State of Ohio
Environmental Protection Agency

Division of Surface Water

Total Maximum Daily Loads for the Upper Auglaize River Watershed

Auglaize River upstream of Cloverdale

Final Report
August 16, 2004

Bob Taft, Governor
Christopher Jones, Director

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EXECUTIVE SUMMARY

The 1972 Clean Water Act (CWA) Section 303(d) requires States, Territories, and authorized Tribes to list and prioritize waters for which technology-based treatment limits alone do not ensure attainment of water quality standards. Ohio EPA identified 3 Assessment Units (AU1, AU2, and AU6) within the Upper Auglaize River watershed as priority impaired waters on the 1998, 2002, and 2004 303(d) lists. There are 3 Assessment Units (AUs) and part of a Large River Assessment Unit within the Upper Auglaize River watershed, each defined by the boundaries of a Hydrologic Unit and represented by an eleven-digit Hydrologic Unit Code (HUC11). The portion of the Large River Assessment Unit within the Upper Auglaize River study area is meeting its designated aquatic life uses and attaining water quality standards.

The Upper Auglaize River basin is a sub-watershed of the Maumee River basin (Lake Erie drainage). Located in west central Ohio, in portions of Auglaize, Allen, Van Wert, Putnam and Paulding counties, it covers approximately 90 miles of the mainstem of the Auglaize River to just upstream of its confluence with the Little Auglaize River, and includes all tributaries except the Ottawa and Blanchard Rivers, encompassing approximately 391 square miles of drainage area and nearly three dozen streams in the five counties. The Upper Auglaize River watershed is intensely agricultural, with approximately 89% of the land used for cropland and pasture, mostly rowcrop on artificially drained soils.

A biological and chemical stream survey conducted in 2000 indicated that changes in agricultural practices, such as conservation tillage and participation in conservation reserve programs, are already having a positive impact on water quality in the Upper Auglaize River mainstem compared to survey results from 1991. Although conservation measures are successfully improving conditions in much of the Upper Auglaize River watershed, there are isolated and segment-specific problems that still exist in some of the tributaries and sub-watersheds. Many of the Auglaize River tributaries share similar, though not necessarily ideal, habitat characteristics, yet some are attaining the designated uses while others do not. What separated the attaining streams from the non attaining streams was largely the level of enrichment and the presence or absence of continuous flow. As long as the minimal habitat and flow characteristics were present and enrichment was not excessive, relatively good aquatic communities were supported. Continued improvement of habitat and flow conditions could go a long way toward ameliorating stream health in the presence of other impairments. However, in some cases, removal or reduction of significant sources of nutrient enrichment and/or bacteria will be necessary to bring some stream segments into full attainment of the designated uses.

The primary causes of water quality impairment in the Upper Auglaize River watershed are habitat degradation (including flow alteration and sedimentation), organic enrichment, excessive nutrients, and elevated bacteria levels. The parameters selected for TMDL development in this report are: habitat (flow and sedimentation), dissolved oxygen (DO), total phosphorus, ammonia, and bacteria. This report calculates a TMDL for each of these parameters that is expected to assure attainment of the designated aquatic life and/or recreational use and suggests how each TMDL may be allocated among the following sources of pollutants identified as contributing to each particular impairment:

- Point Sources - WWTPs, CSOs, package plant discharges, industrial discharges

- Non-point Sources - Agricultural practices (riparian removal, channelization, tiling), failing home sewage treatment systems (HSTSs), unsewered communities, agricultural and urban runoff

- Hydromodification (Impoundments)

Although a draft implementation plan is part of this document, public involvement is the keystone to the success of any TMDL project. There is currently not an organized watershed group in the Upper Auglaize River area. Ohio EPA will continue to support the implementation process and will facilitate to the fullest extent possible an agreement acceptable to the communities and stakeholders in the study area and to Ohio EPA. Ohio EPA is reluctant to rely solely on regulatory actions and strongly upholds the need for voluntary actions facilitated by the local stakeholders and agency partners to bring this section of the Auglaize River watershed into attainment.

1.0 INTRODUCTION

The 1972 Clean Water Act (CWA) Section 303(d) requires States, Territories, and authorized Tribes to list and prioritize waters for which technology-based treatment limits alone do not ensure attainment of water quality standards. The Section 303(d) list of impaired waters is made available to the public and submitted to the U.S. Environmental Protection Agency (USEPA) in every even-numbered year (with the exception that 40 CFR 130.7(d) did not require a 303(d) list submittal in the year 2000). The Ohio Environmental Protection Agency (Ohio EPA) identified the Upper Auglaize River watershed as a priority impaired water on the 1998, 2002 and 2004 303(d) lists (Ohio EPA, 1998, 2002, 2004a).

The Clean Water Act and USEPA regulations require that Total Maximum Daily Loads (TMDLs) be developed for all waters on the section 303(d) lists. A TMDL is a calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources. The process of formulating TMDLs for specific pollutants is therefore, a method by which impaired water body segments are identified and restoration solutions are developed. Ultimately, the goal of Ohio's TMDL process is full attainment of biological and chemical Water Quality Standards (WQS) and, subsequently, delisting of waterbodies from the 303(d) list.

Ohio EPA believes that developing TMDLs on a watershed basis (as opposed to solely focusing on impaired segments within a watershed) is an effective approach toward the goal of full attainment of Water Quality Standards in all Ohio waters. This belief led Ohio EPA to adopt a more watershed-based method of identifying and listing impaired waterbodies for the 2002 303(d) list, as compared to the 1998 303(d) list. Ohio EPA shifted from listing individual impaired waterbody segments within each watershed (the 1998 303(d) list), to listing impaired sub-watersheds, defined by the hydrologic unit boundaries represented by an eleven-digit Hydrologic Unit Code (HUC11), in the 2002 303(d) list. A HUC11 sub-watershed, or Assessment Unit, was listed as impaired in 2002 if even one of the waterbody segments within its boundaries was not fully attaining the Water Quality Standards. The implication of this change for the Upper Auglaize River TMDL process is significant because the new listing method obscures improvements in water quality that would have resulted in the delisting of some of the impaired segments that were identified individually on the 1998 303(d) list.

In 2000, the Ohio EPA conducted a detailed assessment of the chemical, physical and biological quality of streams for the Upper Auglaize River TMDL. The new data demonstrated that many previously impaired waterbody segments are now fully attaining Water Quality Standards (WQS). However, some streams that had never been assessed prior to 2000 were found to be impaired. Therefore, while both the 1998 and the 2002 303(d) lists identify all the Upper Auglaize River HUC11 sub-watersheds (Assessment Units) as priority impaired waters, the focus of the TMDL process will now be much different than was originally indicated by the 1998 303(d) list. To overcome the difficulties of comparison between the two differently formatted 303(d) lists, **Table 1-1** lists all the individual waterbody segments in the Upper Auglaize watershed, grouped within the Hydrologic units (HUC11) that were listed in the 2002 303(d) list, and indicates the causes of impairment for each segment that was individually listed on the 1998 303(d) list, and then the causes of impairment for all waterbody segments evaluated using the new data available in 2002. Because the 2000 biological and water quality survey of the Upper Auglaize River watershed was the most comprehensive to date and the results are the most representative of current conditions, TMDLs will be developed based almost exclusively on the information from the 2000 survey, which is represented in the 2002 and 2004 303(d) lists.

The Upper Auglaize River mainstem is now fully attaining WQS except for a small segment in Wapakoneta, affected by CSOs and an impoundment. Largely due to changes in agricultural management practices and land use throughout the watershed, the primary causes of impairment in each Assessment Unit (HUC11) have already been reduced to several isolated and segment-specific problems in some of the tributaries and smaller subwatersheds within each HUC11. In this case, it made more sense to develop TMDLs for each impaired segment or small drainage area than for each entire Assessment Unit (HUC 11). The main causes of impairment identified for TMDL development were grouped and addressed in this report as: habitat/flow/sediment, organic enrichment/dissolved oxygen, nutrients (phosphorus), ammonia, and bacteria.

This report serves to document the Upper Auglaize River TMDL process and provide for tangible actions to restore and maintain this watershed. The main objectives of the report are to describe the water quality and habitat condition of the Upper Auglaize River and its tributaries and to quantitatively assess the factors affecting non or partial attainment of WQS. A draft implementation plan is also included. This plan addresses these factors and specifies monitoring to ensure actions are carried out and to measure the success of the actions proscribed. The report is organized in sections forming the progression of the TMDL process.

Table 1-1. Summary of current status of all water body segments as compared to 1998 303(d) list.

Water Body Segment [WBID][1]	Conditions based on Data available in 1998[2]		Conditions based on Data available in 2002[3]		TMDL in this report ?[6]	Comments[7]
	Aquatic Life Use	Major Causes of impairment on 1998 303(d) List	Recom-mended Aquatic Life Use[4]	Major Causes of impairment[5]		
HUC 04100007 010 AUGLAIZE RIVER (HEADWATERS TO DOWNSTREAM PUSHETA CK)						Priority Points: 11
Auglaize R (Headwaters to Blackhoof Ck) [OH70 25]	WWH	• Habitat Alterations • Siltation	WWH		☺	**Now in Full Attainment**
Auglaize R (Blackhoof Ck to Pusheta Ck) [OH70 20]	WWH	• Organic Enrich/DO • Habitat Alterations • Ammonia	WWH	• Organic Enrich/DO	✓	Wapakoneta CSOs Impoundment
Auglaize R Trib (RM 108.90) [OH70 25.3]	None		WWH		☺	Full Attainment
Auglaize R Trib (RM 103.69) [OH70 25.2]	None		NA	• Bacteria • Ammonia • Organic Enrich/DO • Nutrients • Oil & Grease	✓ ✓ ✓ ✓ No	Westminster Rudolph Foods
Auglaize R Trib (RM 99.78) [OH70 25.1]	None		WWH		☺	Full Attainment
Wrestle Ck [OH70 28]	WWH		WWH		☺	Full Attainment
Camp Ck [OH70 27]	WWH		MWH/ LRW	• Siltation • Habitat alteration • Flow alteration	✓ ✓ ✓	Channelization Agricultural practice
Virginia Ck [OH70 26]	WWH		WWH		☺	Full Attainment
Blackhoof Ck [OH70 23]	WWH		WWH		☺	Full Attainment
Huffman Ck [OH70 24]	WWH		WWH	• Nutrients • Flow alteration • Bacteria	✓ No ✓	Uniopolis WWTP Septic discharges
Dry Run [OH70 22]	WWH		WWH	• Bacteria	✓	Septic discharges
Quaker Run [OH70 21]	WWH		WWH	• Unknown	No	Spill? or stormwater runoff?
Pusheta Ck [OH70 18]	WWH	• Habitat Alterations	MWH/ WWH		☺	**Now in Full Attainment**
Pusheta Ck Trib (RM 2.87) [OH70 18.1]	None		WWH		☺	Full Attainment
Owl Ck [OH70 19]	WWH		LRW/ WWH	• Bacteria	✓	Septic discharges

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Water Body Segment [WBID][1]	**Conditions based on Data available in 1998**[2]		**Conditions based on Data available in 2002**[3]		**TMDL in this report ?**[6]	**Comments**[7]
	Aquatic Life Use	**Major Causes of impairment on 1998 303(d) List**	**Recom-mended Aquatic Life Use**[4]	**Major Causes of impairment**[5]		
HUC 04100007 020 AUGLAIZE RIVER (DST. PUSHETA CREEK TO UPST. JENNINGS CREEK)						Priority Points: 11
Auglaize R (Pusheta Ck to Twomile Ck) [OH70 17]	WWH		WWH		☺	Full Attainment
Auglaize R (Twomile Ck to Sixmile Ck) [OH70 13]	WWH	• Siltation	WWH		☺	**Now in Full Attainment**
Auglaize R (Sixmile Ck to Jennings Ck) [OH70 12]	WWH	• Siltation • Organic Enrich/DO	WWH		☺	**Now in Full Attainment**
Twomile Ck [OH70 16]	WWH		WWH	• Siltation • Nutrients • Organic Enrich/DO • Flow Alteration • Habitat Alteration • Bacteria	✓ ✓ ✓ ✓ ✓ ✓	Channelization Agricultural practice Package Plants in headwaters
Shearer Ditch [OH70 16.3]	None	• Unknown	NA	• Bacteria • Ammonia • Organic Enrich/DO	see Two-mile Creek	Package Plant
Twomile Ck Trib (RM 3.05) [OH70 16.1]	None		NA		NA	
Trib to Twomile Ck Trib (Oakview Trib) (RM 3.05/0.50) [OH70 16.2]	None		NA	• Bacteria • Ammonia • Nutrients • Organic Enrich/DO	☺	Oakview Subdivision is now sewered
Sims Run [OH70 13.2]	None		LRW	• Bacteria	✓	Septic discharges
Buck Run [OH70 15]	WWH		WWH	• Unknown • Flow Alteration	No ✓	Agricultural practice
Auglaize R Trib (RM 63.54) (Goecke Trib) [OH70 13.1]	None		WWH	• Siltation • Habitat alteration • Flow alteration	✓ ✓ ✓	Channelization Agricultural practice
Sixmile Ck [OH70 14]	MWH-C	• Metals • Organic Enrich/DO • Unknown • Ammonia	MWH/ WWH	• Organic Enrich/DO • Habitat Alteration • Siltation • Nutrients • Bacteria • TDS • Ammonia • Priority Organics	✓ ✓ ✓ ✓ ✓ No No No	Farm Services Inc Spencerville WWTP Agricultural runoff Urban runoff Legacy Pollutants
Sixmile Ck Trib [OH70 14.1]	LRW		NA		NA	
Pigeon Run [OH70 12.1]	None		WWH		☺	Full Attainment

Table 1-1. Summary of current status of all water body segments as compared to 1998 303(d) list.

Water Body Segment [WBID][1]	Conditions based on Data available in 1998[2]		Conditions based on Data available in 2002[3]		TMDL in this report ?[6]	Comments[7]
	Aquatic Life Use	**Major Causes of impairment on 1998 303(d) List**	**Recom-mended Aquatic Life Use[4]**	**Major Causes of impairment[5]**		
HUC 04100007 060 AUGLAIZE RIVER (UPST. JENNINGS CREEK TO UPSTREAM L. AUGLAIZE RIVER); Excluding the Auglaize River mainstem dst. Ottawa River Priority Points: 9						
Auglaize R (Jennings Ck to Ottawa R) [OH70 5]	WWH	• Siltation	WWH		☺	**Now in Full Attainment**
Jennings Ck [OH70 7]	WWH	• Organic Enrich/DO • Unknown • Siltation	MWH/ WWH	• Habitat Alteration • Siltation • Flow Alteration • Ammonia • Organic Enrich/DO	✓ ✓ ✓ ✓ ✓	Delphos WWTP CSOs Channelization Agriculture Septic discharges
Flat Fork [OH70 8]	WWH	• Organic Enrich/DO • Habitat Alteration	MWH	• Habitat Alteration • Siltation • Flow Alteration • Organic Enrich/DO	✓ ✓ ✓ ✓	Channelization Agricultural practice
West Jennings Ck [OH70 9]	WWH		WWH	• Bacteria • Ammonia • Nutrients • Organic Enrich/DO	No No No No	1994 data Septic discharges CAFO?
Jennings Prairie Ditch [OH70 10]	WWH		LRW/ MWH		☺	Full Attainment
Big Run [OH70 11]	WWH		WWH	• Bacteria	✓	Septic discharges
Welch Run [OH70 6]	WWH		NA		NA	
Auglaize R Trib (RM 30.53) [OH70 3.1]	None		LRW		☺	Full Attainment
Lapp Ditch [OH70 4]	WWH		NA	• Bacteria • Ammonia • Nutrients • Organic Enrich/DO	✓ ✓ ✓ ✓	Cloverdale
Auglaize R Trib (RM 25.51) [OH70 1.4]	None		NA	• Bacteria • Ammonia • Nutrients • Organic Enrich/DO	✓ ✓ ✓	Dupont
Auglaize R Trib (RM 24.95) [OH70 1.3]	None		NA		NA	
Auglaize R Trib (RM 19.20) [OH70 1.1]	None		NA		NA	
Prairie Ck [OH70 2]	WWH		MWH/ WWH	• Siltation • Nutrients • Flow Alteration • Habitat Alteration	✓ ✓ ✓ ✓	Channelization Agricultural practice Septic discharges?
Prairie Ck Trib [OH70 2.1]	None		NA		NA	

Table 1-1. Summary of current status of all water body segments as compared to 1998 303(d) list.

Water Body Segment [WBID][1]	Conditions based on Data available in 1998[2]		Conditions based on Data available in 2002[3]		TMDL in this report ?[6]	Comments[7]
	Aquatic Life Use	**Major Causes of impairment on 1998 303(d) List**	**Recom-mended Aquatic Life Use[4]**	**Major Causes of impairment[5]**		
HUC 04100007 001 AUGLAIZE RIVER (OTTAWA RIVER TO MOUTH) Priority Points: 4 [The 2 water body segments listed below represent only the upper 50% (approx.) of this Large River Assessment Unit]						
Auglaize R (Blanchard R to L Auglaize R) [OH70 1]	WWH	• Habitat Alteration • Metals • Organic Enrich/DO • Siltation	WWH			**Now in Full Attainment**
Auglaize R (Ottawa R to Blanchard R) [OH70 3]	WWH	• Siltation	WWH			**Now in Full Attainment**

1 WBID =Waterbody ID. These codes are consistent with the WBIDs associated with segments that were listed on the 1998 303(d) list.
2 Data available for the 1998 303(d) list was collected Pre-1994.
3 Data available for the 2002 303(d) list has been collected since 1994. Most of the data was collected in 2000. The 2004 303(d) list is also based on the 2000 assessment; the listings in 2002 and 2004 are identical for this study area.
4 An aquatic life use designation is provided here if a biological assessment in 2000 supports either the existing use or the proposed use change. NA =No Assessment: there has been no recent biological assessment to support an aquatic life use designation on this segment.
5 Causes are from individual waterbody assessments and water chemistry data and are not limited to those on the 2002 303(d) list for the HUC11 unit.
6 A checkmark (✓) in this column indicates that the cause of impairment has been addressed in this report, either directly with a TMDL, or indirectly by a TMDL for another interrelated cause. For example, organic enrichment/DO is often addressed by recommended load reductions for nutrients (phosphorus) and/or ammonia.
7 Full attainment refers to both aquatic life and recreational uses.

2.0 WATER BODY OVERVIEW

2.1 Description of the Study Area

The Upper Auglaize River basin, a sub-watershed of the Maumee River basin (Lake Erie drainage), is located in west central Ohio in portions of Auglaize, Allen, Van Wert, Putnam and Paulding counties (**Figure 2-1**). The study area covers approximately 90 miles of the mainstem of the Auglaize River to just upstream of its confluence with the Little Auglaize River, and includes all tributaries except the Ottawa and Blanchard Rivers, encompassing approximately 391 square miles of drainage area and nearly three dozen streams in the five counties. The headwater region is east southeast of Lima, OH (Allen Co.), where the Auglaize River originates near Harrod, OH, and the mainstem flows southwest to Wapakoneta, OH (Auglaize Co.), then north to Oakwood, OH (Paulding Co.), passing to the west of Lima.

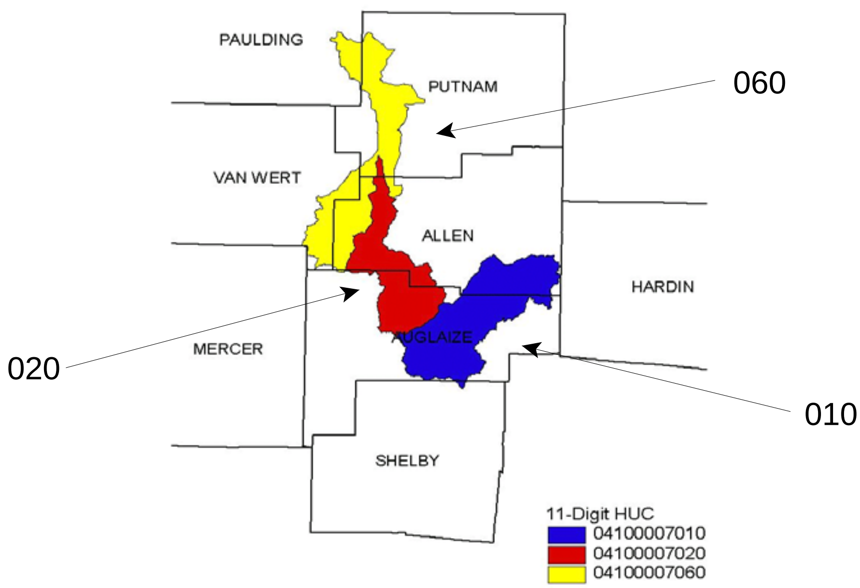


Figure 2-1. Hydrologic Unit Codes (HUCs) of the Upper Auglaize River Sub-watershed

There are 3 Assessment Units (AUs) within the Upper Auglaize River watershed, each defined by the boundaries of a Hydrologic Unit and represented by its eleven-digit Hydrologic Unit Code (HUC11). The Auglaize River and all its tributaries from the headwaters to downstream of Pusheta Creek are within an Assessment Unit identified as HUC 04100007 **010** (referenced in this report as **AU1** or the "Upper AU") (Fig. 2). The Auglaize River and all its tributaries from downstream of Pusheta Creek to upstream of Jennings Creek comprise the Assessment Unit identified as HUC 04100007 **020** (referenced as **AU2** or the "Middle AU"). All the tributaries to the Auglaize River from upstream of Jennings Creek to upstream of the Little Auglaize River are in the Assessment Unit identified as HUC 04100007 **060** (referenced as **AU6** or the "Lower AU"), but only part of the Auglaize River mainstem is included in AU6. Note that AU6 excludes the Auglaize

River mainstem downstream of the Ottawa River confluence. The Auglaize River mainstem from downstream of the Ottawa River to the mouth (33.26 total miles) is classified as a Large River Assessment Unit, identified as HUC 04100007 001. Only the upper 50% of this HUC (16.8 miles from the Ottawa River to upstream of the Little Auglaize River) is included in the Upper Auglaize River watershed. Therefore, in this report, **AU 001** or “Mainstem AU” will refer only to the upper 16.8 miles of this Large River Assessment Unit.

2.1.1 Ecoregions, Soils & Topography

The Upper Auglaize River watershed was entirely glaciated and is physically characterized by broad, nearly level glacial till plains in the Eastern Corn Belt Plain(ECBP) ecoregion of Auglaize and Allen counties. The portions of the watershed in northwest Allen, Van Wert, Putnam and Paulding counties that are in the Huron Erie Lake Plains (HELP) ecoregion have nearly level to depressional glacial lake plains with beach and limestone ridges and end moraines. Moderately poor to poorly drained glacial till soils of the Blount, Pewamo, Glynwood and Millgrove series are widespread in the ECBP ecoregion, and the poorly to very poorly drained soils in the HELP ecoregion of the watershed, derived from clayey lake deposits, are predominantly of the Toledo, Paulding and Latty series (USDA, 1974 and 1981).

Natural vegetation of the ECBP ecoregion was beech forest with elm-ash swamp forest in the old Black Swamp area of the HELP ecoregion. Scattered mixed oak forests are still found on the ridges, but most forest lands have been cleared and drained for agriculture. The entire watershed has sluggish, low gradient streams, many of them with high suspended clay sediment loads. Slope, or gradient, in the Auglaize River averages 3.2 feet per mile, somewhat higher than the neighboring Blanchard and St. Marys rivers. Channelized streams and ditches with clay bottom channels are common in most of northwest Ohio throughout the Maumee River Basin (USGS, 1997).

The Upper AU is entirely in the ECBP ecoregion. The transition from the ECBP ecoregion to the HELP ecoregion occurs within the Middle AU, although the Auglaize River mainstem retains the characteristics of the ECBP throughout this Assessment Unit. The Lower AU and the Mainstem AU are entirely in the HELP ecoregion.

2.1.2 Population Centers and Point Source Discharges

The Upper AU includes the communities of Harrod, Westminster, Uniopolis, and Wapakoneta. The Middle AU includes Buckland and Spencerville, as well as several residential subdivisions associated with the urban growth of Wapakoneta and Lima. Dephos, Fort Jennings, Cloverdale, and Dupont are in the Lower AU. The Village of Oakwood could be considered to be included in both the Lower AU and the Mainstem AU. **Figure 2-2** is a schematic of the Assessment Units within the Upper Auglaize River watershed, showing the locations of tributaries, municipal and industrial point sources, and unsewered areas. For ease of identification, the unnamed tributaries that were part of the 2000 biological and water quality survey are referenced by roman numerals and/or unofficial names. **Table 2-1** lists the NPDES permitted discharges in each AU.

Figure 2-2. Upper Auglaize River Watershed Schematic

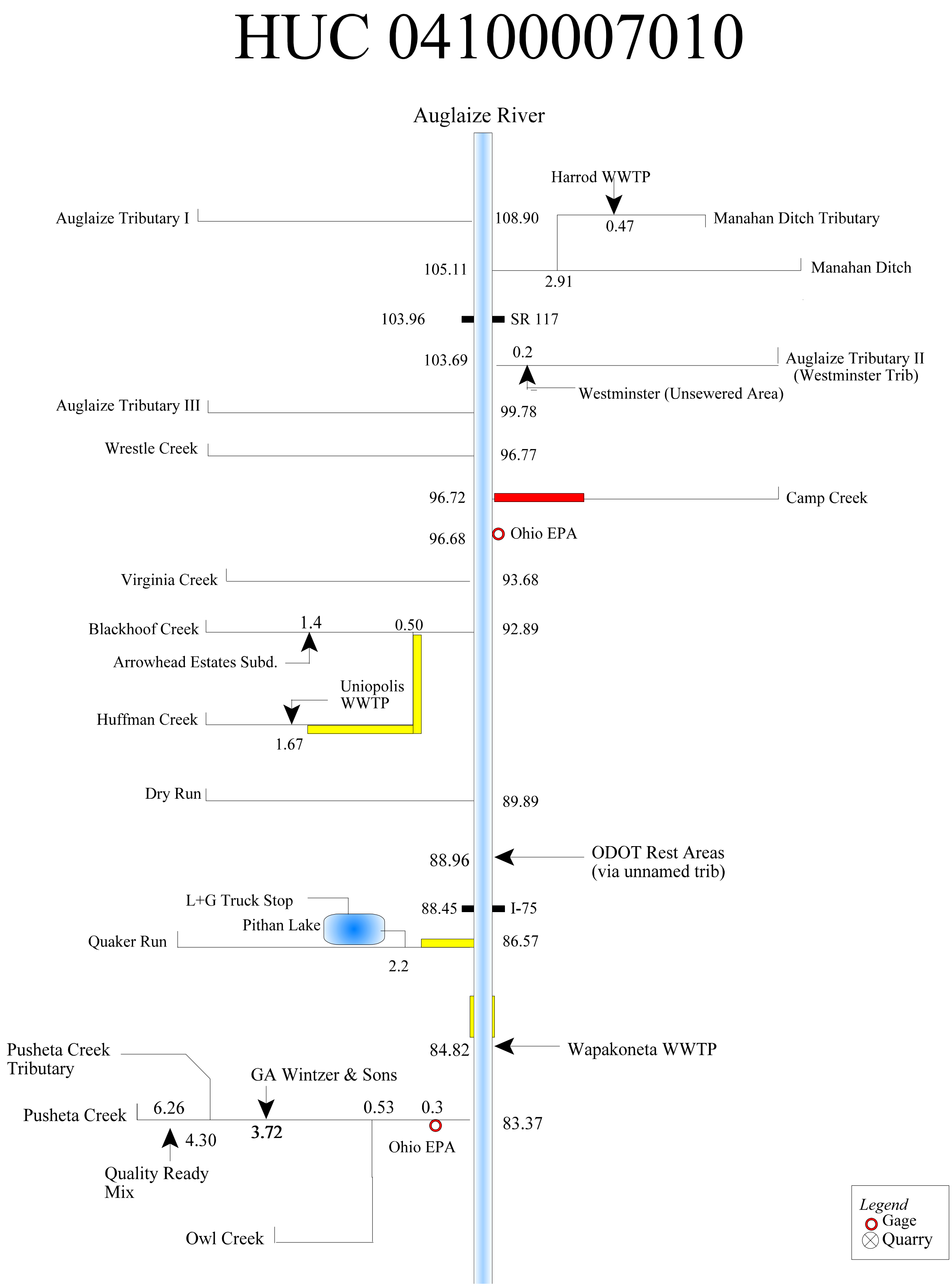


Figure 2-2. Upper Auglaize River Watershed Schematic, continued.

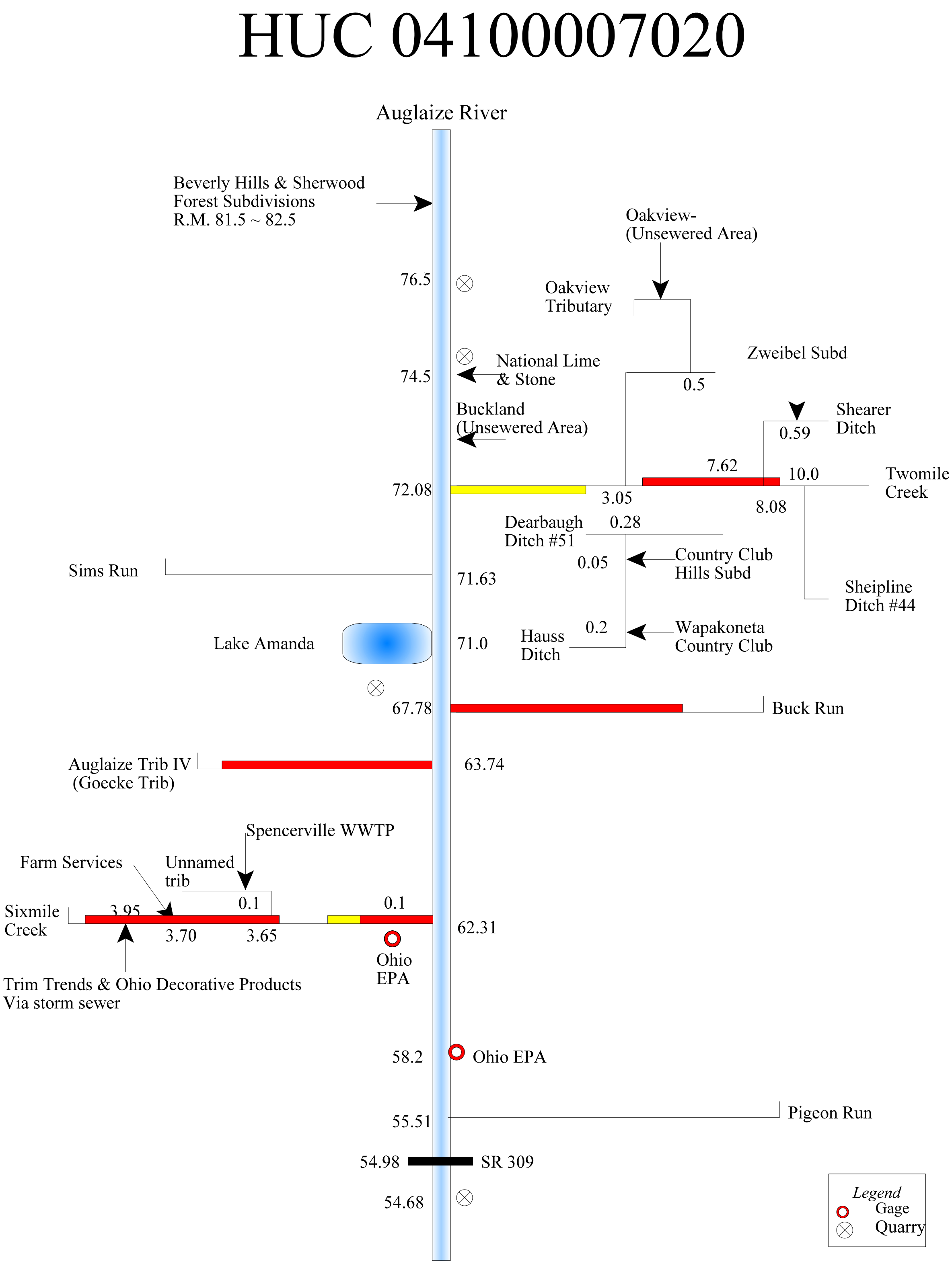


Figure 2-2. Upper Auglaize River Watershed Schematic, continued.

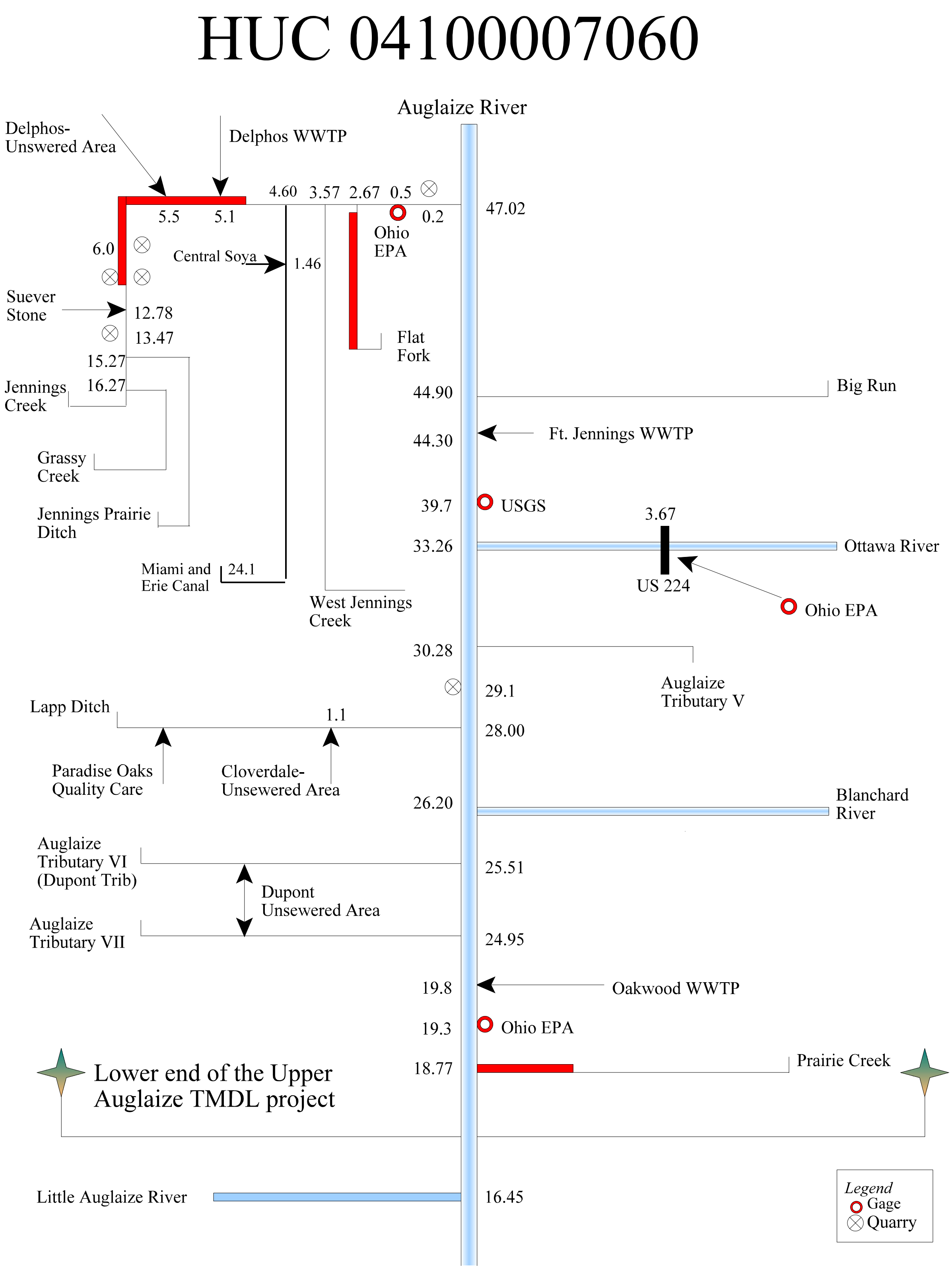


Table 2-1. NPDES Permitted Dischargers in the Upper Auglaize River Watershed

NPDES Permitted Facility	Receiving Stream (Location of Discharge)	Type of discharge
HUC 04100007 010 (Assessment Unit 1)		
Harrod WWTP (2PA00023)	Manahan Ditch Trib at RM 2.91 (RM 0.47)	continuous discharge lagoons
Arrowhead Estates Subd. (2PG00090)	Blackhoof Creek (RM 1.4)	Package plant
Uniopolis WWTP (2PA00054)	Huffman Creek (RM 1.67)	continuous discharge lagoons
ODOT Rest Areas (I-75 NB & SB) (2PP00024 & 2PP00025)	Auglaize R Trib at RM 89.32	Package plants
Wapakoneta WWTP (2PD00019)	Auglaize River (RM 84.82)	WWTP 4 CSOs
Bohrer & Moore Packing Co. (2IH00108)	Auglaize River (in Wapakoneta)	Non-contact cooling water
Superior Tube Co. (2IS00058) does not have a permit	Auglaize River (in Wapakoneta)	Non-contact cooling water
Wapakoneta WTP (2IZ00120)	Auglaize River (in Wapakoneta)	Treated filter backwash
L & G Truck Stop (2IN00039)	Quaker Run via Pithan Lake (RM 2.2)	treated stormwater
Quality Ready Mix (2IJ00086) + General Permit OHG000001	Pusheta Creek (RM 6.26)	stormwater & sand/gravel/truck wash
G.A.. Wintzer & Sons (2IK00002)	Pusheta Creek (RM 3.72)	stormwater + treated process, sanitary wastewater
Schwerman Trucking Co. General Permit OHG000001	Camp Creek	stormwater
Ametek Westchester Plastics General Permit OHR000003	Auglaize River via storm sewer (in Wapakoneta)	stormwater
Koneta Rubber Co. (Park St facility) General Permits OHR000002, OHR00003	Auglaize River via storm sewer (in Wapakoneta)	stormwater
Koneta Rubber Co. (Lunar Dr facility) General Permits OHR000002, OHR00003 (not issued)	Quaker Run	stormwater
Midwest Elastomers Inc General Permits OHR000002, OHR00003	Auglaize River via storm sewer (in Wapakoneta)	stormwater
Modern Ink Technology General Permit OHN000002	Auglaize River via storm sewer (in Wapakoneta)	non-contact cooling water
Dairy Mart Convenience Stores Inc General Permit OHU000001	Quaker Run	Petroleum corrective action (UST)

Table 2-1. NPDES Permitted Dischargers in the Upper Auglaize River Watershed

NPDES Permitted Facility	Receiving Stream (Location of Discharge)	Type of discharge
HUC 04100007 020 (Assessment Unit 2)		
Beverly Hills (2PG00073)	Auglaize River (RM 81.5-82.5)	Package plant
Sherwood Forest Subd. (2PG00013)	Auglaize River (RM 81.5-82.5)	Package plant
Country Club Hills Subd (2PW00007)	Hauss Ditch (RM 0.05)	Package plant
Wapakoneta Country Club Subd. (2PR00126)	Hauss Ditch (RM 0.20)	Package plant
Zweibel Subd. (2PW00006)	Shearer Ditch (RM 0.59)	Package plant
Spencerville WWTP (2PC00000)	Sixmile Ck Trib at RM 3.65 (RM 0.1)	SBR WWTP
National Lime & Stone (2IJ00019)	Auglaize River (RM 74.5)	SW/GW from quarry
Ohio Decorative Products, Inc. (was 2IC00018) General Permits OHN000001, OHN000002, OHR000002, OHR000003	Sixmile Creek via stormsewer (RM 3.95)	non-contact cooling water, stormwater
Harvard Industries/Trim Trends, Inc./ Hayes Albion Corp. (was 2IC00020) General Permit OHR000003	Sixmile Creek via stormsewer (RM 3.95)	stormwater
Flexible Foam Products, Inc. General Permits OHR000002, OHR000003	Sixmile Creek (in Spencerville)	stormwater
Relom, Inc. General Permits OHR000002, OHR000003	Auglaize River (dst Buck Run)	stormwater
Shelly Co. (Northwood Asphalt Plant # 85) General Permits OHG000001, OHR000003	Auglaize River (Buckland)	stormwater

Table 2-1. NPDES Permitted Dischargers in the Upper Auglaize River Watershed

NPDES Permitted Facility	Receiving Stream (Location of Discharge)	Type of discharge
HUC 04100007 060 (Assessment Unit 6)		
Delphos WWTP (2PD00029)	Jennings Creek (RM 5.1)	WWTP
Ft. Jennings WWTP (2PA00052)	Auglaize River (RM 44.30)	controlled discharge lagoons
Paradise Oaks Quality Care (2PR00128)	Lapp Ditch (in Cloverdale)	Package plant
Oakwood WWTP (2PB00031)	Auglaize River (RM 19.8)	controlled discharge lagoons
Suever Stone (2IJ00010)	Jennings Creek (RM 12.78)	GW, stormwater, plant scrubber water
Fruehauf Trailer Corp. (Axle Products Div.) General Permit OHR000002	Flat Fork (in Delphos)	stormwater
Holland Hitch Co. General Permit OHR000003	Flat Fork (in Delphos)	stormwater
Shelly Co. (Northwood Asphalt Plant # 83) General Permits OHG000001, OHR000003	Jennings Creek (in Delphos)	stormwater
Toledo Molding & Die Inc. (SR 697) General Permits OH000002, OHR000003	Jennings Creek (in Delphos)	stormwater
Toledo Molding & Die Inc. (Gressel Dr) General Permits OH000002, OHR000003	Flat Fork (in Delphos)	stormwater
Central Soya Co. General Permits OHN000001, OHN000002	Miami-Erie Canal (in Delphos)	non-contact cooling water

2.1.3 Land Use

Overall land use in the Maumee River watershed is 70% agricultural. The Upper Auglaize River watershed is intensely agricultural, with approximately 89% of the land used for cropland and pasture (**Figure 2-3**). The remaining land use is about 8% forest, 2.2% urban (residential and commercial/industrial), and less than 1% wetlands and open water. Agricultural land use is primarily row crop on artificially drained soils (86%). Only about 14% of the agricultural land use is pasture or range land, with some dairy farming and other livestock operations.

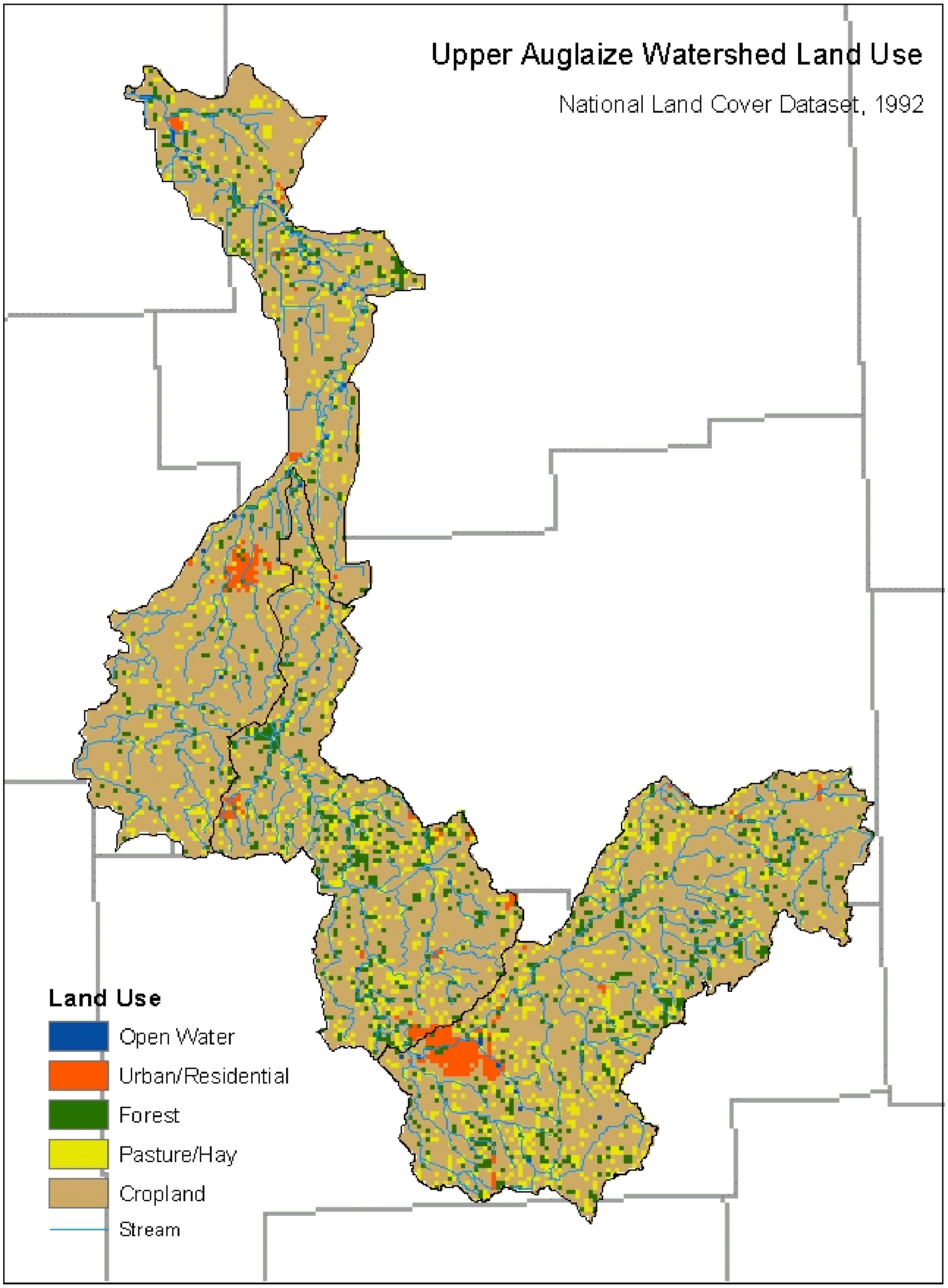
Currently there are only two concentrated animal feeding operations (CAFO), one poultry farm and one dairy farm, within the boundaries of the Upper Auglaize River watershed, which will eventually have NPDES permits. Stoller Farms, Inc., with the capacity for 183,000 laying hens, is located 2-3 miles west of Delphos, in Van Wert Co., right at the edge of the watershed. The nearest stream is an unnamed tributary of West Jennings Creek. Van Ham Dairy went into operation less than 2 years ago, so was not operating at the time of the water quality survey in 2000. Additionally, the Van Ham Dairy is located midway between Dupont and Continental, at the edge of the watershed, but the facility drains to a tributary of the Blanchard River, and the acreage where manure is land applied is also in the Blanchard River watershed, which drains to, but is not included in the Upper Auglaize River basin study area.

2.1.4 Land Use Changes - Conservation Programs

Changes in grain farming and tillage practices have occurred during the ten years prior to this study. Conservation tillage, a practice that reduces cultivation and retains the residue from the previous year's crop at the soil surface, is being implemented in the Maumee River Basin as a means to decrease the amount of soil that is eroded and the amount of suspended sediment that is transported, deposited and dredged annually from the lower Maumee River and Maumee Bay (USGS, 2000). No-till is the minimum cultivation method, and it preserves 40 percent or more of the residue from the previous year's crop on the surface of the soil. Mulch-till and ridge-till are two other methods of conservation tillage that maintain at least 30 percent crop residue, if done properly. A newer technology, fall strip tillage, is being demonstrated in some watersheds.

Conservation tillage was used by farmers throughout the Maumee River basin on 55.4 percent of all crop acres from 1993 to 1998, with 40 percent of those acres in actual no-till. Conservation tillage practices had seen a steady increase, from less than 5 percent in the late 1980's to an average rate of 55 percent in the late 1990s. The 1996-98 tillage transects for the Auglaize River sub-watershed, indicated an even higher rate of conservation tillage adoption, especially in the headwater areas, where rates were in the range of 61-70 percent. The current trend has been a slight decrease in no-till corn acres, but soybean conservation tillage is holding at 65 percent. Alternate tillage methods are being researched to recover and increase the corn yields on no till fields (USGS, 2000).

Figure 2-3. Landuse map.



The Conservation Reserve Program (CRP) which began with the1992 farm bill, offered incentives to farmers to take whole fields or stream side corridors with erodible soils, floodplains, and certain other marginal lands out of production to protect natural resources.

Windbreak incentive programs and a Wetlands Reserve Program (WRP) were offered simultaneously. The agricultural census indicates that the number of farms in the counties of the Upper Auglaize watershed participating in the CRP and WRP farm bill programs increased 200 -300 percent between 1992 to 1997 (USDA, Ag Census, 1997). Although this census did not report statistics specifically by watershed, it is reasonable to assume that the number of landowners adopting conservation practices within the Upper Auglaize watershed increased in a similar proportion.

An enhancement of the Conservation Reserve Program (CREP) became available to watersheds in the Western Lake Erie Basin, including the Auglaize River, in April, 2000. The first acres were being enrolled and converted to riparian buffers, filter strips, wetland restorations, field windbreaks, hardwood plantings, and wildlife habitat during the summer that this water quality survey was being conducted. **Table 2-2** summarizes the progress on the three of these practices that will most benefit water quality from May 2000 to September 2003.

Table 2-2. Acres set aside in the counties of the Upper Auglaize watershed for the 3 CREP practices that will most benefit Water Quality (total since the inception of the program, May 2000 - Sept. 2003).

County	CREP Practice					
	Filter Strips		Riparian Buffers		Wetland Restorations	
	Acres Enrolled	Addl Acres Committed	Acres Enrolled	Addl Acres Committed	Acres Enrolled	Addl Acres Committed
Allen	1067.9	219.4	22.5	6.5	0	0
Auglaize	140.6	8.3	106.9	18.4	2.2	9.7
Paulding	819.9	325.3	138.7	45	149.9	25.7
Putnam	582.9	112.8	10.7	1.4	2.0	14.1
Van Wert	439.5	12	19.3	4.1	26.3	9.5
Total	3050.8	677.8	298.1	75.4	180.4	59
Total Acres	3728.6		373.5		239.4	

2.2 Water Quality and Biological Assessment

2.2.1 Ohio Water Quality Standards and Designated Uses

Under the Clean Water Act every state must adopt water quality standards to protect, maintain, and improve the quality of the nation's surface waters. These standards represent a level of water quality that will support the goal of "swimable/fishable" waters. **Table 2-3** provides a brief description of Ohio's water quality standards. Further information is available in Chapter 3745-1 of the Ohio Administrative Code (OAC). http://www.epa.state.oh.us/dsw/wqs/criteria.html

The foundation for the Ohio Water Quality Standards (WQS) is the concept that public waters have beneficial uses that are to be available to the public. *Beneficial* uses assigned to a waterbody are termed *designated* uses. In order to ensure that these uses are available, the WQS establish water quality criteria by which achievement of designated use may be judged. Ohio WQS include both narrative and numeric water quality criteria. Narrative criteria are descriptive statements applicable to all waters of the state. Numeric criteria consist of biological, physical, and chemical measures. Comparison of instream conditions to applicable water quality criteria establishes a waterbody's achievement of designated use.

As part of the Upper Auglaize River Basin TMDL process, Ohio EPA conducted a detailed assessment of chemical (water column, sediment), physical (flows, habitat), and biological (fish and aquatic insect) conditions in 2000 to determine if streams and rivers in the study area were attaining their designated uses. Impaired designated uses in the Upper Auglaize watershed include aquatic life uses and recreational uses.

Aquatic life use designations applicable to streams in the Upper Auglaize watershed include Warmwater Habitat (WWH), Modified Warmwater Habitat (MWH), and Limited Resource Water (LRW). WWH describes a stream segment that is capable of supporting and maintaining a balanced community of warmwater aquatic organisms. MWH describes a stream segment that is incapable of meeting WWH biocriteria because it has been subjected to extensive, maintained, and essentially permanent hydromodifications, *where the activities have been sanctioned and permitted by state or federal law*. A MWH stream can still support a limited warmwater aquatic community which typically includes species that are tolerant to low dissolved oxygen, silt, nutrient enrichment, and poor quality habitat. LRW applies to small streams (usually <3 $mi.^2$ drainage area) which have been irretrievably altered to the extent that no appreciable aquatic community can be supported.

LRW streams include waterways in extensively urbanized areas, those with extensive drainage modifications, or those which completely lack water on a recurring annual basis (*i.e.,* true ephemeral streams).

Aquatic life use attainment is assessed by comparing existing biological conditions to numeric biocriteria. Ohio's biocriteria are based upon three indices: the Index of Biotic Integrity (IBI), the Modified Index of Well-Being (MIwb), and the Invertebrate Community

<table>
<tr><th colspan="3">Table 2-3. Summary of the components and examples of Ohio's WQS</th></tr>
<tr><th>WQS Components</th><th>Examples of:</th><th>Description</th></tr>
<tr><td>Beneficial Use Designation</td><td>1. Water supply uses
• Public (drinking)
• Agricultural
• Industrial

2. Recreational Uses:
• Beaches (Bathing waters)
• Swimming (Primary Contact)
• Wading (Secondary Contact)

3. Aquatic life habitat uses (partial list):
• Exceptional Warmwater (EWH)
• Warmwater (WWH)
• Modified Warmwater (MWH)
• Limited Resource Water (LRW)</td><td>Designated uses reflect how the water is potentially used by humans and how well it supports a biological community. Every water in Ohio has a designated use or uses; however, not all uses apply to all waters (they are water body specific).

Each use designation has an individual set of numeric criteria associated with it, which are necessary to protect the use designation. For example, a water that was designated as a drinking water supply and could support exceptional biology would have more stringent (lower) allowable concentrations of pollutants than would the average stream.

Recreational uses indicate whether the water can potentially be used for swimming or if it may only be suitable for wading.</td></tr>
<tr><td rowspan="4">Numeric Criteria</td><td>1. Chemical</td><td>Represents the concentration of a pollutant that can be in the water and still protect the designated use of the waterbody. Laboratory studies of organism's sensitivity to concentrations of chemicals exposed over varying time periods form the basis for these.</td></tr>
<tr><td>2. Biological
Measures of fish health:
• Index of Biotic Integrity
• Modified Index of Well Being
Measure of bug (macroinvertebrate)health:
• Invertebrate Community Index</td><td>Indicates the health of the instream biological community by using these 3 indices (measuring sticks). The numeric biological criteria (biocriteria) were developed using a large database of reference sites.</td></tr>
<tr><td>3. Whole Effluent Toxicity (WET)</td><td>Measures the harmful effect of an effluent on living organisms (using toxicity tests).</td></tr>
<tr><td>4. Bacteriological</td><td>Represents the level of bacteria protective of the potential recreational use.</td></tr>
<tr><td>Narrative Criteria

(Also known as 'Free Froms')</td><td colspan="2">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, and nutrients in concentrations that may cause algal blooms.</td></tr>
<tr><td>Antidegradation Policy</td><td colspan="2">This policy establishes situations under which the director may allow new or increased discharges of pollutants, and requires those seeking to discharge additional pollutants to demonstrate an important social or economic need. Includes State Resource Water Use Designation. Refer to http://www.epa.state.oh.us/dsw/wqs/wqs.html for more information.</td></tr>
</table>

Index (ICI). Each index assesses the kinds and relative abundances of various aquatic organisms living in a given stream. Index thresholds were developed from data collected at reference sites, and are distinguished by the type of site (i.e. headwaters, wadeable, small river) and ecoregion (i.e. Huron-Lake Erie Plain, Eastern Corn Belt Plain,). Based upon the applicable biocriteria, stream segments are determined to be in either full (all indices met), partial (some indices met), or non-attainment (no indices met) of their designated aquatic life use.

Recreational use designations applicable to streams in the Upper Auglaize watershed include Primary Contact Recreation (PCR), and Secondary Contact Recreation (SCR). PCR describes waters suitable for full-body contact recreation, such as swimming and canoeing. SCR describes waters suitable for partial-body contact recreation, such as wading. The use attainment status of PCR and SCR is determined by comparing existing bacteria concentrations to numeric criteria for fecal coliform.

2.2.2 Use Attainment and Water Quality in the Upper Auglaize River Basin

In 1991, Ohio EPA assessed only the Auglaize River mainstem, Sixmile Creek, and 1 site on Pusheta Creek (OEPA, 1992). The 1998 303(d) list was based primarily on the 1991 data. The 2000 biological and water quality survey of the Upper Auglaize River watershed was the most comprehensive to date and many streams in the watershed that had never been previously assessed were included in this effort. Because the results are the most representative of current conditions throughout the watershed, TMDLs will be developed based almost exclusively on the information from the 2000 survey, which is represented in the 2002 and 2004 303(d) lists.

Table 2-4 is an aquatic life use attainment table which summarizes the results of the 2000 biological and habitat assessments. The results of sampling conducted prior to 2000 are also included (shaded in the table) for comparison. The table is arranged from upstream to downstream and lists all the mainstem sites first, by rivermile, then lists the sites on the streams that are tributary to the Auglaize River from upstream to downstream. The use attainment status is based on the appropriate aquatic life use designation for the stream segment as determined by the 2000 assessment. If the appropriate aquatic life use designation is different than the use designation that existed prior to the 2000 survey, it is identified as “recommended”.

What is immediately apparent from **Table 2-4** is that the entire Upper Auglaize River mainstem is now in full attainment of its designated aquatic life uses, with the exception of a short segment in Wapakoneta. This improvement in the mainstem stands out as an example of the positive impact that changes in agricultural management practices can have on water quality in just a short time. In 1991, the mainstem of the Auglaize River as it flowed from the ECBP ecoregion into the HELP ecoregion was muddy and heavily silted. In 2000, the substrates in this segment of the river were composed mostly of sand and pea gravel. The improvement was also evident in the response of fish and macroinvertebrate communities. In 2000, there was a significant increase in the number of pollution intolerant, substrate dependent fish species like the hornyhead chub and black redhorse. Black redhorse, an intolerant fish species typically found in only high quality, clean waters, were collected frequently in the mainstem, but were present at only one location in 1991 (OEPA, 2004b).

Table 2-4. Aquatic life use attainment status of the existing and recommended use designations for the Upper Auglaize River study area based on data collected by Ohio EPA, 1984-2000. The Index of Biotic Integrity (IBI), Modified Index of well being (Miwb), and Invertebrate Community Index (ICI) are scores based on the performance of the biotic community. The Qualitative Habitat Evaluation Index (QHEI) is a measure of the ability of the physical habitat to support a biotic community.

RIVER MILE Fish/Macro.	IBI	MIwb	ICI[b]	QHEI	Use Attainment Status[a]	Comments
Auglaize River (2000)						
Eastern Corn Belt Plains-WWH Use Designation (Existing)						
109.1_H/109.1	46	NA	MG[ns]	21.5	FULL	Napoleon Rd.
108.5_H/108.5	48	NA	MG[ns]	47.0	FULL	Hay Rd.
106.7_H/106.7	50	NA	G	51.0	FULL	Faulkner Rd.
101.7_H/101.7	44	NA	VG	52.5	FULL	Osman Rd.
98.1_W/97.9	46	9.0	52	35.5	FULL	Amherst Rd./Ust. Wrestle Creek
96.7_W/96.7**M**	40	8.2[ns]	38	49.5	FULL	Greely-Chapel Rd./Dst. Wrestle Creek
92.5_W/92.5	49	9.2	50	?	FULL	Mudsock Rd./Dst. Blackhoof Creek
87.4_W/87.4	44	8.6	52	58.0	FULL	Dixie Highway
85.3_W/85.1	46	9.4	28*	69.0	PARTIAL	Hamilton St./Dst Wapakoneta CSOs
84.9_W/84.9**mz**	47	8.4	MG	NA	NA	Wapakoneta WWTP Mixing Zone
84.1_W/84.1	50	10.3	40	68.5	FULL	Adj. Green Lawn Cemetery/Dst. WWTP
80.3_W/80.3	49	9.8	50	71.0	FULL	Adj. Glynwood Rd.
72.0_W/71.2	54	10.1	44	75.5	FULL	Main St./Dst. Twomile Creek
67.1_W/67.2**R**	55	10.0	48	66.5	FULL	SR 117
64.8_B/64.8	48	8.9	26	45.5	(FULL)[c]	Bressler Reservoir (Impounded)
62.9_B/63.2	52	9.9	44	?	FULL	Ust. Sixmile Creek
61.6_B/62.1	45	9.5	44	57.0	(FULL)	Dst. Sixmile Creek
58.2_B/58.0	42	9.5	46	66.0	FULL	Piquad Rd.
52.7_B/52.6	54	10.2	50	64.5	FULL	Lincoln Highway
46.0_B/46.0	46	10.5	44	61.5	FULL	SR 189/At City Park
Huron Erie Lake Plain-WWH Use Designation (Existing)						
39.6_B/39.6**R**	45	10.5	44	65.0	FULL	US 224
33.9_W/34.0	42	9.4	46	50.5	FULL	CR M/Ust. Ottawa River
28.8_B/28.8	43	10.4	48	75.5	FULL	SR 114/Ust. Blanchard River

RIVER MILE Fish/Macro.	IBI	MIwb	ICI[b]	QHEI	Use Attainment Status[a]	Comments
Auglaize River (1991)						
		Eastern Corn Belt Plains-WWH Use Designation (Existing)				
87.7_W/87.8	35*	6.6*	G	56.0	PARTIAL	Ust. Wapakoneta
85.3_W/85.1	45	9.3	MG[ns]	74.5	FULL	Dst.CSOs/Ust. Wapakaneta WWTP
84.9_W/84.9**mz**	38	7.7	P	NA	NA	Wapakoneta WWTP Mixing Zone
84.8_W/84.8	45	9.8	<u>12</u>*	81.0	NON	Dst. Wapakoneta WWTP
80.3_W/80.3	43	9.3	36	75.5	FULL	Adj. Glynwood Rd.
67.1_W/67.0**R**	46	9.5	46	74.5	FULL	SR 117
64.8_B/ -	43	8.4[ns]	-	47.0	(FULL)	Spencerville Dam Pool
62.9_B/63.2	37*	8.1[ns]	MG[ns]	33.5	PARTIAL	Ust. Sixmile Creek
61.6_B**/**61.4	38[na]	8.7	MG[ns]	48.5	FULL	Dst. Sixmile Creek
58.2_B/ -	36*	8.8	-	55.0	(PARTIAL)	Piquad Rd.
57.8_B/57.8	29*	8.2[ns]	50	57.0	PARTIAL	
52.7_B**/ -**	31*	8.3[ns]	-	72.0	(PARTIAL)	Lincoln Highway
		Huron Erie Lake Plain-WWH Use Designation (Existing)				
39.6_B**/**39.4**R**	33[ns]	10.0	G	66.5	FULL	US 224
28.2_B/28.8**R**	30[ns]	8.8	48	72.0	FULL	SR 114/Ust. Blanchard River
Auglaize Tributary I at RM 109.1 (2000)						
		Eastern Corn Belt Plains-WWH Use Designation (Existing)				
0.3_H/0.3	48	NA	G	51.0	FULL	Faulkner Rd.
Auglaize Tributary III at RM 99.78 (2000)						
		Eastern Corn Belt Plains-WWH Use Designation (Existing)				
0.7_H/0.6	52	NA	MG[ns]	64.0	FULL	Osman Rd.
Wrestle Creek (2000)						
		Eastern Corn Belt Plains-WWH Use Designation (Existing)				
4.7_H/4.7	52	NA	G	70.0	FULL	Graham Rd.
0.3_H/0.3	50	NA	MG[ns]	43.0	FULL	River Rd.

RIVER MILE Fish/Macro.	IBI	MIwb	ICI[b]	QHEI	Use Attainment Status[a]	Comments
Camp Creek (2000)						
Eastern Corn Belt Plains-LRW Use Designation (Recommended)						
- /2.3	-	-	P*	-	(FULL)	Yoder Rd.
Eastern Corn Belt Plains-MWH Use Designation (Recommended)						
0.6_H/0.6	40	NA	P*	42.5	**NON**	River Rd.
Virginia Creek (2000)						
Eastern Corn Belt Plains-WWH Use Designation (Existing)						
0.9_H/0.9	40	NA	MG^{ns}	47.5	FULL	SR 65
Blackhoof Creek (2000)						
Eastern Corn Belt Plains-WWH Use Designation (Recommended)						
3.3_H/ -	44	NA	VG	64.0	FULL	Blank Pike Rd.
0.8_H/ -	52	NA	G	50.0	FULL	Hengstler Rd.
Huffman Creek (2000)						
Eastern Corn Belt Plains-WWH Use Designation (Recommended)						
1.7_H/1.6**R**	46	NA	26*	60.0	PARTIAL	SR 65, Dst. Uniopolis WWTP
0.3_H/0.3	50	NA	MG^{ns}	44.5	FULL	Townline-Lima Rd.
Dry Run (2000)						
Eastern Corn Belt Plains-WWH Use Designation (Recommended)						
0.3_H/0.3	38^{ns}	NA	MG^{ns}	58.0	FULL	SR 67
Quaker Run (2000)						
Eastern Corn Belt Plains-WWH Use Designation (Existing)						
0.1_H/0.1	48	NA	F*	60.0	PARTIAL	SR 67
Pusheta Creek (2000)						
Eastern Corn Belt Plains-MWH Use Designation (Recommended)						
12.9_H/12.9	28	NA	F	28.0	FULL	Ashburn Rd.
10.9_H/10.9	30	NA	F	33.5	FULL	Townline Rd.
8.8_H/8.9	32	NA	G	40.0	FULL	Fryburg-Shelby Rd.
Eastern Corn Belt Plains-WWH Use Designation (Existing)						
3.0_W/3.0	42	8.7	52	61.5	FULL	Hardin Pike
0.3_W/0.3	44	9.5	48	58.5	FULL	Auglaize St./CR 33A

RIVER MILE Fish/Macro.	IBI	MIwb	ICI[b]	QHEI	Use Attainment Status[a]	Comments
Pusheta Creek (1991)						
		Eastern Corn Belt Plains-WWH Use Designation (Recommended)				
0.3_{W}/0.3	42	9.6	34^{ns}	41.0	FULL	Auglaize St./CR 33A
Pusheta Creek Tributary at RM 4.30 (2000)						
		Eastern Corn Belt Plains-WWH Use Designation (Recommended)				
0.5^{H}/ -	42	NA	-	50.0	(FULL)	Owl Creek Rd.
Owl Creek (2000)						
		Eastern Corn Belt Plains-LRW Use Designation (Recommended)				
3.2_{H}/3.2	30	NA	$\underline{P}$	24.0	FULL	Owl Creek Rd.
		Eastern Corn Belt Plains-WWH Use Designation (Existing)				
0.4_{H}/0.4	40	NA	MG^{ns}	39.5	FULL	Kohler Rd.
Twomile Creek (2000)						
		Eastern Corn Belt Plains-WWH Use Designation (Existing)				
8.1_{H}/8.1	$\underline{26}$*	NA	MG^{ns}	36.0	**NON**	Holden Rd.
1.6_{W}/1.6	38^{ns}	7.2*	G	45.5	PARTIAL	Bowsher Rd.
0.2_{W}/0.2	34*	8.5	G	61.0	PARTIAL	SR 198
Sims Run (2000)						
		Eastern Corn Belt Plains-LRW Use Designation (Recommended)				
4.4_{H}/4.4	$\underline{22}$	NA	$\underline{P}$	25.0	FULL	Conant Rd.
		Eastern Corn Belt Plains-WWH Use Designation (Existing)				
0.8_{H}/0.8	36^{ns}	NA	MG^{ns}	36.5	FULL	National Rd.
Buck Run (2000)						
		Eastern Corn Belt Plains-WWH Use Designation (Existing)				
0.6_{H}/0.6	32*	NA	$\underline{P}$*	43.0	**NON**	Sunderland Rd.
Auglaize Tributary IV at RM 63.54 (Goecke Trib) (2000)						
		Huron Erie Lake Plain-WWH Use Designation (Existing)				
0.5_{H}/0.5	38^{ns}	NA	$\underline{P}$*	39.0	**NON**	Defiance Trail

RIVER MILE Fish/Macro.	IBI	MIwb	ICI[b]	QHEI	Use Attainment Status[a]	Comments
Sixmile Creek (2000)						
Huron Erie Lake Plain-MWH Use Designation (Recommended)						
4.2_H/4.1	26	NA	P*	41.5	**NON**	Bailey St./Ust. OD and TT
3.9_H/3.8	22	NA	P*	27.0	**NON**	SR 66/Dst. OD and TT
3.7_H/3.6	22	NA	P*	29.0	**NON**	Dst. Farm Services
Huron Erie Lake Plain-WWH Use Designation (Existing)						
3.5_H/3.5	32^{ns}	NA	36	33.5	FULL	Dst. Spencerville WWTP
1.2_H/1.2	44	NA	28*	45.5	PARTIAL	SR 81
0.2_H/0.1	40	NA	P*	50.5	**NON**	Defiance Trail
Sixmile Creek (1991)						
Huron Erie Lake Plain-MWH Use Designation (Recommended)						
4.2_H/4.2	12*	NA	P*	43.0	**NON**	Bailey St./Ust. OD and TT
3.8_H/3.8	12*	NA	0*	29.0	**NON**	SR 66/Dst. OD and TT
3.7_H/3.6	12*	NA	0*	26.5	**NON**	Dst. Farm Services
Huron Erie Lake Plain-WWH Use Designation (Existing)						
3.5_H/3.5	12*	NA	2*	35.8	**NON**	Dst. Spencerville WWTP
1.2_H/1.3	12*	NA	P*	56.5	**NON**	SR 81
0.1_H/0.2	23*	NA	18*	44.0	**NON**	Defiance Trail
Pigeon Run (2000)						
Huron Erie Lake Plain-WWH Use Designation (Existing)						
0.2_H/0.2	36	NA	MG^{ns}	43.5	FULL	Good Rd.
Jennings Creek (2000)						
Huron Erie Lake Plain-MWH Use Designation (Rcommended)						
19.3_H/19.3	26	NA	F	27.5	FULL	Purdy Rd.
17.6_H/17.6	24	NA	F	21.5	FULL	Kill Rd.
16.1_H/16.1	26	NA	MG	29.0	FULL	Kill Rd./Ust. Jennings Prairie Ditch
15.0_W/15.0	26	8.1	MG	21.0	FULL	Kill Rd./Dst. Jennings Prairie Ditch
Huron Erie Lake Plain-WWH Use Designation (Recommended)						
7.6_W/7.7**R**	26*	7.2^{ns}	44	47.0	**NON**	CR 244
4.8_W/4.8	32	6.9^{ns}	P*	60.0	**NON**	Pohlmen Rd./Dst. Delphos WWTP
0.5_W/0.4	36	7.7	44	53.5	FULL	CR 23T

RIVER MILE Fish/Macro.	IBI	MIwb	ICI[b]	QHEI	Use Attainment Status[a]	Comments
Flat Fork (2000)						
		Huron Erie Lake Plain-MWH Use Designation (Recommended)				
$1.2_H/2.2$	<u>26</u>	NA	<u>P</u>*	31.0	**NON**	CR U20
West Jennings Creek (2000)						
		Huron Erie Lake Plain-WWH Use Designation (Recommended)				
$0.8_H/1.7$	32	NA	MG^{ns}	37.5	FULL	SR 66
Jennings Prairie Ditch (2000)						
		Huron Erie Lake Plain-LRW Use Designation (Recommended)				
$8.1_H/8.1$	<u>24</u>	NA	<u>P</u>	20.0	FULL	Louth Rd.
		Huron Erie Lake Plain-MWH Use Designation (Recommended)				
$4.8_H/5.0$	32	NA	F	21.5	FULL	SR 81
$0.3_H/0.3$	<u>24</u>	NA	MG	25.5	FULL	County Line Rd.
Big Run (2000)						
		Huron Erie Lake Plain-WWH Use Designation (Recommended)				
$0.3_H/0.3$	38	NA	MG^{ns}	?	FULL	CR 70/Road S
Auglaize Tributary V at RM 30.53 (2000)						
		Huron Erie Lake Plain-LRWs Use Designation (Existing)				
$0.1_H/0.1$	36	NA	<u>P</u>	55.5	FULL	CR 22K/Holden Cemetery
Prairie Creek (2000)						
		Huron Erie Lake Plain-MWH Use Designation (Recommended)				
$3.2_H/3.2$	22	NA	<u>P</u>	25.0	**NON**	County Line Rd.
		Huron Erie Lake Plain-WWH Use Designation (Recommended)				
$0.3_H/0.3$	36	NA	<u>P</u>*	64.0	**NON**	SR 66

* -Significant departure from ecoregional biocriterion; poor and very poor results are underlined.
ns -Nonsignificant departure from biocriterion ($\leq$ 4IBIor ICI units; $\leq$ 0.5 MIwb units).
a -Use attainment status based one organism is parenthetically expressed.
b -Narrative evaluation based on qualitative benthic macroinvertebrate sample (E-exceptional, G-good, MG-marginally good, F-fair, P-poor, and VP-very poor.
c -MWH Impounded biocriteria do not apply to ICI.
H -Headwaters (station $\leq$ 20 miles^2).
W -Wading methods employed to evaluate fish community.
B -Boat methods employed to evaluate fish community.
R -Ecoregional Reference Site.
M -Modified Ecoregional Reference Site.

Table 2-4. Continued.

Ecoregional Biocriteria:

Eastern Corn Belt Plains (ECBP)

INDEX - Site Type	WWH	EWH	MWH	LRW[c]
IBI - Headwaters/Wading	40	50	24	18
IBI - Boat	42	48	24	18
MIwb - Wading	8.3	9.4	6.2	4.0
MIwb - Boat	8.5	9.6	5.8	4.0
ICI	36	46	22	8

Huron Erie Lake Plain (HELP)

INDEX -Site Type	WWH	EWH	MWH	LRW[c]
IBI - Headwaters	28	50	20	18
IBI - Wading	32	50	22	4.0
IBI - Boat	34	48	20	18
MIwb - Wading	7.3	9.4	5.6	18
MIwb - Boat	8.6	9.6	5.7	4.0
ICI	34	46	22	8

c - Interim biocriteria for the LRW aquatic life use designation.

In 1994, U.S.Geological Survey (USGS) began a 5-year study in cooperation with Natural Resources Conservation Service (NRCS) and U.S. Army Corps of Engineers (USACE) to investigate the relation of suspended sediment discharge to conservation tillage practices in the Maumee River Basin. Suspended sediment discharges measured in the Auglaize River near Fort Jennings were 49.8% lower during the period 1996-98 compared to 1970-1974. The reduction in suspended sediment discharge has been attributed to the widespread adoption of conservation tillage farming practices throughout the watershed. The systematic use of conservation tillage practices on farms in the basin was shown to reduce the amount of soil erosion, decrease dredging in the Port of Toledo, and improve the water quality and aquatic habitat (USGS, 2000). Results of Ohio EPA's 2000 biological and water quality survey of the Upper Auglaize River Basin also provide clear evidence that the increasing use of conservation tillage and participation in the conservation reserve programs within the watershed is having a positive impact on improving water quality (OEPA, 2004b). The enhancements to the Conservation Reserve Program (CREP) instituted in 2000 served to further increase the number of acres within the watershed that are involved in conservation activities (see **Section 2.1.4**), which has likely contributed to continued improvements in stream health since the Ohio EPA survey was conducted.

Although conservation measures are successfully improving conditions in much of the Upper Auglaize River watershed, there are isolated and segment-specific problems that still exist in some of the tributaries and sub-watersheds. Many of the Auglaize River tributaries in both ecoregions share similar, though not necessarily ideal, habitat characteristics, yet some are attaining the designated uses while others do not. What separated the attaining streams from the non attaining streams was largely the level of enrichment and the presence or absence of continuous flow. As long as the minimal habitat and flow characteristics were present and enrichment was not excessive, relatively good aquatic communities were supported. Continued improvement of habitat and flow conditions could go a long way toward ameliorating stream health in the presence of other impairments. However, in some cases, removal or reduction of significant sources of nutrient enrichment and/or bacteria will be necessary to bring some stream segments into full attainment of the designated uses.

2.3 Causes and Sources of Impairment

Table 2-5 lists only the impaired stream segments in the Upper Auglaize watershed, organized by assessment unit, along with the identified causes and sources of impairment. Some of these segments were not assessed for attainment of aquatic life uses, but are considered impaired because they are not attaining the recreational use designation, and/or there is water quality evidence of nutrient or organic enrichment. In cases where non attainment of the recreational use is indicated, there are often not enough samples collected within a 30 day period to confirm violations of water quality criteria, but the segment is considered impaired by bacteria if reasonable potential for a violation exists based on the samples that were collected. A more detailed discussion of the attainment status, and the causes and sources of impairment for each of these stream segments follows **Table 2-5**.

Table 2-5. Causes and Sources of Impairment in the Upper Auglaize River Watershed

Water Body Segment [WBID][1] Lower - Upper RM (length)	**Causes of Impairment[2]**	**Sources of Impairment[2]**	**Recom-mended Aquatic Life Use[3]**	**Miles Attaining/Not Attaining (recreational use only = R)[4]**				
				Full	**Threatened**	**Partial**	**Non**	**Not Assessed**
HUC 04100007 010 AUGLAIZE RIVER (HEADWATERS TO DOWNSTREAM PUSHETA CK)								
Auglaize R (Blackhoof Ck to Pusheta Ck) [OH70 20] RM 83.57 - RM 93.09 (9.52)	**H** Organic enrich/DO	**H** CSOs **H** Upstream Impoundment **M** Urban Runoff/Storm Sewers	WWH	9.32		0.2		
Auglaize R Trib II at RM 103.69 (Westminster Trib) [OH70 25.2] RM 0.0 - RM 2.20 (2.20)	Bacteria Ammonia Organic Enrich/DO Nutrients Oil & Grease	Westminster Failing HSTSs Rudolph Foods	NA	(0.2)R			(0.3)R	(1.7)R
Camp Ck [OH70 27] RM 0.0 - RM 4.80 (4.80)	**H** Siltation **H** Habitat alteration **M** Flow alteration	**H** Nonirrigated cropland **H** Agric. Hydromodification **H** Channelization **H** Riparian Removal **M** Unknown	MWH/ LRW	3.4 (2.3)R		1.4		(2.6)R
Huffman Ck [OH70 24] RM 0.0 - RM 3.30 (3.30)	**H** Nutrients **M** Flow alteration **S** Bacteria	**H** Wastewater Lagoon **M** Channelization **M** Riparian Removal **S** Agric. Hydromodification	WWH	0.3		1.4	(1.7)R	1.6 (1.6)R
Dry Run [OH70 22] RM 0.0 - RM 4.10 (4.10)	Bacteria	Failing HSTSs	WWH				(3.0)R	(0.3)R
Quaker Run [OH70 21] RM 0.0 - RM 4.20 (4.20)	**H** Unknown toxicity	**H** Unknown **H** Urban Runoff/Storm Sewers	WWH		(2.0)R	2.0		2.2 (2.2)R
Owl Ck [OH70 19] RM 0.0 - RM 4.20 (4.20)	Bacteria	Failing HSTSs	LRW/ WWH	4.2			(4.2)R	

Table 2-5. Causes and Sources of Impairment in the Upper Auglaize River Watershed, cont'd.

Water Body Segment [WBID][1] Lower/Upper RM (length)	**Causes of Impairment[2]**	**Sources of Impairment[2]**	**Recom-mended Aquatic Life Use[3]**	**Miles Attaining/Not Attaining (recreational use only = R)[4]**				
				Full	**Threatened**	**Partial**	**Non**	**Not Assessed**
HUC 04100007 020 AUGLAIZE RIVER (DST PUSHETA CK to UPST JENNINGS CK)								
Twomile Ck [OH70 16] RM 0.0 - RM 11.60 (11.60)	**H** Siltation **H** Flow alteration **H** Habitat alteration **M** Nutrients **M** Organic enrich/DO Bacteria	**H** Nonirrigated cropland **H** Agric. Hydromodification **H** Channelization **H** Riparian removal Package Plant discharges Failing HSTSs	WWH	(3.0)R		3.0	6.0 (6.0)R	2.6 (2.6)R
Shearer Ditch [OH70 16.3] RM 0.0 - RM 2.67 (2.67)	Bacteria Ammonia Organic Enrich/DO	Package Plant discharge Failing HSTSs	LRW				(2.67)R	
Trib to Twomile Ck Trib (Oakview Trib) RM 3.05/0.50) [OH70 16.2]	Bacteria Ammonia Nutrients Organic Enrich/DO	Oakview Failing HSTSs	NA				(1.0)R	
Sims Run [OH70 13.2] RM 0.0 - RM 8.62 (8.62)	Bacteria	Failing HSTSs	LRW	5.0 (4.0)R			(1.0)R	3.62 (3.62)R
Buck Run [OH70 15] RM 0.0 - 3.60 (3.60)	**H** Unknown **M** Flow alteration	**H** Unknown **M** Agric. Hydromodification	WWH	(1.0)R			1.0	2.6 (2.6)R
Auglaize R Trib IV at RM 63.54 (Goecke Trib) [OH70 13.1] RM 0.0 - RM 4.35 (4.35)	**H** Siltation **H** Habitat alteration **H** Flow alteration	**H** Channelization **H** Nonirrigated cropland **H** Agric. Hydromodification **M** Riparian removal	WWH	(2.0)R			2.0	2.35 (2.35)R
Sixmile Ck [OH70 14] RM 0.0 -RM 6.81 (6.81)	**H** Organic enrich/DO **H** Habitat alteration **H** Nutrients **H** Siltation **M** Priority organics **S** TDS **S** Ammonia Bacteria	**H** Nonirrigated cropland **H** Agric. Hydromodification **H** Channelization **H** Municipal point sources **M** Industrial point sources **M** Spills Failing HSTSs	MWH/ WWH	2.3 (2.7)R		1.2	3.31 (4.1)R	

Table 2-5. Causes and Sources of Impairment in the Upper Auglaize River Watershed, cont'd.

Water Body Segment [WBID][1] Lower/Upper RM (length)	Causes of Impairment[2]	Sources of Impairment[2]	Recom-mended Aquatic Life Use[3]	Miles Attaining/Not Attaining (recreational use only = R)[4]				
				Full	Threatened	Partial	Non	Not Assessed
HUC 04100007 060 AUGLAIZE RIVER (UPST JENNINGS CK TO UPST L AUGLAIZE R); Excluding the Auglaize R mainstem dst of Ottawa R								
Jennings Ck [OH70 7] RM 0.0 - RM 22.0 (22.0)	**H** Habitat alteration **H** Siltation **H** Ammonia **H** Organic enrich/DO **H** Flow alteration	**H** Nonirrigated cropland **H** Agric. Hydromodification **H** Channelization **H** Municipal point sources **T** Riparian removal	MWH/ WWH	11.6 (14.2)R	0.5 (5.1)R		7.2	
West Jennings Ck [OH70 9] RM 0.0 - RM 5.40 (5.40)	Bacteria Ammonia Organic enrich/DO	Failing HSTSs CAFO	WWH	(3.7)R			(1.7)R	
Flat Fork [OH70 8] RM 0.0 - RM 9.60 (9.60)	**H** Habitat alteration **H** Siltation **H** Nutrients **H** Flow alteration Organic Enrich/DO	**H** Nonirrigated cropland **H** Agric. Hydromodification **H** Channelization **H** Riparian removal Failing HSTSs	MWH	(2.0)R			2.0	7.6 (7.6)R
Big Run [OH70 5.1] RM 0.0 - RM 6.78 (6.78)	Bacteria	Failing HSTSs	WWH	2.0			(2.0)R	4.78 (4.78)R
Lapp Ditch [OH70 4] RM 0.0 - RM 1.90 (1.90)	Bacteria Ammonia Nutrients Organic Enrich/DO	Cloverdale Failing HSTSs	NA				(1.9)R	
Auglaize R Trib VI at RM 25.51 (Dupont Trib) [OH70 1.4] RM 0.0 - RM 0.37 (0.37)	Bacteria Ammonia Nutrients Organic Enrich/DO	Dupont Failing HSTSs	NA				(0.37)R	
Prairie Ck [OH70 2] RM 0.0 - RM 6.43 (6.43)	**H** Siltation **H** Nutrients **H** Flow alteration **M** Habitat alteration **M** Bacteria	**H** Nonirrigated cropland **H** Agric. Hydromodification **M** Failing HSTSs	MWH/ WWH				6.43 (6.43)R	

1 WBID =Waterbody ID. These codes are consistent with the WBIDs associated with segments that were listed on the 1998 303(d) list.
2 The significance of Causes and Sources identified during a biological assessment is indicated: **H** = high, **M** = moderate, **S** = small, **T** = threat. Causes and sources based on water quality data only are not ranked.
3 An aquatic life use designation is provided here if a biological assessment in 2000 supports either the existing use or the proposed use change. NA =No Assessment: there has been no recent biological assessment to support an aquatic life use designation on this segment.
4 Numbers in parentheses indicate the stream miles attaining/not attaining the recreational use designation only.

2.3.1 Assessment Unit 1 (AU1)

The Upper AU (HUC 04100007 010) includes the Auglaize River and its tributaries from the headwaters to downstream of Pusheta Creek (**Figure 2-4**). Most of the streams in the Upper AU are fully attaining the recommended/existing aquatic life and recreational uses, with the following exceptions.

Auglaize River

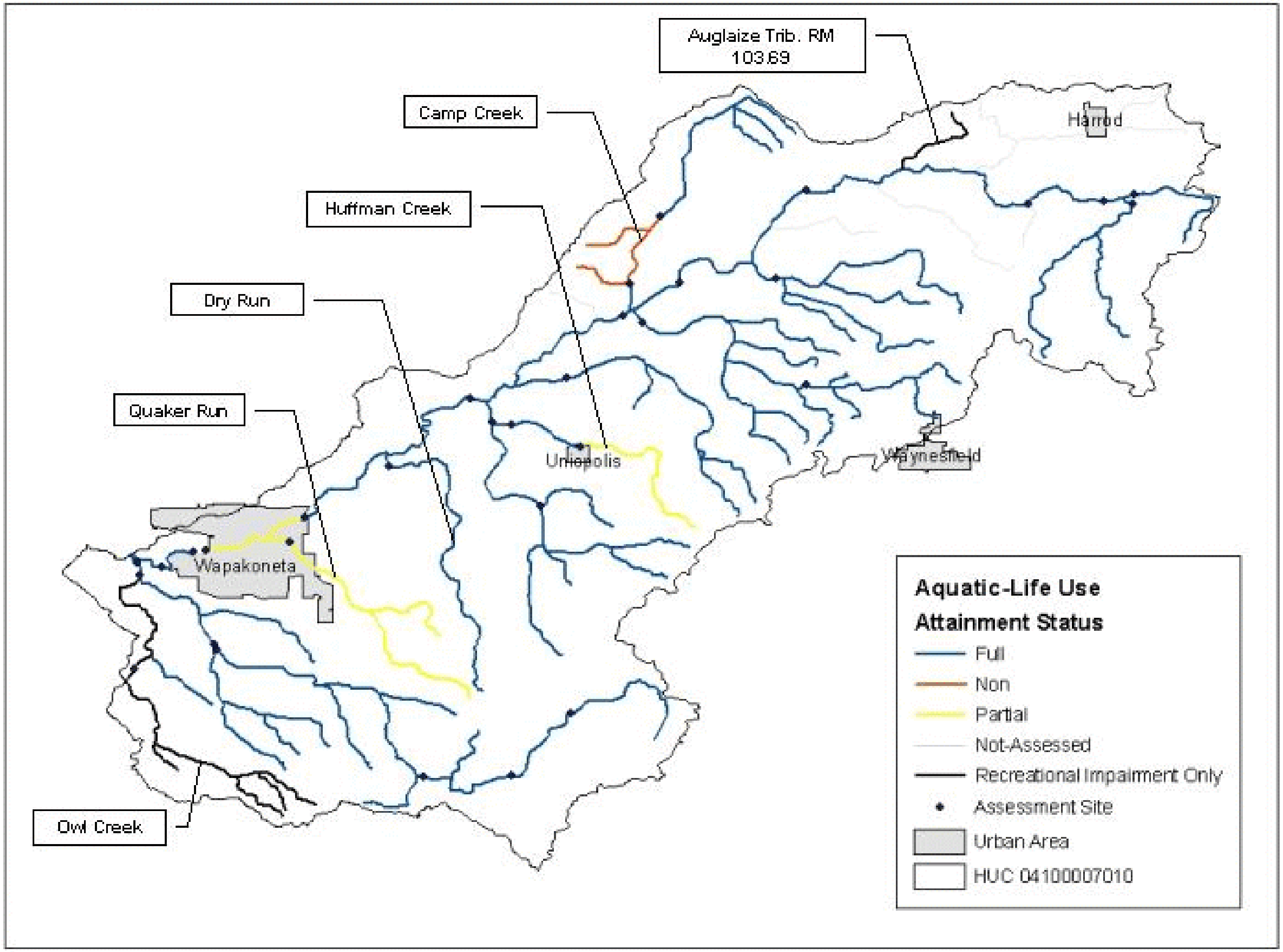
The only section of the Auglaize River mainstem that was not in full attainment is in AU1. This is a short section just upstream of the Wapakoneta WWTP (RM 85.3) where a depression in the macroinvertebrate community resulted in only partial attainment of the aquatic life use. The impairment was short-lived and the ICI recovered to good condition downstream of the WWTP (RM 84.1). The impaired area is downstream of a low-head dam and is also affected by combined sewer overflows (CSOs) from Wapakoneta, which could be contributing nutrients and other contaminants from periodic releases of untreated wastewater. Although water quality in this section was generally good (**Appendix A**), there were several exceedences of the WQS for fecal coliform bacteria further downstream that may have resulted from CSO releases. Sediment samples collected at 2 sites in Wapakoneta, however, contained elevated and highly elevated levels of chromium, and PAHs were detected at the site downstream of the WWTP. No PAHs had been detected in 1991 sediment samples and the 2000 chromium levels were double the 1991 levels. There may be a new source of these contaminants that did not exist in 1991 or levels may simply have been increasing over time due to continued or repeated exposure until reaching an unacceptable level (OEPA, 2004b).

Low-head dams are frequently a source of suspended organic material in the form of algae. Diurnally low dissolved oxygen may also be a result of the impounding of water in the dam pool. It is possible that there is additional impact from urban runoff. There are seven point source discharges of non-contact cooling water and stormwater to the Auglaize River within Wapakoneta that are permitted under NPDES General Permits (**Table 2-1**). A TMDL for phosphorus has been calculated for the impacted stream segment.

Auglaize River Tributary II at RM 103.69 (Westminster Trib)

Although the aquatic community was not assessed in the tributary that flows through Westminster, water chemistry samples were collected to document the severe impact that this unsewered community is having on the stream. Water quality in this stream is severely degraded and also poses a human health risk. The water was gray/black in color and smelled strongly septic. There were violations of water quality criteria for DO, pH, ammonia, fecal coliform bacteria, total dissolved solids (TDS), and phosphorus (**Appendix A**). Violations of ammonia and fecal coliform criteria were also documented in the Auglaize River mainstem just downstream from this tributary. On July 31, 2000, there was visual evidence that there may have been a release of waste from Rudolph Foods. There was a scummy sheen on the water surface, and an accumulation of greasy feeling globs that looked like animal fat along the banks and built up on emergent vegetation. At least one local resident has complained that this happens regularly. Rudolph Foods does not have a permit to discharge to this tributary, but is permitted to land-apply wastewater from the

Figure 2-4. Attainment map (HUC 010)



facility locally. Westminster is currently working on a proposal for installing sewers and treating their sanitary waste. TMDLs have been calculated for phosphorus, ammonia, and bacteria in the Westminster Trib. Low DO levels will be improved through reductions in phosphorus and ammonia.

Camp Creek

Camp Creek is tributary to the Auglaize River at RM 96.72. It has been channelized, and the headwaters are still being routinely maintained, which resulted in the Limited Resource Water (LRW) use being recommended for that section. The Modified Warmwater Habitat (MWH) use was recommended for the slowly recovering downstream section. The macroinvertebrate community was in poor condition because, although relatively diverse, it was predominated by pollution tolerant and facultative taxa. Water quality is generally good, and there is only one point source discharge (stormwater only) to Camp Creek. Camp Creek is impacted by siltation, channelization and nutrients associated with agricultural runoff. A TMDL for sedimentation and habitat has been calculated for Camp Creek.

Huffman Creek

Huffman Creek is tributary to Blackhoof Creek just 0.50 river miles upstream of its confluence with the Auglaize River at RM 92.89. Huffman Creek had relatively good flow and habitat conditions at RM 1.6, but has been channelized and there is ongoing drainageway maintenance in the upstream reaches. The macroinvertebrate community was only in fair condition, resulting in partial attainment of the aquatic life use. The density of filter feeding midges in the riffle suggested that elevated organic material and/or nutrients were present. The presence of the tolerant midge, *Chironomus riparius*, on the artificial substrates is a strong indication that the Uniopolis WWTP was the source of enrichment. Past collections of this midge by Ohio EPA biologists have been strongly associated with WWTP discharges.

The Uniopolis WWTP discharges to Huffman Creek at RM 1.67. Wastewater treatment consists of a continuous discharge lagoon system: 2 aerated lagoons and 1 settling (stabilization) lagoon. Lagoon systems frequently export algae like an impoundment, introducing organic material to the stream in the form of phytoplankton. The Uniopolis WWTP discharge has a history of exceeding NPDES permit limits for TSS and, more frequently, $cBOD_5$, which indicates loading to the stream that would contribute to organic enrichment. Water quality samples from both the stream and the effluent also indicate the WWTP is a source of in-stream phosphorus levels that exceed the threshold level recommended for the protection of aquatic life in the ECBP ecoregion (OEPA, 1999). Fecal coliform counts exceeded water quality criteria both upstream and downstream of the WWTP discharge, so there may also be a source of poorly treated sewage upstream of the WWTP. TMDLs for sedimentation and habitat, phosphorus, and bacteria were calculated for Huffman Creek.

Dry Run

Dry Run is tributary to the Auglaize River at RM 89.89 and was found to be in full attainment of the WWH aquatic life use. However, the recreational use is impaired at RM 0.27 by poorly treated sanitary wastewater being discharged from individual onlot systems.

At least one pipe discharging septic waste to Dry Run was discovered within 50 ft. of the water quality sampling site at SR 67. Black sludge and sewage molds were also observed in the stream at this location. A TMDL for bacteria was calculated for Dry Run.

Quaker Run

Quaker Run, which is tributary to the Auglaize River at RM 86.57 (in the impounded area), had relatively good habitat characteristics, including pool/riffle/run habitats and large substrate. However, the macroinvertebrate community was only in fair condition, resulting in only partial attainment of the aquatic life uses. It appeared that urban runoff from the eastern side of Wapakoneta and/or businesses adjacent to I-75 could be creating periodically toxic conditions, although most of the stormwater from this area is sewered to the Auglaize River. It is also possible that there was an unreported spill from which the stream has not yet fully recovered. The source of this impact has not been identified, therefore, no TMDL for Quaker Run is included in this report.

Owl Creek

Owl Creek is a tributary to Pusheta Creek at RM 0.53. The upper reaches are maintained in a highly artificial state to promote surface and subsurface drainage, and flow at RM 3.2 was found to be intermittent, therefore, the LRW use designation has been recommended from the headwaters to RM 1.0. Owl Creek is in full attainment of the LRW aquatic life use in the headwaters, and although the lower reach has shown little recovery from past channelization, the aquatic community is in full attainment of the WWH use. However, there were 4 exceedences of water quality criteria for fecal coliform bacteria at sampling sites in both reaches. Residential septic discharges were found to be the likely source of this impairment to recreational uses. A TMDL for bacteria has been calculated for Owl Creek.

2.3.2 Assessment Unit 2 (AU2)

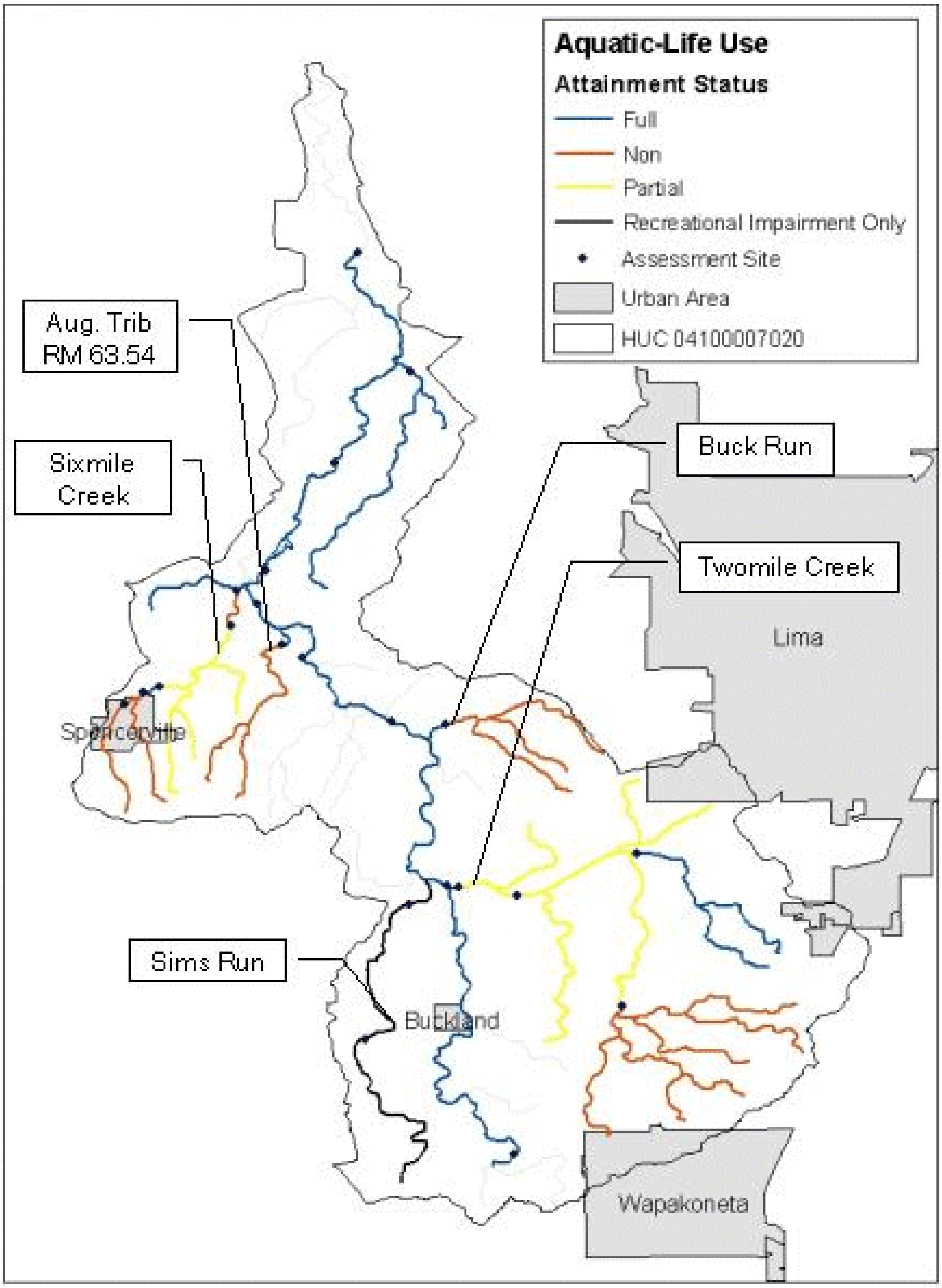
The Middle AU (HUC 04100007 020) includes the Auglaize River mainstem and all its tributaries from downstream of Pusheta Creek to upstream Jennings Creek (**Figure 2-5**).

Twomile Creek and Sixmile Creek are sub-watersheds in AU2. The transition from the ECBP and HELP ecoregions occurs in AU2, although the Auglaize River mainstem retains ECBP characteristics throughout. The Twomile Creek sub-watershed is in the ECBP ecoregion, while the Sixmile Creek sub-watershed is in the HELP ecoregion. The Auglaize River mainstem is in full attainment of WWH aquatic life uses in AU2. The following stream segments/subwatersheds in the Middle AU are not fully attaining the recommended/existing aquatic life or recreational uses.

Twomile Creek Sub-watershed

The headwaters of the Twomile Creek sub-watershed originate just north of Wapakoneta. Twomile Creek flows north and then to the west before its confluence with the Auglaize River southwest of Lima. The entire sub-watershed shows abundant evidence of past channel modification from which there has been little recovery. Formal maintenance activities, however, are limited mainly to segments in the extreme headwaters. Very poor macro-habitat in the headwaters improves longitudinally, and the step-wise improvements

Figure 2-5. Attainment map (HUC 020)



are reflected in the biological performance from upstream to downstream. However, organic enrichment and nutrient input are also factors in preventing full attainment of the WWH aquatic life use throughout the Twomile Creek sub-watershed. There are 3 package plant wastewater treatment systems that discharge to headwater tributaries north of Wapakoneta (Shearer Ditch and Hauss Ditch). Although the effluent quality of the discharges from Zweibel Subdivision, Country Club Hills Subdivision, and Wapakoneta Country Club was not evaluated in 2000, the results of previous sampling documented exceedences of water quality criteria for ammonia, fecal coliform bacteria, and DO, demonstrating that these package plants are inadequately treating wastewater prior to discharge (OEPA, 1994). During 2000, there were exceedences of the water quality criteria for DO and fecal coliform bacteria at the most upstream Twomile Creek site (RM 8.10), which is downstream of all 3 package plants (**Appendix A**). The aquatic community here is impacted by the combination of poor habitat, organic enrichment, nutrient loading, and flow alteration, and is in non attainment of the WWH use.

Oakview, a residential subdivision on the outskirts of Lima, was responsible for organic enrichment and nutrient loading to another tributary in the lower reaches of the Twomile Creek sub-watershed. Although the aquatic community was not assessed there, exceedences of the criteria for DO, ammonia, fecal coliform, TDS, and phosphorus indicate that water quality was significantly degraded downstream of this subdivision. Improvements in habitat quality at the 2 downstream Twomile Creek sites (downstream of the Oakview Trib) helped to minimize the impacts to the aquatic community in that segment, but it still only partially attained the WWH use. TMDLs were calculated for ammonia and bacteria for the Oakview Tributary, however, tThe Oakview Subdivision was recently sewered to the Shawnee #2 WWTP (2003), so is no longer a source of impairment.

Overall, aquatic life use impairments in the Twomile Creek sub-watershed were attributed to deficient macrohabitat, resulting from previous channelization, riparian encroachment, and sedimentation. Enrichment was a contributing factor. Recreation uses are impaired by point source discharges of inadequately treated sanitary wastewater. TMDLs have been calculated for habitat and sedimentation, phosphorus, and bacteria for Twomile Creek. Low DO levels will be addressed through reductions in phosphorus and ammonia and habitat improvements. (Ammonia has already been reduced by the elimination of Oakview Subdivision as a source). Although ammonia was not identified as an impact to Twomile Creek based on 2000 water quality data (no TMDL was calculated for ammonia), the 1994 data indicates ammonia from the upstream package plants may be contributing to low DO downstream and improvements in the operation of these package plants should be a consideration for improving DO levels in Twomile Creek.

Sims Run

Sims Run, a < 10 mi^2 tributary to the Auglaize River at RM 71.63, was extensively channel modified in the past. Although not formally maintained, the upper 6 miles are still highly artificial and have persisted in this state for a considerable period of time with little recovery, therefore, the LRW use designation has been recommended for this stream. Both fish and macroinvertebrate indices meet the prescribed biocriteria. However, the recreational use is impaired at the upstream site (RM 4.37) by poorly treated sanitary wastewater being discharged from individual onlot systems. There were exceedences of the water quality criteria for ammonia and fecal coliform bacteria, and the levels of phosphorus exceeded the threshold level recommended for the protection of aquatic life in the ECBP ecoregion (OEPA, 1999). A TMDL has been calculated for bacteria.

Buck Run

Buck Run is a small drainage area (< 5 mi^2) tributary to the Auglaize River at RM 67.78 that was found to be in non attainment of the WWH aquatic life use. Both fish and benthic macroinvertebrate communities failed to perform at a level consistent with the WWH biocriteria despite adequate habitat quality. In particular, the macroinvertebrate assemblage was dominated by pollution tolerant taxa, with very low organism density. There was evidence of direct cattle access at RM 0.5, but the water chemistry data did not indicate any problems with water quality. Although there has been some flow alteration in the stream from field tiling, there is no apparent explanation for the impairment to the aquatic community. A TMDL has been calculated for habitat and sedimentation.

Auglaize River Tributary IV at RM 63.54 (Goecke Trib)

The Goecke Trib is in non attainment of the WWH aquatic life use largely due to poor habitat quality resulting from the combined effects of past channelization, sedimentation, and riparian encroachment. At RM 0.5, the stream was entirely pooled due to low stream gradient and/or proximity to the Auglaize River. There was no evidence of impairment in the water quality data and the macroinvertebrate taxa collected were reflective of the limited habitat rather than excessive enrichment. A TMDL has been calculated for habitat and sedimentation.

Sixmile Creek

Sixmile Creek flows through the Village of Spencerville and is tributary to the Auglaize River at RM 62.31. Although there has been slight recovery since Sixmile Creek was last sampled in 1991, most of the stream is still impaired and in non attainment of the WWH aquatic life use. The macroinvertebrate community was in poor condition upstream of the Spencerville WWTP, predominated by pollution tolerant snails, which is indicative of a continued toxic impact. Although the ICI showed attainment of the WWH use immediately downstream of the WWTP, the qualitative sampling reflected only fair condition of the macroinvertebrate community here and further downstream, due to siltation and lingering impacts from upstream sources. The attainment at one site was probably an artifact of the presence of larger substrate, comparatively good quality of the WWTP effluent and current in the immediate area.

Water quality results indicate that organic enrichment and nutrient loading continue to impact Sixmile Creek (**Appendix A**). There were 3 violations of DO criteria downstream of the point where occasional overflows from the now-defunct Farm Services facility still affect the stream. In samples from downstream of Farm Services and the WWTP tributary, in-stream phosphorus levels exceeded the threshold level recommended for the protection of aquatic life in the HELP ecoregion (OEPA, 1999). A compliance sample collected by the Ohio EPA at the WWTP indicates that the effluent is contributing to the phosphorus loading. Total dissolved solids also exceeded water quality criteria in 4 of 6 samples downstream of the WWTP. The TDS may be related to chemical additives used to reduce algae related suspended solids discharges from the lagoons. Further downstream (RM 0.19) there were exceedences of the criteria for fecal coliform bacteria (an impairment of the recreational use) and ammonia, suggesting that there may be a septic point source nearby, most likely a discharge from one or more on-lot systems. However, overflows from Farm Services are also a likely source of ammonia. An increase in the levels of phosphorus and the nitrogen parameters (including ammonia) is also evident in the Auglaize River mainstem downstream of the Sixmile Creek confluence, although it did not affect attainment in the mainstem.

Historically, Sixmile Creek was impacted by agricultural related channelization and runoff, and by the acutely toxic combined industrial effluents of Ohio Decorative Products and Harvard Industries/Trim Trends which both discharged via a stormsewer at RM 3.95. Ohio Decorative Products eliminated their process wastewater discharge in 1993, but still discharge non-contact cooling water and stormwater via the same stormsewer under General NPDES Permits. Trim Trends eliminated its process wastewater discharge in 1997 and currently discharges only stormwater under a General NPDES Permit. Although improvements in use attainment are mostly attributed to the elimination of these discharges, and major modifications to the WWTP, residual toxicity from legacy pollutants is still impairing Sixmile Creek. This is especially evident in the sediment chemistry (**Appendix B**).

Levels of metals and organics in the sediments were evaluated against consensus-based sediment quality guidelines developed by MacDonald, et al (MacDonald, 2000). The Threshold Effect Concentration (TEC) for each contaminant was determined to be an accurate basis for predicting the absence of sediment toxicity. The Probable Effect Concentration (PEC) for each contaminant was determined to provide an accurate basis for predicting sediment toxicity.

The sediments of Sixmile Creek in, and just downstream of, Spencerville are contaminated with heavy metals, PAHs and PCBs. The most upstream site (RM 4.24) is relatively unimpacted, with concentrations of all contaminants below the TECs. Just as in 1991, the most contaminated site in 2000 was at RM 3.90, downstream of the stormsewer that once discharged process wastewater from Ohio Decorative Products and Trim Trends to Sixmile Creek. The sediment here and at the next downstream site (RM 3.59, downstream of the WWTP discharge) was black underneath a fine brown silt layer. At RM 3.59, disturbing the sediments during sampling produced an odor and a slight sheen on the water surface.

From RM 3.90, levels of the metals generally decreased longitudinally downstream, except for copper and zinc which increased downstream of the WWTP tributary (RM 3.59). Levels of chromium, copper and zinc fell between the TEC and the PEC at both RM 3.90 and RM 3.59. Nickel exceeded the PEC at both sites. An unusually high lead concentration (>PEC) was discovered at RM 3.90, but lead at all other sites was below the TEC. Near the mouth of Sixmile Creek (RM 0.19), only chromium, copper and nickel were still above the TEC.

As in 1991, PAHs were detected only in the sediment collected at RM 3.90, but total PAHs were lower than they were in 1991. Total PAHs in both 1991 and 2000 fell between the

TEC and the PEC. In 1991, the concentration of total PCBs at RM 3.90 was 6377 ppb, nearly 10 times the PEC (676 ppb), but in 2000 the concentration had dropped to 2490 ppb. However, downstream at RM 0.19, total PCBs increased from 247 ppb in 1991 to 360 ppb in 2000. A sample collected at RM 3.59 in 2000, showed 3024 ppb, an increase in total PCBs from RM 3.90. Although the sediments remain toxic, levels have decreased since the elimination of the potential source, and should continue to decrease with time. Also, because PCBs persist in the environment and bind to the sediments, the results indicate that at least some of the reduction in PCB concentration over time may be due to sediment migration. No PAHs or PCBs were detected in the Auglaize River sediments collected from a site <2 miles downstream of Sixmile Creek.

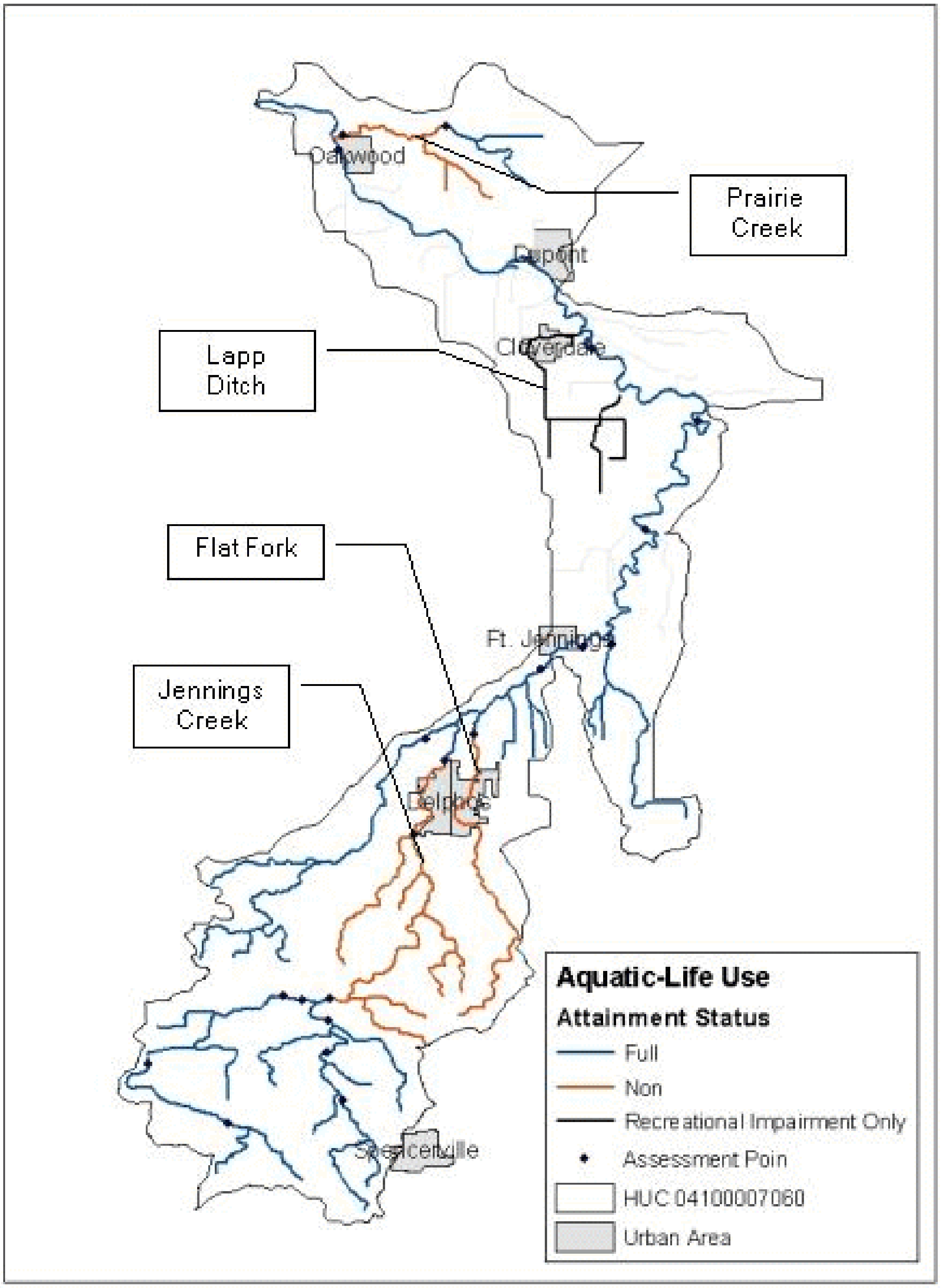
TMDLs have been calculated for habitat and sedimentation, phosphorus and bacteria for Sixmile Creek. No TMDL was calculated for ammonia. The failing HSTSs are addressed by the TMDL for bacteria, and once they are eliminated as a source of ammonia, it may be possible to determine the extent of the impact ammonia from the Farm Services overflows may still be having on Sixmile Creek. Toxicity from legacy organic contaminants will not be addressed by a TMDL in this report, as the original source has been eliminated. Low DO levels will be addressed through reductions in phosphorus and ammonia and habitat improvements. It is unknown if the presence of legacy organic contaminants places an additional oxygen demand on the stream.

2.3.3 Assessment Unit 6 (AU6)

The Lower AU (HUC 04100007 060) includes all of the tributaries to the Auglaize River from upstream of Jennings Creek to upstream of the Little Auglaize River, except for the Ottawa River and the Blanchard River (**Figure 2-6**). The Jennings Creek sub-watershed makes up a large part of AU6. The Lower AU only includes the mainstem of the Auglaize River to downstream of the Ottawa River. The 16.8 miles of the Auglaize River mainstem from the Ottawa River to the Little Auglaize River is part of a Large River Assessment Unit (AU 001). AU6 is in the HELP ecoregion.

The Jennings Creek sub-watershed includes Jennings Prairie Ditch, West Jennings Creek, and Flat Fork, all tributary to Jennings Creek. Much of the watershed has undergone extensive previous channelization. Stream segments that continue to be formally maintained in an artificial state for surface and subsurface drainage (under petition) have been recommended for MWH or LRW aquatic life use designations depending on the degree of the modifications. The entire length of Jennings Prairie Ditch is formally maintained as prescribed by Ohio Drainage Law. Poor stream morphology, particularly lack of canopy, contributed to nuisance algal growth in some locations. The LRW use has been recommended for the upper 3.3 miles, where flow is intermittent, and the MWH use is recommended for the remaining downstream segment. Based on these recommendations and the supporting biocriteria, Jennings Prairie Ditch was in full attainment of these uses.

Figure 2-6. Attainment map (HUC 060)



Jennings Creek

Jennings Creek is tributary to the Auglaize River at RM 47.02. The entire length of Jennings Creek contains abundant evidence of past channel modification. The upper 11.6 miles have been maintained in a highly artificial state. The deficient performance of the aquatic communities in this segment appears directly related to channelization, sedimentation, and riparian encroachment. The MWH use has been recommended for the upper 11.6 miles, and the fish and macroinvertebrate communities were in full attainment of the biocriteria for MWH. Physical recovery of macrohabitat is evident, albeit incomplete, in the lower 7.7 miles of Jennings Creek. Although habitat measures at RM 7.6 meet the criteria for WWH use, this site was in non attainment of that use and the recreational use, affected by siltation from residual upstream impairments and impacts from the adjacent unsewered residential development on the southwest side of Delphos (Greater Delphos Area). There are several other septic discharges, CSOs, and stream side vehicle junkyards that are contributing to water quality problems upstream and downstream of the WWTP, but the discharge from the Delphos WWTP is most severely impacting the stream beginning at RM 5.1, resulting in non attainment in the segment downstream of the plant. Inadequate treatment of wastewater prior to discharge is resulting in low DO, and elevated levels of BOD_5, TSS, fecal coliform bacteria, and ammonia, which reached toxic levels (**Appendix A**). There are also abundant growths of gray “sewage fungus”, or filamentous sewage bacteria, on the substrates of the stream downstream of the WWTP (an indication of an excess of putrescible material), and a very strong septic odor was present. The site at RM 0.5 indicated full recovery, supporting fish and macroinvertebrate assemblages consistent with the WWH biocriteria. A TMDL was calculated for habitat and sedimentation in Jennings Creek. DO in Jennings Creek was modeled to determine appropriate permit limits for the Delphos WWTP, discharging at its current design flow, in order to maintain the instream water quality standard for dissolved oxygen. Low DO levels will be addressed through a reduction in $cBOD_5$ from the Delphos WWTP and through habitat improvements. Although no TMDLs were developed for loads from the CSOs or unsewered area sources, a reduction in phosphorus and ammonia loading from these sources would also improve DO levels instream.

The Greater Delphos Area has been under Ohio EPA Director’s Findings and Orders to sewer since 1992 and revised Findings and Orders were issued in 1999. Current plans are to sewer the Greater Delphos Area to the Delphos WWTP, which will require that the area be annexed to Delphos. The annexation process has begun. Construction is expected to begin by early fall, 2004.

The City of Delphos was recently issued Ohio EPA Director’s Findings and Orders with a schedule for making improvements to the WWTP that would bring it into consistent compliance with its NPDES Permit. The new plant should be constructed and in operation by June 2006, eliminating the WWTP as a major source of toxicity.

West Jennings Creek

Aquatic life use attainment was only assessed at one location on West Jennings Creek during the 2000 survey, less than a mile from its confluence with Jennings Creek. West Jennings Creek at RM 0.86 was found to be in full attainment of the WWH use. However, water quality data collected in 1996 indicate that West Jennings Creek at RM 3.77 and RM 4.92 is impaired by low DO, organic enrichment, ammonia, nutrients, and fecal coliform bacteria (OEPA, 1996). Samples taken at RM 0.86 in 1996 showed recovery from these impairments. The 1996 samples were collected to document that septic discharges at these 2 upstream locations were impacting stream health. An additional sample collected at RM 3.77 in 2001 confirms that these impairments still exist. The source of the septic discharge is likely failing home sewage treatment systems (HSTSs) since there is an obvious pipe discharge at each of these sites, but Stoller Farms, Inc., a poultry CAFO, could also be a contributing source of the impairments to West Jennings Creek. No data have been collected that differentiate or quantify the impacts from the various potential sources, so no TMDLs have been developed to specifically address this impairment. However, there is sufficient evidence of degraded water quality to warrant corrective measures. Meetings are currently being planned to address the issue of the failing HSTSs. The unsewered homes that are discharging to West Jennings Creek near RM 3.77 will likely be sewered to Delphos, however, the HSTSs discharging near RM 4.92 will require an alternate solution.

Flat Fork

Flat Fork was also extensively channelized in the past, and the MWH use has been recommended for the lower two miles because of planned drainageway maintenance activities. However, besides deficient habitat, nutrient enrichment is an additional stressor, preventing the fish and macroinvertebrate communities from meeting the MWH biocriteria. Flat Fork is in non attainment of the MWH use. Levels of nitrogen parameters are somewhat elevated and DO levels demonstrate wide diel fluctuations, indicative of nutrient enrichment (**Appendix A**). The extra nutrient loading to the stream is also evident in the presence of nuisance algae in the stream. It is likely that poorly treated sanitary wastewater from development on the outskirts of Delphos and CSO discharges may be contributing to the nutrient load in addition to agricultural practices mostly upstream of Delphos. TMDLs were calculated for habitat and sedimentation in the Flat Fork. Widely fluctuating diel DO levels will be improved through reductions in phosphorus and habitat improvements.

Big Run

Big Run is tributary to the Auglaize River at RM 44.90 (near Ft. Jennings) and is in full attainment of the WWH use. However, exceedences of the criteria for fecal coliform bacteria indicate impairment of the recreational use. Nuisance algal growth was also observed at this site. The likely source is a septic discharge from one or more on-lot systems discovered upstream from the sampling site. A TMDL for bacteria was calculated for Big Run.

Lapp Ditch

Lapp Ditch is tributary to the Auglaize River at RM 28.0. No biological sampling was done in Lapp Ditch, but water quality samples were collected to document impacts from the Village of Cloverdale, which is currently unsewered. Water quality in this tributary is severely degraded and poses a human health risk. The water was gray/black in color and smelled strongly septic. The stream bottom is covered with black sewage sludge deposits. There were violations of the water quality criteria for DO, pH, ammonia, dissolved solids

(TDS), fecal coliform and phosphorus (**Appendix A**). TMDLs were calculated for phosphorus, ammonia and fecal coliform bacteria. Low DO levels will be addressed through reductions in phosphorus and ammonia.

Auglaize River Tributary VI at RM 25.51 (Dupont Trib)

Although the aquatic community was not assessed in the tributary that originates on the south side of Dupont, water chemistry samples were collected to document the impact that this unsewered community is having on the stream. Water quality in this stream is degraded and also poses a human health risk. The water was cloudy and smelled septic. There was evidence of sewage molds and sludge deposits were observed on the stream bottom. There were violations of water quality criteria for DO, ammonia, fecal coliform bacteria, total dissolved solids (TDS), and phosphorus (**Appendix A**). TMDLs were calculated for phosphorus, ammonia, and fecal coliform bacteria. Low DO levels will be addressed through reductions in phosphorus and ammonia.

Prairie Creek

Prairie Creek flows through the Village of Oakwood and is tributary to the Auglaize River at RM 18.77. Fish and macroinvertebrate communities performed poorly in the upper segment (RM 3.2). Siltation, direct channel modification, modified flow regime, nutrients, and bacteriological exceedences combined to impair the upper reaches. Given the pervasive nature of drainageway maintenance activities, the MWH aquatic life use was recommended for the upper segment. Macrohabitat was significantly improved through the lower mile (higher quality morphology and substrates) and is capable of supporting the WWH use. However, residual problems from upstream (particularly nutrient enrichment) continued to impact the stream despite the improved habitat. Riffle run areas were choked with algae, and water quality criteria for fecal coliform bacteria were still exceeded. The evidence of organic enrichment and the high bacteria levels indicate that septic discharges from on-lot systems are a likely source of impairment, in addition to the impacts from channelization. TMDLs were calculated for habitat and sedimentation, phosphorus, and bacteria in Prairie Creek.

3.0 Problem Statement

The goal of the TMDL process is full attainment of the Water Quality Standards established for aquatic life and recreation uses summarized in **Table 2-3**. As presented in Chapter 2, both of these beneficial uses are impaired to some degree in each of the assessment units of the Upper Auglaize River watershed. The major causes for non attainment of aquatic life uses are excessive nutrients, sedimentation, habitat degradation, flow alteration, and organic enrichment, which are all interrelated. The major cause for non attainment of recreational uses is elevated instream levels of fecal coliform bacteria.

Nutrients, except under unusual circumstances, rarely approach concentrations in the ambient environment that are toxic to aquatic life. *Quality Criteria for Water* concluded that "levels of nitrate nitrogen at or below 90 mg/l would not have [direct] adverse effects on warmwater fish" (U.S. EPA, 1976). However, nutrients, while essential to the functioning of healthy aquatic ecosystems, can exert negative effects at much lower concentrations by altering trophic dynamics, increasing algal and macrophyte production (Sharpely *et al.*, 1994), increasing turbidity (via increased phytoplanktonic algal production), decreasing average dissolved oxygen concentrations, and increasing fluctuations in daily dissolved oxygen and pH. Such changes are caused by excessive nutrient concentrations resulting in shifts in species composition away from functional assemblages of intolerant species, benthic insectivores and top carnivores (*e.g.*, darters, insectivorous minnows, redhorse, sunfish, and black basses) typical of high quality warmwater streams towards less desirable assemblages of tolerant species, niche generalists, omnivores, and detritivores (*e.g.*, creek chub, bluntnose minnow, white sucker, carp, green sunfish) typical of degraded warmwater streams (OEPA, 1999). Nutrient concentrations (phosphorus and nitrogen parameters) in the Upper Auglaize River watershed are excessive in comparison with statewide data from unimpaired streams. Other indicators of nutrient enrichment problems that have been documented in impaired stream segments include: depressed dissolved oxygen levels and wide diel swings, excessive algae, and trophic species shifts.

The effects of nutrient enrichment are exacerbated by poor physical habitat; conversely, high quality habitat can mitigate those effects. High quality riverine habitats with intact riparian zones and natural channel morphology may decrease the potentially adverse effects of nutrients by assimilating excess nutrients directly into plant biomass (*e.g.*, trees and macrophytes), by sequestering nutrients into invertebrate and vertebrate biomass, by "deflecting" nutrients into the immediate riparian zone during runoff events (see reviews by Malanson, 1993; Barling and Moore, 1994), and by reducing sunlight (a principal limiting factor in algal production) through shading. Also, high quality habitats minimize nutrient retention time in the water column during *low flows* because they tend to have high flow velocities in narrow low flow channels (e.g., unbraided vs. braided riffles), and coarse substrates with little potential for adsorption. Additionally, a healthy community of aquatic organisms typical of high quality habitats process and utilize nutrients very efficiently.

Poor quality habitat with reduced or debilitated riparian zones (either no riparian zone is present or runoff bypasses the zone via field tiles) and simplified channel morphology generally exacerbate the deleterious effects of nutrients by reducing the riparian uptake and conversion of nutrients, by increased retention time through increased sediment-water column interface via a wide channel and subsequent loss of low flow energy (*e.g.*, increased intermittency), retention of nutrients within the channel due to diminished filtering time during overland flow events, and by allowing full sunlight to stimulate nuisance growths of algae. These factors also interact to increase the retention of nutrients attached to fine sediments, and in planktonic and attached algae (OEPA, 1999). Low gradient streams, like those in the Upper Auglaize River watershed, are more susceptible to the effects of nutrients because of longer nutrient and sediment retention times.

Sediment flux in and out of an ecosystem is a natural process. When deposition exceeds removal, however, degradation of habitat may result. Sediment deposited on the streambed fills interstitial spaces within the substrate, eliminating the niche in which bottom-dwelling organisms reside. Because phosphorus is delivered to streams attached to fine particles, low gradient streams with a high bedload of fine sediment also provide more time for the available phosphorus to be utilized in undesirable ways such as the production of excess algal biomass, thus promoting tolerant and omnivorous organisms and circumventing assimilation among multiple species and trophic levels (OEPA, 1999).

Flow modification and habitat alteration can exacerbate the effects of sedimentation. Flow modification describes any alteration to a stream's natural flow regime such as upstream impoundment or agricultural field tiling. Channelization is the removal of trees from stream banks coupled with deepening, and often straightening, the stream course and is a direct cause of sedimentation. Upstream impoundment traps sediment, while tiling can intensify storm-event flows, increasing sedimentation from bank erosion. Channelization and tiling to expedite drainage also result in the loss or diminution of sustained stream flow, and less flow for a given drainage area means less assimilative capacity from a pollutant loadings standpoint.

Habitat alterations, such as channel modification and the denuding of riparian zones, can also have detrimental effects upon instream DO concentrations. Denuding riparian zones eliminates or reduces the stream's shade, and the increased intensity of sunlight reaching the stream helps stimulate algal production and increases the water temperature which lowers DO solubility. Channelized streams affect DO concentrations by limiting the potential for atmospheric re-aeration. Atmospheric re-aeration occurs more readily in faster-moving, highly agitated stream segments. Streams with high-quality pool/riffle complexes are more agitated than channelized streams lacking such natural characteristics. Water flowing through a quality riffle consisting of variable substrate effectively stirs oxygen into the stream.

Much of the Upper Auglaize River stream network was historically modified and continues to be maintained in a modified state to facilitate rapid drainage for rowcrop production, which accounts for greater than 80% of the land use in the watershed. Despite the increasing use of conservation measures in agricultural practices throughout the Upper Auglaize River watershed and the resultant improvement in mainstem habitat, agricultural activities remain the major source of habitat degradation responsible for non attainment of aquatic life uses in many of the tributaries.

Consistently low DO is often symptomatic of organic enrichment. Organic enrichment usually occurs with loadings of putrescible material to the stream that increase the oxygen demand. Elevated nutrient levels (particularly phosphorus) which result in detrimentally high algal production can lead to organic enrichment when the subsequent die-off supports oxygen consumptive mircoorganisms. Excessive ammonia-N loading throws the equilibrium between the various forms of nitrogen out of balance, and results in a significant increase in nitrification, which is highly consumptive of DO. The macroinvertebrate community is also highly sensitive to organic enrichment and species composition can specifically indicate this type of impairment. Impacts to macroinvertebrates may include shifts in community composition to populations tolerant of organic wastes, the elimination or reduction of pollution sensitive forms, reductions in population diversity, and sharp increases in densities of pollution tolerant forms. Most often, the sources of organic enrichment include inadequately treated sanitary wastewater discharges from WWTPs, CSOs, and home sewage treatment systems (HSTSs), or runoff from land applied manure.

Bacteria levels in streams that result in non attainment of recreational uses are a human health issue. People can be exposed to organisms while swimming, wading or fishing. In the Upper Auglaize River watershed, fecal coliform was used as the indicator organism to evaluate risk of exposure to pathogens. The presence of fecal coliform indicates that the water has been contaminated with the feces from a warm-blooded animal. Although fecal coliform bacteria are relatively harmless in most cases, where fecal coliform are present there is an increased potential for pathogenic or disease producing bacteria and viruses to also be present. Reactions from exposure to fecal borne pathogens can range from a skin rash, sore throat, or ear infection to diarrhea, severe gastroenteritis (food poisoning), bacterial dysentery or even some more serious contagious diseases.

Fecal coliform bacteria in streams can have both human and animal sources. Human sources include inadequately treated effluent from sewage treatment plants or discharges from septic systems, which tend to be a more continuous problem. Combined Sewer Overflows (CSOs) and animal sources are usually more intermittent and mostly associated with rainfall, except where domestic livestock have access to the water. Liquid manure applied as fertilizer is also a runoff problem if not managed properly and it sometimes seeps into field tiles and is washed into the streams. In the Upper Auglaize River watershed, most of the stream segments that are impaired by high fecal coliform bacteria are primarily impacted by human sources, as identified in Chapter 2.

The parameters selected for Total Maximum Daily Load development are: habitat (including flow and sedimentation), dissolved oxygen (DO), total phosphorus, ammonia, and bacteria.

Rather than develop sediment mass loadings or flow augmentation budgets, which would be infeasible with the information available, the Qualitative Habitat Evaluation Index (QHEI) will be used as a comprehensive measurement of these and other intrinsically linked physical features which act together to promote or preclude aquatic life use attainment. Specifically, aggregate QHEI scores are delineated as numerical habitat (including flow and sediment) goals.

DO impairment is attributable to organic enrichment and/or nutrient enrichment and can be exacerbated by habitat alteration. However, DO is not a parameter for which an allowable load can be calculated. Considering the cause and effect relationship between the sources of pollutants that contribute to oxygen demand in the stream and the DO related impairment in the Upper Auglaize River study area, the following TMDL development strategy was employed. Where runoff is the source of DO impairment, the reduction of nutrient loading from the runoff is necessary to improve DO levels. Where an unsewered area is the source of DO impairment, the reduction of ammonia and nutrient loading is needed to improve DO levels. Where point source discharges are the source of DO impairment, the load of oxygen demanding substances must be reduced to improve DO levels. In segments that are affected by multiple stressors (including habitat alteration), improvement is reliant upon a combination of these load reductions and restoration goals.

3.1 Target Identification

The establishment of instream numeric targets is a significant component of the TMDL process. The numeric targets serve as a measure of comparison between observed instream conditions and conditions that are expected to restore the designated uses of the segment. The TMDL identifies the load reductions and other actions that are necessary to meet the target, thus resulting in the attainment of applicable water quality standards.

3.1.1 Habitat (Flow and Sedimentation)

Various habitat quality attributes including stream flow are strongly correlated with the health of aquatic communities but, are not parameters for which allowable loads are normally calculated. Conversely, although sediment loads can be inferred from parameters such as total suspended solids (TSS), the relationship between this surrogate measurement and aquatic life use attainment is less predictable. To address habitat and sedimentation, Ohio EPA has previously utilized Qualitative Habitat Evaluation Index (QHEI) scores as target values, analogous to the concept of load based assimilative capacity for TMDL development and implementation.

The QHEI is a stream habitat assessment tool developed by the Ohio EPA (Rankin, 1989). It is a composite score ranging from 18 to 100 summed from six physical habitat categories. These are: substrate, instream cover, riparian characteristics, channel characteristics, pool/riffle quality, and gradient/drainage area. Each of these categories are subdivided into specific attributes that are assigned a point value reflective of the attribute's association with aquatic life. High scores are assigned to attributes correlated with high biological integrity and low scores are progressively assigned to less desirable habitat features. **Appendix D** shows the categories, attributes, and scores that make up the index. Ohio EPA QHEI assessments are conducted by trained investigators at every watershed sampling location in conjunction with biological monitoring. Ohio EPA has completed more than 20,000 QHEI assessments since the mid 1980's. Although some minor improvements have been instituted, the fundamental categories and scoring techniques are essentially unchanged. Subsequently, the data underpinning any single

QHEI determination is appreciable. The association between aquatic life use attainment and QHEI scores is as strong as the regression is between any other stress agent.

The TMDL process assumes achievement of adopted targets computed from modeling equations will coincide with aquatic life use attainment. Progressive stressor load *reductions* are expected to yield incremental gains toward use attainment. In this way, use of QHEI scores as TMDL targets may be regarded as a parallel concept analogous with the targets construed from pollutant loading calculations. However, QHEI scores embody both positive and negative attributes and an overall *increasing* value is correlated with higher biological integrity. A total QHEI score of ≥60 implies habitat conditions are conducive to WWH aquatic life use attainment and is an appropriate target.

Alternatively, QHEI scores in the 40's are considered poor to fair. Here habitat is not only insufficient to offer WWH communities the basic rudiments for existence, it effectively acts to prevent biological performance consistent with that use. QHEI scores in that range result from silty, embedded substrates, channel morphology homogeneity, limited flow attributes, functionless cover, inadequate riparian conditions, and in a general sense from to much human modification of the stream course and immediate land use. When habitat conditions are this diminished, the aquatic community is unable to resist impacts, the period of recovery from a sporadic impairment is protracted, and the aspect which is most germane to TMDL development – reduction of a particular pollutant load – will have little measurable biological difference as long as habitat conditions remain below the threshold that is correlated with WWH attainment in Ohio.

3.1.2 Dissolved Oxygen (DO)

Low levels or wide diel fluctuations of dissolved oxygen (DO) in a stream can impact aquatic communities. However, DO is not an independent parameter or pollutant for which a load can be calculated, but instead responds to other conditions in the stream. As such, it can be an indicator of stream health or a symptom of some other cause of impairment to the stream, such as nutrient or organic enrichment. The water quality criteria for DO (OAC 3745-1-07) provide a target for DO levels that will be protective of aquatic life. Attainment of the DO criteria at all times, including during summer low flow conditions is a measurable endpoint of the TMDL process. Meeting target DO levels will be achieved on a segment specific basis through the TMDLs for the causes of impairment that contributed to the DO problems on each segment. DO criteria/targets for the Eastern Corn Belt Plain (ECBP) and Huron-Erie Lake Plain (HELP) ecoregions are given in **Table 3-1**.

Table 3-1 Dissolved Oxygen Targets

Aquatic Life Use	**ECBP** *(mg/L)*		**HELP** *(mg/L)*	
	Minimum	Minimum 24 Hr Average	Minimum	Minimum 24 Hr Average
WWH	4.0	5.0	4.0	5.0
MWH	3.0	4.0	2.5	4.0
LRW	2.0	3.0	2.0	3.0

3.1.3 Total Phosphorus

The nutrient, phosphorus, was identified as a cause of impairment in the Upper Auglaize watershed. While the Ohio EPA does not currently have statewide numeric criteria for phosphorus, potential targets have been identified in a technical report titled *Association Between Nutrients, Habitat, and the Aquatic Biota in Ohio Rivers and Streams* (Ohio EPA, 1999). This document provides the results of a study analyzing the effects of nutrients on the aquatic assemblages of Ohio streams and rivers. The study reaches a number of conclusions and stresses the importance of habitat and other factors, in addition to instream nutrient concentrations, as having an impact on the health of biologic communities. The study also includes proposed phosphorus target concentrations based on observed concentrations associated with acceptable ranges of biological community performance within each ecoregion. The total phosphorus targets are shown in **Table 3-2.** It is important to note that these nutrient targets are not codified in Ohio's water quality standards; therefore, there is a certain degree of flexibility as to how they can be used in a TMDL setting.

Ohio's standards also include narrative criteria which limit the quantity of nutrients which may enter waters. Specifically, OAC Rule 3745-1-04 (E) states that all waters of the state shall be free from nutrients entering the waters as a result of human activity in concentrations that create nuisance growths of aquatic weeds and algae. In addition, OAC Rule 3745-1-04(D) states that all waters of the state shall be free from substances entering the waters as a result of human activity in concentrations that are toxic or harmful to human, animal, or aquatic life and/or are rapidly lethal in the mixing zone. Excess concentrations of nutrients that contribute to non-attainment of biological criteria may fall under either OAC Rule 3745-1-04 (D) or (E) prohibitions.

Table 3-2 Total Phosphorus Targets

Watershed Size	**Use Designation**	
Eastern Corn Belt Plains Criteria (ECBP)	WWH	MWH
Headwaters (drainage area < 20 mi^2) (**H**)	0.07	0.58
Wadeable (20 mi^2 < drainage area < 200 mi^2) (**W**)	0.11	0.22
Huron Erie Lake Plain (HELP)		
Headwaters (drainage area < 20 mi^2) (**H**)	0.081	0.42
Wadeable (20 mi^2 < drainage area < 200 mi^2) (**W**)	0.11	0.33
Small Rivers (200 mi^2 < drainage area < 1000 mi^2) (**SR**)	0.171	0.22

[1] No HELP data available, statewide criteria are used instead.

3.1.4 Ammonia-N

Ammonia-N has been identified as a cause of impairment in localized areas of the Upper Auglaize River watershed. Ammonia is problematic because it is acutely toxic to aquatic organisms, and it has a deleterious effect upon DO. The water quality criteria for ammonia-N (OAC 3745-1-07) provide targets that will be protective of aquatic life uses. Because ammonia criteria are dependent on temperature and pH, assessment-unit-specific ammonia targets were determined for each HUC using temperature and pH data collected during the summer season (critical condition). **Appendix A** lists the sampling locations used as a source of temperature and pH data for target determination in each assessment unit (HUC). The ammonia criteria corresponding to the 75th percentile temperature and pH for each assessment unit were used as targets and are presented in **Table 3-3**.

Table 3-3 Ammonia-N Targets

	75th percentile values[1]		WWH		MWH	
Subwatershed	Temp. (°C)	pH	30-Day Avg.[2]	Max.[3]	30-Day Avg.[4]	Max.[3]
AU1	21.0	7.96	1.3	9.1	1.9	9.1
AU2	21.6	7.77	1.6	12.6	2.4	12.6
AU6	23.0	7.90	1.3	9.1	1.9	9.1

[1] 75th percentile values of all summer season temperature and pH data collected in each HUC.
[2] Outside mixing zone, 30-day average total ammonia-nitrogen (mg/l) (OAC 3745-1-07 Table 7-5).
[3] Outside mixing zone, maximum total ammonia-nitrogen (mg/l) (OAC 3745-1-07 Table 7-2).
[4] Outside mixing zone, 30-day average total ammonia nitrogen (mg/l) (OAC 3745-1-07 Table 7-7).

3.1.5 Bacteria

Bacteria has been identified as a cause of recreation use impairment in localized areas or sub-basins of the Upper Auglaize watershed. Statewide narrative criteria states that for Primary Contact Recreation (PCR) at least one of the two numeric standards (fecal coliform or e. coli) must be met. Only fecal coliform bacteria were sampled as part of the 2000 survey for the Upper Auglaize River watershed. The standards for fecal coliform, applicable outside the mixing zone, state that the geometric mean content (MPN), based on not less than five samples within a thirty-day period, shall not exceed 1,000 per 100 ml and shall not exceed 2,000 per 100 ml in more than 10 percent of the samples taken during any thirty-day period.

The fecal coliform concentration of 1000 counts per 100 ml was used as the numeric target for bacteria TMDL development. The target is derived from the numeric standards stated above. The target of 1000 counts per 100 ml was multiplied by an estimated hourly flow volume to calculate the hourly allowable load. Applied in this manner, the target is essentially an instantaneous maximum, which is protective of both the thirty-day geometric mean and 90^{th} percentile criteria. The target fecal coliform loads, expressed in counts/hour, are presented in **Table 3-4.**

Table 3-4: Fecal Coliform Bacteria Targets

Stream	Sub-Basin (RM)[1]	Target Fecal Coliform Load (cnts/hr)
AU1		
Aug Trib II (RM 103.69)	0.17 - HW	1.56×10^{8}
Huffman Ck.	1.63 - HW	2.95×10^{8}
Dry Run	0.27 - HW	6.94×10^{8}
Owl Ck.	3.03 - HW	2.76×10^{8}
Owl Ck.	0.4 - 3.03	4.41×10^{8}
AU2		
Twomile Ck.	8.10 - HW	2.75×10^{8}
Trib. To Twomile Trib.	Entirety	7.14×10^{7}
Sims Run	4.37 - HW	2.14×10^{8}
Sixmile Ck.	3.95 - HW	9.71×10^{7}
Sixmile Ck.	Mouth - 3.03	7.24×10^{8}
AU6		
Big Run	0.34 - HW	1.67×10^{9}
Lapp Ditch	1.04 - HW	5.42×10^{8}
Lapp Ditch	0.3 - 1.04	6.39×10^{8}
Aug Trib VI (RM 25.51)	Entirety	6.22×10^{7}
Prairie Ck.	3.03 - HW	1.22×10^{9}
Prairie Ck.	0.33 - 3.03	1.96×10^{9}

[1] Sub-basins are defined by their River Mile (RM) measurement. RM is a linear measurement from the mouth of the stream. The designation HW, for headwaters, indicates the sub-basin extends from the stated RM to the upper most reaches of the stream and its tributaries.

3.2 Current Deviation from Targets

The difference between observed instream conditions and the numeric targets established in **Section 3.1** assists in determining the load reduction or other actions that are necessary to restore the designated uses in impaired areas of the watershed. The deviation from target translates to the percent reduction in load required to meet target conditions, which is then used in calculating the TMDL that will protect aquatic life and other beneficial uses.

3.2.1 Habitat and Sedimentation

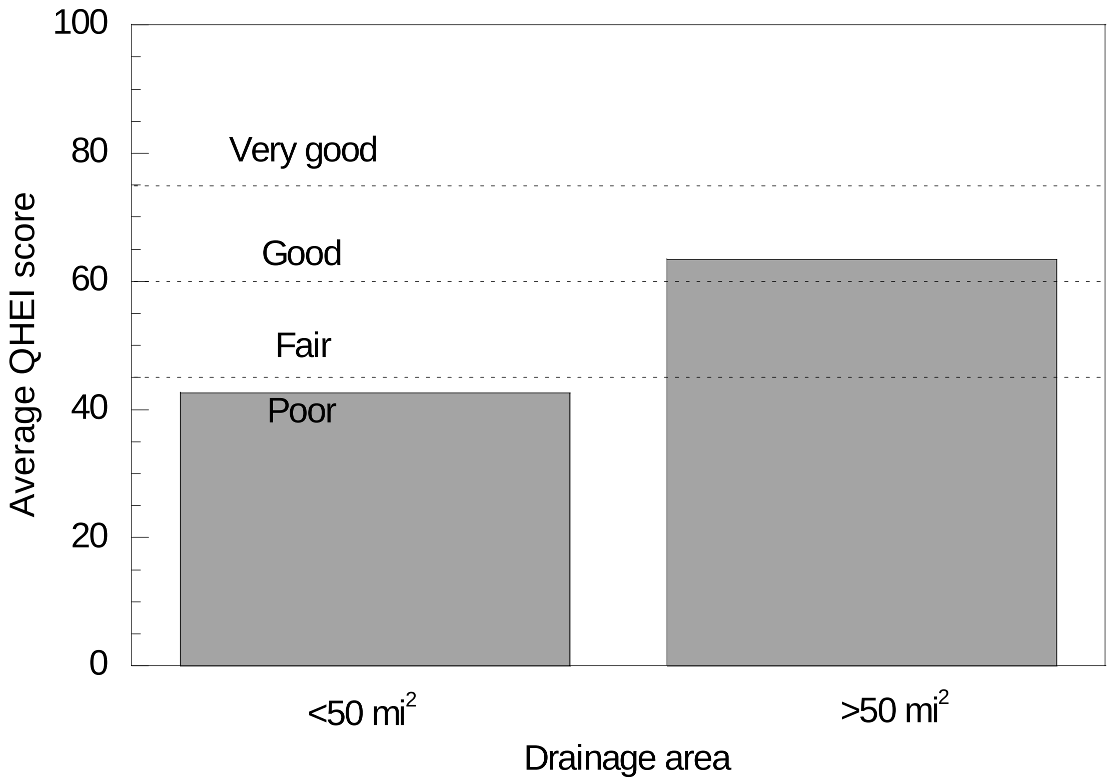
Ohio EPA utilizes the QHEI to assess stream habitat quality including sediment and flow characteristics. The QHEI is best used in a macro-scale approach to evaluate the habitat components of a stream reach or a sub-basin, as opposed to the characteristics of a single sampling site. As such, an individual site may have poor physical habitat due to localized disturbance or may seem to be an oasis of outstanding attributes yet the biological performance at that location will reflect the prevailing habitat conditions in the watershed network. Thus, it is important to consider aggregate QHEI scores to understand how the various component scores may exert site specific influences.

It is most useful to consider habitat data on a drainage area basis. Headwater streams (drainage area < 20 mi^2) tend to reflect the immediate land use. Instead of regarding these streams as linear entities, it is more pragmatic to appreciate them as a product of the upstream and adjacent landscape. On the other hand, it may be prudent to evaluate linear data for large streams or rivers (drainage area > 50 mi^2) which are often able to assimilate a local perterbation with minimal consequence.

Average QHEI scores for stream reaches or sub-basins above 60 are generally conducive to WWH aquatic life use attainment. **Figure 3-1** illustrates the average QHEI scores for two distinct aquatic habitats. The average QHEI score for sub-basins which drained less than 50 mi^2 was 42.4 while the reach which drained more than 50 mi^2 averaged 63.4. The Auglaize River achieves 50 mi^2 of drainage area near Wapakoneta (RM 92.7, 89 mi^2). Habitat conditions in the reach of the Auglaize River with a drainage area greater than 50 mi^2 were considered just minimally capable of supporting WWH biological performance in 2000. Load reductions which have occurred following previous water quality investigations (1991, 1985/1984) are reflected by notable improvement in biological integrity. It is relevant to know that habitat conditions in this reach have not changed much in overall status during this period (1991 QHEI $\bar{x}$=60.2, 1985/1984 QHEI $\bar{x}$=64.7). This facet as much as any other corroborating measure lends credence to the success attributed to agricultural pollution abatement in Section 2.2.2. This improvement would easily have been masked if habitat conditions had varied either positively or negatively in the last decade.

Habitat quality in the small streams (< 50 mi^2) in the Upper Auglaize River in 2000 was poor. Among 54 pertinent biological sample locations the median QHEI score was 43.0. Only six of these sites displayed habitat attributes deemed sufficient for WWH aquatic life use (QHEI > 60). One fourth of the sites harbored very poor aquatic habitat (25th percentile =29.5).

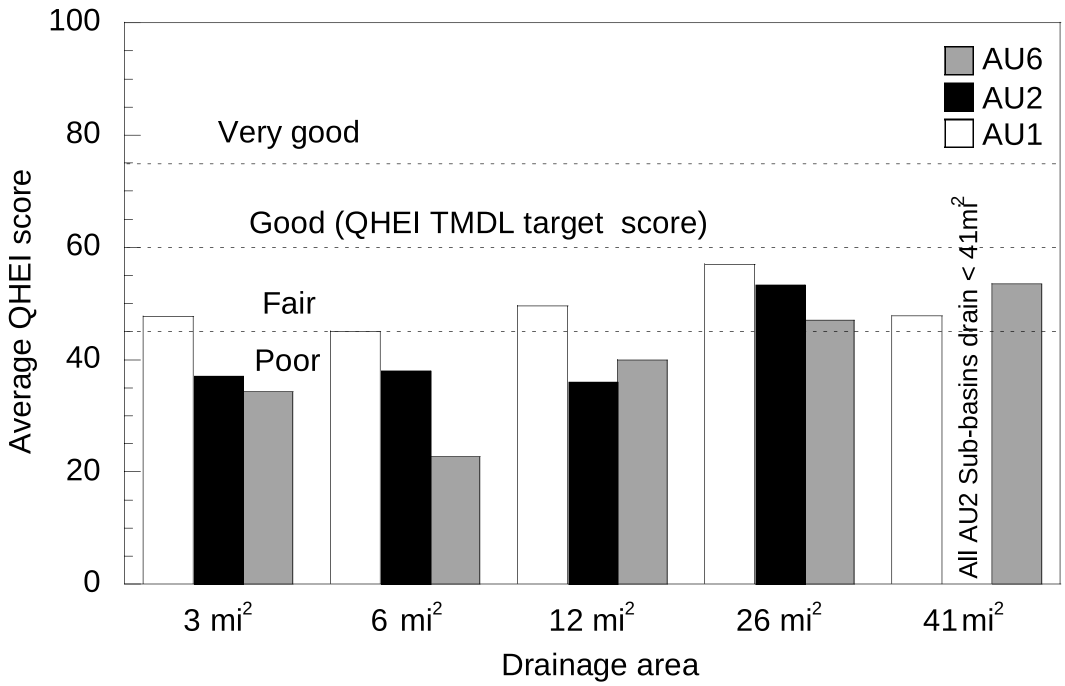
Figure 3-1. Average QHEI scores for sample locations with drainage areas less than and greater than 50 mi^2 in the Upper Auglaize River Watershed, 2000.



None of the small stream systems in the Upper Auglaize watershed offer the minimal amount of natural habitat that is critical for WWH aquatic life. Where such communities that do attain the biocriteria exist, these should be understood to do so by benefit of the contribution of groundwater toward maintaining perennial flow. Despite the absence of many important habitat attributes, the strong flow originating from numerous springs, primarily in AU1, was capable of sustaining WWH aquatic life use at several sample locations. Furthermore, in many of the smallest drainages where flows were not sustained or where stream modifications were likely to be perpetuated, a use attainability analysis resulted in lowered expectations for aquatic communities (LRW or MWH biocriteria recommended). After all of these exceptions are registered, about half of the Upper Auglaize small stream segments failed to meet the assigned aquatic life use. Although other explanations for specific deviations may have merit for other departures from water quality criteria, the prevailing poor habitat conditions across the watershed must be recognized in order to begin any real progress toward water quality improvement.

Figure 3-2 displays the average sub-basin (by drainage area) QHEI scores by Assessment Unit in 2000 compared to the QHEI TMDL target score (QHEI $\bar{x}$=60). Overall, small streams which drained 3 mi^2 (QHEI $\bar{x}$=40.1) or 6 mi^2 (QHEI $\bar{x}$=40.3) deviated the most

Figure 3-2. Average sub-basin QHEI scores by Assessment Unit in 2000



from the target. The 3 mi^2 streams exist either within the 6 mi^2 sub-basins or are direct mainstem tributaries. Little improvement was recorded on average across the entire watershed at 12 mi2 (QHEI $\bar{X}$=42.8). An extremely low QHEI score (21; Jennings Creek, RM 15.0) in AU6 contrasted with better habitat conditions at AU1 and AU2 streams with 26 mi^2 drainage areas. This disparity was not noted between streams draining 42 mi^2.

To provide some direction regarding the relative amount of habitat improvement needed, average 2000 QHEI scores stratified by sub-basin drainage area are presented in **Table 3-5.** The deviation from the QHEI target is expressed as an absolute score and as a percentage. Review of Table 3-5 attests that average habitat conditions in AU6 deviate by 62% from the QHEI target for 6 mi^2 drainage area streams. Proportionally little mitigation is necessary to improve the 26 mi^2 size stream habitat conditions in AU1.

Table 3-5. QHEI Scores and Deviation from Targets

Assessment Unit		Drainage Area (mi^2)				
		3	6	12	26	42
AU1						
Average QHEI		47.7	45.2	49.6	57	47.8
Deviation	Score	12.3	14.8	10.4	3	12.2
	%	21%	25%	17%	5%	20%
AU2						
Average QHEI		34.1	41.9	36	53.3	NA
Deviation	Score	25.9	18.1	24	6.7	-
	%	43%	30%	40%	11%	-
AU6						
Average QHEI		34.3	22.7	37.4	21	53.5
Deviation	Score	25.7	37.3	22.6	39	6.5
	%	43%	62%	38%	65%	11%

3.2.2 Dissolved Oxygen

Table 3-6 lists the stream segments in each Assessment Unit (AU) where some measurable deviation from the target DO levels was observed.

Macroinvertebrate community health can also indicate organic enrichment as a cause of impairment. There are two additional stream segments in the Upper Auglaize survey area where organic enrichment was identified as an impairment, potentially affecting DO levels, though deviations from target may not have been observed due to sampling limitations (if diel fluctuations exist, low DOs might not be observed by single daily grab samples). These segments include the Auglaize River downstream of the Hamilton St dam (RM 85.5) in AU1 and Shearer Ditch in AU2. TMDLs developed in this report for ammonia and/or phosphorus load reductions to improve DO levels will also include these stream segments.

Table 3-6. Instream DO and Deviation from Target

Stream Segment	Use[1]	DO Targets		Instream DO			Deviation from Target[2]	
		Min	Min 24 hr avg	Min	Max	Median	Min	Min 24 hr avg
AU1								
Aug R Trib at RM 103.69 (Westminster Trib) RM 0.0 - RM 0.3	None	4.0	5.0	**0.1**	8.4	**3.05**	67%	67%
AU2								
Twomile Ck RM 1.0 - RM 11.6	WWH	4.0	5.0	**3.8**	10.0	7.5	7%	13%
Hauss Ditch	None	4.0	5.0	**2.9**	8.6	5.67[3]	33%	33%
Oakview Trib	None	4.0	5.0	**1.4**	**2.3**	**1.87**[3]	100%	100%
Sixmile Ck RM 1.0 - RM 6.8	WWH	4.0	5.0	**1.8**	8.4	5.5	14%	27%
AU6								
Jennings Ck RM 4.0 - RM 22.0	WWH	4.0	5.0	**2.4**	14.2	6.55	9%	24%
Flat Fork RM 0.0 - RM 1.2	MWH	2.5	4.0	2.5	17.6	8.4[3]	0%	38%
W. Jennings Ck RM 3.5 - RM 5.4	WWH	4.0	5.0	**2.6**	18.1	6.62[3]	60%	60%
Lapp Ditch RM 1.0 - RM 1.90	None	4.0	5.0	**0.6**	6.1	**2.68**[3]	80%	80%
Aug R Trib at RM 25.51 (Dupont Trib)	None	4.0	5.0	**1.6**	5.6	**3.3**[3]	50%	75%

[1] WWH criteria apply by default in streams where an aquatic life use has not been designated.
[2] Deviation from target is represented as the percent of DO observations below the target
[3] Mean value used because of small number of samples collected.

3.2.3 Phosphorus

Table 3-7 lists the stream segments in each AU where nutrient enrichment (in the form of phosphorus) was identified as a cause of impairment. The median of the instream observed phosphorus concentrations was compared to the target phosphorus concentration to determine the deviation from target. The deviation from target presented here is the percent load reduction used in calculating the TMDLs for phosphorus in **Section 4.3**.

Table 3-7. Instream Total Phosphorus Values and Deviation from Target

Stream	Period of Record	Number of Observations	Instream Observed: *TP (mg/l)*			Target	Deviation from Target [2]
			Min	Max	Median		
AU1							
Auglaize River (RM 85.5)	2000	11	0.06	0.45	0.12	0.11	8.3%
Aug. Trib II (RM 103.69)	2000	18	0.16	6.77	0.68	0.07	89.7%
Huffman Creek	1996, 2000	22	0.05	0.52	0.12	0.07	41.7%
AU2							
Twomile Creek	1994, 2000	21	0.05	0.32	0.13	0.11	15.4%
Sixmile Creek	1991, 2000-1	31	0.31	2.90	1.15	0.08	93.0%
AU6							
Lapp Ditch	2000	12	0.17	2.39	0.835	0.07	91.6%
Aug. Trib VI (RM 25.51)	2000	4	0.76	3.37	2.02[1]	0.07	96%
Prairie Creek	2000	9	0.13	0.59	0.25[1]	0.08	68.0%

[1] Mean value used because of small number of samples collected.
[2] The deviation from target is represented as the percent reduction from the median instream concentration that would be required to meet the target concentration.

3.2.4 Ammonia-N

Table 3-8 presents the instream NH_3-N concentrations observed during Ohio EPA stream surveys in 2000 and the associated deviation from target for stream segments that were identified as ammonia impaired in each AU. The percent load reductions required to meet the average ammonia targets are greater, therefore are used to calculate the ammonia TMDLs in **Section 4.4**.

Table 3-8. Observed Ammonia Concentrations and Deviation from Target

Tributary	Period of Record	# of Observations	Instream Observed NH_3-N (mg/l)			Target[1]		Deviation from Target[2]	
			Min	Max	Mean	Avg	Max	Avg	Max
AU1									
Aug. Trib II (RM 103.69)	2000	6	0.35	34.4	9.27	1.3	9.1	86.0%	73.5%
AU2									
Oakview Trib to Twomile Trib	2000	6	2.11	9.3	7.51	1.6	12.6	78.7%	-
AU6									
Lapp Ditch	2000	5	0.267	16.1	7.89	1.3	9.1	84.0%	43.5%
Aug. Trib VI (RM 25.51)	2000	4	4.16	15.3	9.72	1.3	9.1	87.0%	41.0%

[1] Ammonia targets given are those derived for the WWH use in Section 3.14 (**Table 3-3**). WWH criteria apply by default in streams where an aquatic life use has not been designated.
[2] The deviation from target is represented as the percent reduction from the instream concentration that would be required to meet the target concentration.

3.2.5 Bacteria

Table 3-9 lists the stream segments in each AU where fecal coliform bacteria was identified as a cause of impairment to recreational uses. For each sub-basin, instream concentrations of fecal coliform bacteria have been converted to a load (counts/hr) by multiplying the geometric mean concentration (counts/100 mls) of samples collected during the 2000 survey by the same estimated flow (ml/hr) used in **Section 3.1.5** to calculate the target load. The deviation from target is the percentage reduction in the observed geometric mean fecal coliform load needed to meet the target load. On one segment of Lapp Ditch, the geometric mean load did not exceed the target load, however, 1 or more individual samples exceeded the water quality standards, so this segment will also be addressed with a TMDL. As can be seen from the table, unsewered communities (like Dupont, Cloverdale, and Westminster) cause the greatest deviation from target bacteria levels and will require nearly 100% elimination as a source of bacteria.

Bacteria was also identified as a cause of impairment in several stream segments (based on data collected prior to the 2000 survey) that were not addressed by a TMDL in this report. These include, but are not limited to, Jennings Creek and West Jennings Creek. Although no TMDL for bacteria is calculated for these streams, data exists to warrant the elimination of failing home sewage treatment systems for restoration of beneficial uses.

Table 3-9. Observed Fecal Coliform Bacteria Loads and Deviation from Target

Stream	Sub-basin[1]	Observed FC Load[2] cnts/hr	Target FC Load cnts/hr	Deviation from Target[3]
AU1				
Aug Trib II at RM 103.69 (Westminster Trib)	0.17 - HW	1.27×10^{10}	1.56×10^{8}	99%
Huffman Ck	1.63 - HW	1.06×10^{9}	2.95×10^{8}	72%
Dry Run	0.27 - HW	2.33×10^{9}	6.94×10^{8}	70%
Owl Ck	3.03 - HW	6.22×10^{8}	2.76×10^{8}	56%
Owl Ck	0.4 - 3.03	2.66×10^{9}	4.41×10^{8}	83%
AU2				
Twomile Ck	8.10 - HW	4.25×10^{8}	2.75×10^{8}	35%
Oakview Trib To Twomile Ck Trib	Entirety	2.54×10^{8}	7.14×10^{7}	72%
Sims Run	4.37 - HW	7.69×10^{9}	2.14×10^{8}	97%
Sixmile Ck	3.95 - HW	2.47×10^{8}	9.71×10^{7}	61%
Sixmile Ck	Mouth -3.03	1.81×10^{9}	7.24×10^{8}	60%
AU6				
Big Run	0.34 - HW	8.61×10^{9}	1.67×10^{9}	81%
Lapp Ditch	1.04 - HW	9.15×10^{10}	5.42×10^{8}	94%
Lapp Ditch[4]	0.3 - 1.04	5.88×10^{8}	6.39×10^{8}	0%
Aug Trib VI at RM 25.51 (Dupont Trib)	Entirety	1.72×10^{9}	6.22×10^{7}	96%
Prairie Ck	3.03 - HW	1.78×10^{9}	1.22×10^{9}	31%
Prairie Ck	0.33 - 3.03	3.37×10^{9}	1.96×10^{9}	42%

[1] Sub-basins are defined by their River Mile (RM) measurement. RM is a linear measurement from the mouth of the stream. The designation HW, for headwaters, indicates the sub-basin extends from the stated RM to the uppermost reaches of the stream.
[2] Observed load is calculated based on empirical instream data, however, the associated flow is an estimation from a downstream gage.
[3] Percent reduction in fecal coliform needed to meet target.
[4] The geometric mean of values from this segment did not exceed the 1000 counts/100 ml average WQS, but 1 or more samples did exceed the maximum WQS of 2000 counts/100 ml, so this segment will be addressed in **Section 4.5**

4.0 TOTAL MAXIMUM DAILY LOADS

4.1 Load Calculations and Strategies

4.1.1 Habitat (Flow and Sedimentation)

Exposure variables are the sources of the stressors which cause deviation from water quality criteria in the environment. Response indicators are used to directly measure the environmental influence of stressors. The presence of a water quality stressor in a quantity which exceeds a criterion is not a direct implication of aquatic life use impairment in Ohio. Alternatively, aquatic life use status may be impaired by the presence of a water quality stressor in a quantity which complies with a criterion. More specifically, the relevance of the existence of a stressor as it relates to aquatic life use attainment in Ohio is determined by the performance of response indicators.

When a water quality use is evaluated using a chemical criterion, the measured variable is an environmental stressor. The relationship between many chemical stressors and the routes by which they are exposed in the environment have been studied and models exist to define the cause and source relationship. Thus, the procedure is straight forward. When the concentration of a chemical stressor exceeds a criterion, then the use is not met. Since the stressor is known from particular exposure sources, development of a TMDL is facilitated. This is an oversimplification, but it helps to illustrate the function of response criteria for use determination.

Sources which expose stressors to the environment cause aquatic life use impairment in Ohio if biological response criteria are not attained. Ohio recognizes several "tiers" of aquatic life use (*e.g.,* LRW, MWH, WWH) and the salient criteria are adapted to conform with the differences among the State's (*eco*)regions. So, it is the achievement of *bio*criteria associated with a designated use that determines aquatic life attainment status in Ohio. The addition of a response variable to the stressor and exposure, cause and source relationship does add some complexity toward the development of a TMDL.

Since biological response is the ultimate arbiter of TMDL success, we are challenged in Ohio to associate biocriteria with other criteria in order to adopt the models which have been developed to reduce stress through limiting exposure. The links between exposure, stressor, and response variables are more tenuous and less studied compared to the connections between most typical sources and causes. Hence, Ohio EPA has often drawn from our own 25 years of experience to correlate the associations between aquatic life use status and the factors which affect it.

In *Association Between Nutrients, Habitat, and the Aquatic Biota in Ohio Rivers and Streams* (Rankin et al., 1999) many of these correlations are detailed. In particular, the role of habitat as conveyed through QHEI components is demonstrated and "management criteria" are identified that may aid in determining which attributes act as limiting factors. A strategy for including habitat restoration in conjunction with TMDL implementation is also offered.

All three assessment units in the Upper Auglaize River study area are impaired for aquatic life use. With the issuance of the 2002 Integrated Report (Ohio EPA, 2003), an aquatic life use scoring strategy was introduced for hydrologic units based on attainment status stratified by drainage area. These scores provide a comparison of the amount of attainment for each of the units in this study (Table 4-1).

Table 4-1. Aquatic life use attainment scores stratified by drainage area for the Upper Auglaize River watershed, 2000.

AU1 HUC 04100007 010 [**Auglaize River - Headwaters including Pusheta C.**]	Total	**Aquatic Life Attainment Status**						Assessment Unit Score
		Full		**Partial**		**NON**		
		#	%	#	%	#	%	
Sites < 5 mi^2 drainage area **Sites** 5 to 20 mi^2 drainage area **Sites** 20 to 50 mi^2 drainage area	9 15 5	7 14 5	**92.8**	2	5.5	1	1.7	**94**
Miles of assessed streams with > 50 mi^2 and < 500 mi^2 drainage area	9.1	8.7	95.6	0.4	4.4	-	-	

AU2 HUC 04100007 020 [**Auglaize River- Sixmile Creek** (mainstem and tributaries between Pusheta and Jennings Creeks)]	**Aquatic Life Attainment Status**							Assessment Unit Score
	Total	**Full**		**Partial**		**NON**		
		#	%	#	%	#	%	
Sites < 5 mi^2 drainage area **Sites** 5 to 20 mi^2 drainage area **Sites** 20 to 50 mi^2 drainage area	6 5 2	2 1	**13.3**	 2 2	60	4 2	26.7	**57**
Miles of assessed streams with > 50 mi^2 and < 500 mi^2 drainage area	36.5	36.5	100					

AU6 HUC 04100007 060 [**Auglaize River - Jennings Creek** (Jennings Creek and other tributaries upstream from the Little Auglaize River and the mainstem to the Ottawa River confluence)]	**Aquatic Life Attainment Status**							Assessment Unit Score
	Total	**Full**		**Partial**		**NON**		
		#	%	#	%	#	%	
Sites < 5 mi^2 drainage area **Sites** 5 to 20 mi^2 drainage area **Sites** 20 to 50 mi^2 drainage area	3 9 3	3 7 1	**61.1**		-	2 2	38.9	**81**
Miles of assessed streams with > 50 mi^2 and < 500 mi^2 drainage area	14.8	14.8	100		-		-	

In AU1, 92.8% of small streams were fully attaining the aquatic life use, with 5.5% partially attaining and only 1.7% in non attainment. In AU2, use attainment in small streams was poor, with only 13.3% fully attaining the aquatic life use, 60% partially attaining and 26.7% in non attainment. The performance in AU6 was modestly better, with 61.1% fully attaining, however AU6 also displayed the most non attainment among all small streams (38.9%).

Although much has been done to establish the importance of habitat attributes to biological performance, these connections may sometimes be confounded by various site specific conditions. In AU1, aquatic life use attainment appeared inconsistent with QHEI scores due to the positive effects of groundwater influences. However, the deviation from target QHEI scores presented in **Table 3-5** generally do correspond to the overall impairment represented for small streams in **Table 4-1**. Less deviation from the QHEI target in AU1 corresponds to less aquatic life use impairment although it is not proportional. In AU2 and AU6, the relationship between habitat deficiencies (**Table 3-5**) and use attainment (**Table 4-1**) is easier to reconcile by factoring in the percentage of non attainment.

Many Upper Auglaize River watershed streams are functionally limited. They are incapable of effective pollutant reduction, they serve as sources of downstream degradation, and they are poor flow conveyances. **Table 4-2** provides average QHEI component scores stratified by sub-basin. These QHEI values should be regarded as symptomatic expressions of constituent physical properties. For instance, substrate quality is a function of aggregate parent material, flow regime, erosion, riparian condition, etc.

Therefore, activities to improve substrate quality should be directed according to these functional interactions. Similarly, riparian condition is more than the depth and length of specific land uses along the stream margin. It may be a reflection of topographic constraints, watershed hydrology, or human perseverance. Simply put, installation of artificial instream cover is not recommended if the sole intent is to raise a QHEI metric score. The lack of cover is due to the functional debilitation of cover forming physical processes. Thus, it may be more advisable to address “flash” flows, riparian forest size, or zoning related to development (or all three) in order to improve instream cover.

Ohio EPA has identified a suite of QHEI components which are incongruent with WWH attainment. These “modified” stream attributes include characteristics from all six QHEI components. High influence modified attributes are a sub-set of the total modified attributes at a site. High influence modified attributes include the presence of silt or muck substrates, recent drainage projects, shallow pools, limited cover and straight channels. It is rare for a site to exhibit more than one high influence modified attribute and demonstrate WWH attainment. Additionally, substrate, substrate embeddedness, and channel scores have also been significantly correlated with biocriteria achievement (**Table 4-3**).

Table 4-2. Average QHEI component scores stratified by sub-basin, Upper Auglaize River Watershed, 2000.

Assessment Unit	Mi^2	QHEI	Substrate	Cover	Channel	Riparian	Pool	Riffle	Gradient
maximum score		*100*	*20*	*20*	*20*	*10*	*12*	*8*	*10*
AU1	3	47.7	10.1	10.2	9.1	4.2	5.6	0.5	8.0
AU2		34.1	5.8	7.8	6.5	3.6	3.8	0.3	6.3
AU6		34.3	6.2	4.7	9.0	3.3	4.3	0.8	6.0
AU1	6	45.2	10.2	9.8	8.9	3.5	4.8	0.8	7.3
AU2		41.9	8.8	9.2	8.1	4.4	4.5	0.9	6.0
AU6		22.7	1.8	4.7	5.3	3.5	3.3	0.0	4.0
AU1	12	49.6	12.4	10.6	9.0	3.7	6.8	0.3	6.8
AU2		36.0	9.0	3.0	6.5	3.0	3.5	1.0	10.0
AU6		37.4	6.2	7.8	8.3	3.7	4.9	0.9	5.6
AU1	26	57.0	14.3	11.0	10.5	3.3	5.8	2.3	10.0
AU2		53.3	15.0	12.5	10.3	3.5	6.3	0.8	5.0
AU6		21.0	3.5	2.0	4.5	3.0	4.0	0.0	4.0
AU1	42	47.8	10.2	10.3	9.3	5.0	6.2	0.8	6.0
AU6		53.5	15.3	13.5	10.0	3.8	5.8	1.3	4.0

Table 4-3. Average QHEI total and high influence modified attributes, substrate embeddedness, and cover type scores stratified by sub-basin, Upper Auglaize River Watershed, 2000.

Assessment Unit	Drainage Area (mi^2)	Total Modified Attributes	High Influence Modified Attributes	Substrate Embeddedness score	Cover Types score
AU1	3	7.4	2.4	1.5	4.9
AU2		10.5	4.2	1.5	4.5
AU6		9.0	3.3	1.5	2.3
AU1	6	8.1	2.6	1.7	4.7
AU2		9.6	3.8	1.4	5.0
AU6		10.7	4.7	1.2	2.3
AU1	12	7.4	2.6	1.7	5.4
AU2		11.0	5.0	1.0	2.0
AU6		10.2	3.8	1.3	4.4
AU1	26	7.0	1.0	2.3	4.5
AU2		8.0	1.0	1.8	6.5
AU6		13.0	4.0	1.5	1.0
AU1	42	7.3	1.0	1.7	5.0
AU6		8.0	1.0	2.0	7.5

Table 4-4 is abstracted from the "*Associations*" document. Comparison of these values against the same scores for the small streams of the upper Auglaize River watershed provides additional insight regarding which habitat aspects may be most limiting. For instance, high influence modified attributes are less evident at larger sub-basins while the total number of modified attributes remain rather constant. Substrate conditions are more limiting in AU2 and AU6; although, embeddedness is generally similar everywhere. And, channel quality is particularly reduced across the watershed in respect to a typical WWH stream.

The deviation from the overall QHEI target scores presented as percentages in **Table 3-5** are mirrored by the high influence modified attribute values in **Table 4-3**. Although this corroboration is redundant, it also clarifies that these attributes are the most critical to rectify within the upper Auglaize River watershed. Furthermore, it is evident that remediation of the high influence modified attributes in very small streams ($\leq$ 12 mi^2) is especially important since these streams deviate more from the target and because habitat improvements there are likely to result in subsequent downstream benefits.

Table 4-4. Component scores for QHEI attributes which are strongly associated with WWH attainment. These scores are suggested "management criteria" in *Association Between Nutrients, Habitat, and the Aquatic Biota in Ohio Rivers and Streams* (Rankin et al., 1999)

WWH QHEI attribute "management criteria"	
QHEI component	score
Number of total modified attributes	$\leq$ 4
Number of high influence modified attributes	$\leq$ 1
Substrate metric score	$\geq$ 13
Substrate embeddedness score	$\geq$ 3
Channel metric score	$\geq$ 14
Overall QHEI score	> 60

.

It is tempting to conclude that not so much habitat restoration (analogous to load reduction) is necessary in streams where the aquatic life use is being attained despite some deviation from the habitat target, and that stream reaches where biological scores are the lowest should be targeted to receive the most habitat restoration efforts. However, drawing tight correlations between aquatic life use status for each stream reach and assigning habitat restoration goals using habitat "criteria" is speculative. Although future analysis and better exposure data may improve the predictive power of the associations used to determine which remedial actions are critically necessary and where these absolutely must be applied, such an assessment is not possible now. The best information available implies habitat improvements must occur across an entire watershed to be effective. Yet, habitat restoration across an entire watershed is a monumental undertaking.

Ohio's employment of response indicators can be extremely useful in determining where habitat improvement will be most effective. Knowledge of how the aquatic life attainment status varies between and within the assessment units can be a guide toward restoration. The same amount of habitat remediation will have a much more noticeable influence in areas where use attainment is just less than expected compared to more degraded areas.

Considering all the values in the preceding tables (**Tables 4-1, 4-2, 4-3, 4-4**) along with the percentage deviation from target (**Table 3-5**) provides the essence of habitat restoration as a parallel concept to load reduction. The deviation from the QHEI target is greatest in

AU6 (**Table 3-5**). The non attainment status among small streams in AU6 was 38.9% (**Table 4-1**). Substrate and channel conditions were very poor especially in 6 mi^2 streams within this unit (**Table 4-2**). The prevalence of total and high modified attributes was also apparent further downstream compared to AU1 and AU2 (**Table 4-3**). In summary, habitat improvements in AU6 will require more time to be effective and the extent of this effort will be comparatively larger before response indicators begin to improve.

Conversely, deviation from the QHEI target was least in AU1. Aquatic life use attainment status was 92.8% for small streams. Substrate conditions were close to WWH expectations and modified attributes were less numerous compared to AU2 and AU6. Habitat improvement in AU1 will result in rapid biological response and this response will occur concurrent with less overall investment relative to the same effort in AU2 or AU6.

Further scrutiny of specific QHEI component characteristics revealed that pool depth and current speed were limited across the upper Auglaize River watershed. Cover was generally sparse except in AU1 where some reaches with moderate amounts were observed. Gravel and sand were more typical substrates in AU1 while silt and hardpan were more frequent in AU2 and AU6. High influence modified channel attributes consistently accounted for much of the deviation throughout the basin. These attributes were witnessed as low or no sinuosity, poor or fair development, and recent or little recovery from drainage modifications, especially in very small streams ($\leq$ 12 mi^2).

Land use in the upper Auglaize River watershed is extensively and intensively used for agricultural crop production. Most small streams have been purposefully modified to expedite water removal from farm fields. Where it was appropriate, aquatic life use designations were adjusted to accommodate drainage maintenance. Even so, some of those streams failed to achieve the lower MWH or LRW biocriteria and many other streams that should attain WWH did not. This scenario offers some difficult social issues which need to be fairly mediated.

Various states have enacted comprehensive policies toward maintaining existing riparian conditions along streams or lakes. These statewide regulations are administered across all of the waters encompassed by the states borders. From the perspective of enhancing or maintaining water quality, a statewide rule to perpetuate riparian buffer zones is laudable. The fact that Ohio does not have such a policy is significant. The lack of riparian buffer quality in the the upper Auglaize River watershed has influenced most of the habitat characteristics identified for remediation in this TMDL report. In other words, this habitat TMDL is a sort of riparian restoration policy tailored for the upper Auglaize River watershed.

4.1.2 Dissolved Oxygen

TMDLs that Affect Dissolved Oxygen
While low levels or wide diel fluctuations of dissolved oxygen (DO) can be a cause of impairment in streams, it is not an independent parameter or pollutant for which a load can be calculated. Since the level of dissolved oxygen is usually dependent on other conditions present in the stream, restoration of beneficial uses impaired by DO levels depends on the identification of sources of organic enrichment, nutrient enrichment and/or other oxygen demanding substances that directly affect DO. **Table 4-5** lists the stream segments for which DO levels were a cause (or potential cause) of impairment and identifies the source of the pollutants that are likely affecting DO. The source of DO impairment likewise determines the parameter(s) for which a load reduction (TMDL recommendation) should also improve DO levels.

Table 4-5. Dissolved Oxygen TMDL Summary

Segment or Sub-Basin	Source	Load Reduction Recommended?			
		Habitat	Phosphorus	Ammonia	$cBOD_5$
AU1					
Auglaize R at RM 85.5	Wapakoneta CSOs		✔		
Aug R Trib at RM 103.69 (Westminster Trib)	Westminster Unsewered Area		✔	✔	
AU2					
Twomile Ck + Tribs	Package Plants		✔	✳	
	Runoff	✔	✔		
Sixmile Ck	Spencerville WWTP		✔		
	Runoff	✔	✔		
AU6					
Jennings Ck	Delphos WWTP				✔
	Greater Delphos Unsewered Area		✳	✳	
Flat Fork	Agricultural Practices	✔			
W. Jennings Ck	Delphos Unsewered Areas		✳	✳	
Lapp Ditch	Cloverdale Unsewered Area		✔	✔	
Aug R Trib at RM 25.51 (Dupont Trib)	Dupont Unsewered Area		✔	✔	

✳Although no TMDL was calculated, corrective actions are warranted as noted in text.

Delphos WWTP
The USEPA Multi-SMP dissolved oxygen (DO) model was used to simulate the water quality of Jennings Creek downstream of the Delphos WWTP. This model is a variation of the USEPA Simplified Method, which was developed as a tool that would require less extensive field data than other models, such as QUAL2E. Multi-SMP is based on the Streeter-Phelps equation, which considers the impact of carbonaceous oxygen demand, nitrogenous oxygen demand, and benthic oxygen demand on instream dissolved oxygen. The replenishment of the instream DO is included through atmospheric reaeration. The model allows multiple stream reaches and discharge inputs (discharges or tributaries) and requires estimates of stream velocity and depth at the modeled flow.

The first step in the DO modeling analysis was to attempt to calibrate the Multi-SMP model to reproduce the instream physical and chemical characteristics of Jennings Creek that were observed during field surveys. Available field data to use in the Delphos DO model included data from surveys conducted in July and October 1988, and August 2001. The August 2001 survey was the most extensive.

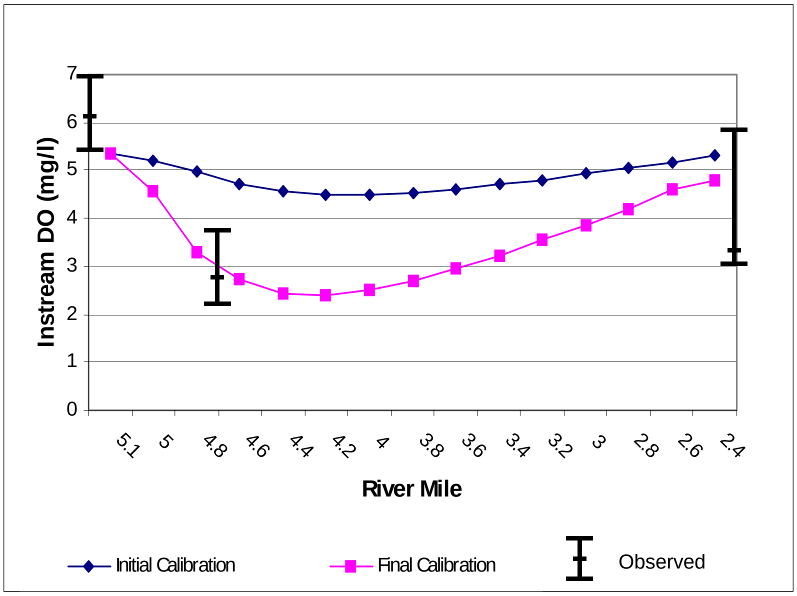
The hydraulic data (flow, time of travel (TOT), and cross-section data) used for the model calibration were obtained from 1988 and 2001 stream data for the study area. The 2001 survey did not use exactly the same reaches for the TOT study as the 1988 surveys; however, there was still good agreement in the velocities measured during the two surveys.

Chemical data for the calibration were obtained from the 8/21/01 sampling data. Although there was some rainfall during this portion of the field survey, most of the data was collected prior to a significant rainfall on 8/22/01.

For the initial calibration, all the instream decay rates (CBOD, NH_3-N, SOD) were set at the values recommended in the USEPA Guidance for the Simplified Method. The selected values were recommended for use downstream of a WWTP providing advanced treatment. The stream reaeration rate was based on the Parkhurst-Pomeroy equation, which is recommended in the Ohio EPA study for reaeration in Ohio streams, based on the stream size and slope. The predicted DO profile for this simulation is shown in **Figure 4-1** below (the upper line).

As can be seen in **Figure 4-1**, the predicted DO profile is significantly higher than the observed DO profile. Possible causes for the lower observed DO profile include combined sewer overflows near the WWTP, an unsewered area SW of Delphos, and the presence of sewage mold covering the stream bottom downstream of the Delphos WWTP. Both these factors could cause a higher instream oxygen demand, and result in a lower DO in Jennings Creek. Two changes were made to the model input to include this additional DO demand. First, the rate for sediment oxygen demand was increased from 0.15 to 1.5 gm/m^2/day for the stream reach starting at the WWTP and continuing to RM 4.8. This change was made to account for the increased demand on the instream oxygen that would occur in the “sewage mold” area. The second change was to increase the BOD decay rate from 0.5 to 1.0 per day for the entire study area. The decay rate of 0.5/day is typical for a highly treated effluent, and would likely be too low for a combined load of treated effluent from the WWTP and load from sewer overflows. These adjustments were made to the model decay rates and the model was re-run. The new predicted DO profile is shown in **Figure 4-1** as the lower line.

Figure 4-1. Pre and Post-Calibration DO Profiles with Observed Conditions



As can be seen in **Figure 4-1**, the predicted DO profile after adjusting the inputs shows a much better correlation with instream DO levels measured during the field survey. If there were more stream data available, it might be possible to further refine the calibration to increase the agreement between simulated and observed water quality. However, based on the amount of available stream data, further adjustment is not warranted. The existing calibration shows that something other than the treated WWTP effluent is causing much of the depression of the instream DO, and it is our belief that these causes include load from sewer overflows, an unsewered area on the southwest side of Delphos, and the oxygen demand that would result from the area of sewage mold downstream of the WWTP.

The next step in the modeling analysis was to determine if the existing permit limits for the Delphos WWTP are adequate to meet water quality standards under 7Q10 design conditions. The current permit limits for the Delphos WWTP at its design flow of 5.93 cfs (3.83 MGD) are shown in **Table 4-6.**

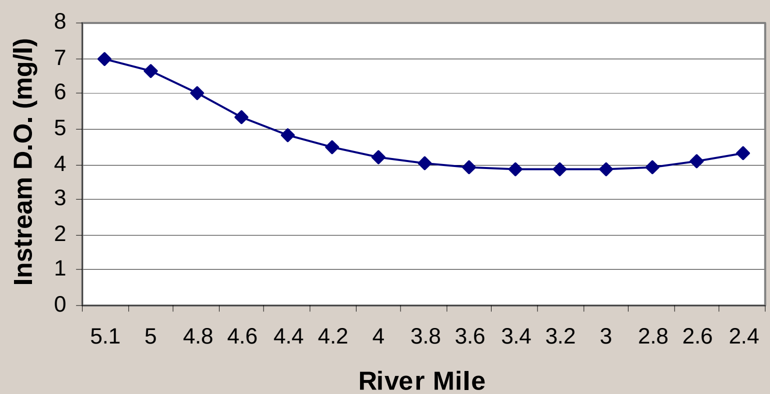
Table 4-6. Current Delphos WWTP Permit Limits

	all values in mg/l		
Season	**$CBOD_5$**	**NH_3-N**	**DO**
Summer	10.0	1.5	7.0
Winter	10.0	3.8	5.0

As part of a May 2002 Wasteload Allocation (WLA) study for the Delphos WWTP, an analysis was conducted to determine if the current permit limits for NH_3-N were adequate to maintain the criteria for toxicity in Jennings Creek. This analysis determined that the facility could discharge 2.0 mg/l in the summer and 7.7 mg/l in the winter; therefore, the current permit limits for NH_3-N were adequate to maintain the criteria for toxicity in Jennings Creek.

Next, an additional simulation for dissolved oxygen was completed using the Multi-SMP model. The purpose of this simulation was to determine if the Delphos WWTP, discharging at its current design flow and permit limits, is able to maintain the instream water quality standard for DO As with the initial calibration attempt, all the instream decay rates (CBOD, NH_3-N, SOD) were set at the values recommended in the USEPA Guidance for the Simplified Method. The upstream flow was the summer 7Q10 value of 0.22 cfs, and the Delphos WWTP was set at its current permit limits and design flow. The model simulation results are shown **Figure 4-2**. As can be seen in the figure, the Delphos WWTP is not able to maintain the water quality standards for DO with this effluent loading. These results are consistent with the results of the 1989 dissolved oxygen modeling study. The current permit limits are adequate to maintain the WQS for dissolved oxygen under winter 7Q10 design conditions.

Figure 4-2. Low Flow Simulation



A final simulation was complete for dissolved oxygen using Multi-SMP. The purpose of this simulation was to determine the Delphos WWTP permit limits necessary to maintain the instream DO standard under summer 7Q10 conditions. As with the initial calibration attempt and the summer low-flow simulation, all instream decay rates were set the values recommended in the USEPA Guidance for the Simplified Method. The upstream flow was the summer 7Q10 value of 0.22 cfs. The permit limits necessary to maintain the instream DO standard as predicted by the model are presented in **Table 4-7.**

Table 4-7. Recommended Delphos WWTP Permit Limits

	all values in mg/l		
Season	**$CBOD_5$**	**NH_3-N**	**DO**
Summer	6.0	1.5	7.0
Winter	10.0	3.8	5.0

An interesting comparison can be made between the summer low flow simulation with Delphos at its design flow and current permit limits, and the conditions observed during the 8/21/01 field survey. The upstream flow was higher during the 2001 survey than the upstream 7Q10. The effluent load during the 2001 survey was substantially lower than the load that would result with Delphos at its design flow and current permit limits. However, the instream DO was lower during the 8/01 field survey than the DO predicted during the summer 7Q10. This further indicates that something other than the WWTP load is causing much of the depression of the instream DO As detailed above, it is our belief that these causes include load from sewer overflows, an unsewered area on the southwest side of Delphos, and the oxygen demand that would result from the area of sewage mold downstream of the WWTP. As stated previously, if there were more stream data available, it might be possible to further refine the calibration, including the definition of the CSO loads during the 2001 survey, to increase the agreement between simulated and observed water quality.

4.1.3 Phosphorus

Most of the phosphorus impairment in the Upper Auglaize River watershed is on the tributaries. Only one short segment of the Auglaize mainstem, just upstream of the Wapakoneta WWTP, is impaired. The remainder of the mainstem in the study area is in full attainment. It appears that while excessive loading to the tributaries is contributing to local impairment, it is not of sufficient magnitude to be detrimental to downstream use attainment. As a result, it was determined that loading and allocation calculations would most appropriately be conducted at the local, segment specific level. Insufficient site or segment specific data was available to support a rigorous, data-intensive loading model such as HSPF or SWAT. As a result, the following methodology was employed to calculate an estimate of the existing TP (total phosphorus) loads to the impaired segments.

The calculated TP loads are an aggregate of the individual TP loads form all major sources in a segment's drainage area. TP sources considered in the load calculation include point sources, non-point sources, combined sewer overflows (CSOs), and unsewered areas (HSTSs).

Point Sources

TP loading attributed to point sources was determined from discharger self-monitoring data collected as a compliance requirement of National Pollutant Discharge Elimination System (NPDES) Permits. The entire period of record for each discharger was examined to determine the continuity of the data. In cases where historical data substantially varied from recent data, the historic data was not used in the load calculation. For each discharger, the 50th percentile annual TP load was determined for each year on record, and the mean of these values was used as the final representation of each discharger's contribution to the instream TP load.

The Uniopolis WWTP discharging to Huffman Creek and the Spencerville WWTP discharing to Sixmile Creek are the only point sources in the Upper Auglaize watershed discharging to phosphorus impaired areas. The TP loads calculated for these two facilities are presented in **Table 4-8**.

Table 4-8. Point Source Total Phosphorus Loads

Stream	**Facility**	**Average Flow *(cfs)***	**Average TP *(mg/l)***	**Average TP *(kg/d)***	**Total TP *(kg/yr)*[1]**
Huffman Creek	Uniopolis WWTP	0.062	2.11[2]	0.310	116.6
Sixmile Creek	Spencerville WWTP	0.418	3.53	3.61	1314.0

[1] Average flow and TP concentration obtained from each WWTP's respective Monthly Operating Report submitted to the Ohio EPA.
[2] No phosphorus monitoring data was available. TP concentration is based upon the average of six Northwest Ohio minor public facilities.

No phosphorus monitoring data was available for the Uniopolis WWTP. As a result, the phosphorus concentration used to represent the quality of Uniopolis WWTP effluent is based upon the average of six northwest Ohio minor public facilities. The facilities used, the period of record examined, each 50th percentile phosphorus concentration, and the average of all six facilities phosphorus concentrations are given in **Table 4-9**.

Table 4-9. Public Facilities used to estimate Uniopolis Total Phosphorus concentration

Facility	Period of Record	50th Percentile TP Concentration *(mg/l)*
Genoa WWTP	01/07/98 - 09/12/03	1.96
Deshler STP	07/13/98 - 07/22/03	1.34
New Bremen WWTP	01/06/98 - 09/11/03	3.00
Stryker WWTP	01/13/98 - 09/09/03	2.32
Holgate WWTP	01/24/01 - 09/03/03	2.45
Pioneer STP	07/03/98 - 07/02/03	1.60
	Average:	2.11

Non-Point Sources

TP loading attributed to non-point sources was calculated by using an export coefficient model based upon land use data. The export coefficient model is a simple pollutant runoff model that incorporates all factors that affect pollutant movement into one value, the export coefficient. The TP load, expressed in kg/year, is determined by multiplying the land use acreage by the export coefficient for each land use (i.e. forest, range/pasture, cropland, and urban). The export coefficients were derrived from the USEPA's Areawide Assessment Procedures Manuals (USEPA, 1976). The land use acreage for each impaired segment's drainage area was determined from the National Land Cover Dataset as produced by the U.S. Geological Survey (**Appendix E**). The land use for each impaired area, TP export coefficients, and TP loads per land use are presented in **Table 4-10**.

Table 4-10. Non-Point Source Total Phosphorus Load

Land Use	Hectare per Land Use							Export Co. (Kg/Ha/yr)	TP Load per Land Use (Kg/Yr)						
	AU1		AU2		AU6				AU1		AU2		AU6		
	Aug Trib II	Huffman	Twomile	Sixmile	Aug Trib	Lapp	Prairie		Aug Trib II	Huffman	Twomile	Sixmile	Aug Trib VI	Lapp	Prairie
Forest	19	84	744	273	6.9	61	226	0.1	2	9	74	27	0.7	6	23
Range/ Pasture	54	102	1035	292	21.9	129	318	0.3	16	31	311	88	6.6	39	95
Crop	304	658	6185	1612	69.2	879	3078	0.8	183	395	3711	968	55.4	70.3	1847
Urban	11	15	198	127	27.1	30	44	0.6	9	12	158	101	16.3	18	35
Total:	388	859	8162	3713	125.1	1099	3666		210	447	4254	4207	79	766	2000

Combined Sewer Overflows

The only phosphorus impaired area in the Upper Auglaize watershed affected by CSOs is the Auglaize River at RM 85.5. This segment of the Auglaize River is affected by three CSO outfalls from the City of Wapakoneta.

TP loading attributed to the CSO's was determined by the following methodology. The load is based on the overflow volume and duration reported to the Ohio EPA. Flow in combined sewers consists of sanitary flows, groundwater infiltration (GWI), and rain-derived infiltration and inflow (RDI/I). During a rain event, RDI/I can be large enough to cause an overflow. In the conservative approach taken, the flow is assumed to consist of only sanitary sewer flow and RDI/I. Load contribution from GWI is considered negligible. Given this scenario, calculating the CSO load requires determining the sanitary sewer load produced during overflow events and the RDI/I load. The sanitary sewer load is the product of the volume of sewage produced and the TP concentration it contains. The volume of sewage produced during overflow events is dependent upon the number of homes served by the sewers contributing to the CSOs, the number of persons per home, and the volume of sewage produced per person. The number of homes served by the sewers contributing to the CSOs was provided by the City of Wapakoneta; the number of persons per home was based upon a county statistic; and the volume of sewage produced per person and the concentration of TP in sewage were based upon a literature values (Metcalf & Eddy, 1991). The urban runoff load is determined by multiplying the urban runoff volume by the TP concentration it contains. The urban runoff volume was determined by subtracting the calculated sanitary sewage volume from the total overflow volume reported to the Ohio EPA. The TP concentration in the urban runoff was derived from literature values (USEPA, 1983). The values used to calculate the TP load from the Wapakoneta CSO's are presented in **Table 4-11**.

Table 4-11. CSO Total Phosphorus Load to Auglaize River at RM 85.5

		# Served		days	(MG/yr)			(kg/yr)			
Stream	**CSO Outfall**	**Households**	**Population**	**Overflow Duration[1]**	**Sewage Volume Produced[2]**	**Overflow Volume**	**Runoff Volume**	**Sewage TP Load[3]**	**Runoff TP Load[4]**	**Total TP Load**	**Adjusted Load[5]**
Auglaize River (RM 85.5)	002	786	2060	6.6	0.952	16.4	15.5	28.8	19.3	48.1	64.0
	003	112	293	8.2	0.168	40.8	40.6	5.2	50.7	55.8	74.3
	004	591	1550	10.4	1.13	42.2	41.0	34.2	51.2	85.5	113.7
	Total:										**252**

[1] CSO overflow duration is an average of the yearly total values reported in 2000 and 2001.
[2] Sewage volume produced is the product of population served, overflow duration, and sewage produced per person (70 gal/day per person). Sewage produced per person is referenced from *Wastewater Engineering - Treatment Disposal Reuse* (Metcalf & Eddy, 1991).
[3] Sewage phosphorus concentrations used is 8.0 mg/l is and referenced from *Wastewater Engineering - Treatment Disposal Reuse* (Metcalf & Eddy, 1991).
[4] Runoff phosphorus concentration used is 0.33mg/l and is referenced from *Results of the Nationwide Urban Runoff Program, Volume 1* (USEPA, 1991).
[5] Load is adjusted to account for the critical rain year (**see Appendix F**).

Unsewered Areas

TP loading from unsewered areas was calculated by multiplying an estimated TP sewage load by the percentage of home sewage treatment systems (HSTS) failing. The TP sewage load calculation is dependent upon the number of unsewered homes within the drainage area, the average number of people per home, the volume of sewage produced per person, and the average concentration in the sewage. Values used for the volume of sewage produced per person, and the average concentration in the sewage were obtained from literature values (Metcalf & Eddy, 1991). The percentages of HSTSs failing were obtained from county health departments in the study area. Values given by the health department were further refined by the calibration process of the Upper Auglaize bacteria model (see **Appendix G**).

The values used to calculate the TP load from unsewered areas are presented in **Table 4-12**.

Table 4-12. Unsewered Area Total Phosphorus Loads

Stream	Houses	Population	Sewage Produced *(gal/day)*	TP Sewage Conc. *(mg/l)*	TP in Sewage *(kg/day)*	TP Reaching Stream[1]	TP Load *(kg/yr)*	Trib. TP Load *(kg/yr)*
AU1								
Aug. Trib. II (RM 103.69)	80	210	14700	8.0	0.445	100%	162.4	**162.4**
Huffman Creek	41	108	7560	8.0	.023	40%	32.9	**32.9**
AU2								
Twomile Creek	94	937	16600	8.0	0.502	50%	91.3	**114.8**
	58	152	10600	8.0	0.161	40%	23.5	
Sixmile Creek	138	359	25100	8.0	0.761	70%	194.4	**194.4**
AU6								
Lapp Ditch	219	617	43190	8.0	1.307	100%	477.1	**477.1**
Aug. Trib VI (RM 25.51)	107	301	21070	8.0	0.638	40%	93.2	**93.2**
Prairie Creek	59	154	10800	8.0	0.326	50%	59.5	**256.6**
	196	507	35500	8.0	1.075	50%	197.1	

[1]TP reaching the stream is a representation of the percentage of failing HSTS's.

TMDL Calculation & Allocation

The TP TMDLs, were determined by *multiplying the calculated existing load by the percent reduction needed to meet instream targets*. As previously stated, the calculated existing load is the sum of the individual source loads: point source, non-point source, CSO, and unsewered areas. The percent reduction needed was determined on a segment specific-basis by comparing the median TP concentration observed in OEPA sampling to the targets set forth in Table 3-2. This method assumes a direct relationship between loadings and instream concentrations and a constant assimilation factor (i.e., the instream concentrations of total phosphorus will respond to future changes in loading in the same manner as they respond to current loads). These simplifying assumptions are warranted by the fact that it is the cumulative, rather than the acute, loadings of nutrients that are impairing the biologic communities (Ohio EPA, 1999).

Except where otherwise stated (see below) phosphorus TMDLs were allocated by the following methods. Point source waste load allocations were based upon the average reported effluent flow for each discharger, and a phosphorus effluent concentration of 1.0 mg/l. The groundwater allocation is the product of a per area groundwater discharge value, the sub-basin's drainage area, and a groundwater phosphorus concentration. The per area groundwater discharge value was calculated at a nearby USGS gage (USGS, 1999). The phosphorus groundwater concentration was obtained from a nearby USGS monitoring well (USGS, 2001). The unsewered area load allocation is the product of the estimated unsewered area source load and HSTS failure rate recommended by the bacteria model management scenario (see Section 4.5). The margin of safety is five percent of the TMDL. The non-point source load allocation is the sum of the point-source waste load allocation, the groundwater allocation, and margin of safety subtracted from the TMDL.

The method of TMDL calculation and allocation for the Auglaize River (RM 85.5) and Sixmile Creek vary from the method described above. The variation is necessary because of the nature of the areas and the individual sources of impairment. A brief description of methods of calculation as applicable to these two stream segments is presented below. The Auglaize River at RM 85.5 is partially-impaired. All upstream and downstream segments of the mainstem are fully-attaining. Three Wapakoneta CSO outfalls discharge to the impaired segment; the effect of which is compounded by a low-head dam near Hamilton Street, Wapakoneta. Considering the Auglaize is impaired neither upstream nor downstream of the segment affected by the CSO, the CSO was concluded to be the principal source contributing to impairment. Non-point source, point source, and unsewered area loads were not taken into consideration for this segment as they would dwarf the significance of the CSO load. This is because of the fact that the methods used to determine phosphorus loadings in this study are only appropriate for small sub-basins. The method makes no attempt to simulate instream processes such as the biological assimilation or physical processing of phosphorus. While this is acceptable for smaller sub-basins were a more direct correlation between loadings and instream concentration is observed, it is not accurate when the spatial scale allows significant time for nutrient cycling. If the non-point or point source loads were to be calculated using the same methods for the Auglaize River at Wapakoneta as the rest of the study area, they would only be indicative of what quantity is loaded to the Auglaize River above Wapakoneta. Such a number would be a poor representation of what quantity actually reaches the area of concern. For this reason, a TMDL was not calculated for this segment, as it would not accurately reflect the total load in the system. The CSO phosphorus allocation for the Auglaize River at RM 85.5 was established by examining the existing Wapakoneta CSO reduction strategy, and basing the allocation on the goals it stipulates.

Similarly, the method of allocation is not appropriate for Sixmile Creek, albeit for different reasons. Sixmile Creek is impaired for nearly its entire length, but an improvement from 1991 biological scores has been observed in 2000 survey results. This improvement is attributed to the elimination of discharges from Ohio Decorative Products, Inc. and Harvard Industries/Trim Trends, Inc, and the improvement of effluent quality from the Spencerville WWTP. These significant improvements aside, Sixmile creek is still impaired, and phosphorus has been assessed as a cause. The hydrological attributes of Sixmile Creek, and specifically the location of the Spencerville WWTP, make the problem difficult to solve. During the summer critical condition, the Spencerville effluent can constitute the majority of the flow in Sixmile Creek, which allows for little dilution. Given this scenario, achievement of the 0.08 mg/l instream phosphorus target is nearly impossible, even with the plant operating at best available demonstrated control technology (BADCAT) levels.

For this reason, maintaining the instream load below a TMDL calculated by the methods stated above is not feasible. The Sixmile Creek phosphorus TMDL is therefore the sum of the individual source loads that are *achievable*. The Spencerville WWTP wasteload allocation is based upon the plant's design flow and the phosphorus concentration of 1.0 mg/l. The non-point source allocation was equitably calculated by applying the same percent reduction to the calculated non-point source load as was applied to the point source load.

The allocation scenario described above may not result in the achievement of the stated instream phosphorus target. The biological response to the load reduction, however, ultimately determines attainment of designated use. It is therefore possible for the TMDL to be successful without achievement of the target. See Section 4.3 for a related discussion regarding the development of phosphorus targets.

Recommending additional load reduction for the Spencerville WWTP is a potentially contentious issue that could considerably delay the TMDL process. The allocation scenario described above may help to circumvent such delays, and is consistent with the adaptive management strategy intrinsic to Ohio's TMDL process. Ohio's TMDL process is based upon twelve-steps that involve a continuous cycle of assessment, development, implementation, and monitoring. The load reductions recommended by this first cycle are a starting point aimed at continuing the improvement Sixmile Creek has experienced since it was last assessed. This first iteration may be sufficient to achieve the designated use; however, future iterations will ensure attainment should this cycle fall short.

Table 4-13 sums the phosphorus load from all sources, gives the phosphorus TMDL for each impaired segment, and allocates the TMDL to the individual sources.

Table 4-13. Phosphorus TMDL and Allocation Table

			AU1			AU2		AU6		
			Auglaize Tributary II (RM 103.69)	**Huffman Creek**	**Auglaize River (RM 85.5)**[1]	**Twomile Creek**	**Sixmile Creek**	**Lapp Ditch**	**Aug. Trib VI (RM 25.51)**	**Prairie Creek**
Existing	*TP (kg/yr)*	NPS	209.5	445.4	-	4254.6	1183.8	766	79	1999.5
		NPDES	-	116.6	-	-	1314.0	-	-	-
		Unsewered	162.4	32.9	-	114.8	194.4	477.1	93.1	256.6
		CSO	-	-	251.9	-	-	-	-	-
		Total	371.9	594.9	-	4369.4	2692.2	1243.1	172.1	2256.1
		% Reduction	89.7%	41.7%	-	15.4%	93.0%	91.6%	96%	68.0%
		TMDL	38.3	346.8	-	3696.5	1244.8[3]	104.4	6.9	722.0
Allocations	*TP (kg/yr)*	Groundwater	9.	19.8	-	188.4	53.1	25.4	2.9	84.8
		NPS	27.3	254.4	0.0	3323.2	560.3	74.7	3.7	588.3
		NPDES	0.0	55.3	0.0	0.0	621.7	-	-	0.0
		Unsewered	0.0	0.0	0.0	0.0	9.7	-	-	12.8
		CSO	0.0	0.0	76.3[2]	0.0	0.0	-	-	0.0
		Margin of Safety	2.0	17.3	-	184.9	-	4.3	0.3	36.1

[1] Source loads not represented by a value were determined not to be contributing to the impairment of the segment.

[2] Allocation is based upon Wapakoneta's CSO reduction strategy. See Appendix F for a description of how the allocation was calculated.

[3] The Sixmile Creek phosphorus TMDL is the sum of the achievable source loads. See the previous section for a description of the Sixmile Creek phosphorus TMDL calculation.

4.1.4 Ammonia

Ammonia (NH_3-N) was identified as a cause of impairment on Auglaize Tributary II at RM 103.69, the Oakview Tributary to Twomile Creek, Auglaize Tributary VI at RM 25.51, and Lapp Ditch. The only identified source of NH_3-N in any of these sub-basins is septic discharge from unsewered areas. As a result, the TMDL is based the product of the percent NH_3-N reduction needed and an estimation of the septic load from unsewered areas. The percent NH_3-N reduction needed was determined in **Section 3.2.4** by comparing observed instream concentration data to the target values. The septic load was estimated via the following methodology.

The NH_3-N septic load is the product of the volume of sewage produced in each unsewered area, the concentration of NH_3-N in sewage, and the associated percentage of HSTSs failing. The volume of sewage produced in each unsewered area is the product of the number of households in the area, the number of persons per household, the volume of sewage produced per person, and the concentration of NH_3-N in sewage. Information regarding the number of households and the number of persons per household was obtained from census data. The percentage of HSTSs failing was obtained from the county health department, and was further refined by the calibration process of the Upper Auglaize bacteria model (see **Appendix G**). The volume of sewage produced per person and the concentration of NH_3-N in sewage are literature values (Metcalf & Eddy, 1991).

Table 4-14 presents the values used to calculate the ammonia load to the affected tributaries in the Upper Auglaize. **Table 4-15** establishes the ammonia TMDL, shows the percent reduction needed to achieve the TMDL, and allocates the TMDL.

Table 4-14. Unsewered Area Ammonia Load

Stream	**House**	**Population**	**Sewage Produced** (gal/day)[1]	**NH_3-N Produced** (kg/day)	**Percent NH_3-N Reaching Stream[2]**	**Point Source** (kg/yr)	**Total NH_3-N Reaching Stream** (kg/yr)
AU1							
Aug. Tributary II (RM 103.69)	80	210	14700	1.39	100%	-	507.4
AU2							
Oakview Tributary to Twomile Creek	94	237	16590	1.57	50%	-	288.4
AU6							
Lapp Ditch	184	515	36050	3.41	100%	13.4[3]	1258
Aug. Tributary VI (RM 25.51)	107	301	21070	1.99	40%	-	290.9

[1] Sewage volume produced is the product of population served, overflow duration, and sewage produced per person (70 gal/day per person). Sewage produced per person is referenced from *Wastewater Engineering - Treatment Disposal Reuse* (Metcalf & Eddy, 1991).
[2] Based on the percent of HSTSs failing as determined during the calibration process of the Bacteria Model (see Appendix G).
[3] Loading data for Paradise Oaks Quality Care obtained from NPDES Monthly Operating Report data.

Table 4-15. Ammonia TMDL and Allocation

Stream	Existing Load *(kg/yr)*	Percent Reduction Needed	TMDL *(kg/yr)*	Allocation *(kg/yr)*	
				Unsewered Area	Margin of Safety
AU1					
Auglaize Tributary II (RM 103.69)	507.4	86%	71	67	4
AU2					
Oakview Tributary to Twomile Creek	288.4	79%	60.6	57.6	3.0
AU6					
Lapp Ditch	1258	84%	201.3	191.3	10
Aug. Tributary VI (RM 25.51)	290.9	87%	37.8	35.8	2

4.1.5 Bacteria

The sources of recreational use impairment in the Upper Auglaize are grossly obvious, as are their cures. A simple model was therefore employed to demonstrate the potential for improvement if the source of Fecal coliform loading is eliminated or reduced. FecalTool (FCLET), a spreadsheet model that calculates the build-up of Fecal coliform (FC), was used to determine the bacteria loading to impaired stream segments. FCLET can estimate the build-up of bacteria from multiple sources, including livestock, wildlife, and failing home sewage treatment systems (HSTSs). For the purposes of this study, livestock was eliminated as a potential source. This decision was based upon the absence of significant livestock operations in any of the modeled stream segment sub-basins. Additionally, there are no point sources of bacteria in the modeled sub-basins, so the only sources considered in the model are from wildlife and failing HSTSs. Following the input of various parameters, the results of the model were calibrated to observed instream values. The final step of the process was to re-run the calibrated model under a management scenario designed to achieve the FC targets.

FCLET required the input of information regarding land use distribution, HSTSs, and wildlife densities for each modeled sub-basin. Land use data was entered describing the percentage of land occupied by built-up areas, forest, crops, and pasture. Built-up areas (i.e., roads, roofs, driveways, etc.) were required to be divided into mixed urban, residential, and transportation/communications/utilities uses to the furthest extent possible. HSTS information required included the number of septic systems, the number of people served by septic systems, and the percentage of failed septic systems in each sub-basin. Finally, wildlife densities for each land use were required to be estimated and entered for each sub-basin.

Once all the necessary information was entered, FCLET produced a daily accounting of the instream FC load. Calibration of the model was accomplished by comparing the model results to FC loads estimated from Ohio EPA sampling data. Each sub-basin was sampled three times in 2000, and the geometric mean of the three samples was used to represent the observed instream FC concentration in counts/100 ml. The geometric mean FC concentration was converted to a load by multiplying by an estimated flow. Flow, expressed in ml/hr, was estimated as the product of the sub-basin's drainage area and a per area discharge that was calculated at a nearby USGS gage. The calculated instream FC load was expressed in counts/hr for easy comparison to the model results.

An effort was made to produce model results within one order of magnitude of the calculated instream load. This was accomplished by adjusting the model input for sub-basins that did not achieve the goal. The percentage of HSTSs that are failing is an input to which the model is very sensitive, and also that is very difficult to estimate. Preliminary estimations were based upon the best professional judgement of the county health departments within the study area. These estimations of the percentage failing were then adjusted during model calibration to produce results similar to the observed condition. The resulting percentage of HSTSs failing was often significantly higher than that reported by the county health departments. This is to be expected, however, considering the modeled sub-basins are those in which bacterial problems were observed. It is logical to expect failure rates to be higher in such areas than those based upon a county-wide average.

The final stage of the bacteria modeling involved re-running the calibrated FCLET model under a management scenario that was designed to achieve the FC targets. This was an iterative process that involved incrementally decreasing the percentage of failing HSTSs until the predicted FC loads were below the targets. The needed decrease of the failure rate was variable from sub-basin to sub-basin, ranging from 5% to 100%.

Table 4-16 presents the observed FC load calculated from sampling data; the pre and post-management HSTS failure rate; and the pre and post-management predicted FC load. The post-management FC load, expressed in counts/hr, is the total maximum hourly load (TMHL) for each sub-basin. For a detailed description of the bacteria modeling process, including the data sources for each input, refer to **Appendix G**.

TMHLs are required to be allocated amongst all known existing sources. As stated previously, there are no point sources of FC in any of the modeled sub-basins, so the wasteload allocation for FC is zero. The entirety of the TMHL is therefore available to be allocated to non-point sources. Considering the prescribed management scenario effectively calls for the elimination of loading from failing HSTSs, the load allocation to HSTSs is zero. Resultantly, the load allocation to FC runoff from wildlife is equal to the TMHL for each sub-basin.

Table 4-16. Bacteria Observed, Target, and Predicted Loads

		Pre-Management			Post-Management			
Stream	Sub-basin[1]	HSTS Failure Rate	Observed FC Load[2] cnts/hr	Predicted Load[3] cnts/hr	HSTS Failure Rate	Target FC Load cnts/hr	Predicted Load (TMHL) cnts/hr	MOS[5]
AU1								
Aug Trib II at RM 103.69 (Westminster Trib)	0.17 - HW	100%	$1.27x10^{10}$	$3.55\ x10^{9}$	0%	$1.56\ x10^{8}$	$7.59\ x10^{7}$	51%
Huffman Ck	1.63 - HW	40%	$1.06x10^{9}$	$8.45\ x10^{8}$	0%	$2.95\ x10^{8}$	$1.29\ x10^{8}$	56%
Dry Run	0.27 - HW	40%	$2.33x10^{9}$	$1.11\ x10^{9}$	0%	$6.94\ x10^{8}$	$3.04\ x10^{8}$	56%
Owl Ck	3.03 - HW	40%	$6.22x10^{8}$	$1.32\ x10^{9}$	0%	$2.76\ x10^{8}$	$1.40\ x10^{8}$	49%
Owl Ck	0.4 - 3.03	40%	$2.66x10^{9}$	$7.87\ x10^{8}$	0%	$4.41\ x10^{8}$	$8.60\ x10^{7}$	81%
AU2								
Twomile Ck	8.10 - HW	40%	$4.25x10^{8}$	$1.16\ x10^{9}$	0%	$2.75\ x10^{8}$	$1.53\ x10^{8}$	44%
Oakview Trib To Twomile Ck Trib	Entirety	50%	$2.54x10^{8}$	$2.02\ x10^{9}$	0%	$7.14\ x10^{7}$	$5.68\ x10^{7}$	20%
Sims Run	4.37 - HW	60%	$7.69x10^{9}$	$9.59\ x10^{8}$	0%	$2.14x10^{8}$	$1.12\ x10^{8}$	48%
Sixmile Ck	3.95 - HW	5%	$2.47x10^{8}$	$3.86\ x10^{8}$	0%	$9.71x10^{7}$	$8.88\ x10^{7}$	3%
Sixmile Ck	Mouth -3.03	70%	$1.81x10^{9}$	$7.85\ x10^{8}$	5%	$7.24x10^{8}$	$8.54\ x10^{7}$	88%
AU6								
Big Run	0.34 - HW	80%	$8.61x10^{9}$	$2.13\ x10^{9}$	5%	$1.67x10^{9}$	$5.18\ x10^{8}$	69%
Lapp Ditch	1.04 - HW	100%	$9.15x10^{10}$	$9.62\ x10^{9}$	0%	$5.42x10^{8}$	$1.88\ x10^{8}$	65%
Lapp Ditch[4]	0.3 - 1.04	100%	$5.88x10^{8}$	$8.04\ x10^{8}$	0%	$6.39x10^{8}$	$1.84\ x10^{7}$	97%
Aug Trib VI at RM 25.51 (Dupont Trib)	Entirety	40%	$1.72x10^{9}$	$2.02\ x10^{9}$	0%	$6.22x10^{7}$	$2.74\ x10^{7}$	56%
Prairie Ck	3.03 - HW	50%	$1.78x10^{9}$	$3.84\ x10^{9}$	5%	$1.22x10^{9}$	$7.63\ x10^{8}$	38%
Prairie Ck	0.33 - 3.03	50%	$3.37x10^{9}$	$2.32\ x10^{9}$	5%	$1.96x10^{9}$	$4.76\ x10^{8}$	76%

[1] Sub-basins are defined by their River Mile (RM) measurement. RM is a linear measurement from the mouth of the stream. The designation HW, for headwaters, indicates the sub-basin extends from the stated RM to the uppermost reaches of the stream.
[2] Observed load is calculated based on empirical instream data, however, the associated flow is an estimation from a downstream gage.
[3] Predicted load based on model inputs.
[4] The geometric mean of values from this segment did not exceed the 1000 counts/100 ml average WQS, but 1 or more samples did exceed the maximum WQS of 2000 counts/100 ml.
[5] The margin of safety (MOS) is the percent change from the target load to post implementation instream load and is calculated as follows: (1- (post treatment load / target load)) * 100.

4.2 Critical Conditions and Seasonality

TMDL development must identify the environmental conditions that will be used when defining allowable loads. TMDLs are designed around the concept of a "critical condition." The critical condition is defined as the set of environmental conditions that, if controls are designed to protect, will ensure attainment of objectives for all other conditions. All impairment in the Upper Auglaize is the result of a water body failing to achieve either its aquatic-life or recreation designated use. Restoration of the impaired segments and removal from the 303(d) list is therefore dependent upon the recovery of the aquatic communities and the reduction of bacteria loading. As such, a discussion of critical condition and seasonality is relevant to aquatic organisms and bacteria.

Aquatic Organisms

The critical condition for aquatic organisms is the summer when aquatic life activity, biomass production, and sensitivity to environmental conditions are at their highest levels. Summer is also the time when excessive algal growth, high instream temperatures, and reduced stream flows occur; all of which contribute to the lowest seasonal DO levels. Since the improvement of DO levels in the Upper Auglaize is dependent upon the reduction of phosphorus and ammonia loading, the allocations of these two parameters must consider the summer as the critical condition. It is, therefore, the summer observed instream conditions that are compared to the targets in order to calculate the necessary load reductions. Habitat is also a limiting factor to aquatic organisms and DO in the Upper Auglaize. The QHEI scores reported herein were also assessed during the summer critical condition; however, they are applicable year-round and are reflective of all seasons and conditions.

Bacteria

The critical condition for bacteria concentration depends on the location and source of the bacteria. In the case of the Upper Auglaize, the primary sources of bacteria loading are failing HSTSs and the direct input of waste from wildlife. The critical condition for both of these sources is the summer low-flow period, when there is the least potential for dilution. The bacteria TMHLs account for this condition, because it was the summer period during which the sampling data was collected. It was to this sampling data to which the bacteria model was calibrated.

4.3 Margin of Safety

Federal statute and regulations require that a TMDL include a margin of safety to account for any lack of knowledge concerning the relationship between load and wasteload allocations and water quality (CWA § 303(d)(1)(C), 40 C.F.R. § 130.7(c)(1)). U.S. EPA guidance explains that the margin of safety (MOS) may be implicit, i.e., incorporated into the TMDL through conservative assumptions in the analysis, or explicit, i.e., expressed in the TMDL as loadings set aside for the MOS.

It is important to keep in mind during the evaluation of the TMDL a major difference in Ohio's program from other programs. In Ohio, one way a stream segment is listed on the 303(d) list is for failure to attain the appropriate aquatic life use as determined by direct measurement of the aquatic biological community. Many other state programs rely solely on chemical samples in comparison to chemical criteria to determine water quality and designated use attainment. However, relying solely on chemical data does not take into account any of the parameters or other factors for which no criteria exist but that affect stream biology nor does it account for multiple stressor situations. Therefore, the chemical specific approach misses many biologically impaired streams and may not detect a problem until it is severe. Ohio's approach incorporates an increased level of assurance that Ohio's water quality problems are being identified. Likewise, de-listing requires attainment of the aquatic life use determined by the direct measurement of the aquatic biological community. This provides a high level of assurance (and an implicit margin of safety) that if the TMDL allocations do not lead to sufficiently improved water quality then the segments remain on the list until true attainment is achieved.

As described above, Ohio's 303(d) listing process provides assurance that the attainment of designated use will ultimately be achieved. This is an implicit margin of safety applicable to all TMDL parameters considered in this report. To account for any additional uncertainty, however, a further margin of safety has been incorporated into the load-based parameter TMDLs. The additional margin of safety, specific to each parameter, is described below.

<u>Bacteria</u>

An explicit margin of safety was included with the bacteria TMDL allocations. A portion of the TMDL was set aside to account for uncertainty in the method when designing the management scenarios recommended by the report. The margin of safety varies by sub-basin, but the average is 56%. This large margin a safety was warranted because of the extensive use of default and literature values in the load calculations that could result in considerable uncertainty.

<u>Phosphorus and Ammonia</u>

A conservative assumption implicit in the phosphorus target development lies in the selection of the median statistic used to represent the phosphorous target which corresponds to an unimpaired biological community. Since Ohio EPA's evaluation of phosphorus data for generating target values is based on measured performance of aquatic life and since full attainment can be observed at concentrations above this target (reinforcing the concept that habitat and other factors play an important role in supporting fully functioning biological communities), water quality attainment can occur at levels higher than the target. The difference between the actual level where attainment can be achieved and the selected target is an implicit margin of safety.

A five-percent explicit margin of safety was included in the phosphorus and ammonia TMDLs. This explicit margin of safety was included to provide additional assurance that designated use will be achieved. Five-percent was selected based upon the best professional judgement of Ohio EPA staff, and combined with the various implicit margins of safety described above is sufficient to address any uncertainty in the method of TMDL development.

5.0 PUBLIC PARTICIPATION

The Ohio EPA convened an external advisory group (EAG) in 1998 to assist the Agency with the development of the TMDL program in Ohio. The EAG met multiple times over eighteen months and in July 2000 issued a report to the Director of Ohio EPA on their findings and recommendations. The upper Auglaize TMDL has been completed using the process endorsed by the EAG.

Ohio EPA involved the partners and public stakeholders in the Upper Auglaize River TMDL project by soliciting input and recommendations for action during a series of meetings during 2001 and 2002. The public outreach activities included three formal presentations by Ohio EPA, and a local watershed coordinator from a neighboring watershed project.

The first meeting of agency partners was hosted by Auglaize Soil and Water Conservation District (SWCD), with Natural Resource Conservation Services (NRCS), other SWCDs and local Health Department staff in March 2001. The Nonpoint Source Program Area Assistance Team (EPA, ODNR, OSUE) facilitated three more meetings in between March and May 2002 which invited broad representation from local agencies, conservation organizations, metro parks and elected officials from the five counties in the watershed area. The issues that brought Auglaize River Watershed stakeholders to the table were identified in April 2002 and included

Safe drinking water	Public Health
Wildlife habitat	Quality of life
Land use planning	Funds for restoration projects

There was not at that time, and still is not an organized watershed group in the area. The NPS Area Assistance Team offered support and information on the Ohio Watershed Coordinator Program during early 2002 and encouraged several local organizations to consider applying for 319 grant funding to employ a full time watershed coordinator for the Auglaize. A potential grant applicant did not reveal itself until February 2003, when Allen County Regional Planning Commission asked about hosting a coordinator. Ohio did not have funding to support any new coordinator positions after 2002, and there was not enough local interest or funding to support one without state funding.

At the end of the May 23, 2002, meeting when no willing local leader stepped forward, it was decided to continue the TMDL development with at least as much public involvement as the local stakeholders could provide. With no further initiative from the Area Assistance Team, we do not believe that any local meetings or discussions took place after February, 2003.

Consistent with Ohio's current Continuous Planning Process (CPP), the draft TMDL report was available for public comment from June 25 through July 26, 2004. A copy of the draft report was posted on Ohio EPA's web page (www.epa.state.oh.us/dsw/tmdl/index.html) and copies were available upon request. No comments were received.

Public involvement is key to the success of any TMDL project. Ohio EPA will continue to support the implementation process and will facilitate to the fullest extent possible an agreement acceptable to the communities and stakeholders in the study area and to Ohio EPA. Ohio EPA is reluctant to rely solely on regulatory actions and strongly upholds the need for voluntary actions facilitated by the local stakeholders and agency partners to bring this section of the Auglaize River watershed into attainment.

Table 5-1. Auglaize River Watershed public involvement

Date	Time	Subject(s)
Mar, 2001	10:00-12:00	Presentation by Ohio EPA to SWCD, NRCS and Health Department staff from Auglaize, Allen, and Putnam counties.
March, 2002	-	Fact sheet/watershed map developed by Ohio EPA for distribution at TMDL stakeholder planning meetings.
March 4, 2002	9:30-12:00	Facilitated meeting with OSU Extension agents from all five counties, with presentation by Ohio EPA. A comprehensive list of stakeholders from entire watershed was drafted
April 11, 2004	9:00-12:00	Expanded stakeholder group including, metro parks, county commissioners, township trustees and agency partners heard another Ohio EPA presentation on the 2000 water quality assessment. The Ottawa River Coalition coordinator and NPS Area Assistance Team spoke about the role and benefits of a coordinator. Stakeholders listed issues of concern with the watershed.
May 23, 2004	9:00-12:00	Final meeting with NPS Area Assistance Team. No local leader stepped forward to support a watershed coordinator grant application.
June, 2002		Conference call and discussions between Ohio EPA and Green Mountain Institute on Leadership Review Board strategy
February 7, 2003	10:00-12:00	NPS Area Assistance Team met with Lima-Allen county Regional Planning Commission to discuss a potential watershed coordinator grant. It was determined that there would be no funding for 2003.
June 25, 2004	-	Public notice of the Upper Auglaize River TMDL Report

6.0 IMPLEMENTATION AND MONITORING RECOMMENDATIONS

Restoration methods to bring an impaired water body into attainment with water quality standards generally involve an increase in the water body's capacity to assimilate pollutants, a reduction of pollutant loads, or some combination of both. As described in Section 2.0, the causes of impairment in the Upper Auglaize River are habitat and sedimentation, dissolved oxygen (DO), total phosphorus, ammonia, and bacteria. Therefore, an effective restoration strategy would include habitat improvements and reductions in pollutant loads, potentially combined with some additional means of increasing the assimilative capacity of the stream.

Potential restoration strategies used to achieve the TMDL restoration targets might include:

- Public education for awareness of watersheds and water quality
- Riparian buffer initiatives
- Corridor protection ordinances
- Dam evaluation and removal
- Flood plain management
- Flow augmentation
- Sediment and erosion control practices in agricultural and urban areas
- Reduce the use of residential fertilizers and pesticides
- Conservation farming practices
- Comprehensive nutrient management plans
- Livestock waste management plans
- Home sewage treatment system management and maintenance
- Storm water management plans
- Enforcement of storm water Phase I and II regulations
- Limit and reuse point source discharge water
- Eliminate point source discharges
- NPDES program - permit limitations and compliance schedules
- Elimination/control of combined sewer overflows (CSOs)
- Municipal pretreatment program
- Centralized treatment for unsewered communities

6.1 Upper Auglaize TMDL Implementation Strategy

Ohio EPA is taking an iterative, adaptive approach to implementation for this TMDL project. Point source reductions will be achieved through effluent limitations, compliance schedules, and special conditions in existing dischargers' NPDES permits. A schedule will be developed for issuance of NPDES permits consistent with implementing the TMDL recommendations. Permits will be issued such that:

- reasonable reductions of total phosphorus and ammonia, and in-stream monitoring of other TMDL parameters will be required;
- enough time will be incorporated into the permit process to allow for nonpoint source controls to become effective and additional data to be collected;

- trends in instream concentrations will be tracked, and the NPDES permits will include an option for permit modifications should data indicate in-stream total phosphorus, ammonia and DO levels have achieved stable and desirable levels or that the use designations are being fully met.

Implementation of nonpoint source reduction measures will be achieved through a locally adopted implementation strategy built around non-regulatory and voluntary incentive programs. Local input to the implementation strategy will result in a planning and decision process that leads to reasonable and sustainable actions that will be the most effective in restoring water resources in the watershed. Ohio EPA recommends an approach that directs resources to improve the overall habitat and physical stability of streams throughout the watershed. A two tiered approach that prescribes land management practices and promotes natural channel stability will be most effective in achieving nutrient and sediment load reductions. Traditional BMPs and barriers should be targeted at the stream segments most vulnerable to erosion during high flow storm events. Restoring stream habitat and maintaining channel stability will increase the nutrient and sediment assimilative capacity of streams during normal and lower flow conditions.

The local implementation strategy will evaluate existing conservation programs and seek opportunities for new funding sources for landowners willing to try innovative practices. Two voluntary nonpoint source control programs available in this watershed are highlighted below.

A successful low-interest loan program began in 1998 through Ohio's Water Pollution Control Loan Fund (WPCLF) Linked Deposit Program and provided more than $3,632,000 for low interest loans to fund at least 125 agricultural best management practices in the Upper Auglaize River watershed. This program, available to landowners in seven watersheds of the Maumee River Basin, was funded by Ohio EPA Division of Environmental and Financial Assistance and administered through the Soil and Water Conservation Districts (SWCDs) in all five counties of the Auglaize watershed. Loans for agricultural practices that benefit water quality were awarded for BMPs such as manure management facilities, conservation tillage equipment, and multiple buffer practices.

Auglaize SWCD was the first local agency to sign on for this five year program in September 1998, followed by Paulding and Putnam SWCDs. Agreements with these three counties expired in late 2003. Van Wert and Allen SWCD joined the program later and they have agreements in effect until 2006 and 2007 respectively. There is interest in renewing and/or continuing the agreements in several of the counties. More information on the WPCLF Linked Deposit Program is available on the Ohio EPA web site at http://www.epa.state.oh.us/defa/wpclf.html.

The 2002 USDA Farm Bill provided funding for a new incentive, the Conservation Security Program with the first sign up scheduled for 2004. It was announced in May 2004 that $41.4 million would be available for 18 priority watersheds in the country. In Ohio, the Auglaize River and St. Joseph River were selected as priority watersheds for funding in 2004. This voluntary program will support ongoing conservation stewardship of agricultural working lands by rewarding producers who maintain and enhance the condition of natural resources in these watersheds. A limited number of participants will be considered on the basis of past conservation efforts and willingness to perform additional conservation activities during their five to ten year contracts. More information on the 2002 Farm Bill Conservation Security Program is available at the web site http://www.nrcs.usda.gov/programs/csp.

On July 22, 2004, the U.S. Department of Agriculture announced a five-year effort to study the collective environmental benefits of government conservation programs on agricultural land. The Conservation Effects Assessment Project (CEAP) will study the environmental benefits of conservation practices implemented through 2002 Farm Bill programs. The upper Auglaize River was one of eight "special-emphasis" watersheds selected for study over the next five years, with the primary conservation issue being subsurface drainage. Additional information about CEAP can be obtained at www.nrcs.usda.gov/technical/nri/ceap.

There are no current or past Section 319 Nonpoint Source grant funded projects in this watershed, however the Upper Auglaize will be considered a priority watershed for TMDL implementation funding in FY2006. Local partners will be encouraged to submit proposals that implement recommendations of the TMDL plan.

6.2 Reasonable Assurances

As part of an implementation strategy, reasonable assurances provide a level of confidence that the wasteload allocations and load allocations in TMDLs will be implemented by Federal, State, or local authorities and/or by voluntary action. The stakeholders will develop and document a list that differentiates the enforceable and non-enforceable selected actions necessary to achieve the restoration targets. Reasonable assurances for planned point source controls, such as wastewater treatment plant upgrades and changes to NPDES permits, will be a schedule for implementation of planned NPDES permit actions. For non-enforceable actions (certain nonpoint source activities), assurances must include 1) demonstration of adequate funding; 2) process by which agreements/arrangements between appropriate parties (e.g., governmental bodies, private landowners) will be reached; 3) assessment of the future of government programs which contribute to implementation actions; and 4) demonstration of anticipated effectiveness of the actions. It will be important to coordinate activities with those governmental entities that have jurisdiction and programs in place to implement the nonpoint source actions (e.g., county soil and water conservation district offices, county health departments, local Natural Resource Conservation Service offices of the U.S. Department of Agriculture, municipalities and local governmental offices).

6.2.1 Minimum Elements of an Approvable Implementation Plan

Whether an implementation plan is for one TMDL or a group of TMDLs, it must include at a minimum the following eight elements:

- *Implementation actions/management measures*

- *Time line*
- *Reasonable assurances*
- *Legal or regulatory controls*
- *Time required to attain water quality standards*
- *Monitoring plan*
- *Milestones for attaining water quality standards*
- *TMDL revision procedures*

6.2.2 Reasonable Assurances Summary

This is a summary of the regulatory, non-regulatory and incentive based actions applicable to or recommended for the Upper Auglaize River watershed. Many of these activities deal specifically with the potential point source discharge regulatory actions. Non-regulatory and incentive based programs are currently delivered through existing local conservation authorities and nonpoint source reduction activities.

Regulatory:

- NPDES permit schedules to meet phosphorus loads at Uniopolis and Spencerville
- NPDES permit limits for ammonia nitrogen, dissolved oxygen, and CBOD at Delphos
- NPDES permit schedules for CSO elimination or Long Term Control Plans for Wapakoneta and Delphos.
- Pretreatment programs
- DFFOs for wastewater treatment facilities in unsewered areas (Westminster, Cloverdale, Dupont, and unincorporated areas around Delphos)
- Statewide rules for home sewage treatment/disposal
- Inspection and operation/maintenance programs for home septic systems
- Urban storm water management programs for Wapakoneta and Spencerville

Non-regulatory:

- Evaluate dams for removal
- Investigate flow augmentation in headwater streams or near point source discharges
- Encourage development and local acceptance of an implementation plan which includes:
  - Watershed awareness education activities
  - Storm water management programs
  - Source protection of ground and surface drinking water supplies (SWAP)
  - Septic system improvements
  - Agricultural conservation practices
  - Riparian buffer initiatives
  - Manure nutrient management plans
  - Develop criteria for ditch maintenance program
- Restore access to flood plains and oxbows
- Encourage local health departments to development HSTS Plans in 5 counties.
- Monitor streams periodically to measure progress

Incentive-based:

- Section 319 grant opportunities for implementation projects that support the goals of this TMDL

- USDA Farm Bill programs for agricultural BMPs
- New USDA Conservation Security Program sign-up in 2004 for Auglaize watershed
- Lake Erie CREP for buffer practices throughout the Lake Erie watersheds
- Clean Ohio Grant Fund opportunities for natural resource protection and improvement and farmland BMPs
- Various loan opportunities for WWTP improvements
- Continued WPCLF Linked Deposit funding at a reduced interest rate for agricultural BMPs and home sewage treatment system replacements in the watershed
- Loan opportunities through WRRSP program for riparian/habitat improvements
- FmHA grants and WPCLF loan opportunities for centralized wastewater treatment in small communities
- Ohio Environmental Education Fund administered by Ohio EPA
- Lake Erie Protection Fund grant opportunities

6.2.3 Point Source Controls

Implementation of the TMDL for the Upper Auglaize River watershed NPDES permit holders is expected to consist of language in the NPDES permits including Long Term Control Plan (LTCP) language (for Wapakoneta), compliance schedules to meet the phosphorus TMDL loads (for both Uniopolis and Spencerville), new limits for winter dissolved oxygen (DO) and $CBOD_5$ limits broken down from yearly to summer and winter (for Delphos).

Wapakoneta

Phosphorus in the form of nutrients is not listed as a cause of impairment in Table 1-1 so a TMDL for phosphorus was not done for the Wapakoneta WWTP (Auglaize River (Blackhoof Creek to Pusheta Creek)). While the combined sewer overflows (CSOs) in the Wapakoneta sewer system are considered a cause of impairment, the reduction of phosphorus will be addressed with the implementation and development of the LTCP for the Wapakoneta sewer system.

Wapakoneta is a combined sewer community with 3 CSOs. The newly drafted NPDES permit for the City of Wapakoneta WWTP requires the implementation of the nine minimum control measures for CSOs that are required by the national CSO Control Policy. The compliance schedule in the permit will require the city to submit a proposal plan for a monitoring program, a report on the characterization of the collection system and the CSOs, complete wet weather stress testing, submit a report on the wet weather stress testing, and submit a LTCP which will include an implementation schedule. Once the LTCP is approved by the Director, implementation will be required either through the NPDES permit or some other enforceable mechanism.

Uniopolis WWTP

Phosphorus in the form of nutrients is listed as a cause of impairment in Table 1-1 so a TMDL for phosphorus was done for Huffman Creek in the vicinity of the Village of Uniopolis WWTP.

Monitoring for phosphorus will likely be added to Uniopolis NPDES permit to verify any contribution of phosphorus the WWTP may have to Huffman Creek. This will be done with three years of monitoring only and a final loading limit of 0.15 kg/day. If it is found that the loading values exceed 0.15 kg/day (which is equivalent to 55.3 kg/year), the Uniopolis NPDES permit will likely be modified to add a compliance schedule to meet the TMDL phosphorus load. The compliance schedule is expected to extend beyond the expiration date of the permit and be carried over to any renewal NPDES permit until the final compliance date is achieved.

The following is a sample compliance schedule:

Part I, C - Schedule of Compliance

A. Upper Auglaize TMDL Phosphorus Reduction Implementation Schedule

As soon as possible, but not later than the dates developed in accordance with the following schedule, the permittee shall achieve an allowable total phosphorus load of 0.15 kg/day (which is equivalent to 55.3 (kg/year)). The permittee may achieve the allowable phosphorus load by reducing phosphorus loads discharged through wastewater treatment plant station number 2PA00054001 and/or by implementing alternative load reduction projects that are reviewed by and are acceptable to Ohio EPA. Alternative load reductions may include any estimated average daily total phosphorus load reductions achieved since 2000.

1. The permittee shall immediately begin an evaluation of the capability of its existing treatment facilities to reduce the effluent loadings of total phosphorus. Operational procedures, unit process configuration, and any other measures shall be evaluated as appropriate.

2. Not later than 24 months from the effective date of this permit, the permittee shall submit to the Ohio EPA Northwest District Office a report on the capability of its existing treatment facilities to reduce the effluent loadings of total phosphorus and a summary of other projects, initiatives or activities the permittee proposes to take to achieve the loading reductions necessary to meet the final allowable phosphorus load of 0.15 kg/day.

3. Not later than 30 months from the effective date of this permit, the permittee shall initiate implementation of any projects, initiatives or activities that the permittee has proposed to take to meet the final allowable phosphorus load of 0.15 kg/day.

4. Not later than 30 months from the effective date of this permit, the permittee shall operate the existing treatment facilities to the best of its capability to reduce the effluent loading of total phosphorus.

5. Not later than 48 months from the effective date of this permit, the permittee shall submit a general plan for achieving the loading reductions necessary to meet the final allowable phosphorus load of 0.15 kg/day. In developing the plan, the permittee shall evaluate various alternatives for achieving the necessary loading reduction. The alternatives may include, but

are not limited to: implementation of nonpoint source loading reduction projects; implementation of projects that increase the capacity of the receiving waters to assimilate total phosphorus loads; entering into cooperative agreements with other parties to implement projects that will achieve the point source loading reductions identified in the report "Total Maximum Daily Load for the Upper Auglaize River Basin"; and/or upgrading the existing wastewater treatment facilities. (Event Code 1299)

Any alternative load reduction projects or other initiatives identified and undertaken by the permittee to achieve the phosphorus loading reductions must comply with the wasteload allocations (WLA) and load allocations (LA) assigned in the Upper Auglaize River Basin TMDL report. Loading reductions achieved by the permittee must be applied to meeting the point source WLA for phosphorus. After review and acceptance by Ohio EPA, any portion of loading reductions achieved by one stakeholder may be credited to it or to another stakeholder(s) so long as such credit is not duplicated.

The general plan for achieving the loading reductions shall address, as a minimum, the following:

a. The alternative(s) chosen to achieve the loading reductions.
b. Cost estimates of implementing the chosen alternatives, including any applicable operation, maintenance, and replacement costs.
c. A fixed date compliance schedule for meeting the reduction targets for total phosphorus. As a minimum, this schedule should include dates for: submission of approvable detail plans (if applicable); completion of implementation/construction; attainment of operational level; notification of the Ohio EPA Northwest District Office within 14 days of attaining operational level (if applicable); and achieving the loading reductions required by Schedule of Compliance Item A.6 not later than 84 months from the effective date of this permit.
d. The financial mechanism to be used to fund the required improvements, operation, maintenance, and replacement costs (if applicable).
e. For alternatives other than upgrading the existing wastewater treatment facilities, demonstrate reasonable assurance by providing information that: the proposed projects are technically feasible based on accepted modeling, data from similar projects, and commonly accepted professional expectations; there is a reasonable expectation that the proposed controls will be implemented; and other appropriate measures identified by the permittee.

6. The permittee shall achieve the final allowable total phosphorus load of 0.15 kg/day not later than 84 months from the effective date of this permit. (Event Code 5699)

This NPDES permit, Ohio EPA permit number 2PA00054*??, expires on ________________. This Schedule of Compliance includes an item that extends beyond the term of the permit. Any requirements this Schedule of Compliance that have not been met, including the compliance dates, will be included in permit ________ when it is renewed.

In the event that evidence becomes available demonstrating to the Director's satisfaction that biological indices applicable to the Upper Auglaize River Basin are in full attainment, or that monitoring data collected at appropriate locations within the TMDL study area show that the median total phosphorus concentration measured at those locations is less than or equal to the instream target for two consecutive years, the Director will evaluate any proposed modification of the TMDL Implementation Schedule included in this NPDES permit.

This permit may be modified or revoked and reissued for the following reasons:

- To include new or revised conditions based on new information resulting from implementation of the TMDL recommendations.

- To include new or revised conditions based on plans submitted by the permittee to upgrade the existing wastewater treatment facilities to achieve the allowable total phosphorus load of 0.15 kg/day.

7. Not later than June 30 of each year, after the effective date of this permit, the permittee shall submit to the Ohio EPA Northwest District Office a status report that includes the following:

a. A summary of changes in operational procedures, unit process configuration, and other measures taken to maximize the ability of its treatment facilities to achieve an allowable total phosphorus load of 0.15 kg/day.
b. The phosphorus load discharged from station number 2PA00054001 during each calendar year since the effective date of this permit.
c. A summary of any projects, initiatives or activities the permittee has taken to achieve the loading reductions necessary to meet the final allowable phosphorus load of 0.15 kg/day.

Spencerville WWTP

Phosphorus in the form of nutrients is listed as a cause of impairment in Table 1-1 so a TMDL for phosphorus was done for Sixmile Creek. The permit would likely include a compliance schedule to meet the TMDL phosphorus load. Here is an example of the language that could be included in the Spencerville WWTP permit:

Part I, C - Schedule of Compliance

A. Upper Auglaize TMDL Phosphorus Reduction Implementation Schedule (Draft 5/21/04)

As soon as possible, but not later than the dates developed in accordance with the following schedule, the permittee shall achieve an allowable total phosphorus load of 1.7 kg/day (which is equivalent to 621.7 kg/year). The permittee may achieve the allowable phosphorus load by reducing phosphorus loads discharged through wastewater treatment plant station number 2PC00000001 and/or by implementing alternative load reduction projects that are reviewed by and are acceptable to Ohio EPA.

The allowable total phosphorus load may be expressed as:

1.7 kg/day total phosphorus = (med Qeff x med Peff x F) - (estimated total phosphorus load reduction from alternative load reduction initiatives) where:

med Qeff = 5-year median daily effluent flow rate (MGD). This flow value shall be the median of the daily flows at station number 2PC00000001 for the previous 5 consecutive calendar years.

med Peff = median daily effluent total phosphorus concentration during January - December (mg/l)

F = conversion factor = 3.785

Alternative load reductions = estimated average daily total phosphorus load reductions achieved since 2000

1. The permittee shall immediately begin an evaluation of the capability of its existing treatment facilities to reduce the effluent loadings of total phosphorus. Both operational procedures, unit process configuration, and other measures shall be evaluated as appropriate.

2. Not later than 24 months from the effective date of this permit, the permittee shall submit to the Ohio EPA Northwest District Office a report on the capability of its existing treatment facilities to reduce the effluent loadings of total phosphorus and a summary of other projects, initiatives or activities the permittee has taken to achieve the loading reductions necessary to meet the final allowable phosphorus load of 1.7 kg/day.

3. Not later than 36 months from the effective date of this permit, the permittee shall complete implementation of measures identified in its evaluation that can reasonably be expected to maximize the ability of the existing treatment facilities to achieve an allowable total phosphorus load of 1.7 kg/day.

4. Not later than 36 months from the effective date of this permit, the permittee shall operate the existing treatment facilities to the best of its capability to reduce the effluent loading of total phosphorus.

5. Not later than 54 months from effective date of this permit, the permittee shall submit a general plan for achieving the loading reductions necessary to meet the final allowable phosphorus load of 1.7 kg/day. In developing the plan, the permittee shall evaluate various alternatives for achieving the necessary loading reduction. The alternatives may include, but are not limited to: implementation of nonpoint source loading reduction projects; implementation of projects that increase the capacity of the receiving waters to assimilate total phosphorus loads; entering into cooperative agreements with other parties to implement projects that will achieve the point source loading reductions identified in the report "Total Maximum Daily Load for the Upper Auglaize River Basin"; and/or upgrading the existing wastewater treatment facilities. (Event Code 1299)

Any alternative load reduction projects or other initiatives identified and undertaken by the permittee to achieve the phosphorus loading reductions must comply with the wasteload allocations (WLA) and load allocations (LA) assigned in the Upper Auglaize River Basin

TMDL report. Loading reductions achieved by the permittee must be applied to meeting the point source WLA for phosphorus. After review and acceptance by Ohio EPA, any portion of loading reductions achieved by one stakeholder may be credited to it or to another stakeholder(s) so long as such credit is not duplicated.

The general plan for achieving the loading reductions shall address, as a minimum, the following:

a. The alternative(s) chosen to achieve the loading reductions.
b. Cost estimates of implementing the chosen alternatives, including any applicable operation, maintenance, and replacement costs.
c. A fixed date compliance schedule for meeting the reduction targets for total phosphorus. As a minimum, this schedule should include dates for: submission of approvable detail plans (if applicable); completion of implementation/construction; attainment of operational level; notification of the Ohio EPA Northwest District Office within 14 days of attaining operational level (if applicable); and achieving the loading reductions required by Schedule of Compliance Item A.7 not later than 118 months from the effective date of this permit.
d. The financial mechanism to be used to fund the required improvements, operation, maintenance, and replacement costs (if applicable).
e. For alternatives other than upgrading the existing wastewater treatment facilities, demonstrate reasonable assurance by providing information that: the proposed projects are technically feasible based on accepted modeling, data from similar projects, and commonly accepted professional expectations; there is a reasonable expectation that the proposed controls will be implemented; and other appropriate measures identified by the permittee.

6. The permittee shall achieve the final allowable total phosphorus load of 1.7 kg/day not later than 118 months from the effective date of this permit. (Event Code 5699)

This NPDES permit, Ohio EPA permit number 2PC00000*??, expires on ________________. This Schedule of Compliance includes an item that extends beyond the term of the permit. The requirements of Schedule of Compliance Item A.7, including the compliance date, will be included in permit 2PC00000*?? when it is renewed.

In the event that evidence becomes available demonstrating to the Director's satisfaction that biological indices applicable to the Upper Auglaize River Basin are in full attainment, or that monitoring data collected at appropriate locations within the TMDL study area show that the median total phosphorus concentration measured at those locations is less than or equal to the instream target for two consecutive years, the Director will evaluate any proposed modification of the TMDL Implementation Schedule included in this NPDES permit.

This permit may be modified or revoked and reissued for the following reasons:

- To include new or revised conditions based on new information resulting from implementation of the TMDL recommendations.

- To include new or revised conditions based on plans submitted by the permittee to upgrade the existing wastewater treatment facilities to achieve the allowable total phosphorus load of 1.7 kg/day.

7. Not later than June 30 of each year, after the effective date of this permit, the permittee shall submit to the Ohio EPA Northwest District Office a status report that includes the following:

a. A summary of changes in operational procedures, unit process configuration, and other measures taken to maximize the ability of its treatment facilities to achieve an allowable total phosphorus load of 1.7 kg/day.

b. The phosphorus load discharged from station number 2PC00000001 during each calendar year since the effective date of this permit. The loads shall be determined using the following equation: kg/day total phosphorus = med Qeff x med Peff x F, where the terms are defined in Item A.

c. A summary of other projects, initiatives or activities the permittee has taken to achieve the loading reductions necessary to meet the final allowable phosphorus load of 1.7 kg/day.

Delphos WWTP

Delphos WWTP is located on Jennings Creek which has a very low dissolved oxygen (DO) level. A TMDL for Jennings Creek was done for QHEI, sedimentation and habitat. Also DO oxygen was modeled. Limits for $CBOD_5$, NH_3-N, and DO have been calculated, as summarized in Table 6-1.

Table 6-1. Recommended Delphos WWTP Permit Limits

		Concentration (mg/l)			Loading (kg/day)	
Parameter	**Season**	**Monthly**	**Weekly**	**Minimum**	**Monthly**	**Weekly**
$CBOD_5$	Summer	6	9	- -	87	130
$CBOD_5$	Winter	10	15	- -	145	217
NH_3-N	Summer	1.5	2.3	- -	22	33
NH_3-N	Winter	3.8	5.7	- -	55	83
Dissolved Oxygen	Summer	- -	- -	7	- -	- -
Dissolved Oxygen	Winter	- -	- -	5	- -	- -

Combined sewer overflows (CSOs) have been identified as a source of impairment. In addition to this TMDL study, the control of CSOs is required by the *Wet Weather Water Quality Act of 2000*, and the components of an acceptable CSO control program are included in the national *Combined Sewer Overflow Control Policy* (U.S. EPA., April 1994).

Delphos has 6 CSOs. Their current permit required them to submit a LTCP by August 1, 2003. It also requires them to implement the nine minimum control measures for CSOs that are required by the national CSO Control Policy. Recently they were issued DFFOs to bring their WWTP into compliance with effluent limitations, by making improvements to it. There is a schedule In the DFFOs for these improvements. As a means to address LTCP issues as well as the DFFOs, the City of Delphos plans to construct a new WWTP to achieve compliance. The new WWTP will be designed to treat increased wet weather flows. The City also plans to construct an additional equalization basin to maximize the amount of wastewater that will be conveyed to the WWTP for treatment and minimize discharges from CSOs.

6.2.4 Unsewered Areas Recommendations

There are several villages in the Upper Auglaize watershed that do not have a central wastewater collection and treatment system. Their collection systems consist of storm sewers that also transport partially treated wastewater from septic tank-type systems. The discharges from these sewers contribute to water quality degradation in the receiving streams. Cloverdale discharges to Lapp Ditch; Dupont to unnamed tributaries referred to as “Auglaize River Tributaries VI and VII”; Westminster to Auglaize River Tributary II. There are also several unsewered subdivisions in the Delphos area, that discharge to Jennings and West Jennings Creeks (see below). See Chapters 2 and 3 for discussions of water quality problems in the respective waters.

Greater Delphos Unsewered Areas

South Unsewered Area is located south of Skinner Street between Bredeick Street and Erie Street. Findings and Orders were issued on August 17, 1992 requiring the submittal of detail plans to eliminate the contamination from Jennings Creek. Findings and Orders were reissued February 16, 1999 requiring construction of sanitary sewers serving this area be completed and operational by December 15, 2000. A meeting was held on May 13, 2004 between the Van Wert County Commissioners and the people in the South Unsewered Area. Two annexation petitions are needed. One for the Erie Street area and one for the Bredeick Street area. The Erie Street Area has sufficient signatures to proceed with annexation. More annexation signatures are needed for the Bredeick Street area. An income survey will be begun shortly. Construction is planned for late summer - early fall of 2004.

State Rte 697-Jennings Delphos Area is located in the triangle between State Rte 697 and Jennings Delphos Road. This area is tributary to West Jennings Creek. The Ohio EPA will plan a meeting with the City of Delphos and the Van Wert County Commissioners to discuss extending sewers to this area.

Dolt Road Area is located along Dolt Road between Brickner Road and the Norfolk Western Railroad track. The Ohio EPA will meet with the Van Wert County Commissioners to discuss methods of eliminating these discharges.

6.2.5 Nonpoint Source Controls

Agricultural Sedimentation and Nutrient Enrichment

The Upper Auglaize River watershed is a predominately agricultural area used mostly for row crop production and, to a smaller degree, livestock production. In the past ten to fifteen years, conservation efforts by farmers, local partnerships and units of government have reduced non-point sources of pollution significantly, and efforts in this direction continue. Significant improvement in the performance of biological communities in the mainstem of the river since 1991 is an example of the positive impact that changes in agricultural management practices can have on water quality in just a short time However, agricultural contributions of sediment and nutrients are still problematic in the smaller tributary and headwater streams.

Landowners can take advantage of several incentive programs that will cover significant costs of adopting Best Management Practices on farmland, while educational initiatives exist to boost participation in these programs. Livestock Environmental Assurance Program, CREP, and other 2002 Farm Bill programs are available through the Farm Service Agency and Soil and Water Conservation Districts in each county of the watershed. A select group of producers in the priority Auglaize watershed will be eligible for the new 2004 Conservation Security Program announced in May, 2004. The watershed partners will be eligible for Section 319 grant funds beginning in FY 2006 to implement projects that address TMDLs.

Habitat Alteration and Hydromodification

A lack of instream and riparian habitat, and low water levels in small tributary streams and maintained channels caused multiple impairments in the Upper Auglaize watershed. In this study, the difference between small streams that were attaining their aquatic use designations and streams that were not, appeared to be related to the amount of nutrient enrichment and the presence or absence of continuous stream flow. In other words, the impacts of sediment and nutrients are magnified by poor physical habitat or intermittent flow. Conversely, good physical habitat and adequate flow can be effective in assimilating these pollutants. Habitat improvements throughout the watershed are recommended with special effort directed at the nonattaining stream segments.

Unlike the standard practices for reducing sediment and nutrient runoff from crop land, the solutions for habitat and flow impaired streams will not be familiar BMPs that have well established incentive programs. Improved habitat will rely on long term changes and social acceptance of new trends in agricultural drainage practices. Implementation actions could include:

- Adopt changes to the Ohio Drainage Laws that restrict streams being put on permanent maintenance programs.
- Promote natural stream management and filter strips to reduce the frequency of maintenance on petition ditches.
- Promote physical stability in streams by restoring active flood plains
- Promote wetlands to provide flood water storage and enhance groundwater recharge.

- Adopt riparian protection ordinances that prevent flood plain encroachment and riparian removal.
- Remove Harrison St.(Wapakoneta) Dam
- Evaluate other dams for modification or removal.
- Limit water withdrawals below prescribed base stream flows.
- Flow augmentation

Home Sewage Treatment System Management

Septic systems impact water quality in the Upper Auglaize River watershed through both point and nonpoint discharges from failed, inadequately designed, or discharging systems in small unincorporated villages and rural areas. Individual sewage systems are used to treat household sanitary waste in areas where no municipal treatment facilities exist. When poorly designed or neglected, they contribute loads of organic matter, nutrients, and pathogens. Site limitations such as lot size, soil type and depth to bedrock or groundwater further reduce effectiveness and increase system failures leading to surface or groundwater contamination.

In small towns water quality and public health can be severely impacted when multiple homes bypass failed systems into the storm sewers or local streams. Sampling conducted during the 2000 TMDL assessment indicated unsanitary conditions and Water Quality Standards exceedances due to sewage discharges from Cloverdale, Dupont, Westminster and unincorporated areas around Delphos.

Implementation actions to address these sources of pollution would include, identification and replacement of faulty septic systems, elimination of on-site septic systems through extension of municipal sanitary sewers, and public education on septic system maintenance. Section 319 grant funds area available to assist homeowners with repair or replacement of failed septic systems in critical areas of the watershed. To be eligible for grant funding, a county health department must prepare and receive Ohio EPA approval of a county wide or watershed based Home Sewage Treatment System (HSTS) plan.

Storm Water Management

In the Upper Auglaize watershed, sources of stream impairment may include discharges from urban storm runoff and storm water dischargers from both Phase I and II Industrial and Construction activities. Although this watershed currently does not have any regulated Phase I or II Storm water communities there is impairment in the mainstem Auglaize River in Wapakoneta and Sixmile Creek in Spencerville. Outside of the Phase II and Individual Storm Water permits that have been issued to facilities in these cities, additional storm water control actions are voluntary.

The formation of a stakeholder based advisory group to guide the development of a Storm water program in a Watershed Implementation Plan would be an important first step. Implementation actions could include drafting ordinances for storm water and sediment and erosion control, and expanding existing programs (i.e. Soil and Water Conservation Districts (SWCDs) to include storm water monitoring. Public education, such as developing an adult education program about storm water pollution, would be an important and necessary part of the implementation plan.

Public Education

The local SWCDs and park districts may have nonpoint source education staff that deliver programs and information to help local landowners and public officials understand causes, sources and solutions to nonpoint pollution. The primary focus would be building public awareness about the value of a healthy watershed and the importance of reducing/eliminating these sources of pollution. Funding for NPS education in the Auglaize watershed is available through grants from ODNR Division of Soil and Water Conservation and the Ohio Environmental Education Fund administered by Ohio EPA.

6.3 Process for Monitoring and Revision

An initial monitoring plan to determine whether the TMDL has resulted in attainment of water quality standards and to support any revisions to the TMDL that might be required begins with in-stream water quality chemical monitoring. This sampling will be done at a minimum by NPDES permit holders at locations upstream and downstream of their outfalls and at ambient monitoring stations to be collected by Ohio EPA.

A more detailed and inclusive monitoring plan could be developed by a local watershed group which would describe steps in a monitoring program, including timing and location of monitoring activities, parties responsible for monitoring, and quality assurance and quality control procedures. It may include a method to determine whether actions identified in the implementation plan are actually being carried out and criteria for determining whether these actions are effective in reaching the TMDL targets. It is recommended that a local watershed group work with the Ohio EPA to develop such a monitoring plan.

A biological and water quality study of the Upper Auglaize River, similar to that conducted by the Ohio EPA in 2000 will be scheduled when indications exist that major changes in the watershed have occurred. In addition, interim and/or surrogate measures that document progress in water quality improvement are recommended. Consideration must be given to the lag time between source control actions (habitat improvements and loading reductions) and observable/measurable instream effects, especially for nonpoint sources.

A tiered approach to monitoring progress and validating the TMDL will be followed; the tiered progression includes:

1. Confirmation of completion of implementation plan activities;
2. Evaluation of attainment of chemical water quality criteria;
3. Evaluation of biological attainment.

A TMDL revision will be triggered if any one of these three broad validation steps is not being completed or if the WQS are not being attained after an appropriate time interval. If the implementation plan activities are not being carried forth within a reasonable time frame as specified in the implementation plan then an intercession by a local watershed group or other appropriate parties would be needed to keep the implementation activities on schedule. Once the majority of (or the major) implementation plan items have been carried out and/or the chemical water quality has shown consistent and stable improvements, then a full scale biological and chemical watershed assessment would be completed to evaluate attainment of the use designations. If chemical water quality does not show improvement and/or water bodies are still not attaining water quality standards after the implementation plan has been carried out, then a TMDL revision would be initiated. The Ohio EPA would initiate the revision if no other parties wish to do so.

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