
CERCLIS (non- NPL) - U.S. EPA	411	411	20	Varied
DOD/DOE	129[a]	72	68	Varied
LUST	34,992[b]	4,133	111[c]	BTEX
RCRA Corrective Action	254	206	206	VOCs, heavy metals, PCBs and others
Underground Injection	Class[d]: I -17 II – 417 III – 48 IV – 6 V – 61,276	 0 0 0 0 19,493	 0 0 0 0 19,493	Varied GW Impacts
State Sites [e]	776	776	264[f]	Varied GW Impacts
Nonpoint Sources	NA	NA	NA	

Notes: NA - Numbers not available

[a] Includes DOE, DOD, FUSRAP and FUD sites

[b] Includes only active LUST sites - Source: Ohio's State Fire Marshal, BUSTR

[c] Sites in Tier 2 or Tier 3 cleanup stages. Source: Ohio's State Fire Marshal, BUSTR

[d] Class I and V injection wells are regulated by Ohio EPA. Class II and Class III injection wells are regulated by the Ohio Department of Natural Resources, Division of Oil and Gas Resources. Class IV injection wells are illegal in Ohio, except where approved as part of a remediation plan.

[e] Facilities in Ohio EPA's ground water impacts database

[f] A site is considered to be contaminating ground water if the Uppermost Aquifer or Lower Aquifer is noted to be impacted, as documented in Ohio EPA's Ground Water Impacts database.

Federal National Priorities List (NPL): Currently, 38 sites in Ohio are on the NPL, most of which (30) have been found to be affecting ground water quality. The primary contaminants are volatile organic compounds (VOCs) and heavy metals. Other contaminants include semi-volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs).

Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) (non-NPL): Ohio has 411 sites in the federal CERCLIS database.

DOD/DOE: The 129 sites on this list are the Department of Defense (DOD)/Department of Energy (DOE) sites in Ohio, including those that are Formerly Used Defense Sites (FUDS) and Formerly Utilized Sites Remedial Action Program (FUSRAP) sites. Of these, 68 have had confirmed releases to ground water.

Leaking Underground Storage Tanks (LUST): In Ohio, underground storage tanks (USTs) are under the jurisdiction of the State Fire Marshal, Bureau of Underground Storage Tank Regulation (BUSTR). Current data indicates that approximately 35,000 sites have been found to be leaking. Of these, 4,133 have confirmed releases, with 111 having a release to ground water. The primary contaminants are the petroleum products of benzene, toluene, ethyl benzene and xylenes.

RCRA Corrective Action: Currently, 254 facilities are in RCRA corrective action. Of these, 206 have confirmed releases to ground water. The primary contaminants are VOCs and heavy metals. This information was obtained from the U.S. EPA RCRA Info Database.

Underground Injection: There are five classes of underground injection wells:

- Class I wells inject hazardous wastes or other wastewaters beneath the lowermost aquifer;
- Class II wells inject brines and other fluids associated with oil and gas production beneath the lowermost aquifer;
- Class III wells inject fluids associated with solution mining of minerals beneath the lowermost aquifer;
- Class IV wells inject hazardous or radioactive wastes into or above aquifers (these wells are banned unless authorized under a federal or state ground water remediation project);
- Class V wells comprise all injection wells not included in Classes I-IV;
- Class VI wells are regulated by U.S. EPA for carbon sequestration.

The Ohio Department of Natural Resources, Division of Oil and Gas Resources Management regulates Class II (417) and Class Ill (48) injection wells. There has been an increase in the number of Class II disposal wells (one of three types of Class II wells in Ohio) permitted, drilled, and operated since 2017. In addition to the 223 active Class II Disposal wells there are 18 wells that are between the permitted and active stage. The other types of Class II wells include 125 enhanced recovery wells and 69 annular disposal wells.

Ohio EPA DDAGW regulates Class I (17), Class IV (6) and Class V (61,276) wells. Although owners and operators of Class V wells are required to register or permit their wells, there are still many that are unknown and unregistered throughout the state.

State Sites: State sites include landfills, RCRA-regulated hazardous waste facilities, unregulated sites (pre-RCRA) and sites investigated through the Voluntary Action Program (VAP). Ground water contamination summary information concerning many of these sites is tracked in the ground water impacts database, maintained by Ohio EPA-DDAGW. The database consists of sites with verified contaminant release to ground water. As of August 2017, the database contained 776 sites. Of the 776 sites, 264 have affected ground water quality within the uppermost aquifer or lower aquifer. This database is deprecated but is consulted to investigate documented ground water impacts.

L4. Major Sources of Ground Water Contamination

Data show much of Ohio's ground water is of high quality and has not been widely influenced by anthropogenic activities, but individual cases of contamination are documented every year from point (site-specific locations) and nonpoint sources. Ohio has a diverse economy and the state uses and produces a range of potential contaminants applied, stored and disposed of in various land use practices. Consequently, ground water quality is susceptible to contamination from a range of substances and a variety of land use activities. From a statewide perspective, major sources are discussed below.

The major sources of ground water contamination in Ohio are indicated in Table L-3 (Table 5-1, U.S. EPA 1997) by checks (✓). These data were obtained from two main sources: Ohio's Source Water Assessment and Protection (SWAP) program and DDAGW's ground water impacts database (deprecated). The SWAP program has completed an inventory of the potential sources of ground water contamination in the delineated Drinking Water Source Protection Areas. This inventory is updated when the SWAP delineation is revised, for example, when new wells are approved. Of the active public water systems that use ground water, 99 percent have had an inventory conducted, an analysis of the aquifer's susceptibility to contamination completed and a determination of whether the ground water quality has been impacted by anthropogenic activities. The ground water impacts database provides information regarding sites where contamination of ground water has been confirmed. These data were evaluated and those sources of highest concern were given a check mark (✓) in Table L-3.

Some of the potentially high priority sources, indicated by (×), were selected based on professional knowledge of the types of sources that exist in Ohio. These sources, such as animal feedlots and mining, are limited in their extent, or are concentrated in regions of the state and may not be sited close to public water system well fields. Thus, they do not rank in the highest priority sources. However, where they are prevalent, these sources may be a threat to local ground water resources, especially in areas with sensitive hydrogeologic settings. Land use activities within sensitive areas have a greater potential of affecting ground water quality.

Contaminant Source Discussion - All sources listed in Table L-3 are potential contaminant sources in Ohio and each may cause ground water quality impacts at a local scale. The sources identified as highest priority or potentially high priority are listed below in the order presented in Table L-3 and discussed briefly to provide additional information.

(✓) Highest Priority Sources

Fertilizer Applications: Use and handling of fertilizers, manure and biosolids can cause ground water pollution. Human and animal biosolids used as fertilizer and chemical fertilizers contribute to nitrate contamination in ground water. Nitrate concentrations in ground water represent one of the better examples of the widespread distribution of nonpoint source pollution. Non-agricultural sources, such as lawn fertilization, sludge application and septic systems also contribute to localized nitrate ground water contamination. Public water systems utilizing sand and gravel aquifers have higher average nitrate levels than public water systems using sandstone and carbonate aquifers, primarily due to the higher vulnerability of unconsolidated aquifers and the shallower nature of the sand and gravel aquifers.

Storage Tanks (Underground and Above-ground): There are 5,312 USTs known to be leaking or undergoing remediation in Ohio. Of these, 1,321 are in drinking water source protection areas for public water systems using ground water. Above-ground tanks are also prevalent throughout Ohio, with 1,225 located in drinking water source protection areas for public water systems using ground water. Many of these are smaller tanks used to store fuel oil for heating individual homes and many are old and rusty with no containment in the event of a leak or spill. Leaking above-ground storage tanks (ASTs) from commercial and industrial facilities are less of an issue, although catastrophic failure can create significant pollution problems to both ground water and surface water. There are only 14 ASTs in the (deprecated) ground water impacts database known to be contaminating ground water from regulated hazardous waste facilities.

Landfills: Currently, there are 130 landfills with documented ground water contamination in Ohio. This constitutes 50 percent of the sites known to be affecting ground water quality based on information in Ohio EPA's (deprecated) ground water impacts database. Most likely, these are from older, unlined landfills (many of which are closed) or construction and demolition debris landfills (C&DD) with limited construction standards. The current siting, design and construction standards for landfills are more stringent than 20 years ago, resulting in new landfills with significantly lower potential to impact ground water quality. Efforts to monitor C&DD landfills and characterize associated ground water quality impacts were initiated in 2015.

Septic Systems: More than 1,000,000 household wastewater systems, primarily septic tanks and leach fields, or in some cases injection wells, are present throughout the rural and unsewered suburban areas of Ohio. A number of these systems are improperly located, poorly constructed or inadequately maintained and may cause bacterial and chemical contamination of ground water which may supply water to nearby wells. Improperly operated and maintained septic systems are considered significant contributors to elevated nitrate levels in ground water in vulnerable geologic settings (for example, shallow fractured bedrock and sand and gravel deposits). More than 1,960 septic systems are in drinking water source protection areas. There are 220 septic systems discharging to surface water and 1,740 systems discharging to tanks, leachfields/mounds. The updated Household Sewage Treatment Systems Rules became effective on Jan. 1, 2015 (Ohio Revised Code Chapter 3718 and Ohio Administrative Code 3701-29) and should help correct deficiencies of failing septic systems.

Shallow Injection Wells: Class V injection wells are widespread throughout the state. Ohio EPA has records for 61,276 Class V wells. The bulk of these (over 40,000) are reported to be closed and abandoned. Of the identified wells, the majority are mine backfill wells used to inject grout into deep mines underneath roadways. The next largest segment of Class V wells (16,459) are used to inject fluids to assist in remediating contaminated aquifers. The last major segment of Class V wells are storm drainage wells. The fact that these wells are used to inject fluids directly into vulnerable aquifers in the State is the main cause for concern. These shallow injection wells provide a direct pathway for nonpoint source contamination and illegal waste disposal into vulnerable aquifers.

Hazardous Waste Sites: Ohio generates a large amount of hazardous waste. Legacy hazardous waste sites are a serious threat to ground water. There are 76 RCRA hazardous waste facilities, 18 Voluntary Action Program sites and 62 unregulated hazardous waste remediation sites (pre-1980) with documented releases to ground water (uppermost or lower aquifer) based on the ground water impacts database.

Pipelines and Sewer Lines: Pipelines and sewer lines all have potential for failure with release of the transported material. In addition, the construction of these lines, with the pipe embedded in permeable material, allows the trench to provide rapid flow paths for other surface contaminants. This is especially true if the trench is dug into fractured bedrock. Numerous gas, oil and industrial pipelines (1,145) and sewer lines (819) have been inventoried in drinking water source water protection areas.

Salt Storage and Road Salting: The widespread use of salt or mixtures of salt and sand for deicing roads has been documented as a nonpoint source contributor of sodium and chloride contamination of shallow ground water (Jones and Sroka 1997; Mullaney et al. 2009). Spreading of salt on roads certainly contributes to ground water quality impacts, but the greatest local impact is associated with salt storage. Seventy-six salt storage piles were identified directly in drinking water source protection areas with 47 of these located in sensitive aquifer settings. One hundred and twenty-four are within one-half mile of a source water protection area and 79 are within a half-mile of a designated sensitive aquifer. Most of these sites had adequate covering and pads. In addition to addressing these sites, Ohio is exploring ways to encourage implementation of best management practices for proper salt storage. Alternative chemicals like acetate-based deicers in combination with reduced salt usage are being promoted in pollution prevention programs. A workgroup, consisting of members from the Ohio Water Resources Council and the State Coordinating Committee on Ground Water, developed guidance for salt storage in 2013: *Recommendations for Salt Storage: Guidance for Protecting Ohio's Water Resources*, located on the web at: ***epa.ohio.gov/portals/35/owrc/SaltStorageGuidance.pdf***.

Suburban Runoff (including storm drains and storm water management): With expanding suburban areas, nonpoint source contamination from suburban/urban runoff is an increasing source of ground water contamination, in contrast with most of the other sources discussed. In addition, the practice of constructing storm water retention basins increases the likelihood that storm water runoff infiltrates into ground water. More than 1,250 storm drains are located within drinking water source protection areas, with many of these going directly to nearby water bodies. Elevated chloride is documented in urban areas within glacial aquifers by Mullaney et al. (2009) and positive trends in chloride concentrations in Ambient Ground Water Quality Monitoring data are present at some sites.

Small-Scale Manufacturing and Repair Shops: Small-scale manufacturing and repair shops include 1,693 facilities in drinking water source protection areas. These include: auto and boat repair shops and dealers; gas stations; junk yards; equipment rental and repair; machine shops; metal finishing and welding shops; and other various small businesses. These businesses typically handle chlorinated solvents (for cleaning) and petroleum products. Limited knowledge of best management practices for handling and disposing of these products increases the risk of impacting ground water.

Fire Training Facilities: Foams containing PFOA and PFOSs are known to have been applied to fight fuel-based fires at airbases and other fire training facilities. These chemicals could have entered the ground water due to releases during training, usage or storage. Ohio EPA has performed sampling (2016-2017) in partnership with the Ohio Air National Guard (OANG), the Ohio Department of Health and local health districts to assess potential health risks to private well users. These Ohio EPA-DDAGW investigations were not intended to take the place of the upcoming detailed federal investigations; rather, they were focused on evaluating risks to private well users based on available information regarding local ground water conditions and the location of fire training areas.

(✗) Potentially High Priority Sources

Concentrated Animal Feeding Operations (CAFO): The growth of CAFOs in numbers and size makes them a significant potential source if the waste is not properly managed. The ground water threats associated with CAFOs are captured in other categories as well, such as manure, sludge and fertilizer application and surface impoundments, so they are not considered one of the 10 highest priority sources. Improper storage or management of the animal waste is the greatest threat to ground water contamination in sensitive hydrogeologic settings, but land application in solid or liquid form also poses risks for ground and surface water contamination.

Surface Impoundments: Surface impoundments are one of the most common waste disposal concerns at RCRA facilities. Historically, they have been a major source for ground water contamination. Older impoundments were not subject to the same engineering standards as newer impoundments and, consequently, the probability of fluids leaching to the ground water was greater. Current siting and engineering requirements have improved this situation. Twenty-five surface impoundments are known to be contaminating ground water based on information obtained from Ohio EPA's ground water impacts database (deprecated), the majority being from regulated and unregulated hazardous waste facilities.

Mining and Mine Drainage: The bedrock (Pennsylvanian Units) that underlies eastern Ohio includes significant coal resources. The disruption of the stratigraphic units and oxidation of sulfides associated with coal mining produces ground water contamination by acid mine waters. Acid mine waters are considered a significant threat to ground water in mined areas.

Spills and Leaks: Leaks and spills of hazardous substances from underground tanks, surface impoundments, bulk storage facilities, transmission lines and accidents are major ground water pollution threats. More than a thousand leaks and spills are reported each year. This release of chemicals on to the surface and into near surface environments is certainly one of the greatest threats to ground water quality. The development of shale gas and associated hydrofracturing activity in eastern Ohio has raised concerns about potential for aquifer impacts. Historically, the surface management of brines has been the greatest cause of ground water contamination associated with oil production and hydro fracking activities (*State Oil and Gas Agency Groundwater Investigations and Their Role in Advancing Regulatory Reforms*, GWPC, August 2011). Revised regulations address the management and disposal of oil and gas production brines with the preferred mode of disposal as injection into Class II injection wells.

The major sources of ground water contamination listed include point and nonpoint sources in roughly equal proportions. In strict terms, a point source is a discharge from a discernable, confined and discrete conveyance, but in practical terms, the distribution or spatial scale of a contaminant controls the designation of a source as point or nonpoint. For example, salt applied for de-icing along roads exhibits nonpoint source behavior, while salt stockpiles behave more like point sources, with the potential for continual release of concentrated brine that may affect ground water quality. This dichotomy is typical of many agricultural contaminants, manure spreading versus storage, fertilizer application versus storage or mixing sites. In Ohio, we generally have better documentation of ground water contamination associated with point source contamination than nonpoint source contamination due to the extensive ground water monitoring programs at regulated facilities.

Rapid runoff in glacial till areas overlying much of Ohio and drainage tiling have protected many of Ohio's aquifers from traditional nonpoint source pollution sources such as nitrate, chloride, pesticides or bacteria. In sensitive settings (for example, sand and gravel aquifers, shallow bedrock aquifers), indicators of nonpoint source pollution are more clearly identified in Ohio's Ambient Ground Water Quality Monitoring program and the public water system compliance monitoring data. However, these monitoring programs do not focus on shallow aquifers, which have a higher likelihood of being influenced by nonpoint source pollution such as agricultural practices.

Table L-3 — Major sources of potential ground water contamination.

Contaminant Source	Highest-Priority Sources	Factors Considered in Selecting a Contaminant Source	Contaminants
Agriculture Activities			
Agricultural chemical facilities			
Animal feedlots	×	4, 5, 6, 8	E, J, K, L
Drainage wells			
Fertilizer applications (manure application)	✓	1, 2, 3, 4, 5, 8	E, J, K, L
Irrigation practices			
Pesticide applications			
On-farm agricultural mixing and loading			
Land application of manure			
Storage and Treatment Activities			
Land application			
Material stockpiles			
Storage tanks (above/below ground)	✓	1, 2, 3, 4, 5, 6, 7	C, D, H, M, N
Surface impoundments	×	6	G, H, M
Waste piles			
Waste tailings			
Disposal Activities			
Deep injection wells			
Landfills	✓	1, 2, 3, 4, 5, 6	A, B, C, D, H, M, N
Septic systems	✓	1, 2, 3, 4, 5, 6	E, H, J, K, L
Shallow injection wells	✓	1, 2, 3, 4, 5, 6, 8	C, D, G, H, M
Other			
Fire training areas	✓	1,3	N
Hazardous waste generators			
Hazardous waste sites	✓	1, 2, 3, 4, 5, 6, 7	A, B, C, D, H, I, M, N
Large industrial facilities			
Material transfer operations			
Mining and mine drainage	×	6, 8	G, H
Pipelines and sewer lines	✓		D, E, J, K, L
Salt storage and road salting	✓	6	G
Spills	×	6	C, D, H, M
Transportation of materials			
Urban runoff (storm water management, storm drains)	✓	2, 4	A, B, C, D, G, H, J
Small-scale manufacturing and repair shops	✓	4, 6	C, D, H, M, N

Notes: (✓) Highest Priority (×) Potentially High Priority
Factor and Contaminant codes on next page.

Factors	Contaminants
1. Human health and/or environmental risk (toxicity)	A. Inorganic pesticides
2. Size of the population at risk	B. Organic pesticides
3. Location of the sources relative to drinking water sources	C. Halogenated solvents
4. Number and/or size of contaminant sources	D. Petroleum compounds
5. Hydrogeologic sensitivity	E. Nitrate
6. State findings, other findings	F. Fluoride
7. Documented from mandatory reporting	G. Salt/Salinity/brine
8. Geographic distribution/occurrence	H. Metals
	I. Radionuclides
	J. Bacteria
	K. Protozoa
	L. Viruses
	M. Other (VOCs)
	N. PFAS

L5. Summary of Ground Water Quality by Aquifer

Table L-4 and Table L-5 (Table 5-4, U.S. EPA 1997) summarize water quality compliance data from Ohio public water systems and raw water data from the AGWQMP, respectively. The compliance data for public water systems in Ohio (Table L-4) documents water quality for treated water (post processing) and some raw (untreated) water quality (new well samples). Parameters generally unaffected by standard treatment, such as nitrate, may be used to characterize Ohio's ground water quality because post treatment values are similar to ground water values. DDAGW created the AGWQMP program (Table L-5) to monitor raw (untreated) ground water. This program's goal is the collection, maintenance and analysis of raw ground water quality data to measure long-term changes in the water quality of Ohio's major aquifer systems.

Ohio does not have statewide ground water quality standards, so data for the major aquifers are compared to primary maximum contaminant levels (MCLs), secondary maximum contaminant levels (SCMLs), health advisory levels (HALs), action levels (copper and lead), and drinking water advisory levels (sodium and sulfate). Primary MCLs are the highest level of a contaminant that is allowed in public drinking water and are set as close to MCL goals (a health-based standard) as feasible using the best available treatment technology and economic considerations. Primary MCLs are enforceable standards. Secondary MCLs are non-enforceable guidelines regulating contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor or color) in drinking water. HALs are levels in drinking water below which there are no adverse health effects over different time periods, such as one day, 10-day, long-term or lifetime. Action levels for lead and copper are set such that if more than 10 percent of tap water samples are above the action level, requirements may be triggered including: water quality parameter monitoring; corrosion control treatment; source water monitoring/treatment; public education; and/or lead service line replacement. Drinking water advisory levels for sodium and sulfate provide information on contaminants that can cause human health effects and are known or anticipated to occur in drinking water. The sodium drinking water advisory level applies only to adults on a low-salt diet.

Primary and secondary MCLs, HALs, action levels and drinking water advisory levels are used as practical benchmarks for water quality characterization in Table L-4 and Table L-5. For primary and secondary MCLs, 50 to 100 percent of the benchmark is used as the range for the watch list determination. The public water systems or wells identified in this category may warrant additional monitoring to identify increasing trends. Benchmark exceedances are used as the criteria for the impaired category for each of the five benchmarks: primary and secondary MCLs, HALs, action levels and drinking water advisory levels. Table L-4 and Table L-5 were generated using the last 10 years of data (1/1/2007-8/17/2017). Mean concentrations of a parameter are used to decide if a public water system or well is included in the watch list (50 to 100 percent of the benchmark) or impaired category (> benchmark). Maximum concentrations of nitrate and nitrite are reported in these tables instead of averages, due to the acute nature of their health concerns.

Public Water System Compliance Data

Mean values were calculated from public water system compliance data for 2007-2017 to determine the number of public water systems on the watch list and in the impaired category. A 10-year period of record was used to increase the statistical significance of the determination due to the infrequent sampling requirements (once per three-year period). **Public water systems included in the impaired category may not match Safe Drinking Water Act regulatory determinations of a violation due to the method of calculation.** A benchmark exceedance for compliance is generally an annual average, so the **decadal average presented in Table L-4 is not a compliance number**, but rather a comparison to set values, as a benchmark to identify public water systems in the watch list and impaired categories.

Table L-4 lists all parameters with MCLs, SMCLs, HALs, action levels and drinking water advisory levels and summarizes the number of public water systems in the watch list (MCLs and SMCLs only) and impaired category for both raw and treated water quality data (all five benchmarks). The results for each parameter are further divided into major aquifer type categories. The total number of public water systems with data used in these determinations is presented to allow comparison of the total number of public water systems to those that exhibit elevated levels. Data from active and inactive systems is included in Table L-4. For parameters with non-MCL benchmarks, treated water data is limited or absent because compliance data is generally not required for aesthetic water quality issues.

Except for a new well analysis, there are no requirements for collecting and reporting raw water data, so the number of public water systems with raw water data is less than the number with treated water data. The public water system data were linked to geologic settings using the DDAGW Source Water Assessment data, which allowed the breakout of the data by major aquifer. In this analysis, any detection in raw water data was used to generate public water system averages. For treated water data, public water system averages were generated only if there were at least two detections of a parameter. The inorganic parameters that place numerous public water systems in the watch list and impaired category warrant additional analysis.

The number of public water systems in the watch list and the impaired categories of Table L-4 for treated water are generally low; however, several parameters do exhibit higher numbers of public water systems in these groups. Fortunately, most of these occurrences are for secondary MCLs, not primary MCLs, HALs, action levels or drinking water advisories. That is, the water quality impacts documented are mostly aesthetic issues and are not health-based. Groups of parameters are discussed individually.

Table L-4 — Counts of public water systems where 2007-2017 decadal mean values of compliance data occur in the Watch List and Impaired Category.

					Public Water Systems					
					Raw Water			Treated Water		
Chemical Group	Chemical	Std. Type	Standard	Major Aquifer	Total # public water systems	Watch List > 50% to 100% Standard	Impaired > Standard	Total # public water systems	Watch List > 50% to 100% Standard	Impaired > Standard
Inorganics	Aluminum	SMCL	200 µg/L	Sand and Gravel						
				Sandstone						
				Carbonate						
	Ammonia	Lifetime HAL	30 mg/L	Sand and Gravel	9					
				Sandstone	11					
				Carbonate	26					
	Antimony	MCL	6 µg/L	Sand and Gravel	112		1	625	1	
				Sandstone	67			645		
				Carbonate	87			376	1	
	Arsenic	MCL	10 µg/L	Sand & Gravel	156	6	12	634	25	23
				Sandstone	103	1	6	646	13	6
				Carbonate	116	3	6	391	17	26
	Asbestos	MCL	7x106 fibers/L	Sand and Gravel	5			162		
				Sandstone				47		
				Carbonate	1			58		
	Barium	MCL	2000 µg/L	Sand and Gravel	120			625	1	
				Sandstone	89			646	2	
				Carbonate	93			82		
	Barium	1/10 Day HAL	700 µg/L	Sand and Gravel	120		1	625		1
				Sandstone	89			646		3
				Carbonate	93			82		2
	Beryllium	MCL	4 µg/L	Sand and Gravel	103			625		
				Sandstone	64			645		
				Carbonate	87			375		
	Cadmium	MCL	5 µg/L	Sand and Gravel	106			625		
				Sandstone	66			645		
				Carbonate	86			375		1
	Cadmium	Lifetime HAL	5 µg/L	Sand and Gravel	106			625		
				Sandstone	66			645		
				Carbonate	86			375		
Inorganics	Cadmium		40 µg/L	Sand and Gravel	106			625		

Chemical Group	Chemical	Std. Type	Standard	Major Aquifer	Public Water Systems					
					Raw Water			Treated Water		
					Total # public water systems	Watch List > 50% to 100% Standard	Impaired > Standard	Total # public water systems	Watch List > 50% to 100% Standard	Impaired > Standard
		1/10 Day HAL		Sandstone	66			645		
				Carbonate	86			375		
	Chloride	SMCL	250 mg/L	Sand and Gravel	102	1				
				Sandstone	92	2				
				Carbonate	95					
	Chromium	MCL	100 µg/L	Sand and Gravel	110			625		
				Sandstone	65			645		
				Carbonate	87			375		
	Chromium	1/10 Day HAL	1000 µg/L	Sand and gravel	110			625		
				Sandstone	65			645		
				Carbonate	87			375		
	Copper	Action Level	1300 µg/L	Sand and Gravel	180		2	606	3	10
				Sandstone	135		1	628	2	8
				Carbonate	115		1	359	1	8
	Cyanide	MCL	0.2 mg/L	Sand and Gravel	102			625		
				Sandstone	62			645		
				Carbonate	87			375		
	Fluoride	MCL	4 mg/L	Sand and Gravel	304			624	1	
				Sandstone	298			645	1	
				Carbonate	269			375	5	
	Fluoride		2 mg/L	Sand and Gravel	122	1		702	6	
		SMCL		Sandstone	85	1		713	1	
				Carbonate	94	21		446	20	
	Iron	SMCL	300 µg/L	Sand and Gravel	295	14	162			
				Sandstone	295	37	144	1		
				Carbonate	278	22	140	1		1
	Lead	Action Level	15 µg/L	Sand and Gravel						
				Sandstone						
				Carbonate						
	Manganese	SMCL	50 µg/L	Sand and Gravel	264	40	106			
				Sandstone	295	32	146	1		
				Carbonate	251	42	45	1		1
Inorganics	Manganese		300 µg/L	Sand and Gravel	264		26			

Chemical Group	Chemical	Std. Type	Standard	Major Aquifer	Public Water Systems					
					Raw Water			Treated Water		
					Total # public water systems	Watch List > 50% to 100% Standard	Impaired > Standard	Total # public water systems	Watch List > 50% to 100% Standard	Impaired > Standard
		Lifetime HAL		Sandstone	295		36	1		
				Carbonate	251		3	1		
	Manganese	1/10 Day HAL	1000 µg/L	Sand and Gravel	264		5			
				Sandstone	295		5	1		
				Carbonate	251		2	1		
	Mercury	MCL	2 µg/L	Sand and Gravel	281		1	702		
				Sandstone	287	1		713		1
				Carbonate	257	1		446		
	Nickel	Lifetime HAL	100 µg/L	Sand and Gravel	287			701		2
				Sandstone	288		1	713		2
				Carbonate	260		1	445		
	Nickel	1/10 Day HAL	1000 µg/L	Sand and Gravel	287			701		
				Sandstone	288			713		
				Carbonate	260		1	445		
	Nitrate * (Max Value)	MCL	10 mg/L	Sand and Gravel	349	16	9	1603	57	17
				Sandstone	331	6	4	2053	31	5
				Carbonate	286	6	7	1397	34	2
	Nitrate* (Max Value)	1/10 Day HAL	100 mg/L	Sand and Gravel	349			1601		1
				Sandstone	331			2053		
				Carbonate	286			1393		
	Nitrite * (Max Value)	MCL	1 mg/L	Sand and Gravel	326			1611	1	2
				Sandstone	311	1		2062	3	3
				Carbonate	269			1407	1	
	pH	SMCL	6.5-8.5 SU	Sand and Gravel						
				Sandstone						
				Carbonate						
	Selenium	MCL	50 µg/L	Sand and Gravel	284			702		
				Sandstone	288			713		
				Carbonate	258	2		446		
	Selenium	Lifetime HAL	50 µg/L	Sand and Gravel	284			701		
				Sandstone	288			713		
				Carbonate	288			445		

Inorganics	Silver	SMCL	100 µg/L	Sand and Gravel	248		1			

Chemical Group	Chemical	Std. Type	Standard	Major Aquifer	Public Water Systems					
					Raw Water			Treated Water		
					Total # public water systems	Watch List > 50% to 100% Standard	Impaired > Standard	Total # public water systems	Watch List > 50% to 100% Standard	Impaired > Standard
				Sandstone	274			1		
				Carbonate	241		1			
	Sodium**	DW Advisory	20 mg/L	Sand and Gravel	246		94			
				Sandstone	280		141	1		
				Carbonate	241		117			
	Strontium	Lifetime HAL	4000 µg/L	Sand and Gravel	3		1			
				Sandstone	3					
				Carbonate	1		1			
	Strontium	1/10 Day HAL	25000 µg/L	Sand and Gravel	3					
				Sandstone	3					
				Carbonate	1					
	Sulfates	SMCL	250 mg/L	Sand and Gravel	291	17	15			
				Sandstone	299	12	17			
				Carbonate	270	30	83	1		
	Sulfates	DW Advisory	500 mg/L	Sand and Gravel	291		9			
				Sandstone	299		7			
				Carbonate	270		54	1		
	Thallium	MCL	2 µg/L	Sand and Gravel	282	2	1	702	3	
				Sandstone	286		1	713	2	1
				Carbonate	257	1		446		1
	Total Dissolved Solids	SMCL	500 mg/L	Sand and Gravel	119	50	30			
				Sandstone	167	71	32			
				Carbonate	144	23	79			
	Zinc	SMCL	5000 µg/L	Sand and Gravel	155					
				Sandstone	145			1		
				Carbonate	137					
	Zinc	Lifetime HAL	2000 µg/L	Sand and Gravel	155					
				Sandstone	145			1		
				Carbonate	137		1			
	Zinc	1/10 Day HAL	6000 µg/L	Sand and Gravel	155					
				Sandstone	145			1		
				Carbonate	137					
	1,2-Dichloroethane	MCL	5 µg/L	Sand and Gravel	326	1		706		

Chemical Group	Chemical	Std. Type	Standard	Major Aquifer	Public Water Systems					
					Raw Water			Treated Water		
					Total # public water systems	Watch List > 50% to 100% Standard	Impaired > Standard	Total # public water systems	Watch List > 50% to 100% Standard	Impaired > Standard
Volatile Organic Chemicals				Sandstone	321			719		1
				Carbonate	277			451		1
	1,1-Dichloroethylene	MCL	7 µg/L	Sand and Gravel	327	1		707		
				Sandstone	321		1	719		1
				Carbonate	277			451		
	1,2-Dichloropropane	MCL	5 µg/L	Sand and Gravel	328		1	707		1
				Sandstone	322			719		
				Carbonate	277			451	1	
	1,1,1-Trichloroethane	MCL	200 µg/L	Sand and Gravel	328			707		
				Sandstone	322			719		
				Carbonate	277			451		
	1,1,2-Trichloroethane	MCL	5 µg/L	Sand and Gravel	328			707		
				Sandstone	322			719		
				Carbonate	277			451		
	1,2,4-Trichlorobenzene	MCL	70 µg/L	Sand and Gravel	328			707		
				Sandstone	321			719		
				Carbonate	277			451		
	Benzene	MCL	5 µg/L	Sand and Gravel	327		3	707		
				Sandstone	322			719		
				Carbonate	275			451		
	Carbon Tetrachloride	MCL	5 µg/L	Sand and Gravel	328	1		707		1
				Sandstone	322	1	1	719		
				Carbonate	277			451		
	Chlorobenzene	MCL	100 µg/L	Sand and Gravel	328					
				Sandstone	321					
				Carbonate	277					
	Cis-1,2-Dichloroethylene	MCL	70 µg/L	Sand and Gravel	328			707		
				Sandstone	321			719		
				Carbonate	277			451		
	Dichloromethane	MCL	5 µg/L	Sand and Gravel	327	2	1	707	2	1
				Sandstone	316	1	1	719		1
				Carbonate	276		1	451	1	1

Chemical Group	Chemical	Std. Type	Standard	Major Aquifer	Public Water Systems					
					Raw Water			Treated Water		
					Total # public water systems	Watch List > 50% to 100% Standard	Impaired > Standard	Total # public water systems	Watch List > 50% to 100% Standard	Impaired > Standard
Volatile Organic Chemicals	Ethyl benzene	MCL	700 µg/L	Sand and Gravel	328			707		
				Sandstone	322			719		
				Carbonate	277			451		
	o-Dichlorobenzene	MCL	600 µg/L	Sand and Gravel	328			707		
				Sandstone	321			719		
				Carbonate	277			451		
	p-Dichlorobenzene	MCL	75 µg/L	Sand and Gravel	328			707		
				Sandstone	320			719		
				Carbonate	277			451		
	Styrene	MCL	100 µg/L	Sand and Gravel	328			707		
				Sandstone	322			719		
				Carbonate	277	1		451		
	Tetrachloroethylene	MCL	5 µg/L	Sand and Gravel	328	3	3	707	3	
				Sandstone	322	1	2	719	1	1
				Carbonate	277			451	1	
	Toluene	MCL	1000 µg/L	Sand and Gravel	328			707		
				Sandstone	322			719		
				Carbonate	277			451		
Volatile Organics	Trans-1,2-Dichloroethylene	MCL	100 µg/L	Sand and Gravel	328			707		
				Sandstone	322			719		
				Carbonate	277			451		
	Trichloroethylene	MCL	5 µg/L	Sand and Gravel	328	3		707		
				Sandstone	322		1	719	1	
				Carbonate	276	1	1	451	1	
	Vinyl Chloride	MCL	2 µg/L	Sand and Gravel	328	3	2	706		2
				Sandstone	321			719		
				Carbonate	277			451		
	Xylenes, Total	MCL	10 mg/L	Sand and Gravel	327			707		
				Sandstone	318			719		
				Carbonate	276			451		
	Alachor (Lasso)	MCL	2 µg/L	Sand and Gravel	270			707		

					Public Water Systems					
					Raw Water			Treated Water		
Chemical Group	Chemical	Std. Type	Standard	Major Aquifer	Total # public water systems	Watch List > 50% to 100% Standard	Impaired > Standard	Total # public water systems	Watch List > 50% to 100% Standard	Impaired > Standard
Pesticides and Synthetic Organic Chemicals				Sandstone	281			723		
				Carbonate	241			453		
	Atrazine	MCL	3 µg/L	Sand and Gravel	269			707		
				Sandstone	282			723		
				Carbonate	241			453		
	Benzo(a)Pyrene	MCL	0.2 µg/L	Sand and Gravel	3			94	1	
				Sandstone				47		
				Carbonate	3			19		
	Carbofuran	MCL	40 µg/L	Sand and Gravel	3			98		
				Sandstone	1			44		
				Carbonate	2			20		
	Chlordane	MCL	2 µg/L	Sand and Gravel	4					
				Sandstone						
				Carbonate						
	2,4-D	MCL	70 µg/L	Sand and Gravel	5			97		
				Sandstone	2			44		
				Carbonate	2			20		
	Dalapon	MCL	200 µg/L	Sand and Gravel	5					
				Sandstone						
				Carbonate						
	Dibromochloro-propane (DBCP)	MCL	0.2 µg/L	Sand and Gravel						
				Sandstone						
				Carbonate						
	Di(2-ethylhexyl) adipate	MCL	400 µg/L	Sand and Gravel	4			94		
				Sandstone				47		
				Carbonate	5			19		
	Di(2-ethylhexyl) phthalate	MCL	6 µg/L	Sand and Gravel	4			97		2
				Sandstone				48		
				Carbonate	5	1		21		1
	Dinoseb	MCL	7 µg/L	Sand and Gravel	5					
				Sandstone						
				Carbonate	1					

Chemical Group	Chemical	Std. Type	Standard	Major Aquifer	Public Water Systems					
					Raw Water			Treated Water		
					Total # public water systems	Watch List > 50% to 100% Standard	Impaired > Standard	Total # public water systems	Watch List > 50% to 100% Standard	Impaired > Standard
Pesticides and Synthetic Organic Chemicals	Diquat	MCL	20 µg/L	Sand and Gravel	3			100		
				Sandstone				46		
				Carbonate	2			18		
	Endothall	MCL	100 µg/L	Sand and Gravel	3			94		
				Sandstone				47		
				Carbonate	2			19		
	Endrin	MCL	2 µg/L	Sand and Gravel	4					
				Sandstone						
				Carbonate						
	Ethylene Dibromide	MCL	0.05 µg/L	Sand and Gravel	6					
				Sandstone						
				Carbonate						
	Glyphosate	MCL	700 µg/L	Sand and Gravel	3			97		
				Sandstone				46		
				Carbonate	2			18		
	Heptachlor	MCL	0.4 µg/L	Sand and Gravel	4					
				Sandstone						
				Carbonate						
	Heptachlor Epoxide	MCL	0.2 µg/L	Sand and Gravel	4					
				Sandstone						
				Carbonate						
	Hexachlorobenzene	MCL	1 µg/L	Sand and Gravel	4					
				Sandstone						
				Carbonate						
	Hexachloro-cyclopentadiene	MCL	50 µg/L	Sand and Gravel	4					
				Sandstone						
				Carbonate						
	Lindane	MCL	0.2 µg/L	Sand and Gravel	4			97		
				Sandstone				46		
				Carbonate	2			18		
	Methoxychlor	MCL	40 µg/L	Sand and Gravel	4			97		
				Sandstone	1			46		
				Carbonate	2			18		

Chemical Group	Chemical	Std. Type	Standard	Major Aquifer	Public Water Systems: Raw Water: Total # public water systems	Raw Water: Watch List > 50% to 100% Standard	Raw Water: Impaired > Standard	Treated Water: Total # public water systems	Treated Water: Watch List > 50% to 100% Standard	Treated Water: Impaired > Standard
Pesticides and Synthetic Organic Chemicals	Oxamyl	MCL	200 µg/L	Sand and Gravel	3			98		
				Sandstone	1			44		
				Carbonate	2			20		
	Pentachlorophenol	MCL	1 µg/L	Sand and Gravel						
				Sandstone						
				Carbonate						
	Picloram	MCL	500 µg/L	Sand and Gravel	5			98		
				Sandstone	2			44		
				Carbonate	2			20		
	Simazine	MCL	4 µg/L	Sand and Gravel	269			707		
				Sandstone	282			723		
				Carbonate	241			453		
	Total PCBs	MCL	0.5 µg/L	Sand and Gravel	3			97		
				Sandstone	1			46		
				Carbonate	1			18		
	2,3,7,8-TCDD (Dioxin)	MCL	3×10^{-5} µg/L	Sand and Gravel				24		
				Sandstone				4		
				Carbonate				3		
	2,4,5-TP (Silvex)	MCL	50 µg/L	Sand and Gravel	5					
				Sandstone						
				Carbonate						
	Toxaphene	MCL	3 µg/L	Sand and Gravel	4					
				Sandstone						
				Carbonate						
Organic Disinfection By-Products	Total Haloacetic Acids (HAA5)	MCL	60 µg/L	Sand and Gravel	81	3	1	526	5	2
				Sandstone	51		1	406	6	4
				Carbonate	56	1	1	275	3	1
	Total Trihalomethanes (TTHM)	MCL	80 µg/L	Sand and Gravel	119	6	4	525	40	6
				Sandstone	61	2	1	406	14	2
				Carbonate	62	5	3	275	23	2
Radiological	Gross Alpha (excl & incl)	MCL	15 pCi/L	Sand and Gravel	208	1		421	2	1
				Sandstone	251	4		265	3	1
				Carbonate	176	12	3	190	3	

Chemical Group	Chemical	Std. Type	Standard	Major Aquifer	Public Water Systems					
					Raw Water			Treated Water		
					Total # public water systems	Watch List > 50% to 100% Standard	Impaired > Standard	Total # public water systems	Watch List > 50% to 100% Standard	Impaired > Standard
Radiological	Gross Beta	MCL	4 mrem/ yr***	Sand and Gravel	162	2	34			
				Sandstone	174	2	48			
				Carbonate	144	2	45			
	Radium 226	MCL	5 pCi/L****	Sand and Gravel	24			1		
				Sandstone	28	2	1	3		
				Carbonate	45	6	2	1		
	Radium 228	MCL	5 pCi/L****	Sand and Gravel	153			418	1	
				Sandstone	159	3	2	265	4	1
				Carbonate	147	2		187	1	
	Uranium	MCL	30 µg/L	Sand and Gravel	3					
				Sandstone	1					
				Carbonate	3					

Note: presented by major aquifer types.
Blank spaces indicate no public water systems exceed the standards (zeros left out to highlight impacted public water systems)
"nda" Indicates no data available
* Numbers for Nitrate and Nitrite are based on maximum values to reflect the acute nature of the contaminant.
** Sodium drinking water advisory level is for adults on low-salt diets.
*** If Gross Beta result is less than 50 pCi/L no conversion to mrem/yr is necessary – table used 50 pCi/L as standard.
**** MCL is for combined Radium 226 and Radium 228

Table L-5 — Counts of wells where 2007-2017 decadal mean values of AGWQMP data occur in the Watch List and Impaired Category (maximum values used for nitrate).

Chemical Group	Chemical	Standard Type	Standard	Major Aquifer	Ambient GW Quality Wells Raw Water Total # Wells	Watch List > 50 - 100% Standard	Impaired > Standard
Inorganic Chemicals	Ammonia	Lifetime HAL	30 mg/L	Sandstone and Gravel	167		
				Sandstone	49		
				Carbonate	61		
	Antimony	MCL	6 µg/L	Sandstone and Gravel			
				Sandstone	1		
				Carbonate			
	Arsenic	MCL	10 µg/L	Sandstone and Gravel	167	27	24
				Sandstone	49	3	1
				Carbonate	61	5	9
	Alkalinity	SMCL	10,000 mg/L	Sandstone and Gravel	167		
				Sandstone	49		
				Carbonate	61		
	Barium	MCL	2,000 µg/L	Sandstone and Gravel	167	2	
				Sandstone	49	2	1
				Carbonate	61		
	Barium	1/10 Day HAL	700 µg/L	Sandstone and Gravel	167		4
				Sandstone	49		5
				Carbonate	61		
	Cadmium	MCL	5 µg/L	Sandstone and Gravel	167		
				Sandstone	49		
				Carbonate	61		
	Cadmium	Lifetime HAL	5 µg/L	Sandstone and Gravel	167		
				Sandstone	49		1
				Carbonate	61		1
	Cadmium	1/10 Day HAL	40 µg/L	Sandstone and Gravel	167		
				Sandstone	49		
				Carbonate	61		
	Chloride	SMCL	250 mg/L	Sandstone and Gravel	167	5	2
				Sandstone	49	5	2
				Carbonate	61	1	1

Chemical Group	Chemical	Standard Type	Standard	Major Aquifer	Ambient GW Quality Wells		
					Raw Water		
					Total # Wells	Watch List > 50 - 100% Standard	Impaired > Standard
Inorganic Chemicals	Chromium	MCL	100 µg/L	Sandstone and Gravel	167		
				Sandstone	49		
				Carbonate	61		
	Chromium	1/10 Day HAL	1,000 µg/L	Sandstone and Gravel	167		
				Sandstone	49		
				Carbonate	61		
	Copper	Action Level	1,300 µg/L	Sandstone and Gravel	167		
				Sandstone	49		
				Carbonate	61		
	Fluoride	MCL	4 mg/L	Sandstone and Gravel	167		
				Sandstone	49		
				Carbonate	61	6	
	Fluoride	SMCL	2 mg/L	Sandstone and Gravel	167		
				Sandstone	49		
				Carbonate	61		
	Iron	SMCL	300 µg/L	Sandstone and Gravel	167	10	121
				Sandstone	49	7	32
				Carbonate	61	8	46
	Lead	Action Level	15 µg/L	Sandstone and Gravel			
				Sandstone			
				Carbonate			
	Manganese	SMCL	50 µg/L	Sandstone and Gravel	167	25	116
				Sandstone	49	4	32
				Carbonate	61	18	8
	Manganese	Lifetime HAL	300 µg/L	Sandstone and Gravel	167		48
				Sandstone	49		13
				Carbonate	61		
	Manganese	1/10 Day HAL	1,000 µg/L	Sandstone and Gravel	167		4
				Sandstone	49		3
				Carbonate	61		
	Nickel	Lifetime HAL	100 µg/L	Sandstone and Gravel	167		1
				Sandstone	49		2
				Carbonate	61		

Chemical Group	Chemical	Standard Type	Standard	Major Aquifer	Ambient GW Quality Wells Raw Water Total # Wells	Watch List > 50 - 100% Standard	Impaired > Standard
Inorganic Chemicals	Nickel	1/10 Day HAL	1,000 µg/L	Sandstone and Gravel	167		
				Sandstone	49		
				Carbonate	61		
	Nitrate* (Max Value)	MCL	10 mg/L	Sandstone and Gravel	167	11	4
				Sandstone	49	1	
				Carbonate	61	2	
	Nitrate* (Max Value)	1/10 Day HAL	100 mg/L	Sandstone and Gravel	167		
				Sandstone	49		
				Carbonate	61		
	Nitrite* (Max Value)	MCL	1 mg/L	Sandstone and Gravel	25		
				Sandstone			
				Carbonate			
	Selenium	MCL	50 µg/L	Sandstone and Gravel	167		
				Sandstone	49	1	
				Carbonate	61		
	Selenium	Lifetime HAL	50 µg/L	Sandstone and Gravel	167		
				Sandstone	49		1
				Carbonate	61		
	Sodium	DW Advisory	20 mg/L	Sandstone and Gravel	167		122
				Sandstone	49		36
				Carbonate	61		45
	Strontium	Lifetime HAL	4,000 µg/L	Sandstone and Gravel	167		30
				Sandstone	49		5
				Carbonate	61		54
	Strontium	1/10 Day HAL	25,000 µg/L	Sandstone and Gravel	167		3
				Sandstone	49		
				Carbonate	61		22
	Sulfate	SMCL	250 mg/L	Sandstone and Gravel	167	16	2
				Sandstone	49	2	1
				Carbonate	61	9	26
	Sulfate	1/10 Day HAL	500 mg/L	Sandstone and Gravel	167		1
				Sandstone	49		1
				Carbonate	61		10

Chemical Group	Chemical	Standard Type	Standard	Major Aquifer	Ambient GW Quality Wells Raw Water Total # Wells	Watch List > 50 - 100% Standard	Impaired > Standard
Inorganic Chemicals	Total Dissolve Solids	SMCL	500 mg/L	Sandstone and Gravel	167	111	55
				Sandstone	49	31	12
				Carbonate	61	7	54
	Zinc	DW Advisory	5,000 µg/L	Sandstone and Gravel	167		
				Sandstone	49		
				Carbonate	61	1	
	Zinc	Lifetime HAL	2,000 µg/L	Sandstone and Gravel	167		2
				Sandstone	49		
				Carbonate	61		1
	Zinc	1/10 Day HAL	6,000 µg/L	Sandstone and Gravel	167		
				Sandstone	49		
				Carbonate	61		
	pH	SMCL	7.0-10.5	Sandstone and Gravel	167		
				Sandstone	49		
				Carbonate	61		
Volatile Organic Chemicals	1,2-Dichloroethane	MCL	5 µg/L	Sandstone and Gravel	160		
				Sandstone	48		
				Carbonate	59		
	1,1-Dichloroethylene	MCL	7 µg/L	Sandstone and Gravel	160		
				Sandstone	48		
				Carbonate	59		
	1,2-Dichloropropane	MCL	5 µg/L	Sandstone and Gravel	160		
				Sandstone	48		
				Carbonate	59		
	1,1,1-Trichloroethane	MCL	200 µg/L	Sandstone and Gravel	160		
				Sandstone	48		
				Carbonate	59		
	1,1,2-Trichloroethane	MCL	5 µg/L	Sandstone and Gravel	160		
				Sandstone	48		
				Carbonate	59		
	1,2,4-Trichlorobenzene	MCL	70 µg/L	Sandstone and Gravel	160		
				Sandstone	48		
				Carbonate	59		

Chemical Group	Chemical	Standard Type	Standard	Major Aquifer	Ambient GW Quality Wells		
					Raw Water		
					Total # Wells	Watch List > 50 - 100% Standard	Impaired > Standard
Volatile Organic Chemicals	Benzene	MCL	5 µg/L	Sandstone and Gravel	160		
				Sandstone	48		
				Carbonate	59		
	Carbon Tetrachloride	MCL	5 µg/L	Sandstone and Gravel	160		
				Sandstone	48		
				Carbonate	59		
	Chlorobenzene	MCL	100 µg/L	Sandstone and Gravel	160		
				Sandstone	48		
				Carbonate	59		
	Cis-1,2-Dichloroethylene	MCL	70 µg/L	Sandstone and Gravel	160		
				Sandstone	48		
				Carbonate	59		
	Dichloromethane	MCL	5 µg/L	Sandstone and Gravel	160		
				Sandstone	48		
				Carbonate	59		
	Ethyl benzene	MCL	700 µg/L	Sandstone and Gravel	160		
				Sandstone	48		
				Carbonate	59		
	o-Dichlorobenzene	MCL	600 µg/L	Sandstone and Gravel	160		
				Sandstone	48		
				Carbonate	59		
	p-Dichlorobenzene	MCL	75 µg/L	Sandstone and Gravel	160		
				Sandstone	48		
				Carbonate	59		
	Styrene	MCL	100 µg/L	Sandstone and Gravel	160		
				Sandstone	48		
				Carbonate	59		
	Tetrachloroethylene	MCL	5 µg/L	Sandstone and Gravel	160		
				Sandstone	48		
				Carbonate	59		
	Toluene	MCL	1,000 µg/L	Sandstone and Gravel	160		
				Sandstone	48		
				Carbonate	59		

Chemical Group	Chemical	Standard Type	Standard	Major Aquifer	Ambient GW Quality Wells		
					Raw Water		
					Total # Wells	Watch List > 50 - 100% Standard	Impaired > Standard
Volatile Organic Chemicals	Trans-1,2-Dichloroethylene	MCL	100 µg/L	Sandstone and Gravel	160		
				Sandstone	48		
				Carbonate	59		
	Trichloroethylene	MCL	5 µg/L	Sandstone and Gravel	160		
				Sandstone	48		
				Carbonate	59		1
	Vinyl Chloride	MCL	2 µg/L	Sandstone and Gravel	160	4	
				Sandstone	48		
				Carbonate	59		
	o-Xylene	MCL	10 mg/L	Sandstone and Gravel	160		
				Sandstone	48		
				Carbonate	59		

Blank spaces indicate no public water systems exceed the standards (zeros left out to highlight impacted public water systems)
"nda" Indicates no data available
* Numbers for Nitrate and Nitrite are based on maximum values to reflect the acute nature of the contaminant
** If Gross Beta result is less than 50 pCi/L, no conversion to mrem/yr is necessary – table used 50 p/Ci/L as standard
*** MCL is for combined Radium 226 and Radium 228

Inorganic Parameters

MCL Parameters

Only a few public water systems fall into the watch list or the impaired MCL category based on inorganic parameters. For treated water data, parameters with MCLs and no public water systems in the impaired category (values > MCL) include: **asbestos; barium; cadmium; chromium; cyanide; fluoride; and selenium.** The use of detection limits at or greater than 50 percent of the MCL and using the reporting limit for the non-detect value can result in public water systems placed in the watch list with no detection of the parameter. The data has been reviewed to assure that public water system in the watch list have detected the parameter. Factors limiting the number of public water systems in these categories include limited solubility of the substance in water, low crustal abundance, local geology and possibly treatment. For example, in treated water, no public water systems exceed the fluoride MCL, but 20 public water systems that draw water from carbonate aquifers exceed 50 percent of the MCL. This association is controlled by secondary fluorite mineralization along fractures and voids in limestone in northwest Ohio.

Several parameters including **antimony, beryllium, mercury and thallium** have low numbers of public water systems in the MCL impaired category for treated water. This small number is consistent with the low solubility and scarcity of these metals in Ohio's geology. The use of decadal averages for determining both watch list and impaired categories may overestimate the numbers of public water systems when compared to actual MCL, SMCL or HAL calculations which use annual averages.

The number of public water systems with **arsenic** in raw water and treated water above the MCL (139 and 91, respectively) is consistent with the number of public water systems that DDAGW worked with to reduce arsenic to meet the 2006 revised MCL of 10 µg/L. These systems are associated with reduced ground water and local areas of naturally occurring arsenic. Sand and gravel and carbonate aquifers are more likely than the sandstone aquifers to exhibit arsenic-impaired ground water. The number of public water systems currently exceeding the arsenic MCL is significantly less than what is listed in Table L-4 because numerous public water systems have installed treatment to remove arsenic since 2006. The elevated arsenic results collected from 2007 and beyond (while treatment processes were installed and refined) are included in the 10 years of data used to generate the public water system decadal averages. These elevated values increase the decadal mean calculated for Table L-4 and thus, result in impaired systems on a decadal mean, but these systems are currently serving water below the arsenic MCL.

SMCL Parameters

Secondary MCL parameters for drinking water are directed at non-health related issues such as taste and odor. Public water systems do not collect compliance data for most parameters with SMCLs. Table L-4 utilized only compliance data and, consequently, it includes little data for treated water for parameters with SMCLs. The raw water data collected through new well samples, however, provides information on the distribution of these parameters.

Multiple public water systems display elevated **chloride**. The largest numbers of public water systems with elevated chloride are associated with the sandstone aquifers followed by sand and gravel aquifers and carbonate aquifers. This may be related to limited natural oil and gas deposits occurring within aquifers, contamination of local aquifers from surface handling of oil and gas production brines, local salt storage facilities overlying sensitive aquifers, road salt application or septic systems. Transportation routes are concentrated in the broad, flat buried valleys and consequently, large salt piles are stored on these broad valleys, which contain sensitive aquifers. Activities to address chloride contamination are discussed in the Major Sources of Ground Water Contamination section.

Iron and manganese have similar oxidation-reduction solubility controls as arsenic and widespread distribution and exhibit elevated numbers of public water systems in the watch list and impaired category of Table L-4 for raw water. Table L-4 utilized only compliance data so little data for treated water is included for iron and manganese. The raw water concentration for Fe and Mn are controlled by the increased solubility of iron and manganese in reduced waters. The deeper wells generally exhibit more reduced conditions (reduced interaction with the atmosphere) and, consequently, elevated iron and manganese. Iron is a common element and is present in all three major aquifers. For manganese, the carbonate aquifer is least likely to exhibit concentrations above the SMCL. Many public water systems remove iron and manganese, so the percentage of public water systems that exhibit impairments in treated water is significantly lower than in raw water.

Sulfate also has an SMCL and only raw water data exists for identifying water quality impacts. A significant number of public water systems exhibit elevated sulfate in the both the watch and impaired categories. Although these sites are distributed in all major aquifers, the carbonate aquifers in NW Ohio exhibit the highest percentage of public water systems on the watch list and in the impaired category (42 percent of carbonate vs. 10-11 percent for sandstone and sand and gravel) due to the presence of evaporates (Gypsum, $CaSO_4 \cdot 2H_2O$) in the Salina Formation in northwest Ohio.

For **Fluoride** results, no public water systems show up in the impaired category for raw or treated water, however, a number of public water systems exhibit watch list concentrations in treated and raw water. Fluoride is unusual in that it has a primary and secondary MCL and the SMCL is 50 percent of the MCL. Thus, all the systems on the watch list for the MCL exceed the SMCL. The *Fluoride Technical Report* (2012) describes how fluorite, which was deposited as a secondary mineral in fractures in the carbonate aquifers, controls the distribution of elevated fluoride.

For **nitrate and nitrite,** maximum values were used rather than average values to reflect the acute nature of the nitrogen MCLs. As a parameter that is stable in oxidized environments, nitrate is more likely to be present in shallower wells. Approximately 2.5 percent (122 of 5,053) of public water systems in Table L-4 (treated water) have maximum nitrate greater than 50 percent of the MCL. Approximately 50 percent of these public water systems are in sand and gravel aquifer settings. A public water system that exceeds 50 percent of the nitrate MCL is required to sample for nitrate on a quarterly basis. Thus, over the last decade, at least 146 public water systems have been required to increase nitrate sampling to at least quarterly. For nitrate in treated water and raw water, 24 and 20 public water systems fall into the impaired category, respectively. Public water systems with maximum results greater than the MCL do not necessarily indicate an MCL exceedance, which is an annual average.

Public water systems with elevated nitrate tend to be associated with more sensitive aquifers such as buried valleys and areas of thin glacial drift over bedrock. Stable nitrate (where decadal averages are relatively high) tend to be found in systems that combine a shallow aquifer with rapid pathways between surface and ground water and stable oxic or sub-oxic ground water. The number of public water systems with maximum nitrates in treated water in the watch list or impaired categories has decreased since 2010 based on the 2010 (243 public water systems), 2012 (227 public water systems), 2014 (181 public water systems), 2016 (149 public water systems) and 2018 (146 public water systems) integrated reports. This is encouraging, but probably reflects improved treatment or use of alternative sources, rather than reduction in nitrate loading.

HAL Parameters

HALs are constituent levels below which there are no adverse health effects over different time periods, such as one day, 10-day, long-term or lifetime. For HAL parameters, only an exceedance of the HAL (impaired status) was calculated in Table L-4. For raw water, a percentage of public water systems are included in the impaired category for **barium** (two percent) and **manganese** (8.5 percent). Barium and manganese exceedances are spread evenly between sand and gravel and sandstone aquifers. For treated water supplies, a very small percentage (<1 percent) of public water systems exceed their respective HAL for barium and **nickel**. Two public water system wells, one in carbonate and one in sand and gravel, exceed the lifetime HAL for strontium.

Drinking Water Advisory Parameters

Exceedances of drinking water advisory levels for **sodium** and **sulfate** can cause human health effects. The sodium drinking water advisory level applies only to adults on a low-salt diet. Only an exceedance of the drinking water advisory (impaired status) was calculated in Table L-4. For raw water, a percentage of public water systems are included in the impaired category for **sodium** (41.3 percent) and **sulfate** (7.6 percent). Sodium exceedances are found most often in sandstone, then carbonate aquifers. The large percentage of public water systems with sodium exceedances may be due to oil and gas production brines, salt storage facilities or road salt applications. Sulfate exceeds the drinking water advisory level most commonly in the carbonate aquifers again due to the presence of evaporates.

Organic Parameters

Only seven organic parameters' mean concentrations for treated water samples place public water systems in the impaired category: 1,2-dichloroethane; 1,1-dichlorethylene; 1, 2-dichloropropane; carbon tetrachloride; dichloromethane; tetrachloroethylene; and vinyl chloride. Two of these parameters are common solvents and a third is a compound used to make plastic. Dichloromethane (methylene chloride) is a known lab contaminant, but it is also possible that it can leach to ground water before it volatilizes, so it is included in Table L-4. In addition to the public water systems identified above, there are about 15 public water systems that are not using a production well or are using air strippers to remove VOC contamination from ground water prior to use. The raw water data may include some of these systems, but if these ground water-based public water systems were not removing VOC contaminants, additional constituents would be identified as a cause of impairment.

Pesticides and Synthetic Organics

One pesticide and synthetic constituent is identified as a cause of impairment, **di(2-ethylhexyl) phthalate.** These data confirm that although we see impact from pesticides and other organic compounds migrating to major aquifers, the protection that the till cover and tile drainage provide to protect Ohio ground water is significant.

Radiological Parameters

For treated water, several public water systems are included on the watch list and the impaired category for **gross alpha** and **radium 228**. The limited number of public water systems in the watch list and impaired category is consistent with the Ohio's geologic setting having few natural sources of radionuclides. The exceptions are uranium associated with reduced geologic settings like glacial tills, the Ohio Shale and coal deposits, but these settings are generally not utilized as aquifers. Gross beta compliance monitoring focuses on anthropogenic sources of radiation. The distribution of radionuclides is discussed in the DDAGW technical report *Radionuclides in Ohio's Ground Water* (July 2015).

Ambient Ground Water Quality Monitoring Data

Mean values were calculated from the AGWQMP data (raw water) for each well over the past 10 years (2007 through 2017) to determine the number of wells in the watch list and impaired categories for each constituent. These numbers are listed in Table L-5 by parameter and major aquifer. The number of wells used in the determinations is also presented to provide the relative number of wells that exhibit ground water quality with elevated concentrations of MCL, SMCL, HAL and drinking water advisory parameters. A limited number of AGWMP wells are listed in the watch list and impaired category, as was the case for the public water system compliance data. The results for groups of parameters are discussed below.

Inorganic Parameters

The AGWQMP does not collect data for **antimony (except for one sandstone well), asbestos, beryllium, cyanide, mercury, nitrite, silver and thallium**, so no comparison can be made to the public water system data. These parameters are not analyzed due to their historically low concentrations in Ohio ground water. No well waters are impaired (have decadal averages that exceed the MCL or SMCL) for **alkalinity, cadmium, chromium, copper, fluoride, nickel, nitrate, selenium or zinc.** Very few wells exceed the lifetime HAL for cadmium (0.07 percent), nickel (0.1 percent), selenium (0.3 percent) and zinc (0.1 percent). Six wells exceed 50 percent of the fluoride MCL. These wells produce water from the carbonate aquifer, as was seen with public water systems in Table L-4. A few well means are greater than 50 percent of the **barium** MCL, with one MCL and nine HAL impairments identified. Averages for **chloride** exceed the SMCL in five cases. Thirteen wells have chloride above 50 percent of the SMCL. The source of contamination is likely associated with improper storage of salt for road deicing, oil and gas drilling brine disposal, brines in bedrock aquifers with a history of oil production, or road deicing.

For **nitrate**, well maximums were used rather than averages to reflect the acute nature of the nitrate MCL. This approach makes it difficult to compare the nitrate numbers to numbers for other parameters in Table L-4. Nitrate is stable in oxidized environments and, thus, is more likely to be detected in shallower wells that have rapid exchange pathways with the atmosphere and surface water. In the AGWQMP, the sand and gravel wells are generally the shallowest and consequently, would be expected to exhibit the largest number of wells with elevated nitrate concentrations. This is the case with about seven percent of the sand and gravel wells exceeding 50 percent of the MCL. Three percent of the carbonate wells exceed 50 percent of the MCL, probably associated with sensitive karst settings and only two percent of the sandstone wells are on the watch list for (maximum) nitrate. The AGWQMP tends to collect samples from higher production wells located deeper in aquifers; consequently, it is not the best program to evaluate ground water quality in shallow (25 to 50 feet), sensitive aquifer settings.

Arsenic, iron, manganese, total dissolved solids (TDS) and sulfate mean concentrations result in significant numbers of wells on the watch list and in the impaired category. These are the same parameters identified in the public water system compliance data, with the addition of TDS. TDS is not required or collected for public water systems compliance data. Except for arsenic, all parameters have SMCLs and treatment is generally not required. Many public water systems remove iron, with the additional benefit of manganese and arsenic removal, since arsenic and iron solubility are controlled by similar redox controls. Sulfate in the AGWQMP is elevated in carbonate aquifers due primarily to the presence of evaporates in the Salina Formation, in the upper portion of the Silurian carbonate aquifer. For the carbonate aquifers, 57 percent of the ambient sites exceed 50 percent of the SMCL for sulfate, which is significantly higher than the percentage of sandstone and sand and gravel aquifers (six percent and 11 percent respectively). The elevated TDS in raw water results from the relative solubility of aquifer material and the residence time for ground water in all of Ohio's major aquifers. The carbonate aquifers generally have higher mean TDS, but all three main aquifers exhibit high percentages of ambient sites with TDS exceeding 97 percent of the SMCL.

HAL exceedances for **strontium** occur most commonly in carbonates followed by unconsolidated aquifers resulting most likely from the presence of the naturally occurring mineral celestite ($SrSO_4$). Twenty-five ambient wells have strontium values greater than the one- and 10-day HAL of 25,000 µg/L (nine percent) while 86 wells (30 percent) exceeded the life-time HAL of 4,000 µg/L.

Organic Parameters - Detection of organic parameters at and above watch list concentrations is not common in the AGWQMP. Organic parameters, each detected at one public water system above the MCL, include carbon tetrachloride and trichloroethylene. These organic solvents were detected in public water systems raw water samples as listed in Table L-4.

Pesticides – Benzo(a)pyrene, 1,2-dibromo-3-chloropropane (DBCP), di(2-ethylhexyl) phthalate (1), ethylene dibromide (EDB), hexachlorobenzene (1) and pentachlorophenol were pesticides detected in the AGWQMP wells above their respective MCLs. The AGWQMP does not analyze for pesticides on a regular basis, as reflected in the low number of wells listed for pesticides, due to the lack of pesticide detections during several sampling rounds in the late 1990s. This sampling and consultations with the Ohio Department of Agriculture regarding its pesticide sampling results, suggests that further pesticide data collection is not cost-effective for the AGWQMP. Review of available data supports the conclusion that the glacial till provides protection for Ohio's ground waters based on low detections rates and low concentrations detected. Nevertheless, local sensitivity and improper use of pesticides can lead to pesticide impacts. The historic data points to the greatest impacts occurring at the mixing sites or areas of spills.

Radiological Parameters – Radiological parameters are not included in the AGWQMP sampling.

Comparison of Public Water System and AGWQMP Data

Overall, we see similar trends in the public water system compliance and the AGWQMP data. This confirms that the AGWQMP data are appropriate for identifying long-term trends in the ground water quality of the major aquifers utilized by the public water systems. Thus, the AGWQMP goal of monitoring and characterizing the ground water quality utilized by public water systems in Ohio is validated by these empirical data.

It is interesting that the ground water quality differences documented between the major aquifers in AGWQMP data based on major components are not obvious in Table L-4 and Table L-5. The major elements or components (Ca, Mg, Cl, Na, K, sulfate and alkalinity) are generally the parameters utilized to identify water types. However, Ca, Mg, K and alkalinity do not have MCLs or SMCLs, so MCL and SMCL comparisons are limited in their capacity to delineate geochemical differences among waters from different aquifers. Chloride and sulfate do have SMCLs and exhibit significant differences between the major aquifers as noted above in Table L-4 and Table L-5. Treatment, such as softening, of public water system-distributed water can mask differences in water quality between major aquifers.

The most recognizable geochemical differences between the major aquifers in Ohio relate to the concentrations of calcium, magnesium, bicarbonate and strontium. These differences relate to the higher solubility of carbonate rocks and the long water-rock reaction time of ground water. The carbonate waters are characterized by elevated calcium, manganese, bicarbonate and strontium compared to water in sandstone and sand and gravel aquifers. The higher percentages of public water systems that exhibit watch list and impaired category results for TDS and sulfate in the carbonate aquifers reflects the dissolution of gypsum within the carbonate stratigraphy. Summary data from the AGWQMP provides a description of Ohio's major aquifers and their water quality available in the technical report, *Major Aquifers in Ohio and Associated Water Quality (2015)*.

Review of Chloride Data from AGWQMP Wells

Many states are experiencing increasing chloride concentrations in ambient ground water quality due to increasing human population and activity[1], and Ohio is no exception. Ohio's Ambient Ground Water Quality Monitoring Program database is comprised of ground water quality results spanning the years 1941 and 2019 obtained from 214 actively sampled and 270 historically sampled Ambient Network wells (wells). Among 275 active and historical wells with sufficient data for statistical comparisons, 158 show a statistically significant increasing trend in chloride, and an additional 48 wells have elevated chloride and other parameter concentrations that indicate impacts from anthropogenic sources and/or brine intrusion.

Geographic Information Systems (GIS) analytical tools and various statistical methods are being used on the AGWDB to evaluate how chloride concentrations vary by aquifer, land use and hydrogeologic variables, and to help determine the leading causes of elevated or increasing chloride concentrations in Ohio's ambient ground water.

Among the three main aquifer types in Ohio [Unconsolidated (UNC), Sandstone (SS) and Carbonate (CB)], median chloride concentrations were highest in unconsolidated wells, second highest in sandstone wells, and lowest in carbonate wells. Median chloride concentrations increase nearly 10 milligrams per liter (mg/L) across aquifer types, as seen in the box plot in Figure L-2. Variance in chloride was greatest among sandstone wells and least among unconsolidated wells.

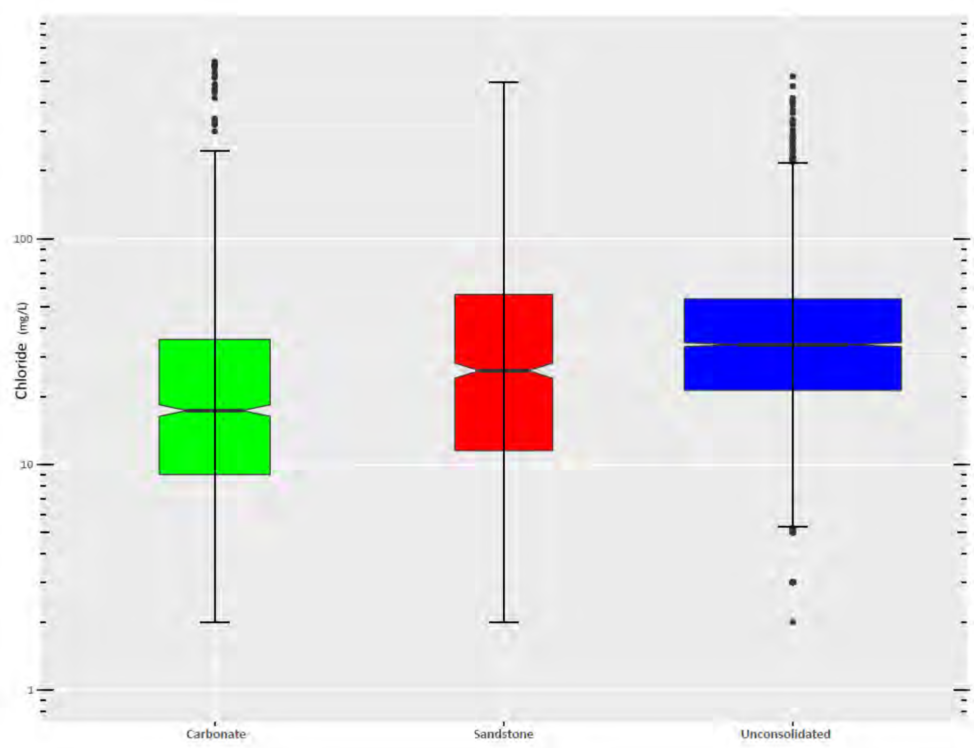

Figure L-2 — Median chloride concentrations in Ohio's major aquifer types.

Median chloride concentrations in unconsolidated aquifer wells were highest in shallow wells [i.e. casing length less than 50 feet below ground surface (bgs)], with median chloride concentrations decreasing with

1 Mullaney, J.R., Lorenz, D.L., Arntson, A.D., 2009, Chloride in Groundwater and Surface Water in Areas Underlain by the Glacial Aquifer System, Northern United States: U.S. Geological Survey Scientific Investigations Report 2009–5086, 54 p.

casing length down to a depth of approximately 100 feet bgs, then increasing again at casing lengths greater than 175 feet bgs (Figure L-3). Median chloride concentrations in carbonate wells (Figure L-4) followed a similar trend, decreasing with well casing length down to a depth of approximately 100 feet bgs. However, median chloride concentrations in sandstone wells followed the opposite trend – increasing with casing length down to approximately 100 feet bgs, shown in Figure L-5.

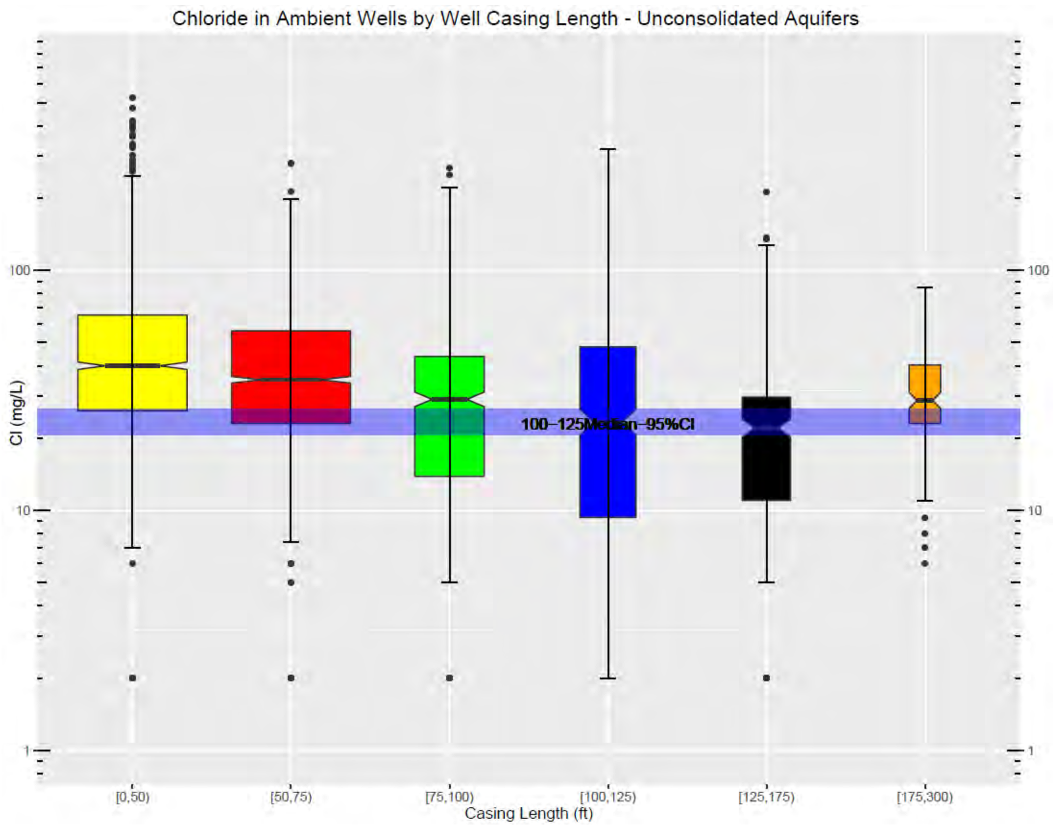

Figure L-3 — Median chloride concentrations in unconsolidated aquifers by casing length.

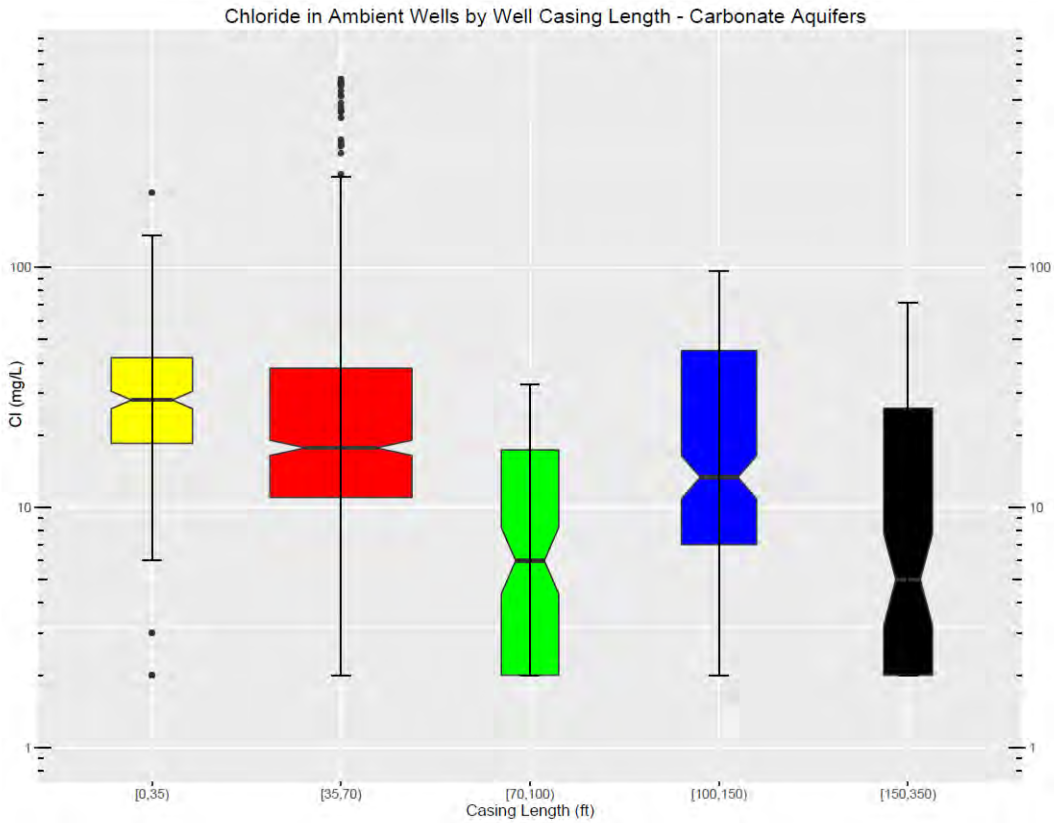

Figure L-4 — Median chloride concentrations in carbonate aquifers by casing length.

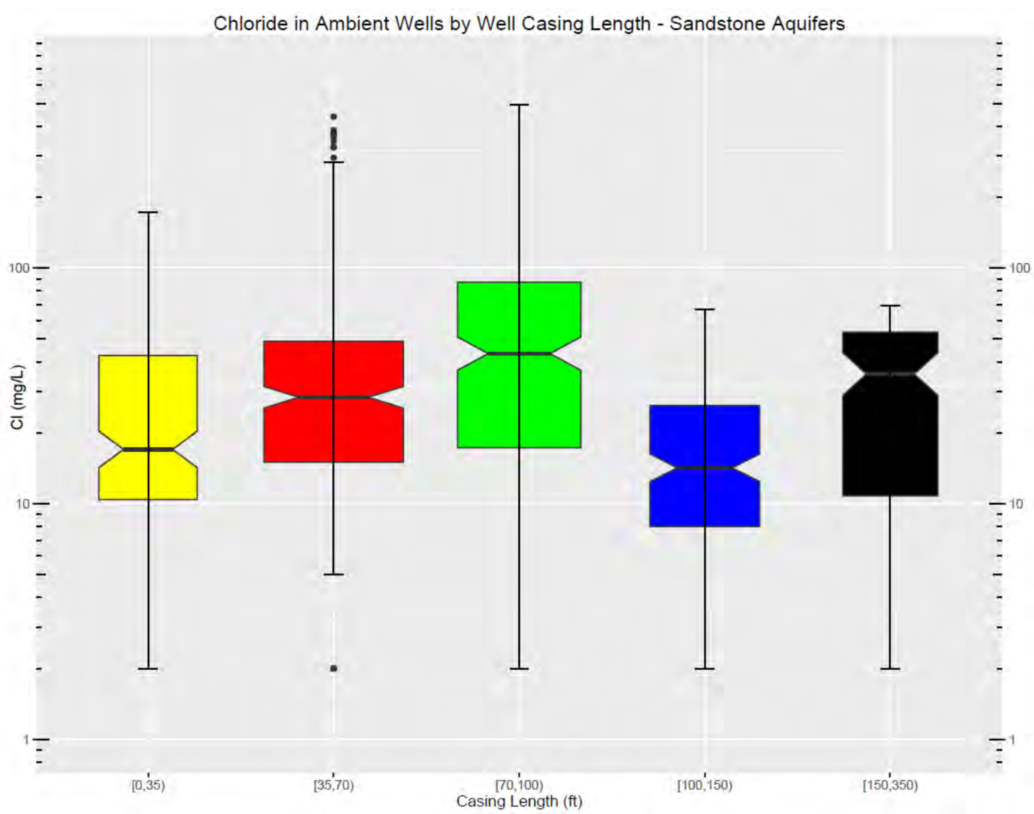

Figure L-5 — Median chloride concentrations in sandstone aquifers by casing length.

The 2016 National Land Cover Dataset (NLCD) was used in GIS to attribute a dominant land use type to each ambient well, based on a 500-meter radius of influence[2] around each ambient well location. As demonstrated in the distinct 95 percent confidence interval bands around the medians in Figure L-6, statistically significant differences exist between median chloride concentrations from wells in the four dominant land use types. The highest median chloride concentrations were seen in the Open Water (i.e. quarry lakes and rivers) land use type, followed by Developed, Forest and Agricultural land use types.

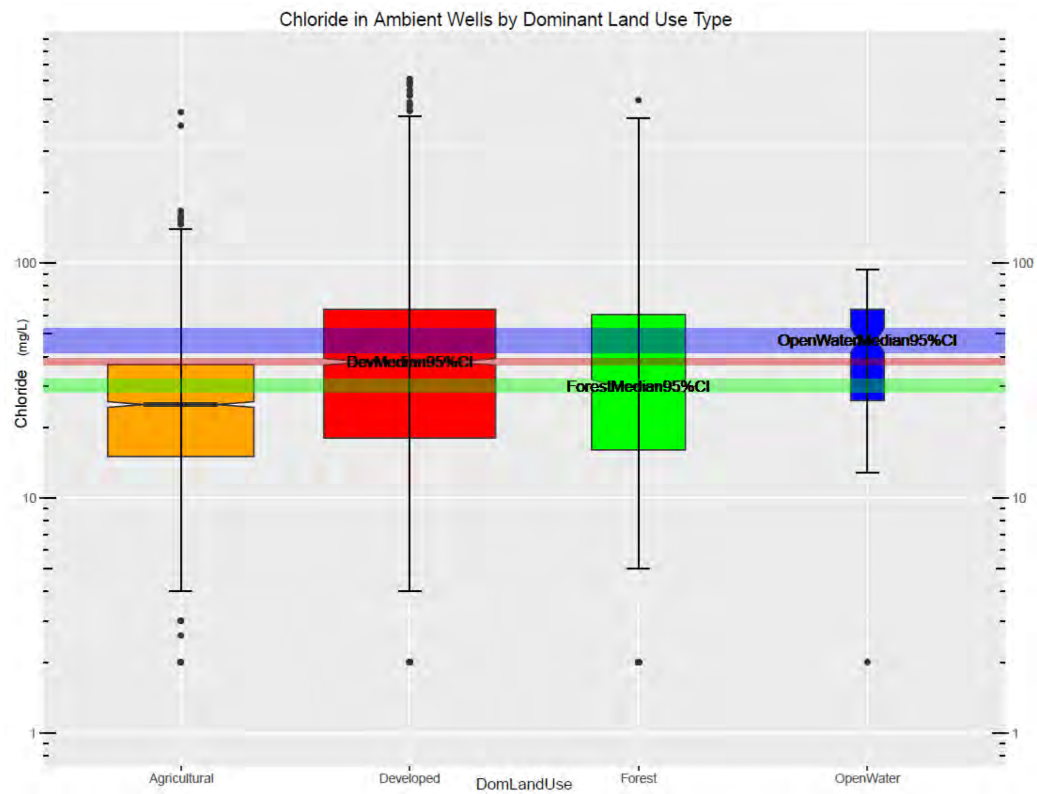

Figure L-6 — Median chloride concentrations in all wells by dominant Land Use Type.

Chloride/bromide ratios are commonly used to help identify and differentiate among various sources of chloride in ground water. A plot of the chloride/bromide ratio versus chloride concentration (in mg/L) per sample against plotted curves of mixing ratios between unimpacted ground water and several common sources of chloride impacts (e.g. sewage/septic, road salt/halite, basin/oil field brine) can help identify the sources of impact.[3] Plots of ambient well results shown in Figure L-7 indicate that the majority of Ohio's ambient wells have some anthropogenic impact (e.g. septic/sewage, road salt/halite), with smaller clusters indicating some impact from basin/oil brines or no impact. Other patterns evident from comparison and contrast of the chloride/bromide plots in Figure L-7 and Figure L-8 include the following:

- Unconsolidated aquifer wells have the highest average level of anthropogenic impact among the three aquifer types, whereas carbonate aquifer wells have the lowest; both are consistent with the pattern of median chloride concentrations shown in Figure L-2;
- Agricultural aquifer wells clustered more densely around the halite/road salt curve and less towards septic/sewage curve, reflecting influences from road salt as well as fertilizer impact.
- Wells plotting along the brine-influenced curve were dominantly bedrock aquifer (i.e. carbonate, sandstone) wells, as expected.

2 Katz, B.G., Eberts, S.M., Kauffman, L.J., 2011, Using Cl/Br ratios and other indicators to assess potential impacts on groundwater quality from septic systems: A review and examples from principal aquifers in the United States, Journal of Hydrology 397, pp.151–166.

- Wells in Open Water land use category plotted almost exclusively in the sewage-road salt mixing zone, indicating a mixture of chloride contamination sources.

Other statistical and graphical data evaluation procedures are being used to identify additional patterns in the AGWQMP and to determine sources of chloride impacts to specific ambient wells and to inform future source water protection strategies in Ohio.

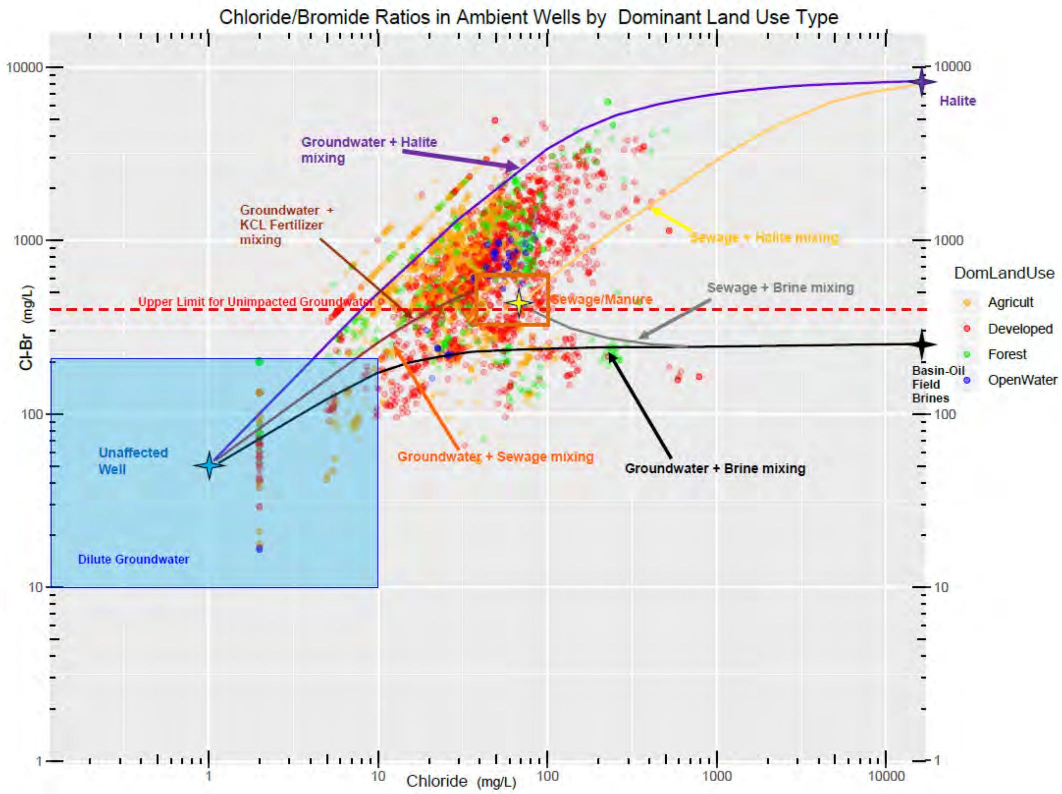

Figure L-7 — Chloride/Bromide ratios in Ambient wells by dominant Land Use Type.

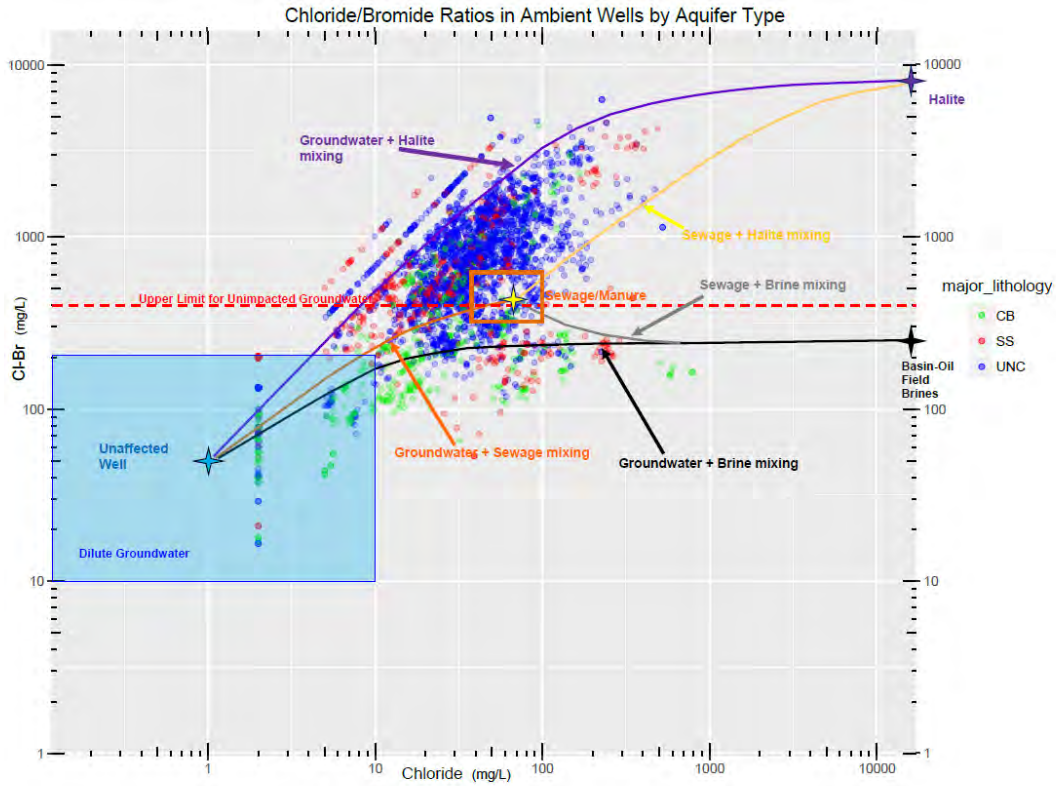

Figure L-8 — Chloride/Bromide ratios in Ambient wells by major aquifer type.

L6. Conclusions and Future Directions for Ground Water Protection

Ohio is fortunate that ground water is plentiful across the state. With the exceptions of a few areas that exhibit effects of over-pumping, decreasing static water levels have not been documented across extensive areas. Some new, high-yielding agricultural wells are being installed, but the duration of pumping is generally limited, so annual recharge appears to replenish the aquifer. Although the quantity of ground water appears stable, the documentation of water quality impacts in this document illustrate that continued protection of ground water resources is necessary. Ground water contamination can eliminate the potential use of water resources, just like diminished quantities. If other water sources are not available, additional treatment will increase the cost of providing a needed resource.

As documented in the previous sections, numerous sites exhibit ground water contamination from anthropogenic and natural point and nonpoint sources. The alternative to combat natural sources of contamination that cause impairment of drinking water is to develop and install treatment that removes the contamination or to locate another water source. The options for managing anthropogenic sources are more numerous, with the most constructive focusing on prevention of releases that migrate to ground water. Instituting best management practices (especially for the use of fertilizers and salt storage), implementing appropriate siting criteria for new waste storage and disposal sites and improving design for material storage and waste disposal facilities are proactive approaches to prevent releases to ground water. These kinds of proactive practices are critical to the sustainability of Ohio's high-quality ground water resources.

The ongoing implementation of the Source Water Protection Program (SWAP) for Ohio's public water systems helps raise awareness of ground water quality issues and promotes source water protection planning. The SWAP potential contaminant source inventory data is instrumental in identifying and ranking major sources of contamination near public water systems. SWAP staff has also had key roles in the development of several guidance documents to help protect ground water in association with the SCCGW.

Generally, awareness and concern about ground water resources is increasing. State agencies are working together to develop appropriate guidance or guidelines for activities that may threaten ground water. This is documented by the development of the *Recommendations for Geothermal Heating and Cooling Systems* (February 2012) and *Recommendations for Salt Storage* (February 2013). A recent guidance is the updated *Regulations and Technical Guidance for Sealing Unused Water Wells and Boreholes*, finalized in March 2015. ODNR, in conjunction with several other agencies, has revised and developed fact sheets and best management practices to provide information on water resource issues associated with shale gas development. These documents are available on the ODNR Division of Oil and Gas Resources web page in the Shale activity section: ***oilandgas.ohiodnr.gov/shale#SHALE***.

To help provide well owners information on water quality, Ohio EPA worked with ODH and OSU Extension on the development of a new web-based water quality interpretation tool for private well owners. In the Know Your Well tool, water sample results from a lab sheet are entered into the tool and with one click, well owners are provided with the standard for the parameter of interest, the natural range in ground water in Ohio for comparison, recommendations on actions, health effects and treatment options if applicable. The tool is part of the website hosted at OSU Extension at: ***ohiowatersheds.osu.edu/know-your-well-water***.

Section

M

References

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