

Ohio 2010 Integrated Report

Section G

Evaluating Beneficial Use: Aquatic Life

G1. Background and Rationale

G1.1 Background

Ohio EPA has been evaluating streams using standardized biological field collection methods for over thirty-five years. Stream assessments are based on the experience gained through the collection of over 22,000 fish population samples, over 11,000 macroinvertebrate community samples and more than 72,500 water chemistry samples. Aquatic life use assessments for the 2010 Integrated Report are based on biological and chemical data collected from 1999 to 2008 at over 4,500 wadeable stream, large river, and Lake Erie shoreline sampling locations. Ohio's Credible Data Law states that all data greater than five years in age will be considered historical, and that it can be used as long as the Director has identified compelling reasons as to why the data are credible. In the case of biological monitoring data, the use of data older than five but ten or fewer years old is necessary. The use of historical data is necessary because not enough 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 generally takes over ten years to visit every WAU and LRAU 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 ten year timeframe.

Ohio's Water Quality Standards (WQS) have seven subcategories of aquatic life uses for streams and rivers (see Ohio Administrative Code 3745-1-07, <http://www.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 program including specifics on each index and how each was derived is available (see Statewide Biological and Water Quality Monitoring and Assessment, <http://www.epa.ohio.gov/dsw/bioassess/ohstrat.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(A)(6)). 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 7-15 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 WQS.

G1.2 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 regulatory program actions.

Adequate sampling is necessary to represent the aquatic life use attainment status for large river assessment units (LRAUs) or watershed assessment units (WAUs); these assessment units are defined in Section G2 below and further detailed in Section J of this report. Despite Ohio EPA's significant biological sampling effort, about one-quarter of LRAUs and one-third of WAUs are precluded from this analysis because of insufficient data. While some data may be available for some of the assessment units, 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 assessment unit 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 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, U.S. Geological Survey, Ohio State University, Heidelberg College, Ohio Northern University, Ohio University, and Midwest Biodiversity Institute/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

G2.1 Rivers and Streams: Large River Assessment Units (LRAUs)

Decades of monitoring work by Ohio EPA has resulted in an extensive data set that includes recent data for 29 of the 38 newly defined LRAUs in Ohio. Since the 2008 Integrated Report, several LRAUs have been further segmented to shorten the reach length and provide more definitive assessments. Large rivers segmented include the Maumee River (three LRAUs), Sandusky River (two LRAUs), Hocking River (two LRAUs), Tuscarawas River (three LRAUs), Muskingum River (three LRAUs), Scioto River (five LRAUs), Great Miami River (three LRAUs), and Little Miami River (two LRAUs). 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 fairly 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). A LRAU is considered meeting its aquatic life designated 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 Integrated Report Category 4 or 5, depending on whether a TMDL is needed.

G2.2 Rivers and Streams: Watershed Assessment Units (WAUs)

Since 1998, the aquatic life use assessment methodology has involved evaluating site data to determine attainment status of aquatic life use designations at that location, and then aggregating the data into WAUs based on the HUC11 (average 130 mi² drainage area) hydrologic units. The 2010 aquatic life use assessment methodology utilizes the HUC12 scale (average <27 mi² drainage area) rather than the previous HUC11 watershed size. 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. Conversion to the HUC12 will be a transitional process and, for the 2010 IR, WAUs with assessments based on the new methodology will be limited to those with data collected from 2005 to 2008. WAUs with assessments based on data collected between 1999 and 2004 will be delineated at the HUC12 scale, but they will be assigned the score from the most recent HUC11 analysis. This residual score will be used until the HUC12 is revisited and new data collected, or until data collected before 2005 are entered into Ohio EPA databases.

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 mi² together. A wading stream score will be determined for all sites with drainage area between 20 mi² and 50 mi² that occur within the WAU. The wading stream score is necessary since a site between 20 mi² and 50 mi² characterizes the entire watershed upstream from the site, potentially two HUC12s, not just to the extent of the WAU boundary where the site resides. A principal stream score for sites >50 mi² 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.

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	$\frac{IS+PA}{2}$

In regard to the headwater assessment score, the smaller size of the HUC12 WAU greatly reduces the number of headwater sites necessary to be assessed, but creates an emphasis on sampling location within the watershed. 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 takes into account 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.

Once it is determined that sampling coverage is adequate to conduct a headwater 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.

The wading stream score and the principal stream score both involve a similar approach to determining the score. The wading stream score is based on the number of wading stream sites (sites draining a watershed between 20 mi² and 50 mi²) 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 mi².

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 (i.e., 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 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 Integrated Report Category 4 or 5, depending on whether a TMDL is needed.

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 intermittent and perennial streams within each assessment unit (based on intermittent and 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 four Integrated Report cycles (2002, 2004, 2006, and 2008) were used along with the 2010 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.

G2.3 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 "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 in the assessment of the tributary river. Excluding lacustuaries, the status of the Lake Erie shoreline is evaluated in three assessment units: Lake Erie Western Basin Shoreline (including Maumee Bay and Sandusky Bay), Lake Erie Central Basin Shoreline, and Lake Erie Islands Shoreline. All available data were collected from the near shore, in this case meaning areas within 100 meters of the shoreline. Status of Lake Erie AUs was determined by the percentage of sites in narrative full attainment of biological expectations and where sufficient and current biosurvey data were available.

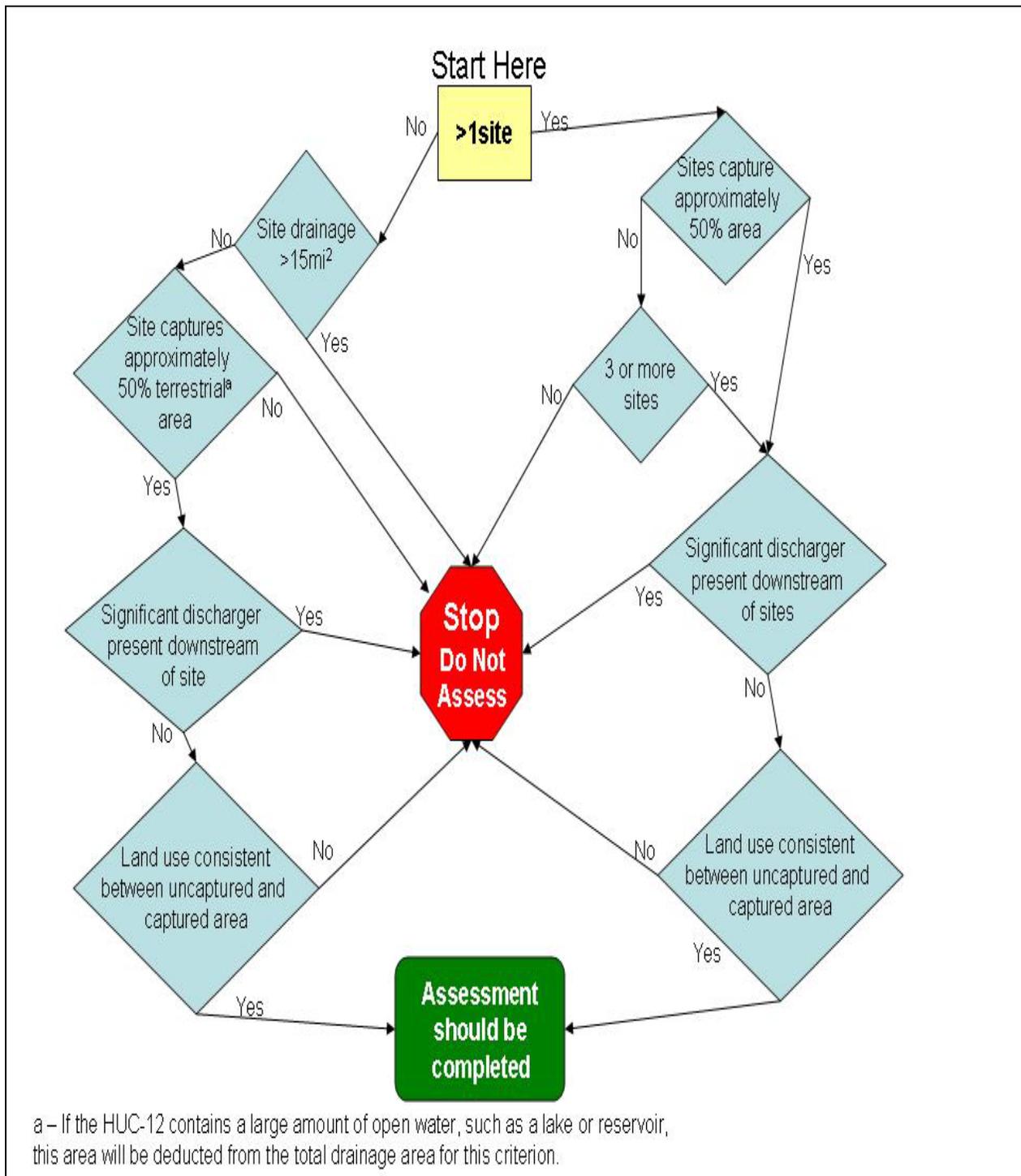


Figure G-1. Flowchart for determining if headwater assessment score can be derived based on available headwater sampling locations.

G3. Results

For the 2010 Integrated Report, new aquatic life data collected in 2007 and 2008 were incorporated into the assessment database. During this period, biosurvey data from over 920 sampling sites located in 61 HUC11 WAUs and nearly 75 sampling sites located in 9 LRAUs were available to completely or partially update previously assessed AUs or provide new assessments for AUs with unknown aquatic life status. Additionally, in the transition to using HUC12 watersheds as the basic assessment unit, 411 HUC12 watersheds were assessed based on data collected from 2005 – 2008. All data were collected by the Ohio EPA or Level 3 Qualified Data Collector external sources. Watersheds intensively monitored during 2007 and 2008 included the lower Little Miami River, Ohio Brush Creek, upper Grand River, Kokosing River, Mohican River, upper Great Miami River, Licking River, Portage River, Moxahala Creek, Salt Creek (Muskingum), and Pymatuning Creek basins. Large river assessment units intensively sampled included the Little Miami River (2 LRAUs), Mohican River, Walhonding River, Licking River, Whitewater River, and Great Miami River (uppermost LRAU) with an additional 2 LRAUs (Cuyahoga River and Stillwater River) revised based on a lesser amount of new data that 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 from the Ohio EPA Division of Surface Water (see Biological and Water Quality Report Index, http://www.epa.ohio.gov/dsw/document_index/psdindx.aspx).

A further examination of individual AUs was made to determine status changes caused by site data collected during 1997 and 1998 that now exceed the 10-year data threshold and have become “historical” since the 2008 Integrated Report. From this examination, it was determined that data from 27 HUC11 WAUs (130 HUC12 WAUs) and 5 LRAUs (3 Maumee River and 2 Great Miami River) were now insufficient to provide adequate spatial coverage either due to (1) all data being age restricted, or (2) enough of the data are age restricted that the number of sites fell below the minimum needed to assess. These AUs are not being delisted if currently Category 5. Summarized 2010 Integrated Report statistics for aquatic life assessments for large river, watershed (using the HUC11 and HUC12 WAUs), 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 (including the 411 HUC12 WAUs specifically assessed for this report using data collected from 2005-2008) are provided at <http://www.epa.ohio.gov/dsw/tmdl/2010IntReport/index.aspx>.

G3.1 Large River Units

Large river assessment units in Ohio (38 AUs spanning 23 rivers with watersheds in excess of 500 square miles and totaling 1,227 river miles) continued to show a positive trend and full attainment has now exceeded the “80 by 2010” aquatic life goal (Table G-1, Figure G-2). Based on monitoring through 2008, the full attainment statistic now stands at 93.1% (793 of 852 assessed LRAU miles). The sizeable increase in full attainment across LRAUs between the 2008 and 2010 IR cycles (78.7% to 93.1%) is largely because of new intensive assessments of the following rivers:

- Little Miami River, 2007: 95% full attainment over 50 miles
- Mohican River, 2007: 100% full attainment over 28 miles
- Walhonding River, 2007: 100% full attainment over 23 miles
- Great Miami River, 2008: 100% full attainment over 39 miles in the upper LRAU
- Licking River, 2008: 96% full attainment over 23 miles
- Cuyahoga River, 2008: 66% full attainment over 18 miles.

Tempering this highly positive trend was the fact that two large mainstem rivers used in the 2008 IR assessment were excluded because available data exceeded 10 years in age and were considered historical. These included

- Great Miami River: 51% full attainment over 81 miles in the two lower LRAUs
- Maumee River: 25% full attainment over 96 miles in three LRAUs.

If the most recent data from all 38 LRAUs are used (including those from the historical LRAUs covering the Great Miami River, Maumee River, Tiffin River, Wills Creek, and Raccoon Creek), irrespective of age of data, the full attainment statistic stands at 79.6% full attainment for over 1,115 monitored miles (Figure G-3).

G3.2 Watershed Units

For the 2010 IR, the average HUC11 WAU score also continued its steady increase, although with an average score considerably lower than the LRAU full attainment statistic (Table G-1, Figure G-4). Based on monitoring through 2008, the average HUC11 WAU score stands at 58.5, a 3.8 point increase from the 2008 IR. Included in Table G-1 is the corresponding average score based on the new HUC12 WAUs and Figure G-3 depicts a comparison between the average HUC11 WAU score and the average score determined for the HUC12 WAUs. Given the nearly five-fold increase in number of assessment units between the HUC11s and HUC12s, the scores are remarkably similar and reflect the large data set (n = 4200) used to compile the statistics. The average HUC12 WAU score of 56.7 establishes the new baseline to compare with future Integrated Reports and track progress towards the new 80 by 2020 goal (see Section B3 of this report). Table G-2 depicts the breakdown of site full attainment based on the watershed size category used to determine an individual watershed's score (HUC11 or HUC12). As in previous reports, 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 aquatic life use impairment causes for the period 1999 through 2008. For this time period, 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, a fact backed up by the numbers presented in Table G-2. It is important to note that between 40% and 50% of assessed HUC12 WAUs were impaired by any individual cause and many had 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 oftentimes close association between these impairment causes (e.g., nutrients, sedimentation/siltation, habitat modifications, and hydro-modifications in rural/agricultural landscapes relying on channelization and field tiles for drainage).

G3.3 Lake Erie Units

Between the 2008 IR and 2010 IR, no changes in status occurred for the Western Basin Shoreline or Lake Erie Islands Shoreline assessment units as no new data were collected nor were any previous data considered newly historical. However, significant changes occurred in the aquatic life use status of the Central Basin Shoreline assessment unit because nearly half of the available 2008 IR data are now considered historical. Sampling that occurred at 15 sites in 1997 and 1998 was not included in the assessment for the 2010 IR. All three AUs 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 and blue-green algae blooms.

Of note for future reporting will be the collection of near shore data for the National Aquatic Resource Survey (NARS) of coastal waters of the United States (the National Coastal Assessment) to take place during the summer of 2010. Fifty sites have been randomly selected along the U.S. Lake Erie near shore including 16 Ohio and Michigan sites in the Western Basin (including two each in Maumee Bay and Sandusky Bay and one site on the Lake Erie Islands shoreline) and 17 Ohio and Pennsylvania sites in the Central Basin. 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 is available at the U.S. EPA NARS website (see National Aquatic Resource Surveys, <http://www.epa.gov/OWOW/monitoring/nationalsurveys.html>).

As mentioned above, little physical, chemical or biological monitoring data are being collected in the Lake Erie near shore area, bays or harbors. A potential project to implement such a monitoring program will be proposed as a project funded by the recently enacted federal Great Lakes Restoration Initiative. This would be a collaborative effort between state agencies (Ohio EPA and Ohio DNR) and major universities with Lake Erie basin research interests and expertise (Ohio State University-Sea Grant, University of Toledo, and Heidelberg University). Physical, chemical, and biological parameters to be monitored are still in the early stages of selection but the project would provide 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 would be used to monitor the progress of implementation projects in Areas of Concern (AOCs) to restore beneficial uses, track implementation of watershed action plans (WAPs), develop total maximum daily loads (TMDLs) for pollutants impairing beneficial uses, support Balanced Growth Initiative actions on the near shore, and provide updated information for Integrated Reports, Lake Erie quality index updates, and updates to the Lake Erie Lake Management Plan (LaMP). More information on the Great Lakes Restoration Initiative and about projects which have been proposed can be found at the Ohio Lake Erie Commission web site (see Great Lakes Restoration Initiative, <http://www.lakeerie.ohio.gov/GLRI.aspx>).

Table G-1. Summary of aquatic life use assessment for Ohio's watershed (HUC11 and HUC12), large river, and Lake Erie assessment units: 2002-2010 Integrated Report cycles.

	2002 (1991-2000)	2004 (1993-2002)	2006 (1995-2004)	2008 (1997-2006)	2010 (1999-2008)
<i>HUC11 Watershed AUs (331)</i>					
No. AUs Assessed (% 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
<i>HUC12 Watershed AUs (1538)</i>					
No. AUs Assessed (% total) ¹					999 (65%)
No. Sites Assessed					4200
Average AU Score ²					56.7
<i>Large River AUs (23 rivers/38 AUs totaling 1226.7 Miles)</i>					
No. Rivers (AUs) Assessed	22	21	17	16	18 (30)
No. Sites Assessed	422	425	374	278	265
No. Miles Assessed (% miles)	905 (70%)	918 (71%)	873 (68%)	850 (66%)	852 (69%)
% Miles Full Attainment	62.5	64.0	76.8	78.7	93.1
% Miles Partial Attainment	23.0	21.4	15.1	13.9	5.5
% Miles Non-Attainment	14.5	14.6	8.1	7.4	1.4
<i>Lake Erie AUs (3)</i>					
No. AUs Assessed	3	3	3	3	3
No. Sites Assessed	92	111	93	49	34
% Sites Full Attainment	12.0	18.0	19.4	10.2	14.7
% Sites Partial Attainment	13.0	14.4	16.1	22.4	17.7
% Sites Non-Attainment	75.0	67.6	64.5	67.4	67.6

¹ 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).

² Statistic based on the average of 999 AU scores derived as explained in Section G2.2.

Table G-2. Breakdown by watershed size category of sites/miles in full attainment in monitored watershed assessment units (221 HUC11 and 999 HUC12) based on data collected from 1999 – 2008.

Watershed Size Category (mi²)	No. of Sites	No. Sites in Full Attainment	No. of Miles Assessed	No. Miles in Full Attainment
< 5	1109	544 (49.1)	-	-
5 - 20	1553	826 (53.2)	-	-
20 - 50	573	325 (56.7)	-	-
50 - 500	965	619 (64.1%)	3100.4	2006.1 (64.7%)

Table G-3. Assessment of the top five causes of aquatic life impairment in HUC12 watershed and large river assessment units based on biological and water quality survey data collected from 1999 - 2008.

Assessment Unit (AU)	#	Number & Percentage of Monitored AUs with Impaired Aquatic Life Use Listed with a Top Five Cause of Impairment				
		Silt / Sediment	Nutrients	Habitat Modification	Hydro-Modification	Organic Enrich./DO
HUC12 Watershed (1538 total)		531 (53%)	479 (48%)	508 (51%)	415 (42%)	408 (41%)
monitored 1999 to 2008	999					
impaired aquatic life use	862					
Unassessed	539					
Large River (38 total)		2 (7%)	3 (10%)	8 (27%)	5 (17%)	7 (23%)
monitored 1999 to 2008	30					
impaired aquatic life use	13					
Unassessed	8					

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.

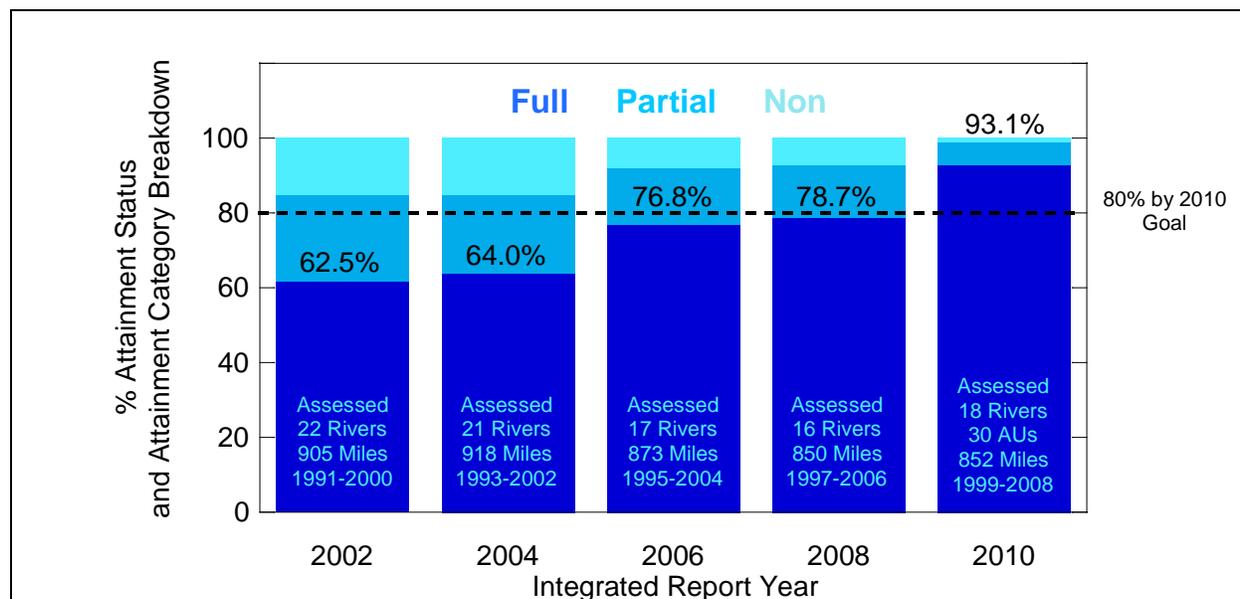


Figure G-2. Percent full attainment and attainment category breakdown for assessed miles of Ohio's large river assessment units (23 rivers/38 AUs/1226.7 miles total). Data compiled over the last five 10-year Integrated Report cycles with the current 2010 cycle including data collected from 1999 - 2008.

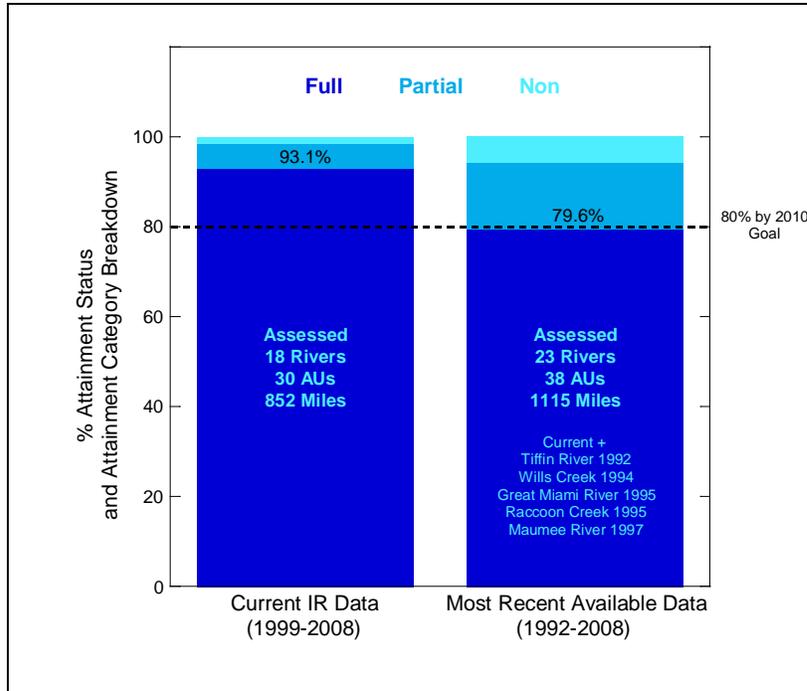


Figure G-3. Comparison of large river assessment unit status between current 2010 Integrated Report data (1999 – 2008) and all available data, irrespective of age (1992 – 2008).

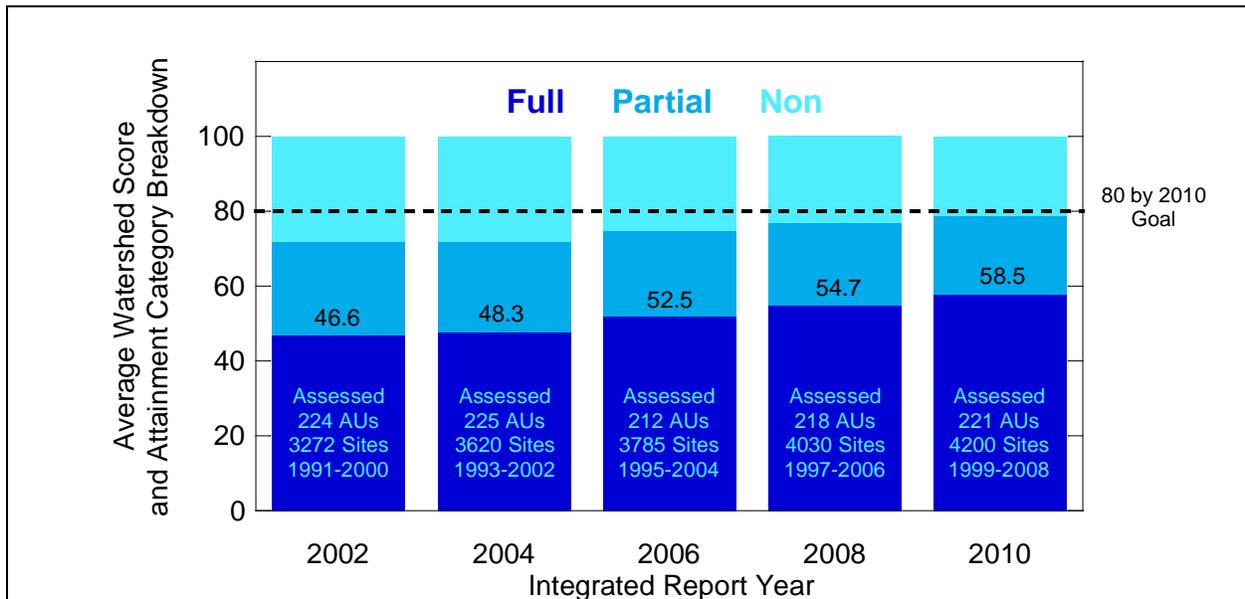


Figure G-4. Average full attainment watershed score and attainment category breakdown for assessed sites in Ohio's HUC11 watershed assessment units (331 total). Data compiled over the last five 10-year Integrated Report cycles with the current 2010 cycle including data collected from 1999 - 2008.

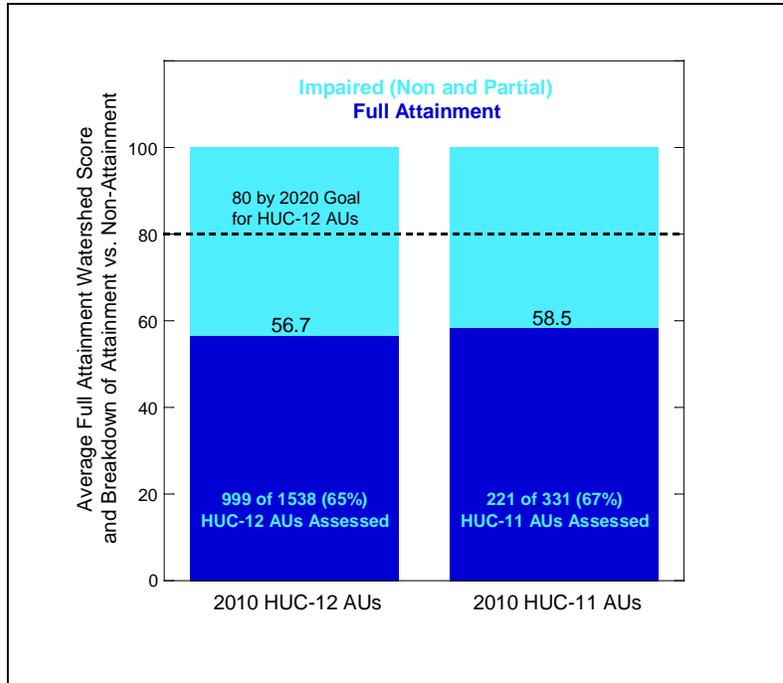


Figure G-5. Comparison of average full attainment watershed scores for HUC11 (331 total) and HUC12 (1538 total) watershed assessment units compiled for the 2010 Integrated Report cycle (scores based on attainment status at 4200 sites collected from 1999-2008).