

Section G:
Evaluating Beneficial Use:
Aquatic Life

2008 Ohio Integrated Report

G1. Background and Rationale

Ohio EPA has been evaluating streams using standardized biological field collection methods for thirty years. Stream assessments are based on the experience gained through the collection of over 23,500 fish population samples, nearly 10,000 macroinvertebrate community samples and more than 72,500 water chemistry samples. Aquatic life use assessments for the 2008 Integrated Report are based on biological and chemical data collected from 1997 to 2006 at over 4,350 wadeable stream, large river, and Lake Erie shoreline sampling locations.

Ohio's Water Quality Standards (WQS) have seven subcategories of aquatic life uses (see summary presented in Section D and <http://www.epa.state.oh.us/dsw/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. 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(A)(6)). The numeric biological criteria applicable to Exceptional Warmwater Habitat (EWH), Warmwater Habitat (WWH), and Modified Warmwater Habitat (MWH) waters are found in Table 7-15 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 (e.g., presence and abundance of coldwater species in CWH streams) and/or interim assessment index benchmarks (LRW streams, flooded Lake Erie river mouths) to assess consistency with the narrative aquatic life use definitions in the Water Quality Standards.

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, in order to be in full attainment of the designated aquatic life use. 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. The chemical and physical data collected as part of Ohio EPA's comprehensive watershed evaluations are considered in gauging causes and sources of pollution and factor into the confirmation of impaired uses. To determine causes and sources of observed aquatic life use impairment based on biocriteria excursions, Ohio EPA relies on the most appropriate linkage and evidence from other available physical habitat and water and sediment quality chemistry data collected at the sampling location. These data, along with signals from the biological data itself and other insights driven by the ecological setting (e.g., prevailing land use, hydrological/ climatological conditions), provide the basis to assign the most likely causes and sources. These will serve as the target parameters for future TMDL development or other regulatory program actions.

Adequate sampling is necessary to represent the aquatic life use attainment status for all streams in a Watershed Assessment Unit (WAU). Despite Ohio EPA's significant biological sampling effort, about one-third of Ohio's WAUs are precluded from this analysis due to insufficient data. 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 a WAU assessment and watershed score. Generally, at least five sample sites are minimally considered necessary for extrapolation. Presently, Ohio EPA prefers that the principal investigators make informed decisions about the data relevance for a particular WAU evaluation rather than institute specific guidance on minimum effort.

Recognizing the state's limited resources, one way to increase WAU assessment coverage is to utilize all available relevant data. While Ohio EPA uses data from a variety of sources in its work, the data used to determine the aquatic life use status in this report were primarily collected by Ohio EPA. Some additional biological data were provided by the Ohio Department of Natural Resources, Northeast Ohio Regional Sewer District, Miami University, Midwest Biodiversity Institute, and Center for Applied Bioassessment and Biocriteria. 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 (e.g., through the Voluntary Action Program Biocriteria Certification or Qualified Data Collector Level 3 Certification) and confirm 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

Large River Assessment Units (LRAUs)

Decades of monitoring work by Ohio EPA has resulted in an extensive data set which includes recent data for 16 of the 23 defined LRAUs in Ohio. 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 attainment status to be fairly precisely estimated based on linear distances. The length of the Large River deemed to be in attainment, as described in the previous sentence, was 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). A LRAU was considered meeting its aquatic life designated use only if a score of 100 was reported. In other words, if all sites are not in full attainment of the designated aquatic life use, the entire Large River Assessment Unit is listed as impaired and placed in Integrated Report Category 4 or 5, depending on whether a TMDL is needed.

Watershed Assessment Units (WAUs)

The assessment of aquatic life use attainment in WAUs was determined using a combination of spatial and linear analysis. Data were grouped according to the watershed size at the point of sampling: sites with drainages ≤ 5 mi² (Spatial Data Group 1); sites with drainages > 5 mi² and ≤ 20 mi² (Spatial Data Group 2); sites with drainages > 20 mi² and less ≤ 50 mi² (Spatial Data Group 3); and sites with drainages > 50 mi² and ≤ 500 mi² (Principal Streams). Within each WAU, a "linear" attainment score was calculated for the assessed Principal Streams (drainage areas between 50 and 500 mi²) in the fashion described above for Large Rivers. A separate "spatial" attainment score was calculated for each WAU using information about the fraction or

proportion of sites within Data Groups 1 - 3 that demonstrated full aquatic life use attainment. To correct a bias in biosurvey design that generates a larger number of data points from small watersheds (Data Groups 1 and 2 sites), the following formula was used to give more weight in the final spatial score to results from larger streams (Data Group 3 sites).

Data Group 1 <u>≤5 mi²</u>	Data Group 2 <u>> 5 mi² to ≤20 mi²</u>	Data Group 3 <u>> 20 mi² to < 50 mi²</u>	<u>Spatial Score</u>
$\frac{(a/b + a/b)}{2} + (a/b) * 100 = c$			
$\frac{\quad}{2}$			

where

- a = number of sites in full attainment
- b = total number of sites in Data Group
- c = spatial attainment score for WAU

The spatial and linear scores calculated for each WAU were averaged for an overall measure of aquatic life attainment in the watershed. Watershed Assessment Units were considered meeting their aquatic life designated use(s) only if a score of 100 was reported. In other words, if all assessed sites within Data Groups 1 - 3 and all assessed Principal Stream sites are not in full attainment of the designated aquatic life use(s), the entire assessment unit is listed as impaired and placed in Integrated Report Category 4 or 5.

Additional synthesis of data was used to provide aggregate statewide statistics for Ohio's universe of assessed principal streams and large rivers. WAU and LRAU scores were used to estimate full attainment, partial attainment, and non-attainment for total miles of perennial streams within each assessment unit (based on perennial stream mile estimates determined from the National Hydrography Dataset). These statistics were then summed and averaged to provide a snapshot of aquatic life use condition (full, partial, and non-attainment) within Ohio. Similar aggregated statistics based on the last three Integrated Report cycles (2002, 2004, and 2006) were used along with the 2008 results to track trends of attainment levels across Ohio's principal streams and large rivers in an effort to quantify progress made in point and nonpoint source pollution controls and in meeting Ohio's goal of 80% full aquatic life use attainment by 2010.

Lake Erie Nearshore, Islands, and Lacustuaries

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 document *Development of Biological Indices Using Macroinvertebrates in Ohio Nearshore Waters, Harbors, and Lacustuaries of Lake Erie in Order to Evaluate Water Quality* (Lake Erie Protection Fund Grant LEPF-06-94, undated draft). In 1999, the document *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, undated draft). The data analyses in these documents, including refinement of field sampling protocols and development of assessment indices, provide a foundation to establish numeric biocriteria for aquatic life use in Lake Erie along the Ohio shoreline and in lacustuary areas.

The term “lacustrary” was coined to specify the zone where Lake Erie water levels have intruded into tributary river channels. The aquatic life use status of a lacustrary is included in the assessment of the tributary river. Excluding lacustraries, the status of the Lake Erie shoreline is evaluated in three assessment units: western basin nearshore, islands, and central basin nearshore (“nearshore” in this case meaning areas within 100 meters of the shoreline). Linear nearshore and island miles monitored and assessed are extrapolated from nearshore and island sites where sufficient and current biosurvey data have been collected.

G3. Results

For the 2008 Integrated Report, new aquatic life data collected in 2005 and 2006 were incorporated into the assessment database. During this period, biosurvey data from over 800 sampling sites located in 50 Watershed Assessment Units (WAUs) and nearly 100 sampling sites located in 8 Large River Assessment Units (LRAUs) were available to update previously assessed AUs or provide new assessments for AUs with unknown aquatic life status. All data were collected by the Ohio EPA or Level 3 Qualified Data Collector external sources. Watersheds intensively monitored during 2005 and 2006 included the Blanchard River, Yellow Creek, Twin Creek, Fourmile Creek, Indian Creek, Walnut Creek, Salt Creek, Paint Creek, Scioto Brush Creek, White Oak Creek, upper Mahoning River, and Swan Creek basins. Large River Assessment Units intensively sampled included the Tuscarawas River, Blanchard River, Scioto River, Paint Creek, and the Muskingum River. An additional 10 Watershed and 4 Large River Assessment Units were revised based on a lesser amount of new data which were used to update portions of each assessment unit. Detailed watershed survey reports for many of the basins mentioned above are or will be available at http://www.epa.state.oh.us/dsw/document_index/psdindx.html.

A further examination of individual AUs was made to determine status changes due to site data collected during 1995 and 1996 that now exceed the 10-year data threshold and have become “historical.” From this examination, it was determined that data from 15 WAUs and 3 LRAUs were now insufficient to provide adequate spatial coverage either because of all data being age restricted or enough that number of sites fell below the minimum needed to assess. These AUs are not being delisted if currently Category 5. Summarized 2008 Integrated Report statistics for aquatic life assessments for Large River, Watershed, and Lake Erie AUs as well as the comparable statistics from the 2002, 2004, 2006, and 2008 Integrated Reports are tabulated in Table G-1. More detailed aquatic life statistics for all AUs are provided in Section M of this document.

Large River Units

Large River Assessment Units in Ohio (23 rivers with watersheds in excess of 500 square miles) continued to show a positive trend and full attainment has nearly met the 80% by 2010 aquatic life goal (Table G-1, Figure G-1). Based on monitoring through 2006, the full attainment statistic now stands at 78.7%. The modest increase in full attainment across all large river units between the 2006 and 2008 cycle is largely due to new intensive assessments of the following large rivers:

- Tuscarawas River, 2005: 86% full attainment over 103 miles (included in the 2006 IR)
- Blanchard River, 2005: 100% full attainment over 35 miles
- Muskingum River, 2006: 100% full attainment over 110 miles
- Paint Creek, 2006: 82% full attainment over 37 miles.

While this amount of full aquatic life use attainment would be expected to result in a larger percent increase in the overall statistic from 2006 to 2008, the numbers are offset by the removal of other large rivers whose assessment data are now older than 10 years in age and thus considered historical. Rivers with older data include those of both higher and lesser quality, as follows:

- Great Miami River: 87% full attainment over 130 miles
- Whitewater River: 100% full attainment over 8 miles
- Walhonding River: 100% full attainment over 23 miles
- Licking River: 93% full attainment over 30 miles
- Raccoon Creek: 100% full attainment over 20 miles
- Tiffin River: 0% full attainment over 20 miles
- Wills Creek: 15% full attainment over 65 miles.

If the most recent data from all 23 Large River Assessment Units were used, irrespective of age of data, the full attainment statistic would be 74% full attainment for nearly 1150 monitored miles (89% of the 1287 total large river miles).

Watershed Units

The average WAU score also continued its steady increase, although with an average score considerably lower than the large river full attainment statistic (Table G-1, Figure G-2). Based on monitoring through 2006, the average WAU score stands at 54.7. Table G-2 depicts the breakdown of site full attainment based on the watershed size category used to determine an individual watershed's score. The results show that biological impairment is more likely at sites on small streams and that impairment lessens significantly as sites drain larger areas. This phenomenon correlates well with the most widespread causes associated with the aquatic life impairment in these watersheds.

Table G-3 lists the top five impairment causes for the period 1997 through 2006. For this time period, principal causes for 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, a fact backed up by the numbers presented in Table G-2. It is important to note that nearly all impaired WAUs (202 of 209) had at least 1 of these causes contributing to impairment and 65% (136 of 209) had three or more of the top five causes listed.

Lake Erie Assessment Units

Changes in the aquatic life use status of the three Lake Erie Assessment Units were due primarily to the age of the available data. Significant sampling that occurred in 1995 and 1996 was not included in the assessments for the 2008 IR because the data are more than 10 years old. This included 25 sampling points along the Western Basin shoreline, 18 along the Central Basin shoreline, and one along the Lake Erie Islands shoreline. There were no new data collected in either 2005 or 2006. The data differential significantly changed the attainment statistics, particularly for the miles of shoreline considered monitored and the status (full, partial, non-attainment) of sampling locations. The overall Category 5 listing of each assessment unit as well as the high magnitude causes and sources remained unchanged.

Table G-1. Summary of aquatic life use assessment for Ohio's Watershed, Large River, and Lake Erie Assessment Units: 2002, 2004, 2006, and 2008.

	2002 (1991-2000)	2004 (1993-2002)	2006 (1995-2004)	2008 (1997-2006)
<i>Watershed AUs (331)</i>				
No. AUs Assessed (percent of total)	224 (68%)	225 (68%)	212 (64%)	218 (66%)
No. Sites Assessed	3272	3620	3785	4030
Average AU Scores				
Full Attainment	46.6	48.3	52.5	54.7
Partial Attainment	25.2	23.6	22.6	22.4
Non-Attainment	28.2	28.1	24.9	22.9
<i>Large River AUs (23 rivers totaling 1287 Miles)</i>				
No. AUs Assessed	22	21	17	16
No. Sites Assessed	422	425	374	278
No. Miles Assessed (percent of miles)	905 (70%)	918 (71%)	873 (68%)	850 (66%)
% Miles Full Attainment	62.5	64.0	76.8	78.7
% Miles Partial Attainment	23.0	21.4	15.1	13.9
% Miles Non-Attainment	14.5	14.6	8.1	7.4
<i>Lake Erie AUs (3)</i>				
No. AUs Assessed	3	3	3	3
No. Sites Assessed	92	111	93	49
% Sites Full Attainment	12.0	18.0	19.4	10.2
% Sites Partial Attainment	13.0	14.4	16.1	22.4
% Sites Non-Attainment	75.0	67.6	64.5	67.4

Table G-2. Breakdown by watershed size category of sites/miles in full attainment in 218 monitored Watershed Assessment Units based on data collected from 1997 – 2005.

Watershed Size Category (mi²)	No. of Sites	No. Sites in Full Attainment (%)	No. of Miles Assessed	No. Miles in Full Attainment (%)
< 5	1151	530 (46.0)	-	-
5 – 20	1386	710 (51.2)	-	-
20 – 50	548	288 (52.6)	-	-
50 - 500	945	-	2912.5	1784.0 (61.3)

Table G-3. Assessment of the top five causes of aquatic life impairment based on biological and water quality survey data collected from 1997 - 2006.

Assessment Unit (AU)	#	Number & Percentage of Monitored AUs with Impaired Aquatic Life Use Listed with a Top Five Cause of Impairment				
		Siltation / Sediment	Nutrients	Habitat Modification	Hydro-Modification	Organic Enrich./DO
Watershed		140 (64%)	132 (61%)	136 (62%)	106 (49%)	118 (54%)
total	331					
monitored 1997 to 2006	218					
impaired aquatic life use	209					
1 or more top 5 causes	202					
2 or more top 5 causes	170					
3 or more top 5 causes	136					
Unassessed	113					
Large River		3 (19%)	6 (38%)	7 (44%)	6 (38%)	7 (44%)
total	23					
monitored 1997 to 2006	16					
impaired aquatic life use	11					
1 or more top 5 causes	11					
2 or more top 5 causes	7					
3 or more top 5 causes	6					
Unassessed	7					

Listed as an aquatic life use impairment cause for at least one stream within the Watershed AU or one reach within the Large River AU.

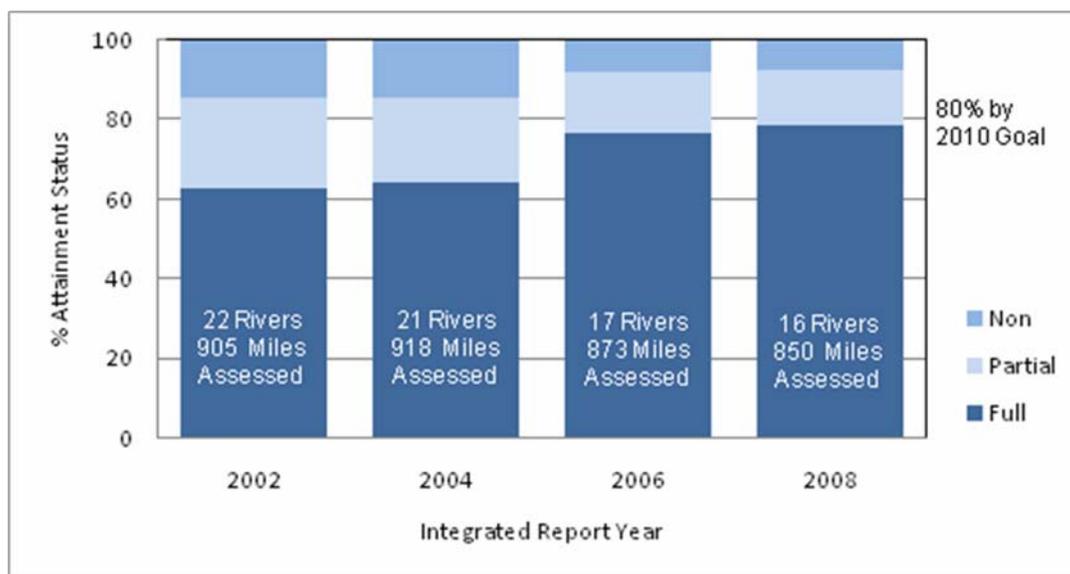


Figure G-1. Progress towards the 80% by 2010 Goal based on Ohio's 23 Large River Assessment Units. Data compiled over the last four 10-year Integrated Report cycles with the current 2008 cycle including data collected from 1997 - 2006.

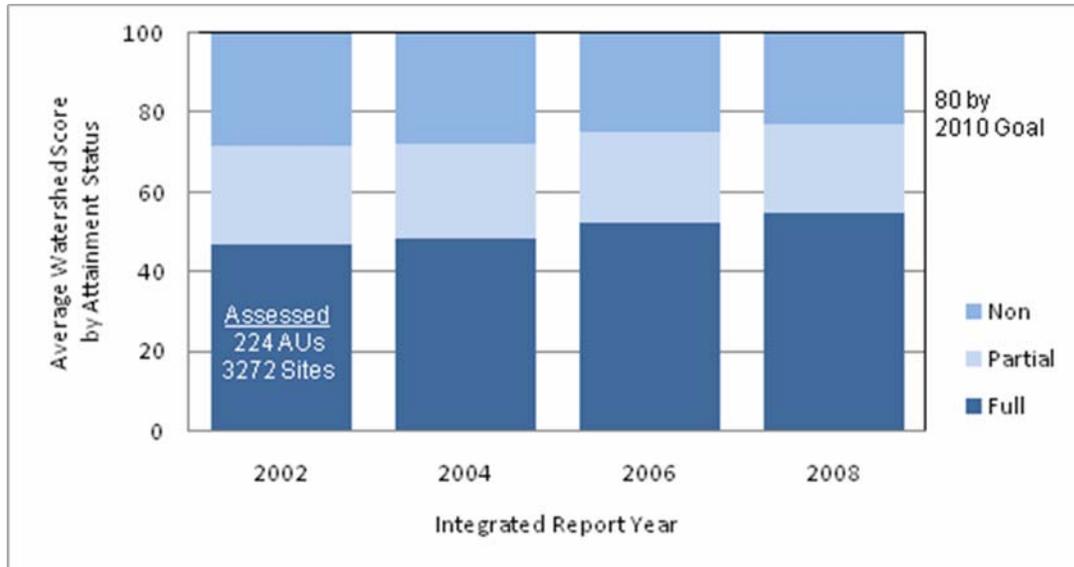


Figure G-2. Progress towards the 80 by 2010 Goal based on Ohio's 331 Watershed Assessment Units. Data compiled over the last four 10-year Integrated Report cycles with the current 2008 cycle including data collected from 1997 - 2006.