DRAFT

Maumee Area of Concern
Stage 2
Watershed Restoration Plan
Volume 1

January 2006

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This plan has been developed by the
Maumee RAP and the Duck and Otter Creeks Partnership,
in conjunction with the Ohio Environmental Protection Agency,
Toledo Metropolitan Area Council of Governments, and
other partners for the use and benefit of the Maumee AOC Community.

TMACOG

Maumee RAP
PARTNERING FOR CLEAN STREAMS

Duck and Otter Creeks
PARTNERSHIP, INC.

OhioEPA

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A Binational Great Lakes Program

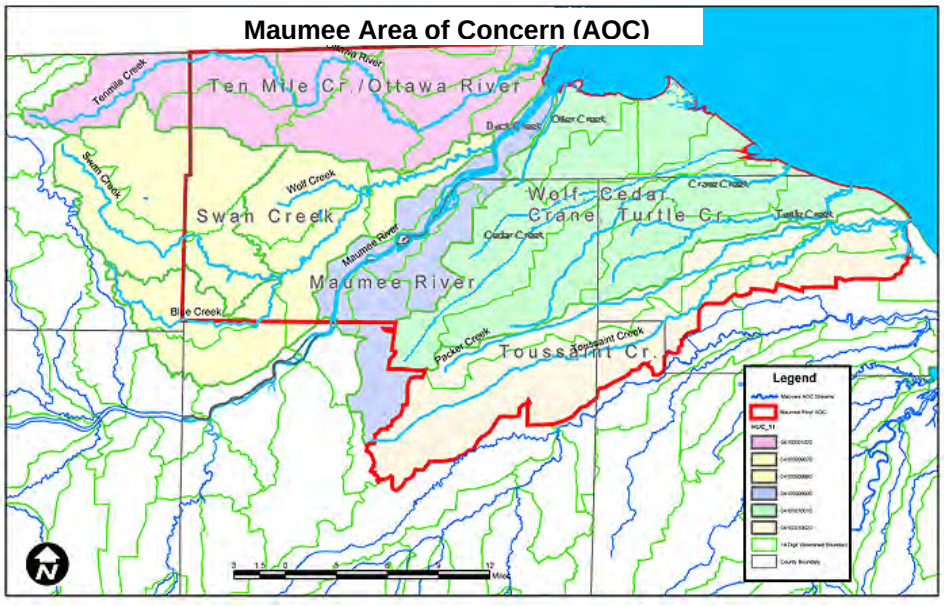
The International Joint Commission (IJC) is a binational organization established by the Boundary Waters Treaty in 1909 to advise the Governments of the United States and Canada on preventing or resolving problems along their common border. This Treaty addresses the pollution problems of the Great Lakes. Over the years the IJC has become involved in issues related to such matters as water and air quality, lake levels, and power generation.

To provide a coordinated cleanup effort on phosphorus and the resulting eutrophication of the Great Lakes, the *Great Lakes Water Quality Agreement* was signed by the two governments in 1972. This Agreement was later revised in 1978 in order to focus on toxics using an ecosystem approach, as well as further defining phosphorus control. This ecosystem approach called for an integrated and comprehensive perspective to restoring and protecting water quality throughout the Great Lakes. The IJC oversees the implementation of the *Great Lakes Water Quality Agreement.*

In 1985, based on the recommendations of the US Great Lakes states and Canadian provinces, the International Joint Commission's Water Quality Board identified forty-two Areas of Concern (AOC) in the Great Lakes basin. An AOC is an area where water uses are impaired or where objectives of the *Great Lakes Water Quality Agreement* or local environmental standards are not being achieved. Areas of Concern generally included major municipal and industrial centers on Great Lakes rivers, harbors, and connecting channels. Four AOCs are located in Ohio: Ashtabula, Cuyahoga, Black, and Maumee rivers.

Map by Environment Canada

The Maumee AOC was originally identified as the area extending from the Bowling Green water intake near Waterville along the Maumee River at river mile 22.8 downstream to Maumee Bay. The area includes direct drainage into the waters that are within Lucas, Ottawa and Wood counties. This includes Swan Creek, Ottawa River (Ten Mile Creek), Duck Creek, Otter Creek, Cedar Creek, Grassy Creek, and Crane Creek. In 1992, this area was extended to the east to include Turtle Creek, Packer Creek, and the Toussaint River. Heavy metals and organic chemical sediment contamination are what led to the lower Maumee River being classified as an Area of Concern.[1] Also a noted concern was that the Maumee River contributes the largest tributary load of suspended sediments and phosphorus to Lake Erie.[2]



The 1987 amendments to the *Great Lakes Water Quality Agreement* were signed in Toledo at the 1987 Biennial Meeting of the IJC. The amendments re-emphasized the ecosystem approach and required the development of specific programs to achieve the goals previously listed in the 1978 agreement. The amendments presented in Annex 2 were guidelines for the preparation of Remedial Action Plans to address the problems in the Areas of Concern and restore beneficial uses.

A Process: Remedial Action Plans

The process for the development of Remedial Action Plans (RAPs) to clean up Areas of Concern was outlined in Annex 2 of the *Great Lakes Water Quality Agreement.*[3] The plans were to be created in three stages:

Stage 1 – Identification of environmental problems and sources
Stage 2 – Elimination of the pollution source to improve water quality
Stage 3 – Protection of the improved state

Also outlined in Annex 2 were 14 beneficial use impairments (BUI) that were to be used to define the problems in Areas of Concern. These problems were negative changes in the physical, chemical or biological integrity sufficient to cause any of the following:

BUI #1 Restrictions on fish and wildlife consumption;
BUI #2 Tainting of fish and wildlife flavor;
BUI #3 Degradation of fish and wildlife populations;
BUI #4 Fish tumors and other deformities;
BUI #5 Bird or animal deformities or reproduction problems;
BUI #6 Degradation of benthos;
BUI #7 Restrictions on dredging activities;
BUI #8 Eutrophication or undesirable algae;
BUI #9 Restrictions on drinking water consumption, or taste and odor problems;
BUI #10 Beach closings;
BUI #11 Degradation of aesthetics;
BUI #12 Added costs to agriculture or industry;
BUI #13 Degradation of phytoplankton and zooplankton populations; and
BUI #14 Loss of fish and wildlife habitats.

Toxic substances, bacterial contamination, nutrient enrichment, and landfills are some of the causes of these environmental problems. Sources of these pollutants include urban storm water runoff,

commercial and residential development, municipal and industrial discharges, combined sewer overflows, sanitary sewer overflows, wastewater treatment plant bypasses, hazardous waste disposal sites, and agricultural runoff.

The development of Remedial Action Plans was to address the causes and sources of the use impairments. The RAPs would guide federal, state and local governmental agencies with the support of area business, industry, citizens and academia to restore the water quality and beneficial uses in each AOC. Ohio EPA was designated the lead agency for the RAP effort in Ohio. Local governments and citizens in the Maumee AOC expressed their interest in being involved in the process. The Toledo Metropolitan Area Council of Governments (TMACOG), with the assistance of Ohio EPA, organized the first Maumee Remedial Action Plan Public Meeting on October 1, 1987.

An Organization: Maumee RAP

The Maumee RAP as an organization was created after the first public meeting in October 1987. It has grown and changed over the years, but has always been a public-private partnership working to restore the health of our area's waterways to fishable and swimmable conditions.

The Maumee RAP involves a diverse cross-section of environmentally concerned businesses, industries, government agencies, non-profit organizations, educators, and citizens. The Maumee RAP Committee makes the official decisions for the organization and provides general program oversight. The Maumee RAP Committee has action groups (or sub-committees) that are integral to the progress of the Maumee RAP. These action groups address specific issues that affect the Maumee AOC, such as open space, wetlands, agriculture, rural, and urban concerns. There are two action groups utilizing a comprehensive watershed approach to improving Swan Creek and the Ottawa River. The Maumee RAP has focused on public outreach and education. This focus is ongoing and primarily coordinated through its own action group. Additional information on the Maumee RAP is available in Appendix B.

Since that initial public meeting a great deal of information has been compiled and developed concerning the Maumee AOC. Some of the reports written by the Maumee RAP include: *Maumee RAP Investigation Reports (1988, 1989)*; *Maumee RAP Stage I Investigation Report (1990)*; *Maumee RAP Recommendations for Implementation (1991);* and *Activities and Accomplishments in the Maumee AOC 1991-2001 (2002).*

The *Maumee RAP Stage I Investigation Report* identified the environmental problems of the Maumee AOC in 1990. This Report also identified the known sources of the pollutants and the impairments resulting from these problems. The *Stage I Report* was the first of three stages in the development of the complete remedial action plan trilogy. This document was referred to often during the development of the *Maumee Area of Concern Stage 2 Watershed Restoration Plan.*

The *Maumee RAP Recommendations for Implementation (1991)* was written as a comprehensive listing of the many issues and tasks that needed to be undertaken to restore the Maumee AOC. This report led to extensive sampling throughout the Maumee AOC and guided other research and community education projects.

The Maumee RAP continues to advocate and/or directly sponsor programs and activities to address the projects and issues outlined in the *Maumee RAP Recommendations for Implementation*. Many of these programs and activities, along with those projects conducted by others in the Maumee AOC

community were highlighted in the *Activities and Accomplishments in the Maumee Area of Concern 1991-2001 (2002).*

While the above documents were being prepared, many other activities were also occurring. Research was being conducted and issues were being addressed. These occurred from both within the RAP structure by the action groups and outside through community partners.

Community Partnerships

The Maumee RAP philosophy, process, and program all rely on the power of partnerships. Without community partners the Maumee RAP would not succeed and the Maumee AOC would not be restored. A very critical partner in the success of the Maumee RAP is the Duck and Otter Creeks Partnership. The Partnership worked very closely with the Maumee RAP to develop this document for the Maumee Area of Concern and provided nearly all of the information concerning the Duck Creek and Otter Creek watersheds.

The Duck and Otter Creeks Partnership promotes human and ecological health through education, protection, and restoration of these watersheds with diverse collaborative efforts dedicated to building community stewardship. The Partnership is a voluntary non-profit organization whose members include citizens, local businesses, industries, government agencies, institutions, and public organizations.

The membership in the Partnership is comprised of three main groups: voting members, non-voting members, and the Friends of Duck and Otter Creeks. Signing the Charter and paying annual dues are conditions of a voting membership and each individual and/or organization signing the Charter receives one membership vote. Individuals and/or organizations that do not sign the Charter may participate in the Partnership as non-voting members. A number of governmental groups participate as non-voting advisory members. For those individuals or businesses interested in financially supporting the mission and activities of the Partnership, but not interested in becoming a voting board member, the Friends of Duck and Otter Creeks provides an appropriate avenue. The Friends of Duck and Otter Creeks are not voting members, but receive occasional mailings and special invitations to events for a small annual donation. Additional information on the Duck and Otter Creeks Partnership is available in Appendix C.

The members of the Maumee RAP and their community partners, like the Duck and Otter Creeks Partnership, all share a common goal of taking the remedial action plan beyond planning and discussion, and putting it into action for the benefit of all who live, work and play in our watersheds.

References

[1] International Joint Commission Great Lakes Water Quality Board, 1985 as referenced in *Maumee River Remedial Action Plan Stage I Investigation Report*, TMACOG, Oct. 1990, p 1.

[2] *Maumee River Remedial Action Plan Stage I Investigation Report*, TMACOG, Oct. 1990, p 4.

[3] *Revised Great Lakes Water Quality Agreement of 1978 (as amended by Protocol signed November 18, 1987),* International Joint Commission, 1988, pp 31-36.

Introduction

- Why was this Plan Created?
- What is Included in the Plan?
- Why was the Plan Created this Way?
- Who Created the Plan?

Introduction *(last updated 1/20/06)*

The *Maumee Area of Concern Stage 2 Watershed Restoration Plan* (*Stage 2 Watershed Plan*) is a living document to guide and assist the Maumee Area of Concern community in restoration of the beneficial uses of the area's waterways. This living document will be updated as projects develop, funding opportunities arise, and problems are addressed. It will change and grow as needed to guide our region's activities through the next decade and beyond.

Why was this Plan Created?

This *Stage 2 Watershed Plan* was developed to meet a requirement of the Ohio Environmental Protection Agency (Ohio EPA) and Ohio Department of Natural Resource (ODNR) Watershed Coordinator Program[1] and to fulfill a Stage 2 report requirement for the Maumee Area of Concern (AOC). Each major update of this plan will be submitted to Ohio EPA and ODNR for state 319 watershed plan endorsement consideration until all sections are fully state endorsed. The plan was first submitted for endorsement consideration in December 2004. The January 2006 version was submitted for both state endorsement consideration and as a Stage 2 Report.

Also incorporated into the *Stage 2 Watershed Plan* is information used by Ohio EPA's Total Maximum Daily Load (TMDL) for Toussaint Creek and Ohio Department of Natural Resource's Coastal Nonpoint Source Program. All of these programs have the ultimate goal of having area waterways meet Ohio's Water Quality Standards; however, the language, titles, and methods differ for each. The *Stage 2 Watershed Plan* has attempted to address the requirements and/or needs of all of these programs, which made this document challenging to create. The *Stage 2 Watershed Plan* will be extremely useful as a comprehensive, integrated community master plan for improving the water quality of area streams, rivers, and ultimately, Lake Erie.

The Ohio EPA/ODNR Watershed Coordinator Program requires watershed action plans to be submitted by all organizations that receive watershed coordinator grants. These plans are to include topics and issues as outlined in *A Guide to Developing Local Watershed Action Plan in Ohio,*[2] specifically Appendix 8 as updated in 2003. There are two watershed coordinators working under this grant program in the Maumee AOC. These coordinators are working through the following organizations:

1) *Duck and Otter Creeks Partnership, Inc.*
   - Grant began: December 2000
   - Grant ends: December 2006
   - Focusing on Duck Creek and Otter Creek
2) *Toledo Metropolitan Area Council of Governments/Maumee RAP*
   - Grant began: October 2001
   - Grant ends: October 2007
   - Focusing on the Maumee AOC, plus the headwaters of the Ottawa River and Swan Creek

The Ohio EPA also has special responsibility for waterways of the Maumee AOC through its Lake Erie Program. Through this program, Ohio EPA assists the Maumee RAP in creating the 3 stages of reports required by the International Joint Commission (IJC) for all Great Lakes RAPs. There are not specific format requirements for these RAP reports; however they should state the local community's approach to meeting each stage.

The report for Stage 2 should provide an outline of the communities' approach to restoring the BUIs, utilizing the delisting targets develop by the State of Ohio as well as:

- An evaluation of remedial measures in place;
- An evaluation of alternative, additional measures to restore beneficial uses;
- Selection of the additional remedial measures;
- A proposed schedule for implementation;
- Identification of person or agencies potentially responsible for implementation;
- Utilizes an ecosystem approach to protection and restoration; and
- The public was adequately consulted.

The Ohio EPA Maumee RAP Coordinator is located in the Ohio EPA Northwest District Office to assist with the restoration and delisting of the Maumee AOC.

These three coordinators work closely to coordinate programs and implement mutually beneficial projects whenever possible. The creation of the *Stage 2 Watershed Plan* is an example of extensive collaboration among Ohio EPA, Toledo Metropolitan Area Council of Governments (TMACOG), Maumee RAP, and the Duck and Otter Creeks Partnership, as well as numerous community stakeholders and partners.

The *Stage 2 Watershed Plan* will serve as a "one-stop shop" for watershed planning and projects. This comprehensive plan includes information and maps regarding the establishment of areas of concern (AOCs) and remedial action plans (RAPs), an environmental background (i.e. hydrology, geology, ecoregions, land use, etc.), and information for six 11-digit hydrologic units, one large river unit, and detailed project lists for each major watershed.

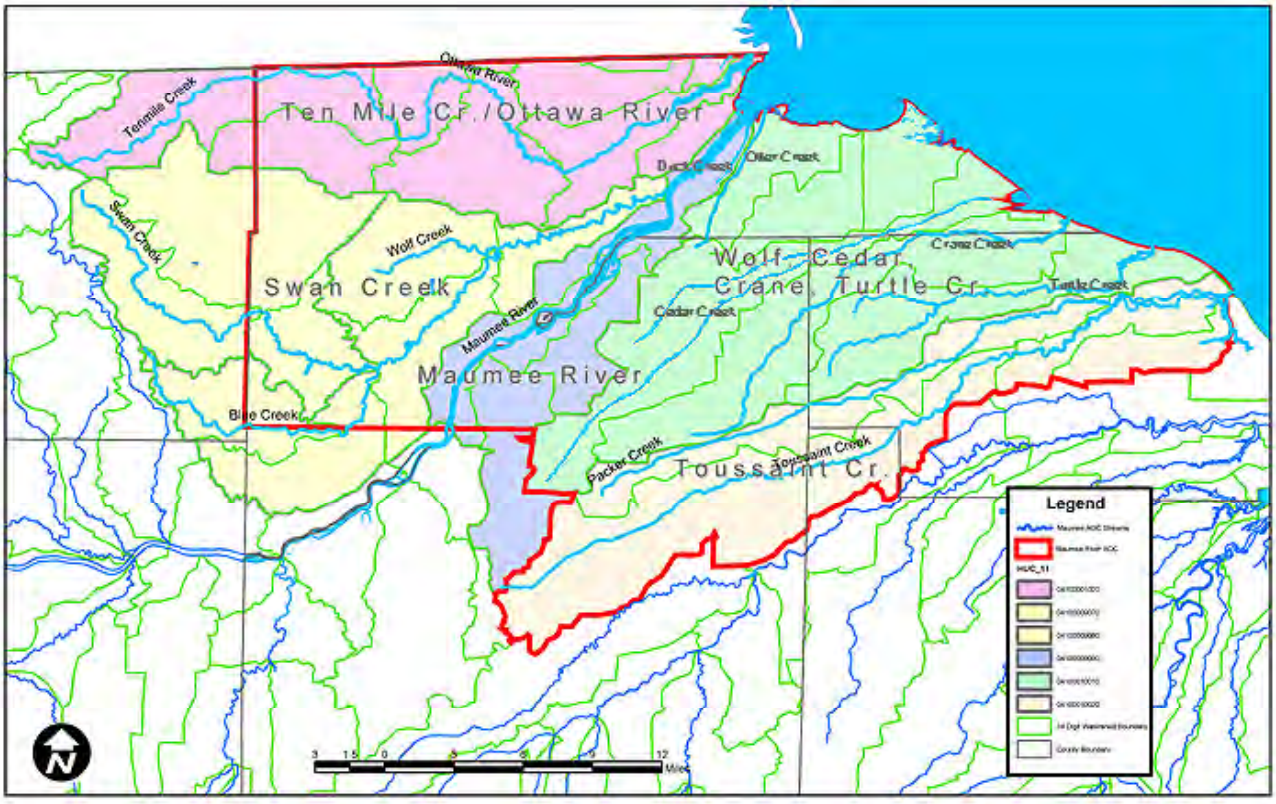
This integrated plan can make any agency, jurisdiction, or organization within the *Stage 2 Watershed Plan* area eligible to apply for numerous funding sources that often have higher rankings for RAP or watershed planning areas, especially Ohio EPA and ODNR grant programs (i.e. 319, Water Resource Restoration Sponsorship Program (WRRSP), Coastal Management Assistance). This plan is not just for the Maumee RAP or the Duck and Otter Creeks Partnership to implement, but it is intended to serve as a summary of actions needed by everyone that lives, works or sets policy to improve water quality in this area.

What is Included in the Plan?

The *Stage 2 Watershed Plan* has been organized based on the watershed referencing standard "Hydrologic Units." This U.S. Geological Survey (USGS) nomenclature describes drainage areas through a hierarchical system of "Hydrologic Unit Codes" (HUCs). The more digits in the drainage area's code, the smaller the area. Eight digit HUCs are roughly equivalent to river basins, 11-digit HUCs are equivalent to principle watersheds, and 14-digit HUCs are smaller or sub-watersheds. For instance:

04 = Great Lakes [2 digits]
041000 = Western Lake Erie [6 digits]
04100009 = Lower Maumee River [8 digits]
04100009 080 = Swan Creek (above Blue Creek to Maumee River) [11 digits]
04100009 080 040 = Wolf Creek [14 digits]

Maumee Area of Concern plus Headwaters



The *Stage 2 Watershed Plan* focuses on the Maumee AOC, plus the headwaters of the Ottawa River and Swan Creek. Whenever the Maumee AOC is referred to throughout the document, it includes these headwaters unless otherwise noted. Although these areas are not officially within the Maumee AOC they are often addressed by RAP projects.

The formal boundaries of the Maumee AOC extend from the Bowling Green water intake near Waterville along the Maumee River (RM 22.8) downstream to Maumee Bay. This area includes direct drainage into the waters that are within Lucas, Ottawa, and Wood counties. The watersheds include Ottawa River (Ten Mile Creek), Swan Creek, Grassy Creek, Duck Creek, Otter Creek, Wolf Creek, Cedar Creek, Crane Creek, Turtle Creek, Packer Creek, and the Toussaint River. The entire Area of Concern drains ultimately to Lake Erie. The Maumee AOC is comprised of six 11-digit HUCs and one large river unit. For ease of use, this plan has put both Swan Creek HUCs into one chapter and addressed the large river unit with the HUC that it flows through. The map illustrates the Maumee AOC, 11-digit HUC areas, large river unit area, and watershed grouping used throughout this document.

Significant efforts have taken place to address the water quality needs since the establishment of the Maumee AOC in 1985. This plan builds on the problems listed in the *Maumee RAP Stage 1 Report,*[3] actions outlined in the *Recommendations Report,*[4] and activities highlighted in the *Activities and Accomplishment in the Maumee Area of Concern (1991-2001).*[5]

This document was not intended to be read cover to cover. Volume 1 was designed to be used as an environmental background reference source. Volume 2 was created as a listing of what needs to be done, who might be responsible for doing it, how it might be funded, and the benefit to restoring the water quality.

Volume One of this plan provides a general environmental setting and the conditions of the Maumee AOC by HUC and watershed. Volume 2 is the "living" portion of the plan. It includes Watershed Project Tables by HUC and major watershed as follows:

HUC 04100001 020
- Ten Mile Creek/Ottawa River Watershed Projects Table

HUC 04100009 070 and 04100009 080
- Swan Creek/Blue Creek Watershed Projects Table

HUC 04100009 090
- Maumee River Watershed Projects Table
- Grassy Creek Watershed Projects Table
- Duck Creek Watershed Projects Table

HUC 04100010 010
- Otter Creek Watershed Projects Table
- Wolf Creek/Amlosch Ditch Watershed Projects Table
- Cedar Creek Watershed Projects Table
- Crane Creek Watershed Projects Table
- Turtle Creek Watershed Projects Table

HUC 04100010 020
- Packer Creek Watershed Projects Table
- Toussaint Creek/Toussaint River/Rusha Creek Watershed Projects Table

The Watershed Project Tables (WPTs) are the portion of the report that will change and grow, as projects are implemented and goals are attained. These tables have been organized by the Causes and Sources of pollutants and include Projects, Potential Project Partners, Funding Sources, Timeline, Status, Performance/Environmental Measures, HUC/Stream Segment Addressed, and indicate the Beneficial Use Impairment (BUI) that could be effected by the project. Also incorporated into the tables (where applicable) is a reference to the ODNR Coastal Management Measures that may benefit from the implementation of an identified project.

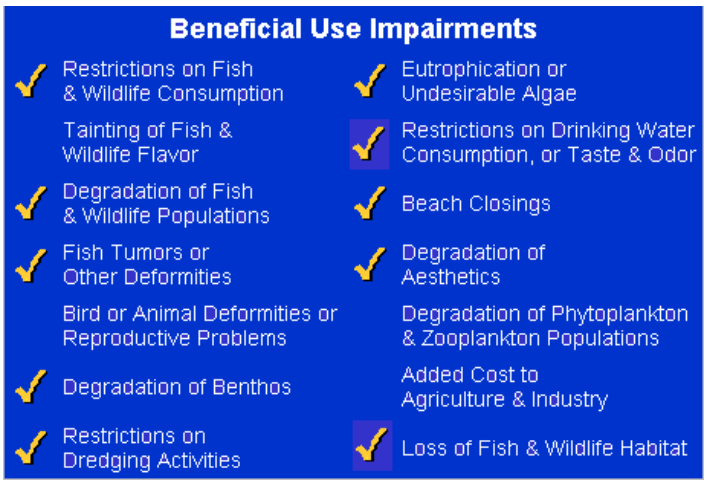
There are differing levels of detail in the WPTs, often depending on how soon a project will be implemented, what source will be funding it, or by the amount of data available for that watershed. The status of projects in the WPTs have been organized and color coded as follows:

- **In Progress**: These projects are currently funded, have a detailed workplan, and are underway. *In progress* projects have the text colored red in the WPTs.
- **Planning**: These projects may have a rough workplan or grant application developed, but are lacking a component(s) to make it implementable (i.e. project coordinator, funding, project site). These are usually shorter range projects. *Planning* projects have the text colored pink in the WPTs.
- **Concept**: These project may be needed or desired, but a plan or method for implementation has not been developed. These are usually longer range projects. *Concept* projects have the text colored blue in the WPTs.
- **Ongoing**: These projects are reoccurring projects that regularly repeat; usually annually. These are commonly public involvement, outreach or educational projects (i.e. cleanups, sampling, monitoring). *Ongoing* projects have the text colored green in the WPTs.
- **Complete**: These projects have been finished. Many past activities have been recorded in previous reports. Some of them have been kept here to explain past steps that are leading/developing to future projects. (i.e. hot spot delineation to risk assessment to remedial design). *Complete* projects have the text colored black in the WPTs.

Why was the Plan Created this Way?

The format was selected for the *Stage 2 Watershed Plan* to help facilitate the clean up and delisting of the Maumee AOC, while still meeting the needs of the other integrated programs.

Delisting of an AOC is based upon restoration of 14 beneficial use impairments (BUIs). According to the *Maumee RAP Stage 1 Investigation Report*, 10 of the 14 beneficial use impairments needed to be addressed in the Maumee AOC. This report did not identify impairments by watershed, only for the entire Maumee AOC, because the only means of delisting in 1990 was through a total restoration of the entire AOC.



An incremental approach to delisting was adopted in 2001 by the U.S. Policy Committee and has provided an improved means of measuring RAP progress.[6] Prior to this recommendation it was difficult to track progress because the emphasis was on total restoration of an AOC. This incremental alternative allows stream segments of an AOC to be delisted as they are restored or a beneficial use impairment to be delisted as established goals are achieved. This provides for a truer representation of the tremendous amount of work being invested in AOCs, as opposed to the measurement of progress based only on whether an entire AOC had been delisted.

With the possibility of incremental delisting and the development of this *Stage 2 Watershed Plan,* the Maumee RAP and Duck and Otter Creeks Partnership with the help of other community partners, has re-evaluated the 1990 BUIs identified in the *Maumee RAP Stage 1 Report*. This re-evaluation was conducted based on data and information available in the late 1980s/early 1990s and resulted in BUI summary tables for each watershed in the Maumee AOC (see Volume 1 – HUC/Watershed chapters). From these new tables the Maumee RAP will be able to better determine progress toward restoration of a watershed and/or a beneficial use.

Another interim step that was adopted by the US Policy Committee in 2001 was the possibility of redesignating a watershed or stream segment as being in a Recovery Stage. This Recovery Stage option can be utilized post-implementation when the area is responding to actions taken. This was adopted as a means to report that no further active intervention is needed, and that a period of recovery is required to fully achieve the delisting target.[7]

With the new flexibility of incremental delisting and the possibility of an Area of Recovery designation, Ohio created *Delisting Targets for Ohio Areas of Concern (June 2005)* to outline the minimum delisting targets acceptable under State of Ohio regulations and policies, and to provide Ohio's RAPs with a baseline from which to develop targets and milestones that may be specific to their AOC. BUI summary tables have been created based on the criteria outlined in *Delisting Targets for Ohio Areas of Concern* and the data available for each watershed (see Volume 1 – HUC/Watershed chapters).

Who Created this Plan?

The creation of the *Stage 2 Watershed Plan* involved numerous community members, including members or staff of the Ohio EPA, TMACOG, Maumee RAP, Duck and Otter Creeks Partnership, Toledo Area Metroparks, The University of Toledo, local businesses, government agencies, and citizens. Numerous opportunities were provided for other governmental agencies, academia, businesses, non-profit organizations, and citizens to review and comment on this report, including two formal review periods for a targeted audience in September 2005 and for potential users in November 2005.

The staff for the Maumee RAP (Ohio EPA and TMACOG) and Duck and Otter Creeks Partnership facilitated the creation of the *Stage 2 Watershed Plan*. They will also be responsible for maintaining this as a living document that includes updating completed projects and adding any new projects being planned or implemented.

The Development Team utilized the publications and knowledge of many organizations, agencies, and personnel that have been working for decades on water quality issues in the Maumee AOC. Although volumes of environmental background information were available, Volume 1 of the *Stage 2 Watershed Plan* primarily created utilized only a few documents,[8] especially the *Areawide Water Quality Management Plan (208 Plan).*[9] Additional historical, cultural, and environmental information not presented within this report is available within the other referenced documents.

Special thanks to the dedicated Development Team, who put their hearts and souls into the research, facilitation, and creation of this plan from February 2004 to January 2006.

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References

[1] *A Guide to Developing Local Watershed Action Plan in Ohio*, Ohio EPA, June 1997 and *Appendix 8 updated*, Ohio EPA, 2003.
[2] *A Guide to Developing Local Watershed Action Plan in Ohio*, Ohio EPA, June 1997 and *Appendix 8 updated*, Ohio EPA, 2003.
[3] *Maumee River Remedial Action Plan Stage I Investigation Report*, TMACOG, October 1990.
[4] *Maumee River Basin Area of Concern Remedial Action Plan Recommendations for Implementation Vol. 4*, TMACOG, July 1991.
[5] *Activities and Accomplishments in the Maumee Area of Concern (1991-2001)*, Maumee RAP, April 2002.
[6] *Restoring United States Great Lakes Areas of Concern: Delisting Principles and Guidelines*, Adopted by the U.S. Policy Committee, December 2001, pp 4-5.
[7] *Restoring United States Great Lakes Areas of Concern: Delisting Principles and Guidelines*, Adopted by the U.S. Policy Committee, December 2001, p 5.
[8] *Maumee River Remedial Action Plan Stage I Investigation Report*, TMACOG, October 1990; *Maumee River Basin Area of Concern Remedial Action Plan Recommendations for Implementation Vol. 4*, TMACOG, July 1991; *Areawide Water Quality Management Plan (208 Plan)*, TMACOG, 2004.
[9] *Areawide Water Quality Management Plan (208 Plan)*, TMACOG, 2004.

Natural Resources

- Rivers and Watersheds
- Ecoregions
- Geology
- Soils
- Wetlands
- Public and Protected Lands
- Fisheries and Wildlife
- Rare, Threatened, and Endangered Species
- Exotic Species

The long-term stability of a watershed is determined by the viability and sustainability of its natural resources. This chapter of the *Stage 2 Watershed Plan* includes information about the physical, biological, chemical, and habitat characteristics of the Maumee Area of Concern plus the headwaters.

Rivers and Watersheds

Every pollutant that is removed or eliminated from the Maumee AOC has an added benefit of improving Ohio's greatest natural resource ~ Lake Erie. Lake Erie provides numerous benefits to those who share this watershed, including: fresh water for drinking, industrial resources, shipping, transportation, recreation, and enjoyment for its own sake. The river and streams within the Maumee AOC affect Lake Erie and Lake Erie often affects the Maumee AOC. Because of this relationship details of this Great Lake are also provided.

Western Lake Erie/Maumee Bay (041000)

Lake Erie is the oldest, smallest, and shallowest of the Great Lakes. It is also the warmest, most turbid, most biologically productive, and most eutrophic. Lake Erie is divided into eastern, central, and western basins. The Eastern Basin has an average depth of 80 feet and holds lake water 322 days. The Central Basin is the largest, with an average depth of 61 feet and a detention time of 635 days. The Maumee AOC is within the Western Basin, which has an average depth of 24 feet and a detention time of 51 days. The Western Basin extends from the Lake's west end at Toledo to Cedar Point at Sandusky.[1]

> *Lake Erie is unusual among the Great Lakes for two reasons. First of all, it is extremely shallow. At its deepest, in the eastern end of its basin, the lake is 210 feet deep. In its western end, west of the series of islands north of Catawba, depths average only 24 feet and rarely exceed 30 feet. Secondly, the axis of the lake is oriented almost parallel to both the prevailing winds from the west and southwest, and to the less common but more destructive storm winds that comes from the northeast.*
>
> *Wind, passing over a lake, creates waves. In addition, due to frictional drag, the wind actually pushes some of the surface water of the lake in the direction toward which it is blowing. … The water level at the eastern end of the lake may be raised by as much as 5-6 feet, while in the western end, near Toledo, will be lowered by an equal amount. …*
>
> *This "slosh" back and forth is a characteristic feature of all lakes, and it is particularly strongly developed in lakes that happen to be large, long, and shallow, like Lake Erie. Technically, such an oscillation of water from one end of the lake to the other, produced by wind or by strong changes in atmospheric pressures, is called a seiche, or wind tide. The period, or time necessary for the water to move both ways across a lake, varies; in Lake Erie the period of the seiche is 14 hours. … The maximum difference in level of water recorded at the west end of the lake (at Toledo) is about 12 feet, but this maximum almost never occurs; most seiches produce a difference of not more than a foot or two in the elevation of the lake.*[2]

The seiche effect explained above can, and does, cause local flooding, sediment erosion, and pollutant movement both up and downstream in most of the Maumee AOC waterways. The wind effect can be stronger than downstream river flows, causing the surface water of the streams to actually follow backwards. The seiche effect area for the Maumee River has been seen as far upstream as the Maumee-Perrysburg Bridge (State Route 25/US Route 20)(RM 15.1). The effect area for the Ottawa River has been seen as far upstream as Auburn Ave. (RM 8.8) and beyond Hawley St. (RM 2.6) on Swan Creek.[3] Other streams in the Maumee AOC that flow directly to Lake Erie, or whose mouths are in the seiche zone, are similarly affected.

Maumee Bay is in the southwestern corner of Lake Erie and is approximately 21 square miles. The northern boundary of the bay is Woodtick Peninsula, a four-mile spit of land extending south from the State of Michigan, with the southern boundary referred to as Little Cedar Point in Ohio. Both areas are marshes with the southern spit being armored and smoothly defined. The landward side of the Woodtick Peninsula is shallow with bars and marshes, and dotted with small islands. Maumee Bay is divided into approximately two equal parts by the federal navigation channel that serves the Toledo Harbor.[4]

Between 1844 and 1970 the southern shoreline of Maumee Bay had retreated 2,000 feet. In 1976, the average depth of Maumee Bay was 2 feet less than in 1844, and the reduction has been attributed to deposition of sediments from culturally induced processes. "The shallow depths, wind and wave activity tend to sustain high background turbidity in the Bay."[5]

Maumee River (04100009 090)
The Ohio EPA addresses the Maumee River mainstem as an independent Large River Unit. For the purposes of this report, the information on the Maumee River within the Maumee AOC is included under this Hydrologic Unit along with Grassy Creek and Duck Creek.

The Maumee is the largest Great Lakes tributary, draining all or part of 17 Ohio counties, two Michigan counties, and five Indiana counties. The total river basin covers 8,316 square miles. The mainstem of the Maumee River is approximately 130 miles in total length with 105 miles in Ohio. Only the lower 22.8 miles of the Maumee River is included in the Maumee AOC, therefore only this lower portion is addressed by the *Stage 2 Watershed Plan.*

The Maumee mainstem begins in Fort Wayne at the confluence of the St. Joseph and St. Mary's rivers. It flows through Defiance and Napoleon, and then into Toledo. Along the way the Maumee is joined by several major tributaries: the Tiffin, Auglaize, and Blanchard rivers. In Wood and Lucas counties, several smaller streams flow into the Maumee: Beaver Creek and Tontogany Creek from the south; and Swan Creek, which joins the Maumee in downtown Toledo. The area in Wood and Lucas counties draining directly into the Maumee River is comparatively small. Most drainage flows to the tributaries, which then flow into the Maumee River. Most of the Oak Openings Region is in the Maumee River Basin and a large part of the basin south of the river is in the area formerly covered by the Great Black Swamp.

The Maumee River was designated a State Scenic River on July 18, 1974 from the Ohio/Indiana state line to the US Route 24 bridge west of Defiance. This Scenic River designation includes 43 miles of the Maumee River. It also designated as a State Recreational River in July 1974 from the US Route 24 bridge west of Defiance to the Maumee/Perrysburg Bridge (State Route 25/US Route 20) at RM 15.1. This Recreational River segment includes 53 miles of the Maumee River. These

two designated areas have special restrictions on development, permitted discharged, etc. within them.

The highest elevations of 1,100 feet above mean sea level occur in the Michigan portion of the watershed. At the Ohio/Indiana border the elevation of the Maumee River is 707 feet above mean sea level. While at its mouth at Maumee Bay, the river is 573 feet above mean sea level, dropping an average of 1.3 feet per mile.[6] The steepest section is between Waterville and Maumee, at 5 feet per mile.[7] Below Rossford, the Maumee is at the same elevation as Lake Erie.[8]

Grassy Creek is one of the tributaries that joins the Maumee River within the Maumee AOC and is included in this HUC. Grassy Creek combined with the Grassy Creek Diversion have a drainage basin of 38.6 square miles.[9] Grassy Creek flows parallel to the Maumee River starting in Perrysburg and flowing toward Rossford where it joins with the Maumee River at RM 9.2.

Duck Creek is 3.27 miles long and begins at Hecklinger Pond in East Toledo. It flows northeasterly back and forth over the Toledo/Oregon city limits. Duck Creek is the last stream to join with the Maumee River (RM 0.25) before it enters Maumee Bay.

Swan Creek (04100009 070 and 04100009 080)
The drainage area of Swan Creek is 204 square miles. Its headwaters rise in Henry, Fulton and western Lucas counties. Over 200 miles of creeks and ditches drain this watershed. Swan Creek itself is only about 40 miles long.[10] Swan Creek's gradient is similar to the Maumee River with a drop of 2.1 feet per mile. Swan Creek is the only major tributary to the Maumee River that is located within the Maumee AOC.

The headwaters of Swan Creek flow southeasterly through Fulton County until joining with Blue Creek to flow in a northwesterly direction toward downtown Toledo and the Maumee River. The major streams that feed Swan Creek are Ai Creek, Blue Creek, and Blystone Ditch. Tributaries to Swan Creek that have extensive floodplain lands are Wolf Creek, Blystone Ditch, Stone Ditch, Cairl Creek, Drennan Ditch, and Heilman Ditch.

Ottawa River/Ten Mile Creek (04100001 020)
The Ottawa River is 45 miles long with a drainage basin of 220.9 square miles; 146.7 of which are in Ohio.[11] Its average gradient is 4 feet per mile.[12] The watershed begins in northeastern Fulton County where the river is known as Ten Mile Creek. It flows east through Lucas County, where it is joined by the North Branch of Ten Mile Creek from Lenawee and Monroe counties (Michigan). The river continues to flow through Lucas County until it joins Maumee Bay and Lake Erie in Monroe County. Low lake levels and sedimentation have made the river shallow and difficult to navigate.

Halfway, Silver, and Shantee creeks are also included under this HUC. These creeks flow along similar paths to the Ottawa River; back and forth along the Ohio/Michigan state line, ultimately ending up in north Maumee Bay and Lake Erie. Compared to the Ottawa River, these creeks have relatively small watersheds, draining 18.6 square miles in Ohio and 36.9 in Michigan.[13]

Lake Erie Tributaries (04100010 010)
The Lake Erie Tributaries are a series of watersheds that flow in a northeasterly direction directly to Maumee Bay or Lake Erie. Otter Creek is 7.98 miles long. It flows northeasterly from Northwood through Oregon and Toledo towards Maumee Bay. Otter Creek is the first stream after the Maumee River to discharge into the south side of Maumee Bay.

Wolf Creek is the watershed immediately east of Otter Creek with Cedar, Crane, and Turtle creeks following. Wolf Creek (a.k.a. Berger Ditch) has a drainage area of 15.9 square miles.[14] Wolf Creek also begins in Northwood flowing through Oregon where it joins with Berger Ditch, then emptying into Maumee Bay at Maumee Bay State Park marina.

Cedar, Crane, and Turtle creeks flow in a similar northeasterly direction and are each 20 to 25 miles in length. Each of these waterways flows through mostly agricultural lands and small villages, such as Walbridge, Millbury, and Clay Center. The Cedar Creek drainage area when combined with Big Cooley Creek, and Reno Side Cut (a.k.a. Cooley Canal) is 58.3 square miles. Crane Creek drainage area is 55.5 square miles and the Turtle Creek drainage area is 41.5 square miles.[15]

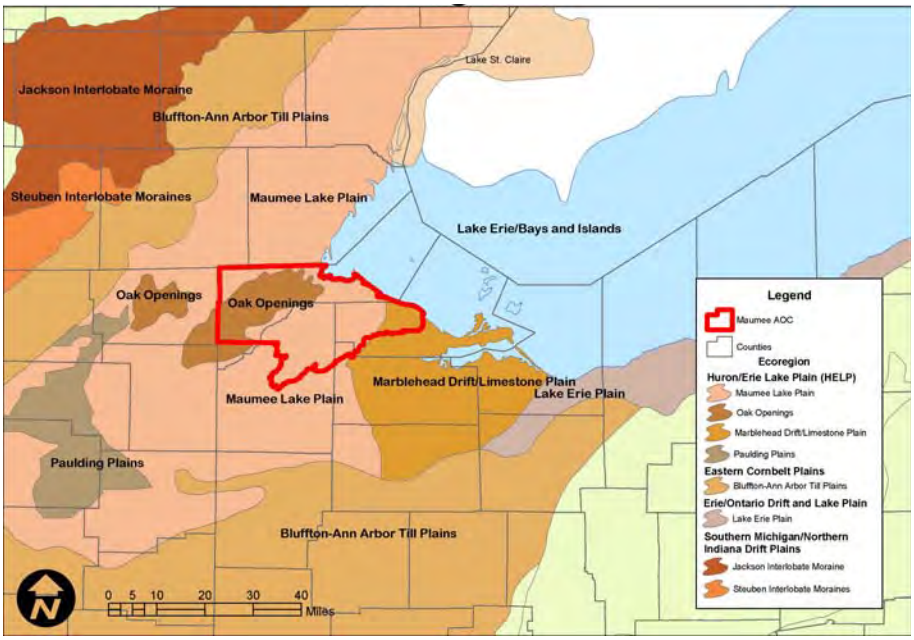
Toussaint River (04100010 020)
The Toussaint is a small Black Swamp river that flows from northern Bowling Green in Wood County, through Luckey, Genoa, and Rocky Ridge, and into Lake Erie in Carroll Township of Ottawa County. The entire drainage area covers 143.1 square miles. Toussaint Creek is 96.3 square miles of the total drainage area. Packer Creek is the Toussaint's primary tributary with 34 square miles of drainage. Rusha Creek enters the Toussaint River near the mouth with a drainage area of 12.8 square miles.[16] Above its confluence with Packer Creek, the Toussaint is considered a creek; below it, the Toussaint widens to become a river as it reaches lake level.

Major Watersheds of the Maumee AOC[17]

Hydrological Unit Code (11-digit)	Description	Watershed Acres	River Basin	Total Basin Square Miles
04100009 090	Maumee River (below N. Granger Island to Lake Erie [except Swan Cr.])	48,892	Maumee	6,586 in Ohio; 8,316 total
04100009 080	Swan Creek (above Blue Creek to Maumee River)	69,291	Maumee	
04100009 070	Swan Creek (headwaters to above Blue Creek)	61,224	Maumee	
04100001 020	Ten Mile Creek/Ottawa River	141,376	Ottawa	147 in Ohio; 221 total
04100010 010	Otter Creek, Wolf Creek, Cedar Creek, Crane Creek, and Turtle Creek	131,023	Lake Erie Tributaries	204
04100010 020	Toussaint Creek	91,616	Toussaint	143

Ecoregions

Ecoregions of Northwest Ohio

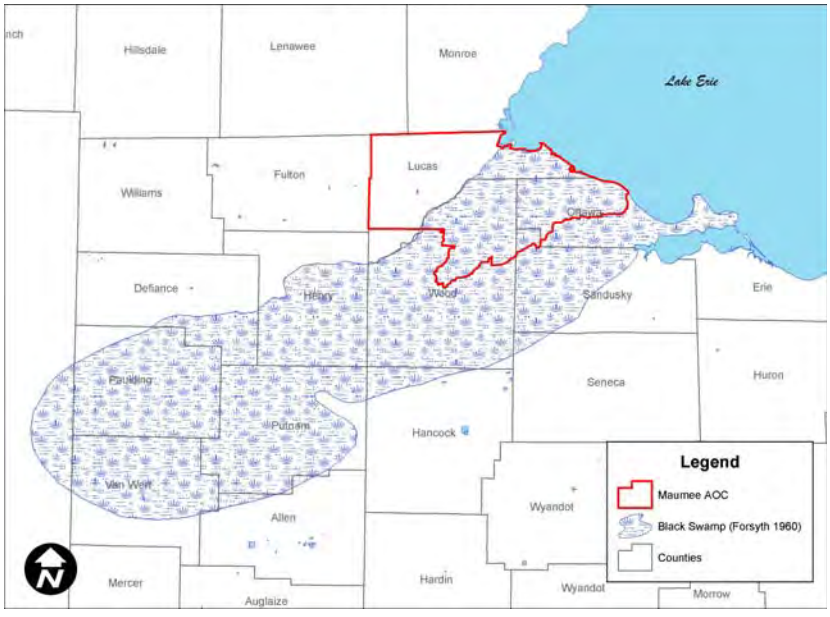


The Great Lakes area is divided into ecoregions, which denote areas of generally similar ecosystems. These large landscape areas are defined by climate, physical characteristics of the landscape, and the plants and animals that are able to live there. Ecoregions contain many different physical settings and biological communities, which occur in predictable patterns.[18] They are designed to serve as a framework for the research, assessment, management, and monitoring of ecosystems.[19]

The entire Maumee AOC is within the Huron/Erie Lake Plains (HELP) Ecoregion. This Ecoregion takes its name from being formed by retreating glacial lakes. US EPA describes it as "Fine, poorly-drained, water-worked glacial till and lacustrine sediment; also coarser end moraine and beach ridge deposits." Described below are several areas of the HELP Ecoregion that have special ecological importance in the Maumee AOC.

Great Black Swamp

Great Black Swamp

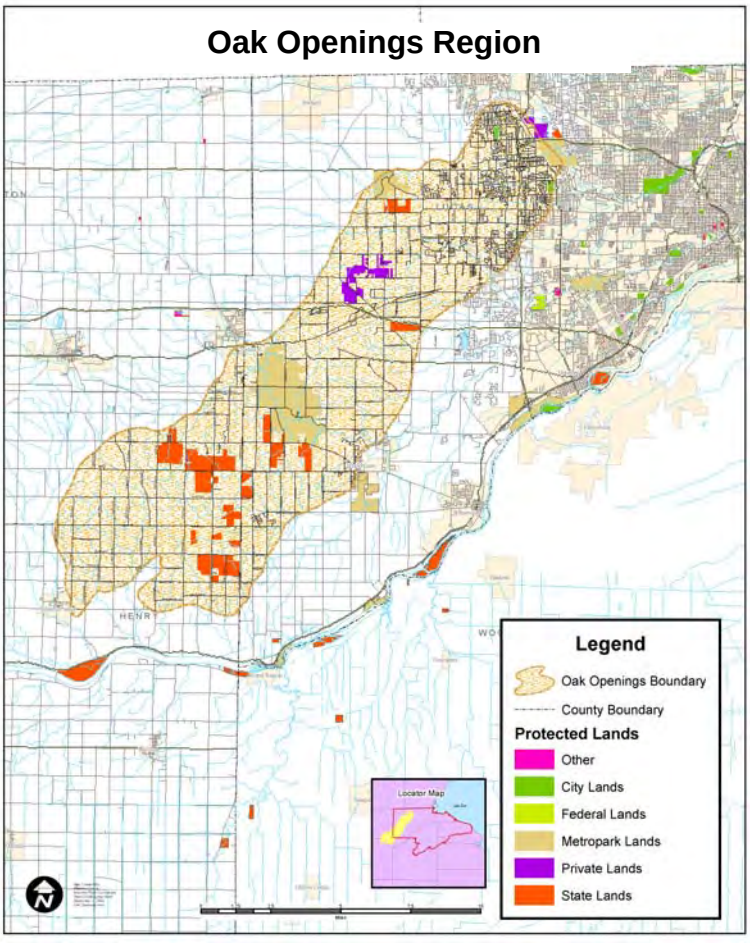


Part of the Huron/Erie Lake Plains Ecoregion is the Great Black Swamp. The black muck associated with this Swamp gave the area its name.[20] Large parts of the Maumee River and Maumee Bay watersheds, and Lake Erie direct drainage areas are formerly part of this Swamp. The Swamp is oriented northeast southwest along the south side of the Maumee River, it is about 100 miles long and 20-30 miles wide.[21] Like the entire Lake Plains area, the Swamp was glacial lake bottom. It is flat and is dominated by soils that have a high clay content and very low permeability, with an occasional sand ridges or lenses. Some parts of the Lake Plains area have shallow bedrock, and seasonally high groundwater is common.

The Great Black Swamp was covered with wet forests of hardwood, shallow lakes, and wet prairies. Between the water, vegetation, mosquitoes and malaria, and heavy, sticky (and sometimes deep) mud, European settlers found the Swamp an obstacle to development. The difficulties presented by the Swamp to the early settlers and soldiers are clearly indicated in their writings, of which the following are excerpts (taken from pages 3-7 of a paper by Martin R. Kaatz in the 1955 Annuals of the Association of American Geographers). David Zeisberger, a Moravian missionary, describes the "deep swamps and troublesome marshes," where no bit of dry land was to be seen, and the horses at every step wading up to their knees," it took him two and a half days to travel from Sandusky to the Maumee River, a distance of about 30 miles. Joseph Badger refers to the "hideous swamps" and Brown wrote about the problems faced by General Hull's army in the War of 1812: "man and horse had to travel mid leg deep in mud" and "the mud was ankle deep in our tents." [22] As a result of these difficulties, northwest Ohio was the last part of Ohio to be settled.

"This period saw a steady annual increase in the number of miles of streams which were ditched. In 1850, the Black Swamp of northwestern Ohio, which was about 120 miles (193 km) long and averaged 40 miles (64 km) wide, was still undrained except for isolated areas about its periphery."[23] In 1859 a law providing for public ditches was passed. This law resulted in the entire Black Swamp being drained through extensive ditch systems and more people began to settle there. By 1900, most of the Great Black Swamp was gone.

It has been estimated that there are three miles of man-made ditches to every mile of natural stream. Today, there are "square mile" ditches along many roads in Wood and Ottawa counties. Drainage ditches make productive farming possible, but many do not provide fish or wildlife habitat. Ditches that lack buffer areas and are farmed up to the ditch bank provide a route for nutrients and sediment runoff to Lake Erie.



Despite draining and channelizing streams, the Swamp is still there. It remains subject to flooding and Black Swamp streams could be good candidates for restoration and re-establishment of habitat by expanding floodplains and wetlands. Habitat areas on these headwater streams support the base of the food chain, which ultimately feeds Lake Erie.

Oak Openings

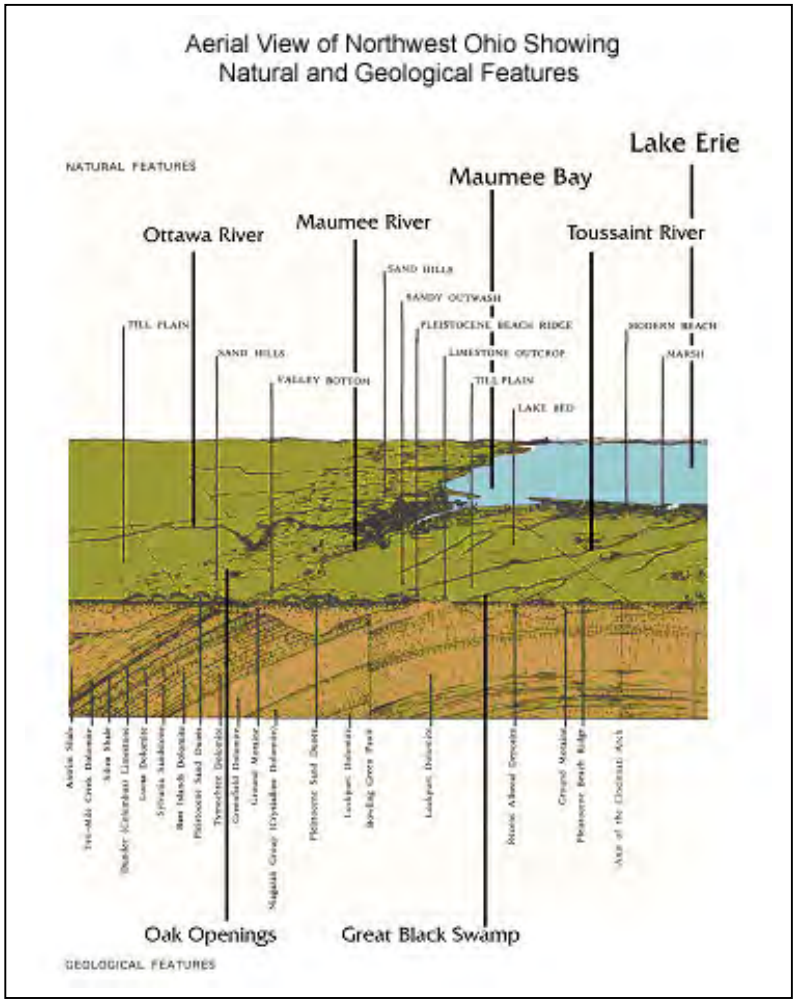
The Maumee AOC's single most important natural habitat area is the Oak Openings region, which borders the Great Black Swamp. The Maumee RAP calls for preservation and acquisition of fish and wildlife

habitats, specifically recommending wet prairies and oak savannahs of western Lucas County, in the Oak Openings area.[24] The *Swan Creek Plan of Action* gives its highest priority to preserving floodplains and wetlands as natural habitats.[25]

The Oak Openings Region, located within portions of the Swan Creek and Ottawa River watersheds, is a 130 square mile area supporting globally rare oak savanna and wet prairie habitats. It is home to more rare species of plants and animals than any other area of Ohio. Its trees, plants, sandy soils, wet prairies, and floodplains benefit the region by acting as natural filters for our air and water.

Natural floodplain corridors occur between the Oak Openings Region and Lake Erie along the Maumee River, Swan Creek, and Ottawa River. Preserved natural floodplains in these areas help to balance the effects of development and the resulting downstream effects of increased urban runoff. Floodwater is slowed within the broad forested areas of the floodplain allowing for groundwater replacement and evaporation to take place.

The Oak Openings Region with its wet prairies and savannas, together with the connecting corridors along the Maumee River, Swan Creek, and Ottawa River should be given the highest priority for preservation. By maintaining the natural character of these areas, they will continue to benefit humans and wildlife long into the future.



Geology

To understand the geology of the Maumee AOC you need to begin with the bedrock, and the overlying layers of gravel, sand, silt, and clay left behind by glaciers and glacial lakes. Most of the bedrock in the region is dolomite, a magnesium-bearing form of limestone. There are a number of different layers of dolomite in the region, of different ages and chemical compositions. These differences result in differing commercial uses and values; physical strength; and presence, depth, and quality of groundwater. There are smaller areas of sandstone and shale, notably in northwestern Lucas County.

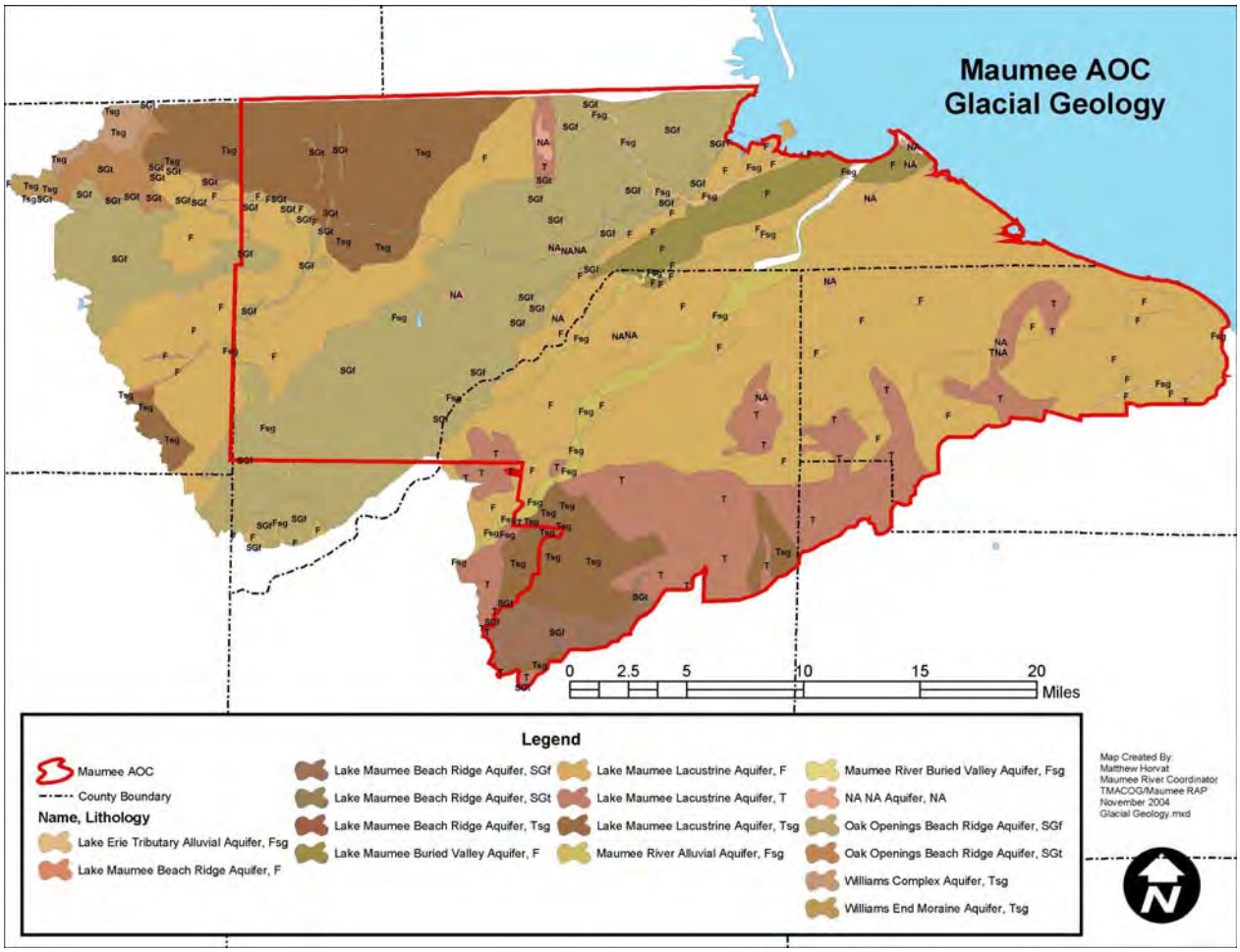
The soils and terrain of the region result from the advance and retreat of glaciers and glacial lakes. Between 14,000 and 12,200 years ago glaciers advanced and retreated across Ohio at the end of the Ice Age. During this time a series of lakes covered what is now the Lake Erie basin, at elevations ranging from 640 to 800 feet. Lake Erie came into existence about 12,000 years ago at an elevation of about 492 feet, compared with today's level

at 571 feet. The glacial lakes from oldest to youngest are known to geologists as Lakes Maumee, Arkona, Ypsilanti, Whittlesey, Warren, Wayne, Grassmere, Lundy, and Erie. Lake bottoms left behind flat silt-clay deposits that became the Great Black Swamp. Former beaches are now sand ridges, and retreating glaciers left behind moraines.[26]

The Maumee AOC includes three major geological areas. Starting from the west there are Sand Hills. These are former beach areas of glacial lakes that include the Oak Openings Region and prairies. Some areas are well drained, although the sandy soils are the region's best farmland.

The center of the area is Lake Plain. This former lake bottom includes the Great Black Swamp. This area is very flat, with heavy, slow-draining silt and clay soils. Originally there were many wet prairies, shallow lakes, and forests. Since settlers cleared the forests and built artificial drainage, the area has become some of the state's most productive farmland.

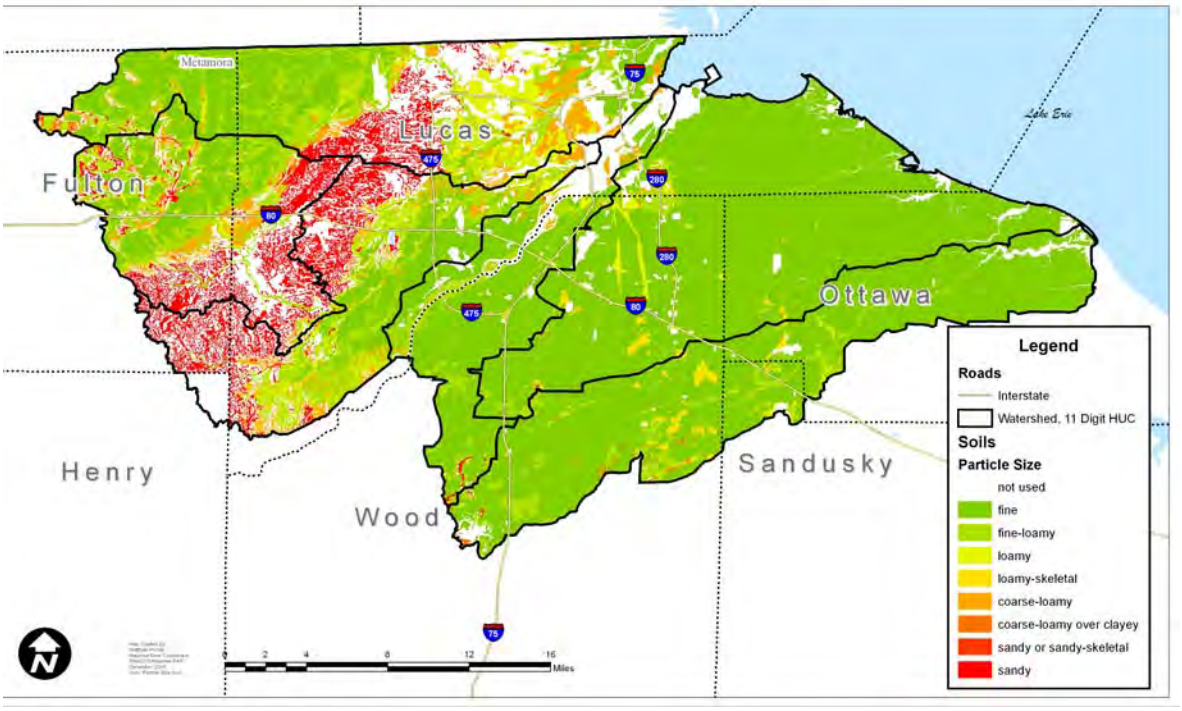
The third geologic area is Lake Erie itself. All drainage from Northwest Ohio leads to Lake Erie. The Lake provides water for residents and commerce, as well as recreation and habitat for fish and wildlife.



Soils

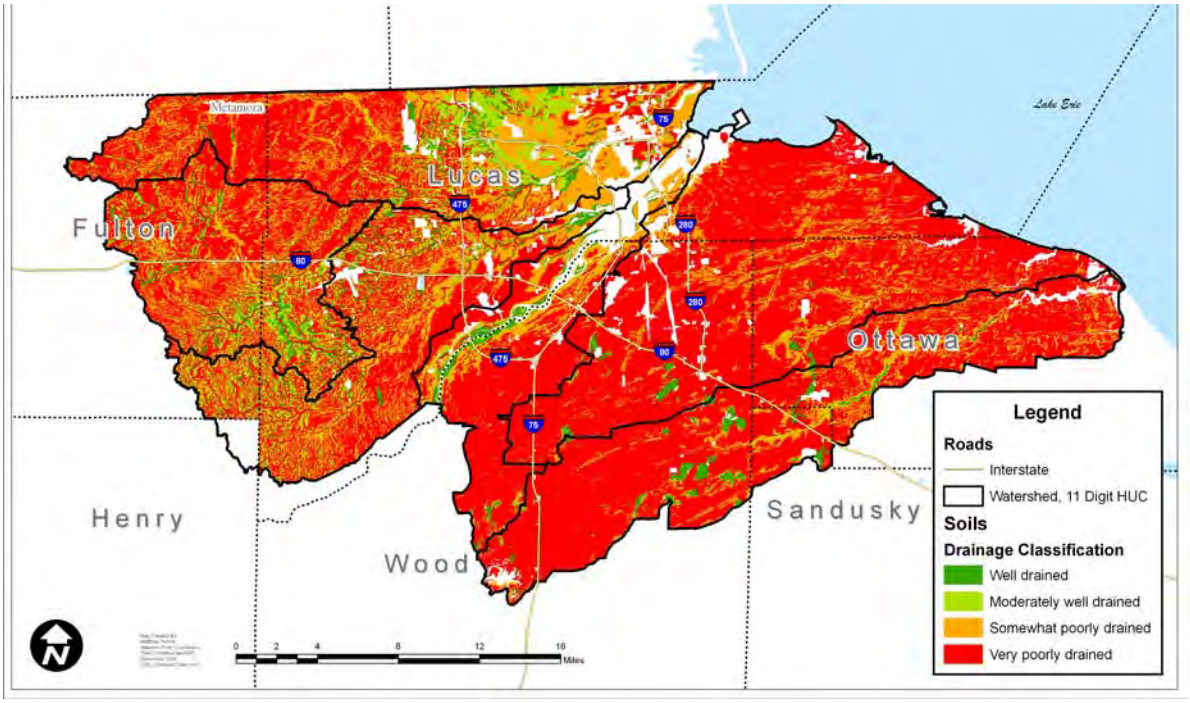
The characteristics of soil are determined by the interaction of five factors of soil formation: climate, plants and animals, parent materials, relief, and time. The relative effect of each factor varies from place to place. Climate and vegetation act on the parent material and gradually change it to a natural body of soil. Relief modifies the effects of the climate and vegetation, mainly through its influence on runoff and temperature. And time is needed for soil to form from parent material; generally, a long period of time is required for distinct soil horizons to develop.[27]

Soils by Particle Size



The soils of the Maumee AOC and headwater areas level to gently sloping and are very poorly drained and somewhat poorly drained. Lucas County formed in clayey and loamy lake-laid sediment and water-reworked glacial till on broad flats of an old glacial lake.[28] Wood County lies entirely within the lake plain formed by the glacial lakes that preceded the present Lake Erie. This flat plain is traversed by sand ridges that extend generally east-northeastward representing former beaches, dunes, and offshore bars of the lake stage known as Lake Warren.[29] Ottawa County soils are post-glacial in origin, and most of the county is in the lake plain of the glacial Lake Maumee. Glacial lake sediments in which the soils formed are variable in thickness. The lake plain sediments covering most of Ottawa County are underlain by glacial till, which is further underlain by limestone.[30]

Soils by Drainage Classification

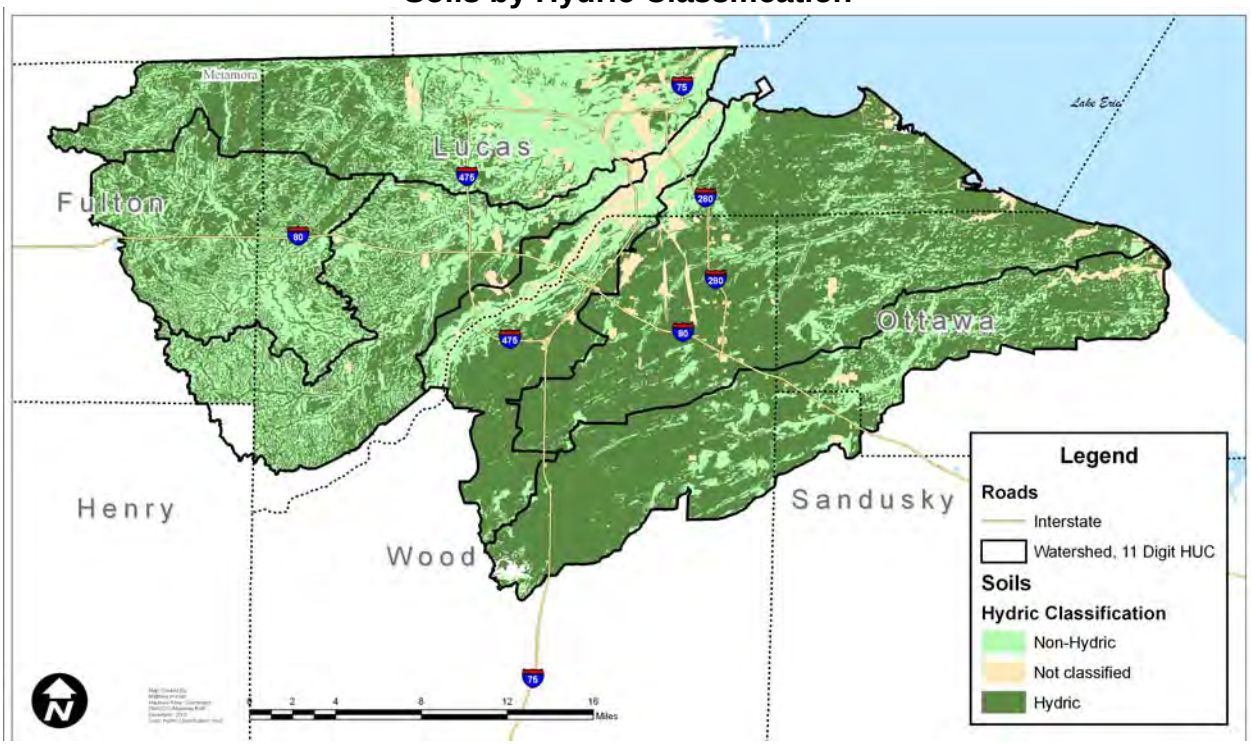


The drainage classes shown in the map above refer to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening a of channels or the blocking of drainage outlets. Of the seven drainage types, four apply to our area as defined below:[31]

- *Well drained*: Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons.
- *Moderately well drained:* Water is removed from the soil somewhat slowly during some periods. These soils are wet for only a short time during the growing season, but periodically they are wet long enough that most cops are affected.
- *Somewhat poorly drained:* Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of come sops unless artificial drainage is provided.
- *Very poorly drained:* Water is removed from the soil so slowly that free water remains at or on the surface during most of the rowing season. Unless the soil is artificially drained, most crops cannot be grown.

Hydric soils are soils that are grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of bare soil to permit infiltration.[32] Mapping the hydric soils can be very helpful when done in conjunction with wetland mapping. Using these two maps together can help to direction wetland mitigation and restoration opportunities in the Maumee AOC and headwater areas.

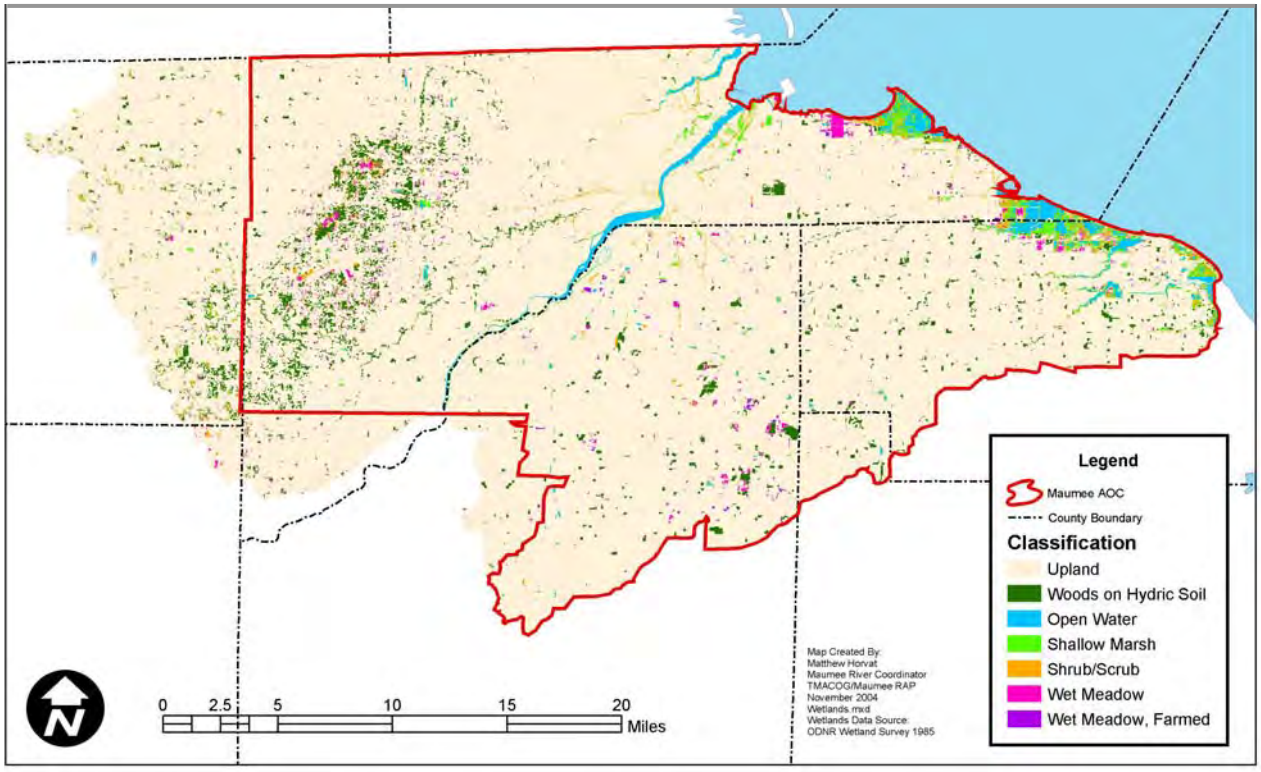
Soils by Hydric Classification



Wetlands

Wetlands are one of the most valuable and fragile components of a watershed, but for many years they were filled and drained for agriculture and development. We now know that wetlands are crucial to the health of our waters and wildlife.[33]

Wetlands in the Maumee AOC



The Maumee AOC includes the largest stretches of undeveloped Ohio Lake Erie coastline. It is a remnant of a 300,000 acre marsh which bordered most of western Lake Erie from Vermilion, Ohio to Gibraltar, Michigan.[34] These coastal natural areas provide important habitat for insects, small fish, and many birds. The Lake Erie marshes gained fame during the late 1800s as some of the best waterfowl hunting areas in the United States. As early as 1890 much of the wetland area was being operated for private shooting. By the end of 1951, the entire 30,000 acres of remaining marshland along Lake Erie, from Toledo to Sandusky, was under private club ownership. Today the region still supports some of the most intensively developed and managed waterfowling clubs in the Midwest.[35]

These clubs include wetlands but also provide shoreline habitat and natural beauty for both recreational users and residents. With a good habitat base, these coastal areas are a strong tourism attraction for hunting, bird-watching, and hiking. Public areas within these significant coastal areas have been set aside as preserves or to provide public access, including Maumee Bay State Park, Cedar Point National Wildlife Refuge, Ottawa Wildlife National Refuge, Metzger Marsh, Magee Marsh, Crane Creek State Park, and Toussaint Creek Wildlife Area. *(see Public and Protected Lands section)* The Davis Besse Nuclear Power Station site preserves a large area of coastal wetlands that supports Lake Erie fisheries and wetlands.

Public and Protected Lands

Recreational usage (swimming, boating, and fishing) and waterfront parks must share the limited shoreline with shipping and port activities, municipal wastewater and industrial facilities, wetlands that are managed for waterfowl, agricultural activities, historic preservation sites, and private home sites. Public access and enjoyment of the shoreline is a necessary element in establishing local commitment to improving water quality. The public and protected lands in the Maumee AOC are shown on the map below with some of the more significant properties explained in the paragraphs that follow.

The Maumee AOC has a variety of waterfront parks, public, and protected lands. Water provides a natural attraction for people who enjoy active or passive recreation. Municipal parks provide picnicking, walking paths, and waterfront access within Toledo, Oregon, Rossford, Maumee, Perrysburg, and Waterville.

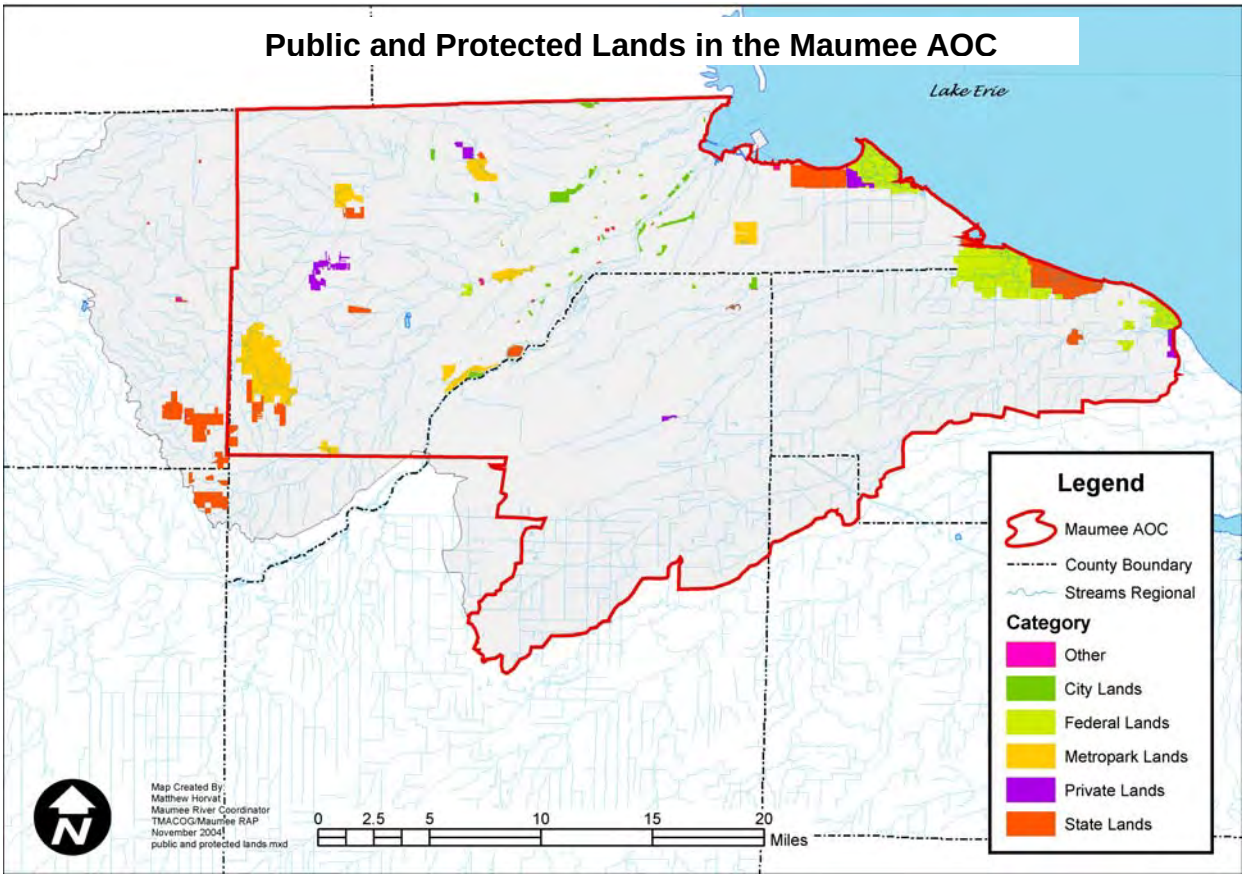
The Metroparks of the Toledo Area administers over 8,000 acres of natural, historical, and cultural parklands in Lucas County. Eleven parks and two recreational trails provide access and interpretation in northwest Ohio's premier natural areas: the Oak Openings Region; the Great Black Swamp; and Maumee River, Ottawa River, Swan Creek Corridors.[36]

The Toledo Metroparks are creating and preserving a system of natural area parks to be held in public ownership and maintained in essentially an unimpaired form for the use and enjoyment of this and future generations. They are also acquiring and preserving historic areas of our region. Recreational facilities are provided including picnic areas, playgrounds, and playfields. Nature trails for hiking, bird watching, jogging, bicycling, and winter skiing are also provided on Metropark lands.

Designated historical sites are the focus of several parks in the Maumee AOC, including Fort Meigs, Fort Miami, the Side Cut canal locks and Fallen Timbers Battlefield Monument in the Side Cut Metropark. Other sites are Fort Deposit and Roche de Boeuf at Farnsworth Metropark, and the Miami-Erie canal lands, Lock #10, Isaac Ludwig Mill, and the Providence Dam at the Providence Metropark. All areas offer fine riverfront views, picnicking, hiking, and play areas.[37]

Maumee Bay State Park is a 1,336 acre state resort that is located along two miles of the south shore of Maumee Bay. This park offers lake oriented activities, such as a lakefront beach, marina, pier fishing, a 3-mile hiking trail, and a 2-mile handicapped accessible boardwalk through wetlands and other natural areas.

Crane Creek State Park comprises 79 acres of beach and marshlands adjoining the Magee Marsh



Wildlife Area and Ottawa National Wildlife Refuge. The park includes a 3,500 foot sandy beach and a handicapped accessible one-half-mile boardwalk on a remnant beach ridge which offers exceptional bird watching opportunities. It is common to observe more than one hundred species of birds in one day during times of migration.

The Ohio Department of Natural Resource also manages the Maumee State Forest (3,068 acres) and several nature preserves in the western portion of the Maumee AOC including Irwin Prairie (223 acres) and Louis W. Campbell (169 acres). The Kitty Todd Preserve is a 672 acre nature preserve that is managed by The Nature Conservancy.[38]

The City of Toledo has small city parks throughout Toledo and a few larger ones such as the Ottawa Park on the Ottawa River (RM 10). Walbridge Park (RM 9), Promenade Park (RM 4.5), International Park (RM 3.75), and Jamie Farr Park/Riverfront NW Park (RM 3.0) are all located directly along the Maumee River providing public access to this valuable resource. The City of Toledo has established walking paths along Swan Creek from Summit St. (RM 0.2) to the Erie Street Market (RM 0.9). A variety of native plant materials have been placed along the Walk to help

prevent bank erosion and beautify the area. The Maumee RAP helped to fund these plantings and signage. The City of Toledo also built a dock along the Riverwalk at the Erie Street Market for canoe and pontoon boat access to Swan Creek.

There are five state and federally owned wildlife refuges within the Maumee AOC. These refuge areas are important for migratory birds, fisheries, and wildlife. This area of the western basin of Lake Erie lies at the intersection of the Mississippi and Atlantic flyways. As much as 70 percent of the Mississippi flyway population of black ducks uses Lake Erie marshes for migration.[39]

The two national refuges are Cedar Point National Wildlife Refuge and the Ottawa National Wildlife Refuge. The Cedar Point National Wildlife Refuge is 2,445 acres that is entirely marsh except for the dikes and a few remnant beaches covered with hardwoods. The open bay outside of the diked system is known as Potter's Pond. This 15 acre pond is open for fishing during the summer months.[40] The Ottawa National Wildlife Refuge is 5,794 acres. This refuge averages 130,000 visitors annually and offers interpretive foot trails, wildlife observation, and excellent photographic opportunities. This diked wetland is maintained for migratory waterfowl.[41]

There are three state wildlife areas in the Maumee AOC, Metzger Marsh State Wildlife Area, Magee Marsh State Wildlife Area, and Toussaint State Wildlife Area. The Metzger Marsh State Wildlife Area consists of 558 acres of diked wetlands. The site is managed to provide optimum vegetation for wetland wildlife. With the restoration of the outer dike along Lake Erie, this site is now used for waterfowl hunting, trapping, and fishing.

Magee Marsh State Wildlife Area is a diked 2,000 acre waterfowl hunting area which is allowed on a controlled, hunt-by-permit basis only. This site is also the home of the Crane Creek Wildlife Research Station. Biologist at the research station are responsible for statewide research and management of wetland dependent wildlife, including waterfowl, furbearers, and endangered wetland species, such as the bald eagle.[42]

The Toussaint Wildlife Area is 236 acre wildlife area of which three-quarters is managed wetlands and open water areas. The Toussaint River runs through and divides the wildlife area. The site is managed to encourage natural waterfowl foods, and use by migrating waterfowl and other wetland wildlife.[43]

Fisheries and Wildlife

In 1887 Maumee Bay was believed to be the most prolific fish spawning ground in Lake Erie.[44] The Black Swamp area contained a fish fauna dominated by species requiring a habitat with rooted aquatic vegetation and with water almost entirely free of clayey silts.[45]

In 1815, Samuel Brown, an officer with General Harrison, described Maumee Bay as being similar to Sandusky Bay in resembling a little lake and that "within the bosom of this bay grow several thousand acres of follie avoine (wild rice)."[46] He commented that "the quantity of fish at the rapids (Grand Rapids) is almost incredible. ... So numerous are they at this place that a spear may be thrown at random, and will rarely miss killing one! ... Some days there were not less than 1,000 taken with the hook within a short distance of the fort, and of an excellent quality. ... The river, Swan Creek (in downtown Toledo), and the shoals of the bay, swarm with ducks, geese, etc. The woods are filled with deer, elk and wild turkeys."[47]

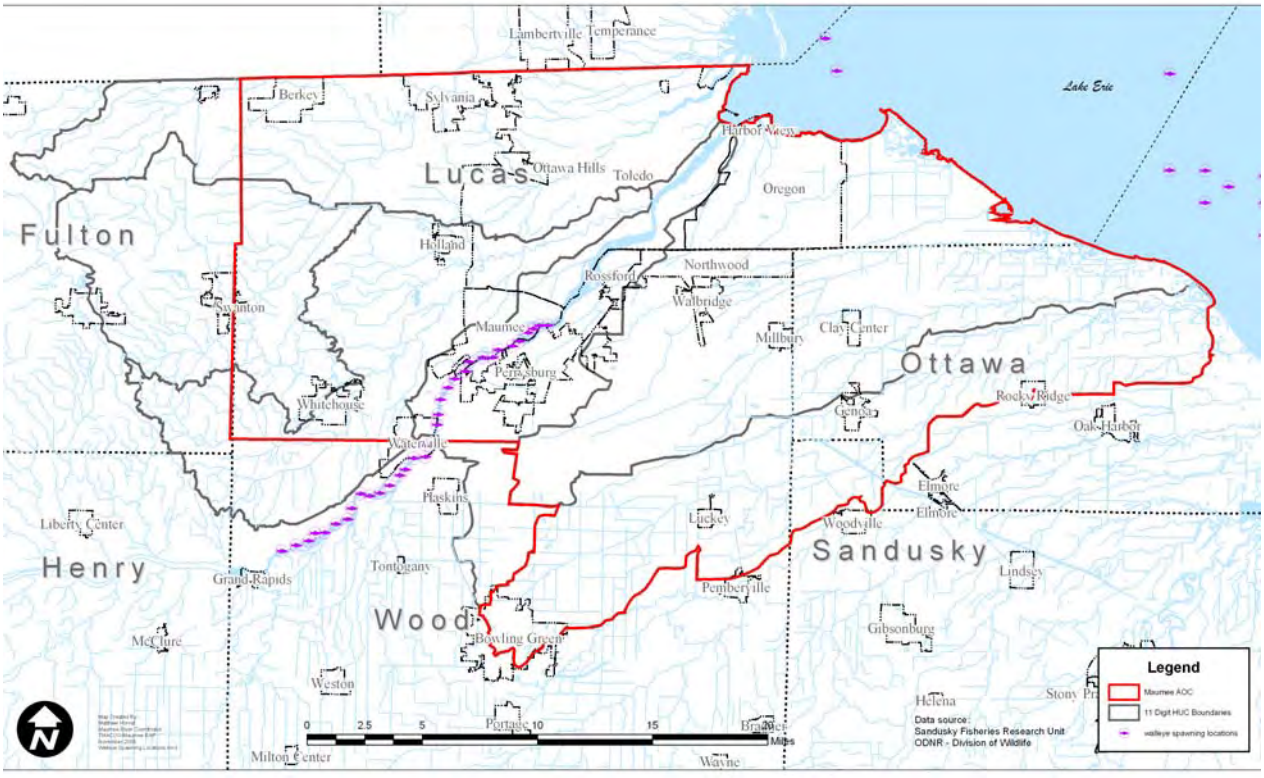
By 1927-28 pollution at the mouth of Maumee Bay was an acute fishery problem but the Bay, beyond a few miles, was not yet greatly affected. “Maumee Bay was the most polluted area in the western basin and contained the most phytoplankton due to the large nutrient load from the Maumee River during 1928-30 (Wright, 1955).”[48] Valuable clear water fish began to be superseded in the Bay by species more tolerant of low dissolved oxygen and turbidity. Phenol and industrial wastes in 1930 had not yet affected algae and crustacea. Large beds of aquatic vegetation were present in the Maumee River until about 1950, after which only small remnants remained.[49]

Problems that may be effecting the fishery in Maumee Bay today include increased predation on fry due to a decrease in marshy areas for protection and sand and gravel removal from the Bay causing reduced spawning habitat. Also, the thermal discharge from the Toledo Edison power plant is suspected of causing premature spawning, an increase in carp and goldfish, diversion of fish migration, unnatural feeding habits in fish, thermal stress, and killing of zooplankton.[50]

Prior to 1953 the dominant organism in the mud bottom of western Lake Erie was the mayfly, *Hexagenia*. After 1953 they declined from an average of 400 larvae per square meter to virtually none by 1965.[51] This was due to eutrophication which became extreme during the 1960s. Fortunately, the mayfly has shown a resurgence in Maumee Bay in the early 2000s.

Despite land use and population pressures on the Maumee River, it continues to be a major spawning area for Lake Erie walleye. The Maumee River offers the largest population of migrating walleyes east of the Mississippi River. These walleye populations are made up of two separate groups of fish. The group migrating from Lake St. Clair comprises about 40 percent of the population and the rest come from the Western Basin of Lake Erie. The walleyes migrating up the Maumee River from the Western Basin are a separate group than the fish that spawn on the reefs of Lake Erie. Once these fish near the mouth of the river they will stage in Maumee Bay before making the run up river.

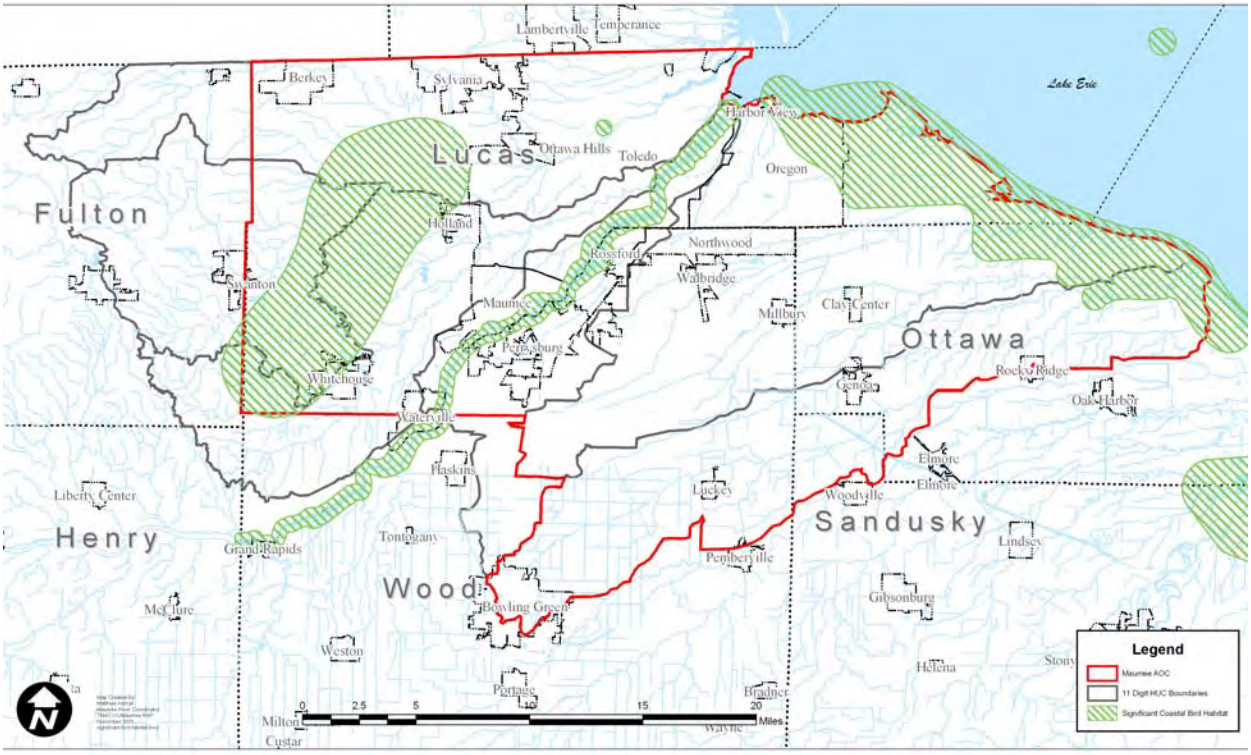
Walleye Spawning Locations



Spawning in the Maumee River usually begins shortly after the ice breaks up on Lake Erie with peak spawning typically occurring in mid- to late-April.[52]

It is also worth noting that northern pike are commonly caught in the Maumee River just upstream of the borders of the Maumee AOC at the Providence Dam near Grand Rapids. These can be caught just after the ice breaks up in early spring.[53]

Significant Bird Habitat



Lake Erie represents one of the most diverse and important habitats in the country because of its location at the intersection of the Mississippi and Atlantic flyways. During spring and fall migrations, bird watchers from across the country and around the world flock to the area to observe more than 300 bird species. Some of the largest areas of protected marshland along the Lake Erie shoreline are location within the Maumee AOC. The protection of these critical breeding grounds and migration stopover sites is extremely important for animal populations far beyond our watersheds. The Magee Marsh and Metzger Marsh State Wildlife Areas, the Ottawa National Wildlife Refuge Complex, Crane Creek State Park, and the eastern portion of the Toussaint River, encompasses more than 8,000 acres and provides a major feeding, nesting, and resting area for migrating birds. This area is Ohio's number one birding destination for many species such as: bald eagles, great blue herons, great egrets, green herons, American coots, herring gulls, and pied-billed grebes. [54]

Rare, Threatened, and Endangered Species

Many kinds of wildlife have come and gone in Ohio throughout the past centuries. About 200 years ago, buffalo, bears, timber wolves, elk, and river otters lived here along with many other kinds of

wildlife. Wildlife becomes endangered for primarily one reason, their habitat is destroyed. Habitat loss and degradation are by far the most serious problems faced by wildlife.[55]

Federal and state laws afford extra protection for endangered species. Some of these laws are aimed at restricting or eliminating the economic benefit of selling or trading endangered species. Other laws protect the species habitat as well as the species itself. Below are two tables of the endangered species. The table of animals includes those species that are endangered throughout Ohio. The table of plants includes those in Lucas, Wood, and Ottawa counties; many of which are found in the Oak Openings Region. A comprehensive list of all rare, threatened, endangered, and extirpated species would require numerous pages of tables, therefore only the endangered species are listed here. A complete listing is available through the Ohio Department of Natural Resource.

Endangered Animals in Ohio[56]

MAMMALS	Indiana bat, *Myotis sodalis*
	Allegheny woodrat, *Neotoma magister*
	Bobcat, *Felis rufus*
	Black bear, *Ursus americanus*
	Snowshoe hare, *Lepus americanus*
BIRDS	American bittern, *Botaurus lentiginosus*
	Bald eagle, *Haliaeetus leucocephalus*
	Northern harrier, *Circus cyaneus*
	Peregrine falcon, *Falco peregrinus*
	King rail, *Rallus elegans*
	Sandhill crane, *Grus canadensis*
	Piping plover, *Charadrius melodus*
	Common tern, *Sterna hirundo*
	Black tern, *Chlidonias niger*
	Yellow-bellied sapsucker, *Sphyrapicus varius*
	Bewick's wren, *Thryomanes bewickii*
	Loggerhead shrike, *Lanius ludovicianus*
	Golden-winged warbler, *Vermivora chrysoptera*
	Kirtland's warbler, *Dendroica kirtlandii*
	Lark sparrow, *Chondestes grammacus*
	Osprey, *Pandion haliaetus*
	Trumpeter swan, *Cygnus buccinator*
	Snowy egret, *Egretta thula*
	Cattle egret, *Bubulcus ibis*
REPTILES	Copperbelly water snake, *Nerodia erythrogaster neglecta*
	Eastern plains garter snake, *Thamnophis radix radix*
	Timber rattlesnake, *Crotalus horridus horridus*
	Eastern massasauga, *Sistrurus catenatus*
REPTILES *(continued)*	Lake Erie water snake, *Nerodia sipedon insularum*
AMPHIBIANS	Eastern hellbender, *Cryptobranchus alleganiensis alleganiensis*
	Blue-spotted salamander, *Ambystoma laterale*
	Green salamander, *Aneides aeneus*
	Cave salamander, *Eurycea lucifuga*
	Eastern spadefoot, *Scaphiopus holbrookii*
FISHES	Ohio lamprey, *Ichthyomyzon bdellium*
	Northern brook lamprey, Ichthyomyzon fossor
	Mountain brook lamprey, *Ichthyomyzon greeleyi*
	Lake sturgeon, *Acipenser fulvescens*
	Shovelnose sturgeon, *Scaphirhynchus platorynchus*
	Spotted gar, *Lepisosteus oculatus*
	Cisco or lake herring, *Coregonus artedi*
	Pugnose minnow, *Opsopoeodus emiliae*
	Popeye shiner, *Notropis ariommus*
	Blackchin shiner, *Notropis heterodon*
	Blacknose shiner, *Notropis heterolepis*
	Mississippi silvery minnow, Hybognathus nuchalis
	Blue sucker, *Cycleptus elongatus*
	Longnose sucker, *Catostomus catostomus*
	Blue catfish, *Ictalurus furcatus*
	Mountain madtom, *Noturus eleutherus*
	Northern madtom, *Noturus stigmosus*
	Scioto madtom, *Noturus trautmani*
	Pirate perch, *Aphredoderus sayanus*
FISHES *(continued)*	Western banded killifish, *Fundulus diaphanus menona*
	Spotted darter, *Etheostoma maculatum*
	Shortnose gar, *Lepisosteus platostomus*
	Goldeye, *Hiodon alosoides*

	Speckled chub, *Macrhybopsis aestivalis*
MOLLUSKS	Fanshell, *Cyprogenia stegaria*
	Butterfly, *Ellipsaria lineolata*
	Elephant-ear, *Elliptio crassidens crassidens*
	Purple catspaw, *Epioblasma obliquata obliquata*
	White catspaw, *Epioblasma obliquata perobliqua*
	Northern riffleshell, *Epioblasma torulosa rangiana*
	Long-solid, *Fusconaia maculata maculata*
	Pink mucket, *Lampsilis orbiculata*
	Sharp-ridged pocketbook, *Lampsilis ovata*
	Yellow sandshell, *Lampsilis teres*
	Eastern pondmussel, *Ligumia nasuta*
	Washboard, *Megalonaias nervosa*
	Sheepnose, *Plethobasus cyphyus*
	Clubshell, *Pleurobema clava*
	Ohio pigtoe, *Pleurobema cordatum*
	Pyramid pigtoe, *Pleurobema rubrum*
	Rabbitsfoot, *Quadrula cylindrica cylindrica*
	Monkeyface, *Quadrula metanevra*
	Wartyback, *Quadrula nodulata*
	Purple lilliput, *Toxolasma lividus*
	Rayed bean, *Villosa fabalis*
	Little spectaclecase, *Villosa lienosa*
	Snuffbox, *Epioblasma triquetra*
	Ebonyshell, *Fusconaia ebena*
DRAGONFLIES	Hine's emerald, *Somatochlorahineana*
	Mottled darner, *Aeshna clepsydra*
	Plains clubtail, *Gomphus externus*
	American emerald, *Codulia shurtleffi*
	Uhler's sundragon, *Helocordulia uhleri*
	Frosted whiteface, *Leucorrhinia frigida*
	Elfin skimmer, *Nannothemis bella*
	Canada darner, *Aeshna Canadensis*
DRAGONFLIES *(continued)*	Racket-tailed emerald, *Dorocordulia libera*
	Brush-tipped emerald, *Somatochlora walshii*
	Blue corporal, *Ladona deplanata*
	Chalk-fronted corporal, *Ladona julia*
	Yellow-sided skimmer, *Libellula flavida*
DAMSELFLIES	Seepage dancer, *Argia bipunctulata*
	Lilypad forktail, *Ischnura kellicotti*
CADDISFLIES	*Chimarra socia*
	Oecetis eddlestoni
	Brachycentrus numerosus
MAYFLIES	*Rhithrogena pellucida*
	Litobrancha recurvata
MIDGES	*Rheopelopia acra*
BUTTERFLIES	Persius dusky wing, *Erynnis persius*
	Frosted elfin, *Incisalia irus*
	Karner blue, *Lycaeides melissa samuelis*
	Purplish copper, *Lycaena helloides*
	Swamp metalmark, *Calephelis muticum*
	Regal fritillary, *Speyeria idalia*
	Mitchell's satyr, *Neonympha mitchellii*
MOTHS	Unexpected cycnia, *Cycnia inopinatus*
	Graceful underwing, *Catocala gracilis*
	Spartiniphaga inops
	Hypocoena enervata
	Papaipema silphii
	Papaipema beeriana
	Lithophane semiusta
	Trichoclea artesta
	Tricholita notata
	Melanchra assimilis
	Pointed sallow, *Epiglaea apiata*
	Ufeus plicatus
	Ufeus satyricus
	Hebard's noctuid moth, *Erythroecia hebardi*
BEETLES	Kramer's cave beetle, *Pseudanophthalmus krameri*
	Ohio cave beetle, *Pseudanophthalmus ohioensis*
	American burying beetle, *Nicrophorus americanus*

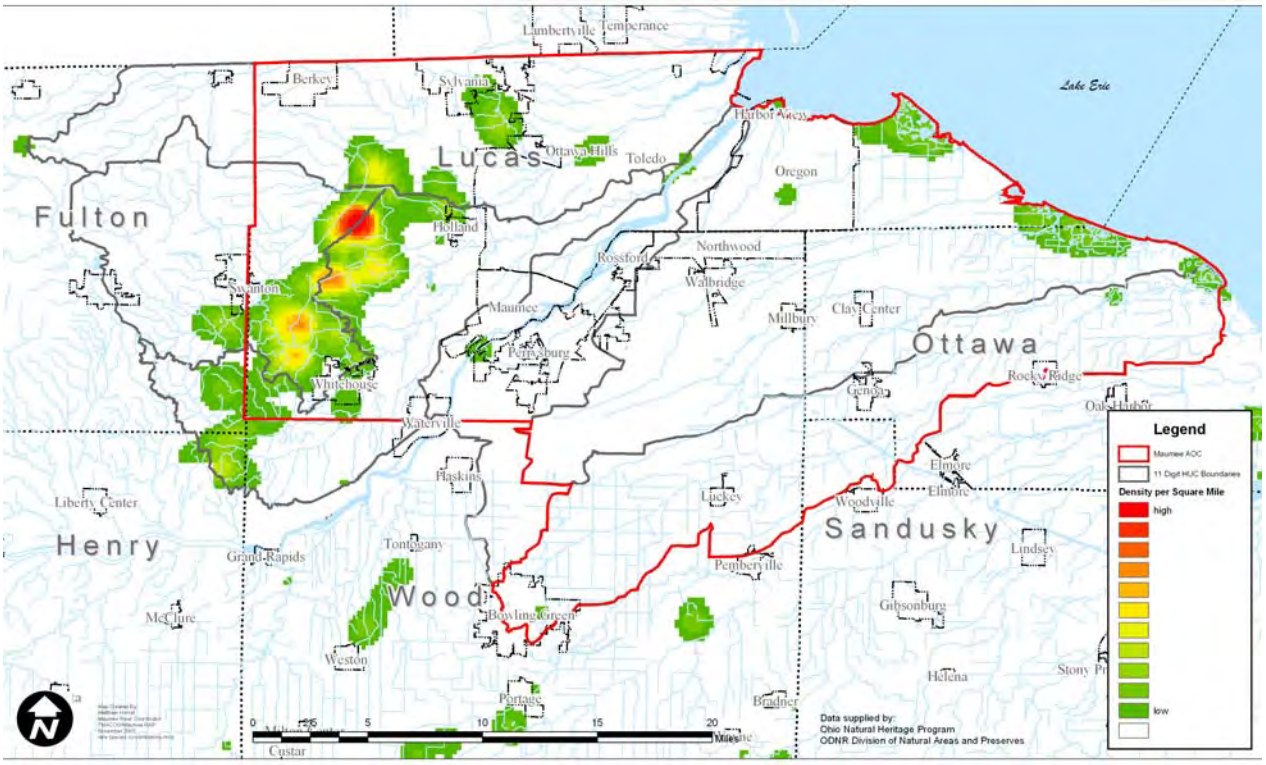
Endangered Plants in Lucas, Wood, and Ottawa counties[57]

Agalinis Skinneriana – Skinner's Foxglove	*Arabis Divaricarpa* – Limestone Rock-Cress
Amelanchier Sanguinea – Rock Serviceberry	*Arabis Drummondii* – Drummond's Rock-Cress

Arabis Hirsuta var. Pycnocarpa – Western Hairy Rock-Cress
Aristida Necopina – False Arrow-Feather
Aureolaria Pedicularia var. Ambigens – Prairie Fern-Leaf False Foxglove
Botrychium Simplex – Least Grape-fern
Campanula Rotundifolia – Harebell
Carex Alopecoidea – Northern Fox Sedge
Carex Garberi – Garber's Sedge
Carex Longii – Long's Sedge
Carex Lucorum – Fire Sedge
Carex Merritt-Fernaldii – Fernald's Sedge
Carex Pseudocyperus – Northern Bearded Sedge
Carex Siccata – Hay Sedge
Ceanothus Herbaceus – Prairie Redroot
Coeloglossum Viride – Long –bracted Orchid
Cuscuta Coryli – Hazel Dodder
Cuscuta Pentagona – Five –Angled Dodder
Cyperus Acuminatus – Pale Umbrella –Sedge
Desmodium Sessilifolium – Sessile Tick-Trefoil
Drosera Intermedia – Spathulate-leaved Sundew
Epilobium Angustifolium – Fireweed
Eleocharis Caribaea – Caribbean Spikerush
Eleocharis Ovata – Ovate Spikerush
Gentiana Puberulenta – Prairie Gentian
Gentiana Saponaria - Soapwort Gentian
Geranium Bicknellii – Bicknell's Crane's-Bill
Hymenoxys Herbacea – Lakeside Daisy
Hypericum Canadense – Canadian St. John's Wort
Juncus Greenei – Greene's Rush
Juncus Interior – Inland Rush
Koeleria Macrantha – Junegrass
Linaria Canadensis – Old Field Toadflax
Lipocarpha Drummondii – Drummond's Dwarf Bulrush
Lycopodiella Subappressa – Northern Appressed Clubmoss
Monarda Punctata – Dotted Horsemint
Moneses Uniflora – One-Flowered Wintergreen
Muhlenbergia Cuspidata - Plains Muhlenbergia
Nuphar Variegata – Bullhead-Lily
Oenothera Clelandii – Cleland's Evening-Primrose
Panicum Commonsianum – Commons' Panic-Grass
Panicum Perlongum – Long-Panicled Panic-Grass
Panicum Praecocius – Early Panic-Grass
Panicum Spretum – Narrow-Headed Panic-Grass
Panicum Tuckermanii – Tuckerman's Panic-Grass
Phlox Latifolia – Mountain Phlox
Platanthera Psycodes – Small Purple Fringed Orchid
Polygala Cruciata – Cross-Leaved Milkwort
Polygala Paucifolia – Gay-Wings
Populus Balsamifera – Balsam Poplar
Potamogeton Gramineus – Grass-like Pondweed
Potentilla Arguta – Tall Cinquefoil
Pycnanthemium Verticillatum var. Pilosum – Hoary Mountain-Mint
Pyrola Chlorantha – Green-Flowered Wintergreen
Rhynchospora Globularis – Grass-like Beak-Rush
Sagittaria Graminea – Grass-Leaf Arrowhead
Scirpus Smithii – Smith's Bulrush
Sisyrinchium Atlanticum – Atlantic Blue-eyed Grass
Sisyrinchium Montanum – Northern Blue-eyed Grass
Sisyrinchium Mucronatum – Narrow-leaved Blue-eyed Grass
Smilax Herbacea var. Pulverulenta – Downy Carrion-Flower
Tortella Inclinata – Curved Tortella
Vernonia Missurica – Missouri Ironweed
Viola Nephrophylla – Northern Bog Violet
Xyris Torta – Twisted Yellow-eyed Grass

The number of rare plants and animals is higher in the Maumee AOC than any other place in Ohio primarily because the Oak Openings Region is located within the Maumee AOC,. This area is home to approximately 180 rare plant and animal species whose survival depends upon the region's unique combination of wet and dry, sand and clay, forest and prairie.[58]

Rare Species Concentration



Exotic Species

Each year the introduction of harmful, non-native species into the United States has been increasing. Collectively, these nuisance species can make tremendous impacts to many different things, including water usage or habitat loss. Ultimately, the cost of invasive species, both terrestrial and aquatic, in the United States amounts to more than $100 billion each year.[59]

Native species for our area are considered to be those species that have been present since before the Europeans settled here in the 1700s. Naturalized species are those that have arrived after that time. An exotic species is a naturalized, or non-native, species that aggressively reproduces, taking over habitat or food sources from native species. Exotic species can have devastating effects on native populations.[60]

There are hundreds of different harmful exotic species ranging from plant, fish, amphibians, crustaceans, mollusks, diseases or pathogens. While some of Ohio's non-native species arrived here by accident, others were introduced for agriculture, erosion control, food, aesthetics, etc. Approximately one-fourth of the plant species known to occur in Ohio originated from other parts of the continent or world.[61]

In the late 1980s and 1990s the invasive zebra mussel spread throughout Lake Erie. These small filter feeders were accidentally introduced from Europe. They have thrived in Lake Erie and its tributaries, encrusting boats, docks, water intakes, and everything else in the shallow waters. They have made the lake clearer and more attractive, but they have not made it cleaner. They did change the routing of nutrients through the ecosystem, however their ecological impact is still not completely understood. Some of the invasive exotic species found in the Maumee AOC are as follows:

Common Exotic Species

Plants	Animals
Purple Loosestrife	Zebra Mussel
Buckthorn	Round Goby
Garlic Mustard	Eurasian Ruffe
Honeysuckle	Fishhook Water Flea
	Spiny Water Flea
	Sea Lamprey
	Common Carp

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Pollutant Causes and Sources

- Land Use and Population Changes
- Urban Runoff
- Rural and Agricultural Runoff
- Habitat Modifications and Flow Alterations
- Nutrients
- Pesticides
- Sediment
- Toxic Substances
- Bacteria

Pollutant Causes and Sources *(last updated 3/9/06)*

Pollution, in its broadest sense, can be defined as any alteration of the natural environment producing a condition that is harmful to living organisms. While pollution can be a result of a natural process (i.e. gas emissions associated with an erupting volcano), the term typically refers to negative impacts from human activities. Pollution can be subdivided into two broad categories based on its origin:

> *Point Source Pollution* is any negative impact that originates from or can be readily traced to a specific physical source of discharge. Water pollution most often discharges through a pipe or outfall.
>
> *Nonpoint Source Pollution*, as the name implies, includes all of the less tangible sources of harmful impacts that cannot be pinned to a definite structure, but instead come from general human land uses, such as rainwater running off a parking lot.

In order to reduce and/or eliminate pollution it is necessary to understand the causes and sources of the pollution for each impairment.

> *Causes of impairment* keep waters from meeting the criteria adopted to protect designated uses including: chemical contaminates (i.e. PCBs, metals, etc), physical conditions (i.e. temperature, excess siltation, alterations of habitat, etc.), and biological contaminants (i.e. bacteria, noxious aquatic weeds).
>
> *Sources of impairment* are the activities, facilities or conditions that generate the pollutants including: municipal sewage treatment plants, factories, storm sewers, modifications of hydrology, agricultural runoff, etc.)[1]

According to the National Water Quality Inventory for 2000, a biennial summary of State surveys of water quality, approximately 40 percent of rivers and streams surveyed in the US in 2000 were impaired by pollution and did not meet water quality standards. The top causes of impairment were siltation, nutrients, bacteria, metals, and oxygen-depleting substances. The leading source of this impairment is pollution transported by urban and agricultural runoff.[2]

The majority of the point sources have been addressed through the early focus of the Clean Water Act. Now, the more difficult nonpoint sources must be dealt with in order to continue to improve our water resources. The causes and sources highlighted in this section are some of the key impairments and pollutants used to develop and organize projects for improving the Maumee AOC and the headwaters.

Land Use and Population Changes

Lake Erie was the last of the Great Lakes to be discovered by Europeans and the Maumee basin was one of the last areas around Lake Erie to be settled. "The Maumee lake plain, on which Toledo is located, was once a part of a vast swamp known as the Great Black Swamp, which was drained, canalized, and deforested during the past 140 years for agricultural development."[3]

In the late 1800s to early 1900s, the Toledo area experienced a large population and industrial growth. When the Miami and Erie Canal was completed in the 1840s, trade in the area quickly

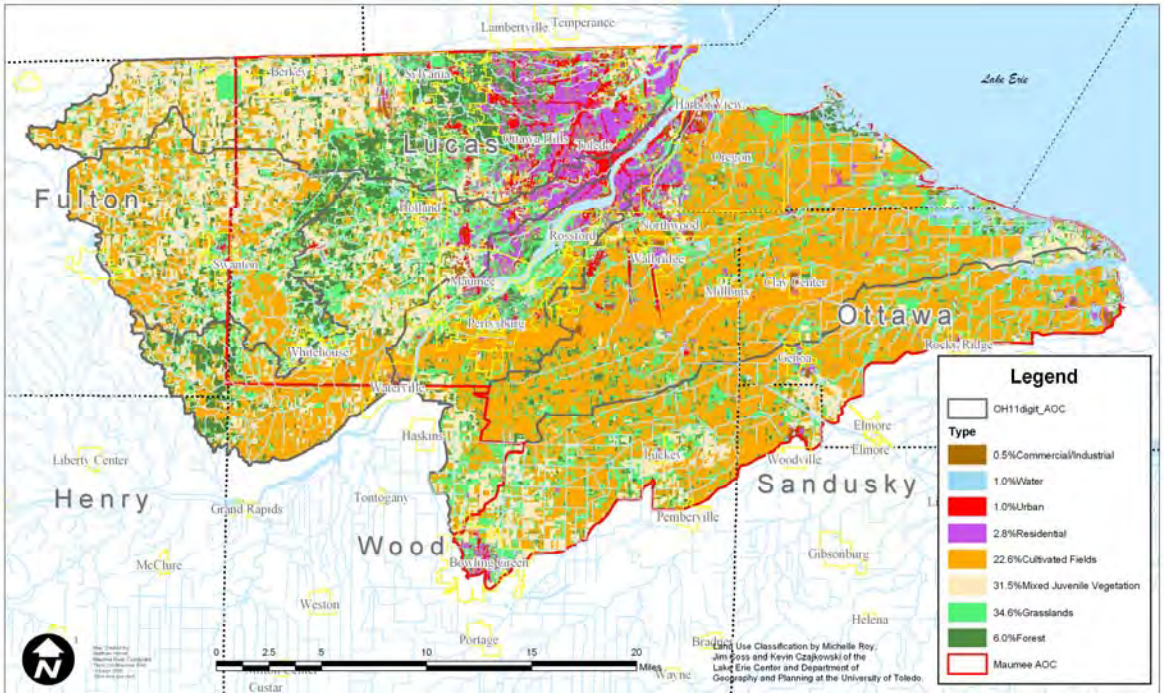
expanded, and Toledo took its first step toward becoming a major shipping port.[4] In the early 1900s, Toledo was one of the top 30 most populated cities in the United States. Toledo's industrial success was in part due to its proximity to Detroit and the automotive industry. The auto industry, as well as glass manufacturing and oil refineries, found the abundant water supply of the Maumee River and Lake Erie to be a valuable resource. However, the City of Toledo reached its population peak in the 1960s before manufacturing and industries began moving to warmer climates and out of Rust Belt Mid-West; leaving behind a legacy of environmental pollution.

The next significant population shift was from the urban to the suburban areas, resulting in accelerated storm water runoff problems. Urban development increases the amount of impervious surface in a watershed, as farmland, forests, and meadowlands with natural infiltration characteristics are converted into roads, parking lots, buildings, driveways, and sidewalks with virtually no ability to absorb storm water. Since the new land cover is less permeable than the existing cover, this change results in a greater percentage of the precipitation becoming runoff. The increased runoff causes larger and more frequent floods and increases erosion of stream banks and beds. The higher flows can lead to increases in stream temperature, changes in habitat, and decreases in stream flow stability.

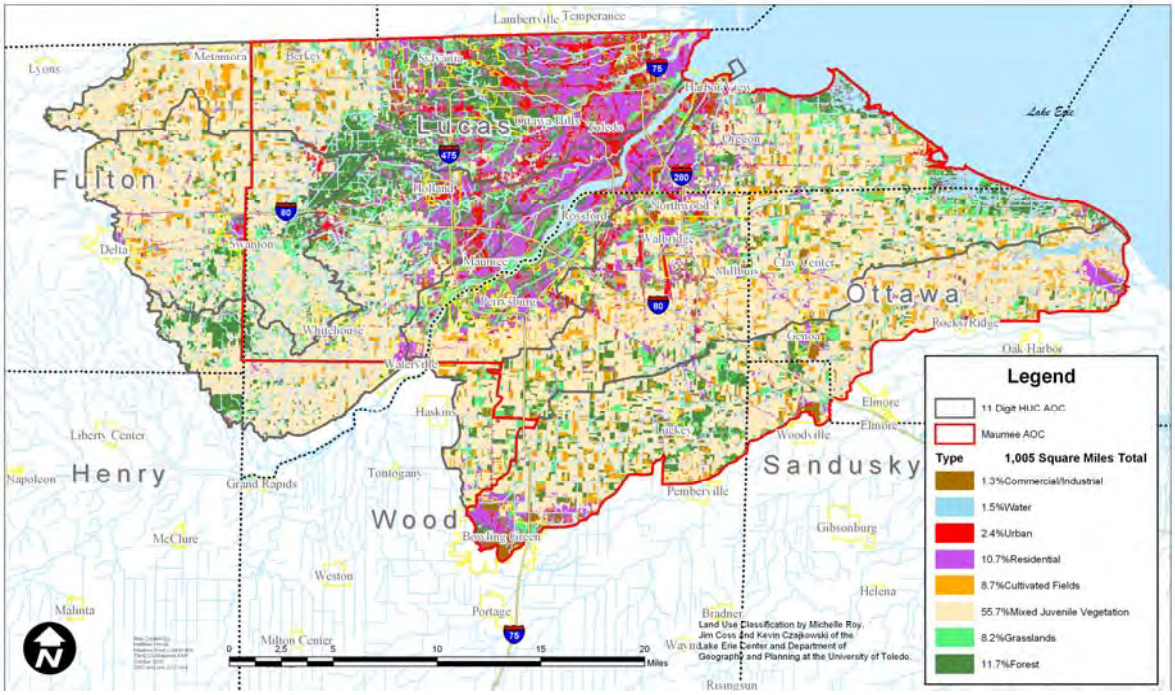
Watershed Impervious Area Changes in the Maumee AOC[5]

River Basin	1994 Impervious Area	Impervious Area Increase 1974-1994
Lower Maumee River	6.1%	10.4%
Ottawa River	30.8%	9.6%

1984 Land Use of the Maumee AOC



2003 Land Use of the Maumee AOC



Most urban land use activities deposit detrimental and sometimes hazardous materials on the impervious surfaces: sediments such as dust and sand, toxic metal particles, pesticides and fertilizers, petroleum products, harmful bacteria, salt, pet waste, and trash. As rainfall and snowmelt move rapidly across this transformed landscape, these pollutants are carried to surface and underground collection systems. These polluted, untreated flows often reach waterways that we use for drinking, swimming, fishing, and recreation, such as Lake Erie.

Categories of Primary Storm Water Contaminants[6]

Category	Examples
Metals	Zinc, Cadmium, Copper, Chromium, Arsenic, Lead
Organic Chemicals	Pesticides, Oil, Gasoline, Grease
Pathogens	Bacteria, Viruses, Protozoa
Nutrients	Phosphorous, Nitrogen
Biochemical Oxygen Demand (BOD)	Grass clippings, Hydrocarbons, Animal waste, Fallen leaves
Sediment	Sand, Soil, Silt
Salts	Sodium Chloride, Calcium Chloride

Storm water pollution has two main impacts: the increased volume and velocity of surface runoff and the concentration of pollutants in the runoff. Both of these impacts are directly related to development in urbanizing areas.[7] As the greatest growth continues to occur on the fringes of the metropolitan areas, the impervious areas within our watersheds expand at ever increasing rates. As these land use changes occur, so have our requirements for clean water. Water can be used for many purposes; each has its own requirements as to how "clean" the water needs to be.

Water Quality Requirements for Use

Water Use	Water Quality Requirements
Commerce	Navigable waters
Industry, agriculture, power generation	Free of debris and pollutants to serve the industrial purpose, without damaging equipment or plumbing
Recreation (swimming, boating)	Microbes such as bacteria and viruses must be at low enough levels not to cause infection. Free of toxics and chemical irritants
Public supply	Must be safe to drink: free from toxics, microbes, and carcinogens, and free of unpleasant taste and odor.
Fishing	Water and sediments must be free of toxics. Nutrients (nitrates, phosphates) must be below levels that cause "toxic algae" blooms. River sediment deposits must not cover feeding or spawning areas. Water must contain dissolved oxygen to support life. Headwater streams must meet these standards to produce a food chain that ultimately feeds the fish in Lake Erie. Some fish (like carp and bluegill) are pollution tolerant, while others (like trout) are intolerant.
Natural habitat, rare or endangered species	Sediment loadings, nutrients, and toxics must be at low levels. Streams should have shaded areas to keep water cool, and riffles to provide oxygenation. The more streams that meet these qualities, including small headwater streams, the better the watershed habitat will be.

An overall population increase of 0.5 percent for the area between the 1990 and 2000 censuses does not reflect the significant shifts in population from the urban to the suburban and rural areas. For example, the City of Toledo lost over 19,000 (-5.8%) people but communities such as Monclova (+48.8%), Springfield (+20.3%) and Sylvania (+10.7%) Townships had large increases during the 1990s. Similar patterns can be seen throughout Northwest Ohio in the Jurisdictional Population Change Table below.

Jurisdiction Population Changes 1990-2000*

County	Jurisdiction	1990 Population	2000 Population	Percent 2000/1990
Lucas	Harding Township	593	724	122%
Lucas	Holland Village	1,210	1,306	108%
Lucas	Jerusalem Township	3,253	3,181	98%
Lucas	Monclova Township	4,547	6,767	149%
Lucas	Oregon City	18,334	19,355	106%
Lucas	Providence Township	3,016	3,454	115%
Lucas	Richfield Township	1,178	1,308	111%
Lucas	Spencer Township	1,665	1,708	103%
Lucas	Springfield Township	18,835	22,817	121%
Lucas	Swanton Township	3,329	3,330	100%
Lucas	Sylvania City	17,301	18,670	108%
Lucas	Sylvania Township	22,682	25,583	113%
Lucas	Washington Township	3,803	3,574	94%
Lucas	Waterville Township	1,958	1,908	97%
Lucas	Waterville Village	4,517	4,828	107%
Lucas	Whitehouse Village	2,528	2,733	108%
Ottawa	Allen Township	2,888	3,297	114%
Ottawa	Benton Township	2,046	2,232	109%
Ottawa	Carroll Township	1,735	1,931	111%
Ottawa	Clay Township	3,005	2,888	96%

County	Jurisdiction	1990 Population	2000 Population	Percent 2000/1990
Sandusky	Woodville Township	1,135	1,327	117%
Wood	Bowling Green City	28,151	29,636	105%
Wood	Center Township	1,158	1,246	108%
Wood	Freedom Township	1,241	1,330	107%
Wood	Lake Township	6,632	6,643	100%
Wood	Luckey Village	848	998	118%
Wood	Middleton Township	1,911	1,960	103%
Wood	Millbury Village	1,082	1,161	107%
Wood	Perrysburg Township**	13,176	13,613	103%
Wood	Perrysburg City	12,551	16,945	135%
Wood	Plain Township	2,021	1,706	84%
Wood	Rossford City	5,861	6,406	109%
Wood	Troy Township	3,000	3,357	112%
Wood	Washington Township	1,195	1,324	111%
Wood	Webster Township	1,111	1,277	115%

** - Township populations are unincorporated areas only. In some cases population changes may not fully reflect urbanization during the period because newly developed areas were annexed. Similarly, growth in some municipalities was due to annexation. ** - During the decade, Perrysburg City's population increased 35%, and Rossford's by 9%, while Perrysburg Township's increased 3%. The city population increases were due largely to annexation from Perrysburg Township. Perrysburg Township is therefore considered a high growth jurisdiction.*

Urban Runoff

Urban storm water runoff pollution sources are diffuse and not easily identified. With the development of open lands have come abrupt changes in the relationships between vegetation, soils, and waterways. The existing surface cover is replaced with roads, rooftops, driveways, parking lots, and other impervious surfaces. The effect of impervious surfaces on the volume of storm water runoff is dramatic. For example, a one-inch rainstorm on a 1-acre natural meadow produces approximately 218 cubic feet of runoff. The same storm over a 1-acre paved parking lot would produce almost 16 times that volume, 3,450 cubic feet of runoff. The proliferation of hard surfaces not only changes the volume of storm water flows, but also the distribution of flows over time. The storm water is forced off the land immediately, causing much sharper peaks in runoff. These "flashy" flows can lead to problematic changes in the hydraulics of the system.

Impacts from Increases in Impervious Surfaces[8]

Increased Imperviousness Leads to	Resulting Impacts				
	Flooding	Habitat Loss	Erosion	Channel Widening	Streambed Alterations
Increased volume	•	•	•	•	•
Increased peak flow	•	•	•	•	•
Increased peak flow duration	•	•	•	•	•
Increased stream temperature		•			
Decreased base flow		•			
Increased sediment loadings	•	•	•	•	•

In most communities, the majority of impervious cover is related to the transportation infrastructure-roads and parking lots. Research has show that when impervious cover reaches between 10 and 20 percent of the area of a watershed, hydrological and ecological stresses become apparent.[9] A second threshold appears to exist at around 25 to 30 percent impervious cover, where most indicators of

stream quality consistently shift to a poor condition (e.g., diminished aquatic diversity, water quality, and habitat scores).

Historically, water pollution control has focused on the more obvious point sources: municipal wastewater treatment plants and industrial discharges. The water pollution potential for storm water runoff was not fully appreciated until repeated studies revealed that urban nonpoint sources seriously threaten water quality and can exceed the impact of municipal sewage discharges.

Nonpoint problems are both water quality and quantity based. In urban areas a variety of created surfaces now cover much of the landscape. Many of these surfaces are impervious and therefore prevent rainwater and snowmelt from following their natural course into the soil. Roofs and pavement prevent infiltration completely, while even suburban lawns absorb far less than natural areas. Impervious surfaces increase the rate and volume of storm water runoff, resulting in higher flows and more frequent floods. In the Lucas County portions of the Swan Creek watershed flood flows have increased 17 to 85 percent from pre-settlement times. The elevated flows increase the erosion of waterway beds and banks.[10] Other negative impacts include increasing the receiving water's temperature, changing habitat, and decreasing stream flow stability.

Automobiles contribute a number of different types of pollutants to urban runoff. High levels of metals are found in tire wear, used motor oil and grease, diesel fuel, and vehicle rust. Engine coolants and antifreeze containing glycols are toxic and can contribute to high biochemical oxygen demand in the receiving waters. Generally, fossil fuel combustion is the largest contributor of nitrogen to the waters in urbanized areas of the United States. Salts are used to keep facilities free of ice, but in large volumes can be toxic to fish and other wildlife. These pollutants accumulate on impervious surfaces during dry weather conditions, only to form a highly concentrated first flush during storm events.

Landscaping practices and poor housekeeping practices are other potential sources of pollutants in urban runoff. Chemicals that are used in fertilizers and pesticides can lead to water quality impacts. Over and improper application at homes, golf courses, public parks, etc. is very common and the excess eventually makes its way to ditches and streams. Rain and melting snow erode piles of stored materials such as sand, loose topsoil, or road salt that is left uncovered. Similarly, precipitation can flush contaminants off "dirty" equipment that is stored outside. These common pollutants can degrade the quality of receiving waters, almost to the same degree as if they were introduced by direct discharge.

Erosion rates from construction sites are significantly greater than from almost any other land use. Field studies and erosion models have shown that erosion rates from construction sites are typically an order of magnitude larger than row crops and several orders of magnitude greater than rates from well-vegetated areas such as forest or pastures.[11] Excess sediment causes a number of problems for waterbodies. Suspended sediments increase turbidity and reduce light penetration in the water column, which directly impacts aquatic organisms. Long-term effects of sedimentation include habitat destruction and increased difficulty in filtering drinking water.

During the construction process, soil is the most vulnerable to erosion by wind and water. Studies indicate that poorly managed construction sites can release 7 to 1,000 tons of sediment per acre during a year, compared to 1 ton or less from undeveloped land.[12] Suspended sediment lowers the quality of water for municipal and industrial uses as well as for boating, fishing, swimming, and other water based recreation. Deposited sediment clogs storm sewers, culverts and drains, reduces

the storage capacity of stream channels and reservoirs, fills ponds and lakes, and buries aquatic life habitat.

While sediment is the major pollutant generated on construction sites, other pollutants may be present. Potential secondary pollutants include petrochemicals (oil, gasoline, and asphalts), solid wastes (paper, wood, metals, plastics, etc.), construction related chemicals (acids, soil additives, concrete curing compounds, paints, etc.), wastewater (aggregate wash water, concrete cooling water, clean-up water, etc.), sanitary wastes, and fertilizers. Sediment can serve as a transport mechanism for a chemicals such as phosphorous and nitrogen, which in excess amounts lead to water quality impairments. Since March 2003, construction sites of one acre or more have been required to obtain a National Pollutant Discharge Elimination System (NPDES) permit for storm water discharge.

Illicit or illegal connections to the storm sewers from homes and businesses introduce pollutants and pathogens to the storm sewers that are released without appropriate treatment. Sources of illicit discharges include, but are not limited to: sanitary wastewater, effluent from septic tanks, car wash, laundry, household waste, and other miscellaneous waste products. Industrial facilities often negligently discharge wastewater that should be directed to the sanitary sewers through floor drains, dry wells, and/or cesspools, which feed into their storm water system. The result is untreated discharges that contribute high levels of pollutants into receiving waterbodies.

Some of the older urbanized areas in the region have combined sewers, where storm water and sanitary sewage flow in the same system. The storm water problems associated with urban areas can be intensified by occasional overflows from these combined systems. The City of Toledo also has sanitary sewer overflows, which discharge raw sewage straight to local waterways during periods of excessive flow and infiltration. Overflow points and treatment plant bypasses are provided, by design, to prevent damage to the wastewater treatment plant and reduce local flooding during periods of high flow. Permits for the installation of new combined and sanitary sewers overflows are no longer issued. Most communities have developed plans to reduce the number of combined and/ or sanitary sewer overflows. Upgrading existing systems requires complex engineering and can be an extremely expensive capital improvement project.

CSOs & SSOs in the Maumee AOC

Jurisdiction	Combined Sewer Overflows (CSOs)	Sanitary Sewer Overflows (SSOs)
Bowling Green	•	
Genoa	•	
Luckey	•	
Perrysburg	•	
Swanton	•	
Toledo	•	•

Rural and Agricultural Runoff

The rural population reached its peak in the Maumee AOC about the turn of the twentieth century, 50 years later than in the rest of Ohio. Soils were so productive in this newly drained land that more of the land was put into crops here than anywhere else in Ohio. What was once a vast muddy swamp on the flats of an old postglacial lake-bed has become one of Ohio's most productive rural areas.[13] In the late 1970s the Maumee River basin led the State in the number of acres devoted to farming.[14] According to the 2002 Ohio Agricultural Statistics, Wood County ranked first in Ohio for soybean

and wheat production, and fourth in corn production.[15] In 2004 Wood County was first in wheat production, third in corn, and fourth in soybeans.[16]

Detailed information on farms, crops, and livestock in the counties of the Maumee AOC are in the tables below. Please note that these are complete county representations and not specific to the Maumee AOC and headwater areas.

2004 Farm Information for Lucas, Ottawa and Wood Counties[17]

County	Number of Farms	Average Farm Size	Total Land in Farms
Lucas County	400	193	77,000
Ottawa County	520	213	111,000
Wood County	1,050	297	312,000

2004 Crop Information for Lucas, Ottawa and Wood Counties[18]

Crop Type	Acres Harvested	Yield	Production	Rank in Ohio
Lucas County				
Corn for Grain (bushel)	23,300	170.2	3,964,800	46
Soybeans (bushel)	27,800	42.1	1,171,200	52
Wheat (bushel)	7,000	72.9	510,400	33
Oats (bushel)	-	-	-	-
All Hay (per ton)	1,500	3.47	5,200	87
Tobacco (per pound)	-	-	-	-
Processing Tomatoes (ton)	-	-	-	-
Ottawa County				
Corn for Grain (bushel)	18,100	150.7	2,727,200	52
Soybeans (bushel)	44,800	36.6	1,640,000	47
Wheat (bushel)	16,600	62.9	917,800	24
Oats (bushel)	-	-	-	-
All Hay (per ton)	4,100	3.37	13,800	77
Tobacco (per pound)	-	-	-	-
Processing Tomotoes (ton)	-	-	-	-
Wood County				
Corn for Grain (bushel)	93,600	164.1	15,357,400	3
Soybeans (bushel)	128,600	46.4	5,963,500	4
Wheat (bushel)	51,700	72.4	3,740,600	1
Oats (bushel)	-	-	-	-
All Hay (per ton)	5,800	3.88	2,500	58
Tobacco (per pound)	-	-	-	-
Processing Tomotoes (ton)	600	23.4	14,070	5

2004 Livestock Information for Lucas, Ottawa and Wood Counties[19]

County	All Cattle & Calves		Milk Cows		All Hogs & Pigs		All Sheep & Lambs	
	Quantity	Rank in Ohio	Quantity	Rank in Ohio	Quantity	Rank in Ohio	Quantity	Rank in Ohio
Lucas County	1,100	86	-	-	9,000	41	-	-
Ottawa County	1,400	84	-	-	3,100	58	-	-
Wood County	4,900	78	1,000	55	6,000	49	-	-

Since the 1970s, the increased use of conservation tillage farming practices has been found to correspond to decreases in suspended-sediment discharge over time at two locations in the Maumee River Basin.[20] A 49.8 percent decrease in suspended-sediment discharge was detected when data from 1970–74 were compared to data from 1996–98 for the Auglaize River near Ft. Jennings, Ohio. A decrease in suspended-sediment discharge of 11.2 percent was detected from 1970–98 for the Maumee River at Waterville, Ohio.

Heidelberg College Water Quality Laboratory has provided long-term gauging and water quality sampling for several Lake Erie tributaries, since the mid 1970s. Discharges from the rivers of sediment and nutrients can vary widely from year to year, depending on the amount and severity of rainfall. Consistent monitoring over a long period of time is necessary to show whether sediment and nutrient loads are increasing or decreasing. The table below gives a trend summary for four primarily agricultural watersheds. The parameters are TSS: Total Suspended Solids, TP: Total Phosphorus, SRP: Soluble Reactive Phosphorus, NO_3: nitrate, and TKN: Total Kjeldahl Nitrogen. The Maumee River station is at Waterville, the beginning of the Maumee AOC for the Maumee River.[21] Other sampling stations have been included below for comparison.

Sediment and Nutrient Trend Summary

		Parameter				
Waterway	Flow	TSS	TP	SRP	NO3	TKN
Maumee River	9.2	-18.1	-41.6	-84.5	21.3	-28.4
		*	****	****		****
Sandusky River	6.7	-27.2	-46.3	-87.9	12.0	-21.0
		****	****	****		****
Honey Creek	-16.7	-2.5	-28.7	-78.5	45.9	-14.2
			****	****	****	**
Rock Creek	-30.5	-37.2	-41.4	-54.8	-36.9	-40.6
	*	****	****	****	**	****

Percent change from 1975 to 1995, estimated as described in the text. Negative numbers corresponding to decreasing concentrations, positive numbers to increasing concentrations. Significance levels are based on t-values adjusted for autocorrelation. *: p<.05, **: p<.01, ***: p<.001, ****: p<.0001.
* Percent change during 1983 to 1995 only, reflecting the shorter period of record for Rock Creek

Heidelberg College's data for sediment and nutrients at the four stations from 1975-1995 generally shows decreases in sediment and phosphorus loads, but increases in nitrates. The inference is that farming conservation practice changes over those 20 years reduced sediment loads (and phosphorus as well, because phosphorus tends to attach to fine soil particles). Conservation practice changes, however, have not similarly reduced nitrate loadings; nitrates are soluble, and are carried more by water flow than sediment. Use of tile drainage may increase loadings of soluble nitrates to the rivers. It should be noted, however, that the data, especially for nitrates, is highly variable and dependent on weather.

Habitat Modifications and Flow Alterations

Habitat is a critical part of the stream environment including the type and quality of substrate, amount of in-stream cover, channel morphology, extent of riparian canopy, pool and riffle development and quality, and stream gradient. Altering these features can damage the health of a stream. Stream modifications can also exacerbate other concerns, such as thermal stress.

Hydrologic modifications can also damage a stream by altering the flow of water. Structures or activities in the waterway that alter stream flow may be a source of stressors, such as increased sedimentation or a barrier to the upstream migration of aquatic organisms. There are several dams and/or control structures located in the Maumee AOC.

Dams and Structures in the Maumee AOC

Watershed	Name	Type	Location/River Mile
Ottawa River	Ottawa Hills Dam	Low Head Dam *(removal is being planned)*	Upstream of Secor Rd. RM 11.8
	Unnamed Dam 1	Low Head Dam	~ RM 13.5 to 14.5
	Unnamed Dam 2	Low Head Dam	~ RM 13.5 to 14.5
	Miakonda Dam	Low Head Dam *(removed 12/03)*	Boy Scout Camp Miakonda RM 17.25
Swan Creek	Highland Park Dam	Low Head Dam	Highland Park RM 4.2
	Anderson Dam	Low Head Dam *(evaluating possibility of removal)*	Downstream of Holland Rd. RM 12.5
Duck Creek	Hecklinger Pond outflow	Control Structure	Hecklinger Pond RM 3.27

The use of best management practices (BMPs) to correct the effects of stream alteration must consider all impacts. For example, restoring habitat will not restore aquatic life, unless sediment and nutrient loadings have also been addressed. It takes a combination of the following types of projects to restore the habitat in a watershed. However, the best method is to protect the waterway before an alteration can be done.

- *Stream bank restoration projects:* These projects provide habitat while reducing bank erosion that threatens property and contributes sediment to degrade stream quality.

- *Upland habitat restoration:* These projects are important for developing a thriving wildlife community, with an emphasis on plants and animals that are water dependent but not solely aquatic.

- *Aquatic habitat restoration:* These projects are needed to support stream quality that will allow for a diversity of fish and wildlife more like those that existed before the pollution occurred.

- *Free flowing stream restoration projects:* These projects involve removing dams and other obstructions that serve as barriers to fish movement (i.e. dams) or those that restrict or alter flow conditions and/or a waterway's access to the floodplain (i.e. dikes, levees).

- *Wetland restoration:* These projects allow for returning areas to their original important wetland functions affecting stream quality, hydrology and wildlife habitat.

Nutrients

Eutrophic is a term that describes a waterbody enriched with nutrients (phosphates and nitrates) and organic matter. That enrichment results in increasing biological productivity. Over-nourishment leads to accelerated nuisance growths (blooms) of cyanobacteria. Cyanobacteria are photosynthetic, and were once thought to be blue-green algae.[22] Their blooms are still popularly called "toxic algae." The immediate effect is an unpleasant area because of the cyanobacteria's strong odor. Over the following winters, the mass of cyanobacteria would die and sink to the bottom. The following season the dead cyanobacteria would decay at the bottom and deplete the oxygen dissolved in the water. The eutrophication will adversely affect fish and aquatic organisms, fishing and boating, and the taste and odor of finished drinking water.[23]

Streams in the Huron-Erie Lake Plains ecoregion (where the Maumee AOC is located) have the highest background levels of phosphorus and nitrate. Small streams with low phosphorus levels have the best aquatic communities, and therefore are more likely to meet water quality standards. As phosphorus levels rise, the aquatic community quality decreases.[24]

Phosphorus has been identified as a key controlling factor in the eutrophication of Lake Erie and other area streams. These nutrients can produce nuisance growths of algae and higher aquatic plants. While some lakes are naturally eutrophic, excessive nutrient loads that accelerate eutrophication usually result from human activity.

In 1983 the United States and Canada ratified Annex III of the *Great Lakes Water Quality Agreement*. This agreement called for the reduction of annual phosphorus loadings to Lake Erie to 11,000 metric tons. This was estimated to be enough to eliminate the "algae" blooms and the resulting dead zones.[25] The needed 11,000 metric ton reduction was allocated among the watersheds, and split between point and nonpoint source loadings. Ultimately the required nonpoint source reductions were assigned to individual counties, with targets for agricultural and urban runoff reductions. The phosphorus reduction targets are listed in the table below.[26]

Annex III Phosphorus Reduction Targets

Tributary	Point Source Phosphorus Reduction Target, metric tons/year	Non-Point Source Phosphorus Reduction Target, metric tons/year	Total Phosphorus Reduction Target, metric tons/year
Ottawa	0.0	74.2	74.2
Maumee (the 74% in Ohio)	22.5	2,113.3	2,335.8
Portage / Toussaint	13.7	535.1	548.8

Public agencies took a number of steps to achieve these reductions in the amount of phosphorus entering Lake Erie:

- The discharge permit requirements for sewage treatment plants were strengthened. Phosphorus discharges were reduced to 1.0 mg/l for treatment plants discharging over 1 million gallons per day.

- The Ohio Legislature banned phosphorus from laundry detergents sold in the Lake Erie drainage area.

- Sanitary sewers have eliminated thousands of septic systems; thus reducing the direct discharge of phosphorus from residential and small commercial systems, such as cleaners (other than laundry detergent, cooking/food wastes and or residue, and drinking water treatment additives.

- Agricultural agencies and the county Soil and Water Conservation Districts promoted conservation tillage, buffer strips, and other Best Management Practices to reduce phosphorus runoff from farmland. Financial incentives have encouraged these practices through programs such as the Conservation Reserve Enhancement Program and the Ohio EPA 319 nonpoint source program.

- US EPA established the NPDES Storm water Permit program requiring urban jurisdictions to identify and control pollution from urban runoff. In Phase I of this program, large cities were required to apply for permits by 1998, and smaller jurisdictions in urban areas applied by 2003 under Phase II. The NPDES Storm water program also regulates construction sites that disturb more than an acre of land.

Progress toward achieving these agricultural phosphorus reduction goals has been substantial. NRCS tracked reductions for each Lake Erie county in Ohio through 1997. For the entire Lake Erie basin, 49 percent of the agricultural phosphorus reduction target had been met by 1997. Agricultural phosphorus reductions through 1997 for counties in the Maumee AOC are in the following table.

Agricultural Phosphorus Reduction Targets through 1997

County	Agricultural Phosphorus Reduction through 1997 (pounds)	Agricultural Phosphorus Reduction target (pounds)	Percent of Goal
Lucas	29,567	38,060	77.69%
Ottawa	27,742	46,200	60.05%
Wood	109,467	153,120	71.49%
Totals	166,776	237,380	69.74%

In 2002 the International Joint Commission discussed the issue in its biennial report on Great Lakes Water Quality:

> *Major tributaries to Lake Erie, such as the Maumee River, have achieved notable decreases in suspended sediment discharges and reductions in phosphorus loads as a result of improved agricultural practices. However, these tributaries are still very large sources of phosphorus with year-to-year loads varying with the frequency and intensity of flooding. For example, phosphorus stored in the sediment of tributaries can build up during dry or average rainfall years and can serve as a substantial load to the lake during a single flood event.*

Such major events could become common in the Great Lakes as a result of climate change, adding a further management challenge to achieving target loads.[27]

In streams and rivers phosphorus is more often a limiting factor in algal growth than nitrate.[28] Nitrate concerns usually center on drinking water impacts, not algae blooms. Nitrate contamination of drinking water usually results from runoff of agricultural fertilizers, or from human or animal wastes, such as livestock feedlots or faulty septic systems.[29]

Nitrate is essentially harmless to most people, but is considered an acute toxin to infants under six months of age. In infants it can cause a condition known as methoglobinemia or "blue baby syndrome," which can be fatal. Blue-baby syndrome is caused when bacteria in the digestive tract of infants change the nitrate into nitrite, a much more harmful substance. The nitrite then enters the bloodstream, where it can lower the blood's ability to carry oxygen to the body, causing blueness to the skin. Infants under six months of age are at higher risk than others because their digestive tract is not fully developed. By six months of age, the hydrochloric acid in the stomach increases to a level that kills most of the bacteria which change nitrate to nitrite, significantly reducing the risk of methoglobinemia. If a nitrate advisory is issued, bottled water should be substituted for tap water until the nitrate advisory is lifted. Boiling tap water will not get rid of the nitrate; it only concentrates it. It is safe to bathe or shower in tap water.[30]

Nitrate levels only affect stream aquatic life scores in headwater streams with high nitrate levels (i.e., medians above 3-4 mg/l).[31] Additional efforts to control nitrate may be needed for small streams with high average nitrate levels. Nitrate levels over 3-4 mg/l are not uncommon.

The Heidelberg College Water Quality Lab conducts a Lake Erie Tributary monitoring program that provides nearly a thirty-year continuous record of nutrient and sediment loadings. One of its principle sites is the Maumee River at Waterville.[32] This site is very important for the comparison of water quality entering the Maumee AOC verses other sites downstream.

Pesticides

Pesticides are used to protect gardens and farms from nuisance insects and weeds. DDT has been banned for years, and is gradually decreasing in the environment. A variety of pesticides are used for agriculture and residential gardens, including "Triazines," Atrazine, and Simazine. At certain exposure levels, they are potential carcinogens. Pesticides may enter surface waters either dissolved in runoff or attached to sediment or organic materials, and may enter ground water through soil infiltration. Public drinking water supplies are monitored and regulated for pesticides.[33]

U.S. EPA notes:

Pesticides and their effects on human health are often the focus of debate between scientists, environmental groups, public water systems, and the public. Two important issues included in the debate center on exposure, or the amount of these chemicals that people either ingest or inhale, and the duration of the exposure. Exposure is an important issue because the amount of a chemical either ingested or inhaled and the length of the exposure determine whether or not human health will be negatively affected. Consuming water that is contaminated with pesticides is one route of exposure that has made headlines over the last several years.

The U.S. EPA has established different drinking water criteria for both short term and long term exposure periods. For children, health advisories are established for exposure durations of 1-day, 10-days and 7-years. For adults, health advisories are calculated for 7-years and lifetimes (all health advisories are non-enforceable). In addition to health advisories, the U.S. EPA has established maximum contaminant levels (MCLs), which are enforceable standards that are based on a lifetime of exposure. Compliance with the MCL is based on a public water system's running annual average of all samples taken during a 12-month period. Consumption of water with chemical concentrations less than or equal to a health advisory or MCL for the duration of time covered by the criteria or standard is considered by U.S. EPA to pose negligible health risks.[34]

Sediment

Sediment is a pollutant in its own right. Ecologically it is important because phosphorus attaches to and is carried with sediment. Generally speaking, actions that reduce the amount of sediment going into the lake will reduce the amount of phosphorus. When sediment settles out, it covers the bottom of streams, bays, and lakes. It may destroy fish habitat by: (1) blanketing spawning and feeding areas; (2) eliminating certain food organisms; (3) causing gill abrasion and fin rot; and (4) reducing sunlight penetration, thereby impairing photosynthesis. Suspended sediment decreases recreational values, reduces fishery habitat, adds to mechanical wear of water supply pumps and distribution systems, and adds treatment costs for water supplies. Nutrients and toxic substances attached to sediment particles may enter aquatic food chains, causing fish toxicity problems, impaired recreational uses or degrade the water as a drinking water source.[35]

Accumulating sediment can make Maumee Bay and some nearshore areas inaccessible. The Toledo shipping channel connects the Maumee River with the Western Basin of Lake Erie. It is dredged a distance of 22 miles from 18 to 28 feet below low water datum[36] (LWD), depending actual location in the Maumee River and Maumee Bay. Without annual dredging, which averages about 950,000 cubic yards per year,[37] the Port of Toledo cannot operate. Recreational access is also affected. The Ottawa and Toussaint rivers have needed recreational dredging in recent years, but have been restricted or delayed for various reasons. Access to marinas is also strongly influenced by the fluctuating lake levels.

One of the biggest environmental issues regarding sediment in the Maumee AOC is what to do with the material dredged from the Toledo shipping channel. Since the mid-1980s disposal of the dredged material has been split between a Confined Disposal Facility (CDF) and open-lake disposal. Sediments contaminated by chemicals or metals are placed in the CDF. Uncontaminated sediments (which are still a pollutant) have been confined or dumped out in Lake Erie, depending on CDF capacity. Here are some of the issues:

- CDFs are expensive to build. When a CDF is full, it is necessary to expand it or build another one. CDFs cover lake bottom, which is habitat for fish and other aquatic organisms. A new or expanded CDF can interfere with access and enjoyment of the Lake Erie by lakefront property owners.

- Dredging removes sediment and any chemicals they contain from the ecosystem. Confining uncontaminated sediments benefits water quality by taking sediment and phosphorus out of the system.

- Open lake disposal of dredged materials may promote eutrophication by bringing sediment and phosphorus back into contact with the lake water.

- Dredged materials dumped out in Lake Erie may be washed back into Maumee Bay by storms. By not removing sediments from the River, Bay, and Lake, we could be dredging the same sediments year after year. Sediment currents in Maumee Bay are not well understood, and are influenced by Lake Erie seiche, the shallowness of the Bay, and strong flows from the Maumee and Detroit rivers. A recent study commissioned by the Toledo-Lucas County Port Authority has greatly contributed to our understanding of sediments in Maumee Bay.[38]

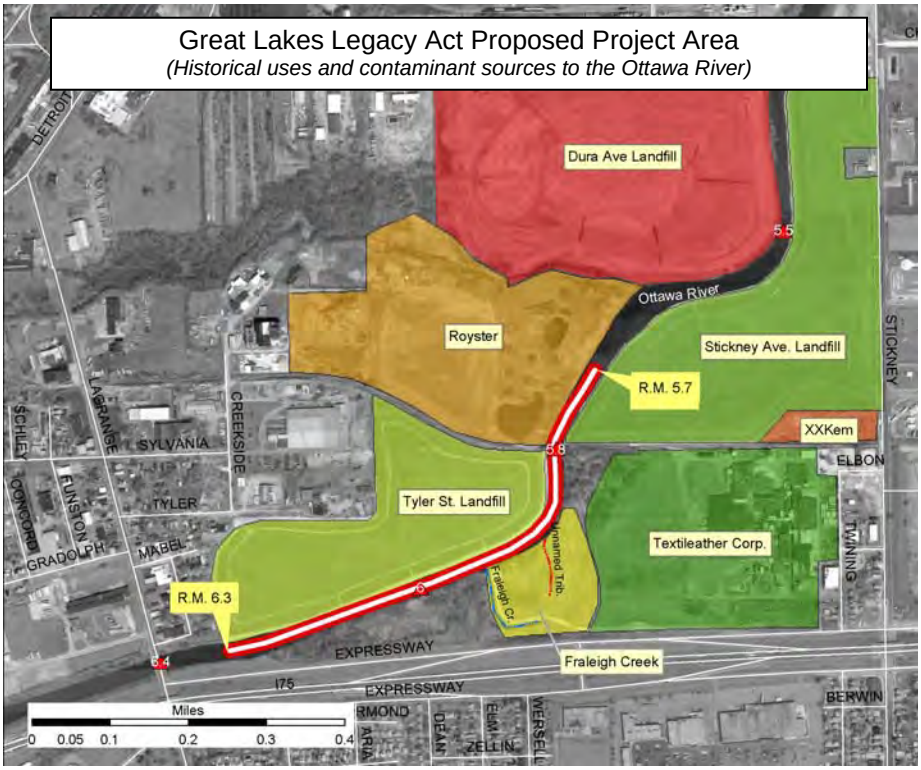
- Dredging is necessary for the Port of Toledo to operate. It is one of the largest ports on the Great Lakes, and it is economically very important to the region.

Sediment issues in the Maumee River watershed are more complex than any other area in Ohio due to the volume of materials. The complexity of nutrient loadings combined with dredging and disposal concerns makes the need for load reductions critical to the restoration of the Maumee AOC.

Toxic Substances

Since the 1800s, the industrial heritage and population growth in Maumee AOC has left a legacy of environmental pollution. The oldest continually operating automotive assembly plant in the world, the North Cove Assembly Plant (presently owned by the Chrysler Corp.), was built along the Ottawa River at RM 7.6. Although most of this plant was closed and demolished in 2003, a new plant replaced it downstream on the Ottawa River at river mile 4.75. With this major industrial investment early in Toledo's economic history, many other industries developed to meet the production demands of creating the world famous Jeep. Industries, as well as landfills, grew through the Maumee AOC.

Another key investment of early industry was in the Otter Creek watershed. The first documented industrial development in this area began in 1895 as the Crystal Oil Co. In 1919 the Standard Oil Company constructed its first plant in the watershed. These and other environmental pressures had a profound effect on the health of the Creek. Between 1895 and the 1920s, the Otter Creek fish community declined, until it was eliminated in the mid-1920s.[39]



The lack of environmental regulations during early industrial development encouraged the disposal of industrial wastes into the naturally occurring floodplains and wetlands. This common practice resulted in the degradation of all environmental and economic aspects of the industrially developing area. This industrial heritage has led to historical contamination in our waterways. Toxic substances enter the surface waters either dissolved in runoff or attached to sediment or organic materials. The sources can include leaching industrial and municipal landfills, and abandoned industrial sites. The results can be contaminated sediments, poor water quality, and fish or wildlife deformities. The Ottawa River between river mile 5.0 and 7.0 are a very good example of a waterway that was historical abused.

The table below is a listing of the dumps, landfills, and brownfields as identified by the Maumee RAP in 2001.[40] The *Activities and Accomplishments in the Maumee Area of Concern* provides specific information about each site listed below including information such as the site location, former facility names, sampling results, and remedial actions implemented.

Dumps, Landfills and Brownfields in the Maumee AOC[41]

Watershed	Facility/Site Name	Facility/Site Location
Duck Creek	Buckeye Pipeline Company	3321 York Street, Oregon
	Consaul Street Dump	2510 Consaul St., Toledo
	Gulf Oil Refinery and Terminal (a.k.a. Chevron)	2935 Front St., Toledo
	Millard Ave. Overpass	Millard Ave. between Front St. and Otter Creek Rd., Toledo and Oregon
	Norfolk & Southern Railway (a.k.a. Norfolk & Western, Ironville Yard)	2750 Front Street, Toledo
	Paine Street Landfill	Northwest corner of Paine Street and Consaul Street, Toledo
	Phillips Petroleum (a.k.a. Toledo Philblack Plant, River East Industrial Park)	275 Millard Ave., Toledo
Maumee River	Bassett Street Warehouse (a.k.a. Oldberg Manufacturing Co., Schachner Property, Maumee Refining, Greise Brothers)	600 Bassett Street, Toledo
	Florence Avenue Dump	Florence Ave., Toledo
	Gulf Oil Refinery and Terminal (a.k.a. Chevron)	2935 Front St., Toledo
	Koppers (a.k.a. Toledo Coke)	2563 Front St., Toledo
	Libbey Plant 27 (a.k.a. Owens-Illinois, Inland Chemical)	940 Ash Street, Toledo
	Old Peanut Hill Dump	Oak Street, near Akron St., Oaklawn Dr., and Richford St., Toledo
	Phillips Petroleum (a.k.a. Toledo Philblack Plant, River East Industrial Park)	275 Millard Ave., Toledo
	Plaskon	2829 Glendale Ave., Toledo
	South Avenue Dump (a.k.a. South and Western Dump, Toledo Municipal Sanitary Landfill, S/W Dump)	103 South St., Toledo
	Sun Oil Company	1819 Woodville Rd., Oregon
	TAG Chemicals, Inc.	100 Edwin Dr., Toledo
	Unitcast	1440 East Broadway, Toledo
Ottawa River	Cleveland Metals (a.k.a. New York Central Railroad, Fanner Manufacturing, HLR Enterprises)	2351 Hill Ave., Toledo
	Dura Avenue Landfill	Dura Ave., Toledo
	Harrison Junk Yard (a.k.a. Reneger)	10259 ½ Dorr Street, Spencer Township
	Herbert E. Orr Company (a.k.a. Devilbiss Manufacturing)	3863 Lagrange Street, Toledo

Ottawa River *(continued)*	Jeep/DaimlerChrysler (a.k.a. Overland, American Motors Company, Chrysler Corporation)	1000 Jeep Parkway, 4000 Stickney Ave., and 4400 Chrysler Drive
	Joe E. Brown Park Landfill	Manhattan Blvd., west of Lagrange, Toledo
	King Road Landfill	3535 King Rd., Sylvania Township
	North American Car Corporation	3648 Hoffman Road, Toledo
	North Cove Landfill	Foot of Drexel Dr., I-75 and North Cove Blvd.
	Northern Ohio Asphalt Paving Company	7950 Sylvania Avenue, Sylvania
	Owens Illinois-Hilfinger	1800 N. Westwood Avenue, Toledo
	Owens Illinois-Tech Center	1700 N. Westwood, Toledo
	Perstorp Polyols (a.k.a. Pan American, Dupont E.I. DeNemours & Co., Inc.)	622 Matzinger Road, Toledo
	Royster Property (a.k.a. Stickney West Industrial Park)	4401 Creekside Ave., Toledo
	Scott Park	Hill Ave., Toledo
	Sheller-Globe/Armored Plastics (a.k.a. City Auto Stamping, United Technologies Automotive Systems, Inc., Globe-Warnicke Industries, Inc)	4510 Lint Ave. and 303 Dura Ave., Toledo
	South Cove Landfill	South Cove Blvd. near Beatty Park, Toledo
	Stickney Avenue Landfill	3900 Stickney Ave, Toledo
	Textileather Corporation (a.k.a. Gencorp Maunfacturing)	3729 Twining, Toledo
	Toledo Tie Treatment Facility	Arco Industrial Park, S. Frenchmens Rd., Toledo
	Treasure Island Landfill (a.k.a. Miracle Park, Manhattan Park, Manhattan Dump)	between New York and Counter Streets, south of Manhattan St.
	Tuber Dump (a.k.a. Miracle Park, Manhattan Park, Manhattan Dump)	north of the intersection of Columbus and Ontario Streets
	Tyler Street Landfill	east end of Tyler St. near Creekside Ave., Toledo
	Willy's Park Landfill (a.k.a. Willy-Jeep Test Track)	Drexel Dr., Toledo
	XXKem Company (a.k.a. Incorporated Crafts, Robert Oberly)	3903-3905 Stickney Ave., Toledo
Otter Creek	Bill's Road Oil Services	3500 York St., Oregon
	BP Oil Company- ToledoRefinery (a.k.a. Standard Oil)	4001 Cedar Point Road, Oregon
	Buckeye Pipeline Company	3321 York Street, Oregon
	Gulf Oil Refinery and Terminal (a.k.a. Chevron)	2935 Front St., Toledo
	Commercial Oil	3600 Cedar Point Road, Oregon
	Envirosafe Services of Ohio, Inc. (a.k.a. Fondessy Enterprises, Inc.)	876 Otter Creek Road, Oregon
	Fondessy Landfill #1 (a.k.a. Millard Ave. Landfill)	southwest corner of Otter Creek Road and Millard Ave. Overpass, Oregon
	Gradel Landfill (a.k.a. Old Westover Landfill)	1150 Otter Creek Road, Oregon
	Libbey-Owens-Ford, Inc. (a.k.a. Pilkington)	1769 East Broadway, Toledo
	Matlack Trucking	1728 Drouillard Road, Toledo
	Millard Ave. Overpass	Millard Ave. between Front St. & Otter Creek Rd
	Sun Oil Company	1819 Woodville Rd., Oregon
	Toledo Powdered Metals (a.k.a. Republic Steel Corp., Metal Deck, Inc., Epic Metals Corp., Co-Bar Corp.)	1700 Landis Ave., Oregon
	Union Oil Company (a.k.a. UNO-VEN Corp., UNOCA, Pure Oil Co.)	1840 Otter Creek Rd., Oregon
	Westover Corporation Sanitary Landfill	815 Otter Creek Road, Oregon
Swan Creek	Allied Automotive Toledo Stamping (a.k.a. Toledo Stamping and Manufacturing, Co.)	43 S. Fearing Blvd., Toledo

Swan Creek *(continued)*	American National Can Company	10444 Waterville-Swanton Road, Whitehouse
	Angola Road Landfill	7717 Angola Road, Holland
	Arlington Ave. Dump	Arlington Ave., southwest of Detroit and South Ave., Toledo
	Bethel Lutheran Church	1853 South Ave., Toledo
	Champion Spark Plug (a.k.a. Cooper Automotive Company)	900 Upton Ave., Toledo
	Champion Street Dump (a.k.a. Swan Creek at Champion Street Dump)	Swan Creek at Champion St, Toledo
	Chester Street Dump	Swan Creek at Chester St, Toledo
	Columbia Gas (a.k.a. Toledo Coal Gas Plant, Toledo Gas, Light, and Coke Company, Ohio Fuel Gas Co.)	328 South Erie St, Toledo
	Detroit Lead Battery Recycler	5715 Angola Road, Toledo
	Frankfort Auto Parts (a.k.a. Hudson Site)	229 South Schwamberger Road, Holland
	Griswold Landfill	10745 Old State Line Road, Swanton
	Holland Village Dump	Northwest Corner of Front St and Conrail Tracks
	International Mineral and Chemical	10401 Old State Line Road, Spencer Township
	Irwin Road Dump	809 South Irwin Road, Spencer Township
	Jennison-Wright Corporation	2332 Broadway Ave, Toledo(east of Toledo Zoo)
	Louie Street Dump	Louie Street at Swan Creek, Toledo
	NL Industries Bearings Division (a.k.a. Bunting, Brass, and Bronze, Inc., Eagle-Picher Bearings Co.)	715 Spencer Street, Toledo
	Ohio Air National Guard	at the Toledo Express Airport, Swanton
	Providence Township Dump	7349 and 7421 Manore Road, Providence Township
	Providence Township Dump	Between Schadel Road and Hertzfeld Road, Providence Township
	Spencer Township Dump (a.k.a. Eber Road Dump)	340 Eber Rd. - between Frankfort Rd. and the Tributary, Spencer Township
	Springfield-Monclova Township Dump (a.k.a. Reed Road Landfill)	Reed Rd, Swanton
	Swan Creek Landfill	north side of Glendale Road near Reynolds Road, Toledo
	Swanton Township Dump	on Manore Rd, North of Neapolis-Waterville Rd., Swanton Township
	Swanton Township Dump	North of Monclova Rd., East of Southern Rd., South of Route 295, and West of Spencer St., Swanton Township
	Webstrand Corporation	525 Hamilton St., Toledo
	Western Ave. Dump a.k.a. Swan Creek at Western Ave. Dump	1401-1463 Western Ave., Toledo
Shantee Creek	Dial Corporation	6120 N. Detroit Ave., Toledo
	General Motors Corp.	1455 W. Alexis Rd., Toledo
	NL Industries (a.k.a. Doehler-Jarvis Farley/Farley Metals, Inc.)	5400 N. Detroit Avenue, Toledo
Silver Creek	General Motors Corp.	1455 W. Alexis Rd., Toledo
	NL Industries (a.k.a. Doehler-Jarvis Farley/Farley Metals, Inc.)	5400 N. Detroit Avenue, Toledo
Driftmeyer Ditch	Heist Corporation (a.k.a. Colander, C.H. Heist Cleaning Services)	3804 Cedar Point Road, Oregon
Ward Canal	Jerusalem Township Dump	11670 State Route 2, Jerusalem Township

These substances may also enter ground water through soil infiltration. The principal infiltration concerns for watersheds are the entry of these contaminants into the food chain; bioaccumulation; toxic effects on aquatic organisms, other wildlife and microorganisms; habitat degradation; and degradation of water supplies. The concerns regarding ground water contamination are primarily from the impacts related to the degradation of drinking water supply sources.

Today's environmental regulations require any discharge to a waterway to be permitted. The tables below list general, industrial, and public National Pollutant Discharge Elimination System (NPDES) permitted point sources in the Maumee AOC.

Petroleum Corrective Action General Permits in the Maumee AOC[42]

Watershed	Facility
Amolsch Ditch	BP Gas Station #06824
Blue Creek	Former EMRO Propane
Crane Creek	Flying J Travel Center
Ottawa River	BP Gas Station #06793
	BP Gas Station #06850
	BP Gas Station #06725
	Speedway SuperAmerica # 3556
	Sterling Food Store #12
Packer Creek	BP Gas Station #16400
Shantee Creek	7-Eleven Inc Store # 19775
Swan Creek	Former Buckeye Pipeline – Right of Way

Non-Contact Cooling Water General Permits in the Maumee AOC[43]

Watershed	Facility
Cedar Creek	First Solar Inc
	DaimlerChrysler Toledo Machining Plant
Maumee River	Arbor Biodiesel Co LLC
Ottawa River	Fenner Nationwide Conveyor Belting
Shantee Creek	New Mather Metals Inc

Industrial and Public Permits in the Maumee AOC[44]

Watershed	Facility
Berger Ditch	Oregon WTP
Cedar Creek	Stoneco Inc Lime City Plant
Crane Creek	Wildflower Place Subdiv WWTP
	BP Amoco Oil Corp Bulk Plant Millbury
	Fuel Mart #641
	National Auto - Truckstop Inc
	Perrysburg Estate MHP
	Petro Stopping Center Inc No 17
	Pilot Travel Center LLC No 012
	Village Green
	Luther Home of Mercy
Driftmeyer Ditch	CITGO Petroleum Corp Toledo Terminal
	Marathon Ashland Petroleum LLC Oregon Terminal
Duck Creek	Toledo WTP
Grassy Creek	Southview Estates MHP
Heckman Ditch	Asphalt Materials Inc
Maumee Bay	BP Oil Co Toledo Refinery
	Oregon WWTP
	Toledo Edison Bay Shore Plant
Maumee River	Bowling Green WTP
	Country Manor Estates
	Maurer's MHP
	Perrysburg WWTP
	Pilkington North America Rossford Plt 6
	Consolidated Rail Corp Conrail Toledo Maint
	Libbey Glass Inc
	Paxton Recycling Operations
	Shell Oil Products US - Toledo Terminal
	Sun Co Inc R & M Marine Terminal
	Toledo Bay View Park WWTP
	Hanson Aggregates Midwest Inc-Waterville Quarry
	Maumee River WWTP

Watershed	Facility
Ottawa River	DaimlerChrysler Corp Jeep Parkway Assembly Plant
	Fenner Dunlop Toledo LLC
	Hoffman Road Sanitary Landfill
	Perstorp Polyols Inc
	Textileather Corp
	EI Dupont de Nemours and Co Toledo Plant
Otter Creek	Evergreen Recycling & Disposal
	BP Oil Co Toledo Refinery
	Buckeye Pipe Line Co LP Toledo Station
	CSX Transportation Inc
	Envirosafe Services of Ohio
	TWO LLC Sunoco WWTP
	Pilkington North America E Broadway
	Toledo WTP
Packer Creek	Troy Energy LLC
Silver Creek	Browning-Ferris Industries of Ohio and Michigan
	GM Powertrain Group
	Remediation & Liability Mgmt Co
Swan Creek	StoneCo Inc Maumee Quarry
	US Dept of the Air Force 180 Fighter Group
Ten Mile Creek	Hanson Aggregates Sylvania Quarry
	Old Castle Materials - Sylvania Quarry
Toussaint Creek	Genoa WWTP
	Graymont Dolime OH Inc
	Luckey STP
	Uretech International Inc
	Eastwood Middle School
	Rocky Ridge Elem School
Turtle Creek	White Rock Quarry LP
	Stoneco Inc Rocky Ridge Quarry

Bacteria

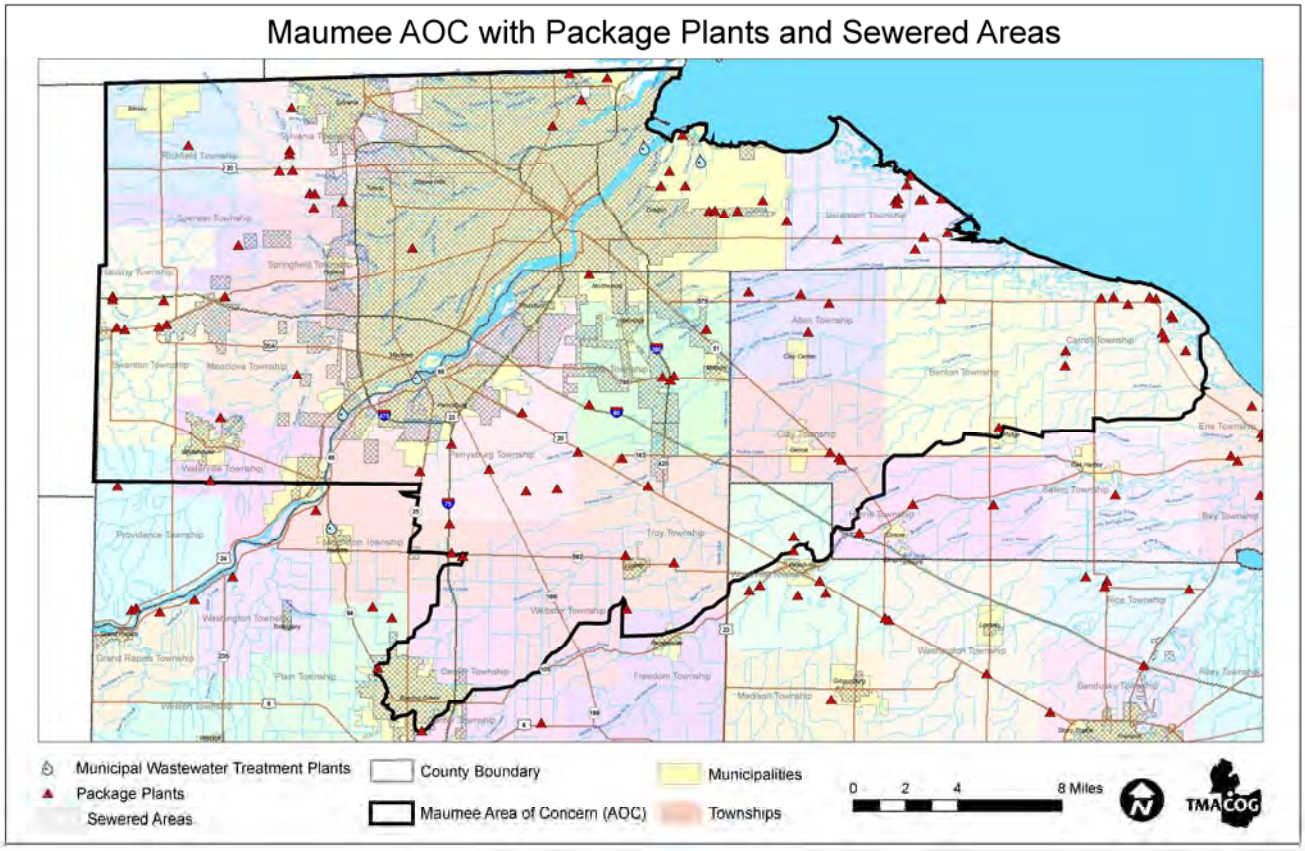
Fecal bacteria can carry a variety of disease organisms, including typhoid fever, cholera, dysentery, infectious hepatitis, and numerous others.[45] There were outbreaks of cholera in northwest Ohio before public sewerage systems came into use.[46] In terms of public health, fecal bacteria is the most critical pollutant. Waterborne disease can lead to sickness and death within days. Major outbreaks of these diseases are a thing of the past — a tribute to our public health and wastewater treatment systems.

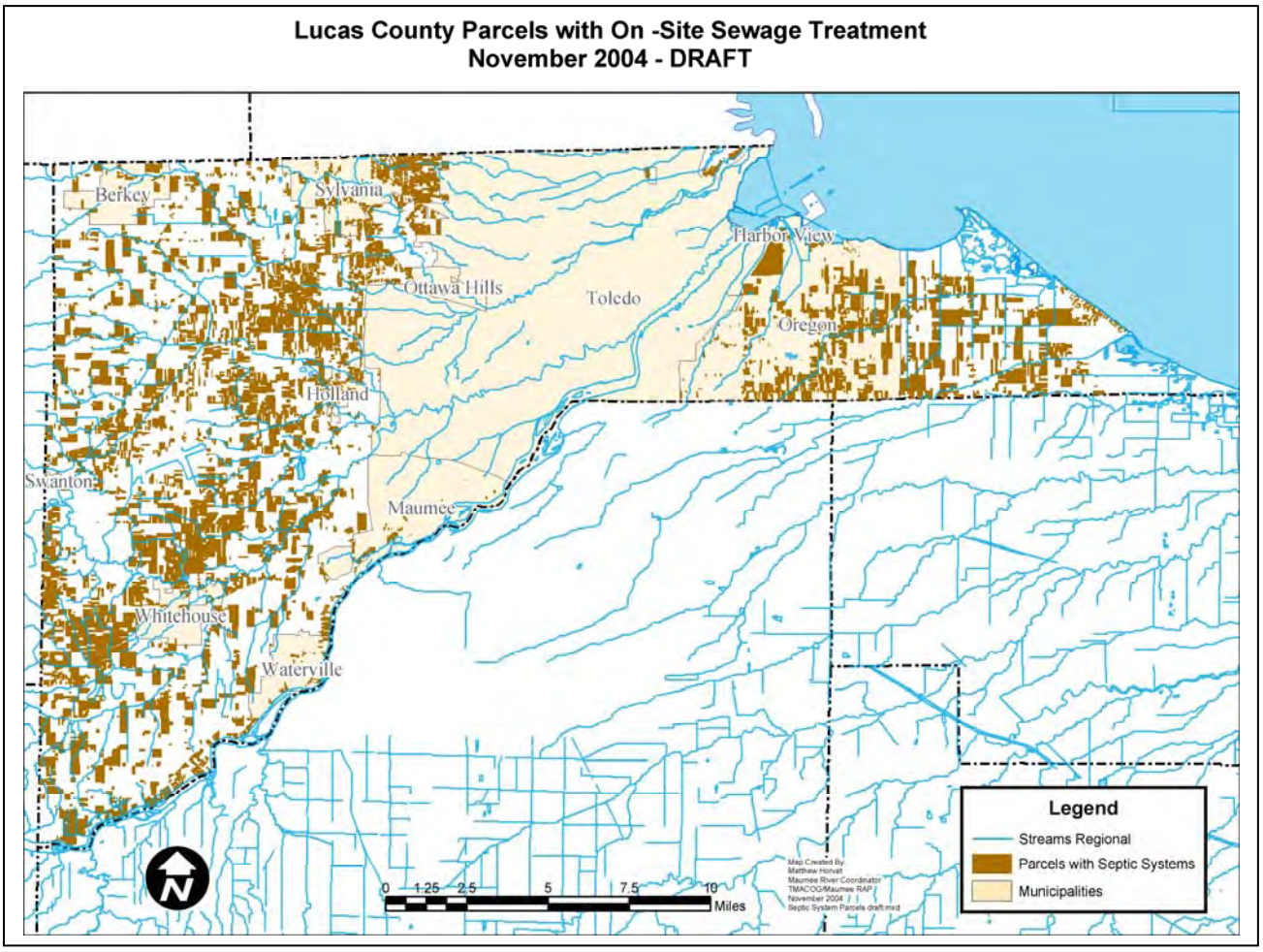
The sources of fecal bacteria are birds, mammals, and humans. Sewage in water is detected by testing for “indicator” bacteria. One indicator group is called fecal coliform. These bacteria are present in sewage and contaminated water in far greater numbers than pathogens. As such, they are

easier to detect, and demonstrate the presence of fecal matter. In recent years many regulatory agencies have begun using a test for a specific bacterium, *Escherichia coli* (*E. coli*).

In streams the presence of fecal coliform has documented the need for sewerage facilities to eliminate septic systems, package plants, sewer overflows, and to mandate improved sewage treatment. Despite these improvements, fecal bacteria counts often exceed standards at public beaches. This problem is not unique to the Maumee AOC; in fact, it is very common on beaches nationwide.

TMACOG created the map below to illustrate the location of package plants and wastewater treatment plants throughout the Maumee AOC. A similar map for septic systems is also being created under another TMACOG grant. The preliminary version is also below.





There are many possible sources of fecal bacteria, as noted above. Understanding what bacteria sources contaminate a given beach is complicated by the question of survival. Normally fecal bacteria do not survive long in a waterway. Studies of Maumee Bay and Wolf Creek in eastern Lucas County indicate *E. coli* accumulate in stream sediment, where they may survive for extended periods and be stirred up again by a later storm.[47] Further research is needed for a better understanding of the sources of fecal contamination, survival, and travel in Maumee Bay and the Lake Erie nearshore.

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[37] Public Notice: Operation and Maintenance Dredging and Dredge Material Discharge, Toledo Harbor, US Army Corps of Engineers, September 2003.
[38] *The Results of a Sediment Trend Analysis in Maumee Bay, Lake Erie*, GeoSea Consulting, 2003.
[39] *Duck and Otter Creeks: The Watersheds, The Problems, and The Cleanup*, Maumee RAP Newsletter, January 1999.
[40] *Activities and Accomplishments in the Maumee Area of Concern (1991-2001)*, Maumee RAP, April 2002.
[41] *Activities and Accomplishments in the Maumee Area of Concern (1991-2001)*, Maumee RAP, April 2002.
[42] Ohio EPA GENTRAK data, extracted November 5, 2004.
[43] Ohio EPA GENTRAK data, extracted November 5, 2004.
[44] Ohio EPA SWIMS data, extracted October 29, 2004.
[45] *Water and Wastewater Engineering, Volume 2*, Fair, Geyer, and Okun, John Wiley & Sons, 1958; pp 19-4 through 19-9.
[46] One such outbreak is discussed in *An Historical Gazetteer of Wood County Ohio*, Lyle Rexford Fletcher, Emeritus Professor of Geography, Bowling Green State University, 1988, p 116.
[47] *Wolf Creek Bacterial Impact on Maumee Bay State Park Beach*, University of Toledo and TMACOG, June 2003.

Measuring and Managing Water Quality

- Parameters of Measurement
- Water Quality Assessments
- Contact and Consumption Advisories
- Storm Water Management
- Total Maximum Daily Load Program
- Coastal Nonpoint Pollution Control Program
- Public Drinking Water Supply

"Is this stream polluted?" "Is this stream cleaner than that stream?" These questions are more complicated than they sound. There are many different types of pollutants, with different impacts on human and ecological health. The earliest water pollution laws were concerned with eliminating odors and visible pollution from sewage and industrial waste. In the early days of the Clean Water Act, water was "clean" if it passed a series of chemical tests. Today, concerns are more encompassing; assessing chemical parameters, fish and macroinvertebrate communities, and habitat. Some of the parameters used to measure water quality and the methods of interpreting this data are addressed in this chapter.

Parameters of Measurement

A variety of methods and materials can be used to test water quality. Some of the parameters and the methods for measuring them are described below.

Physical

Stream sampling usually includes physical characteristics of the water: temperature, pH, and sediment load (suspended solids, turbidity). These physical characteristics can be affected by a variety of external stressors from industrial thermal discharge to agricultural practices.

Biological

Today, water quality is measured by a stream's ability to support life. The chemical tests are still important, but so are spawning areas, siltation, and vegetation along the streambanks. Ohio EPA classifies each stream with a "use designation." A use designation calls up a set of standards based on the water quality that could be expected in a stream. For instance, the quality of a coldwater stream flowing down out of the mountains over a rocky stream bed would likely be higher than a flat stream with a muddy bottom. The flatness of most of the streams in our region means that they are less likely to achieve high standards than streams in other parts of the state with more slope and turbulence. The majority of streams in our region are classified as Warmwater Habitat (WWH) or Modified Warmwater Habitat (MWH).[1]

Ohio EPA measures a stream's Aquatic Life Use Designation attainment with a series of index scores. Two of the multi-metric indexes are the Index of Biotic Integrity (IBI) and Invertebrate Community Index (ICI). These indexes are derived from the number of fish, insects, and invertebrates in a stream, their health, the number of different species, and how pollution-tolerant those species are. For instance, mayfly larvae are pollution intolerant, so their presence indicates good water quality.[2]

Another multi-metric index, the Qualitative Habitat Evaluation Index (QHEI), measures a streams habitat quality. It considers the stream substrate (e.g., boulders, pebbles, sand, silt, mud), type, and amount of vegetation along and in the waterway.

Chemical

All stream water contains chemicals. Many are benign in moderate concentrations. Some are necessary for a healthy ecosystem. Constituents include hardness (calcium, magnesium), chlorides, organic content (biochemical oxygen demand or BOD), nutrients (various forms of phosphorus and nitrogen), and dissolved oxygen.

There are many industrial chemicals in waterways. Three categories are usually of greatest concern. Metals [cadmium (Cd), chromium (Cr), lead (Pb), copper (Cu), zinc (Zn), and mercury (Hg)] can cause toxic effects depending upon the metal and concentration. Polychlorinated biphenyls (PCBs) are recognized as probable carcinogens. Now banned, PCBs were once widely used in manufacturing and cooling. Polycyclic Aromatic Hydrocarbons (PAHs) are a related class of toxic chemicals and are often byproducts of coking facilities and petroleum processing, such as creosote.

Other chemicals may be present, depending on the area's industries. Other industrial chemicals include arsenic (As), cyanide (CN), phenol, and beryllium (Be).[3] Many industrial contaminants have a tendency to bond or diffuse into organic particles such as silts and fatty tissues in biota. As a result, these types of chemicals are often concentrated in stream sediments, where they may stay for years, move with the sediment, or enter and biocumulate through the food chain posing risks to higher-level animals (i.e. osprey, eagles, mink) as well as humans. Many industrial chemicals, like PCBs and certain PAHs, are also resistant to biodegradation and remain in the environment for decades.

Water Quality Assessments

The ultimate goal of the Maumee RAP is to restore the beneficial uses of the Maumee AOC and to attain Ohio's Aquatic Life Use designation for all streams in the Maumee AOC. Attainment and non-attainment of aquatic life uses is determined by using biological criteria as outlined in Ohio Administrative Code §3745-1-07. The majority of the waterways in the Maumee AOC have a Warm Water Habitat use designation, however small stream segments and portions of several tributary ditches have a Modified Warm Water Habitat or Limited Resource Water Habitat aquatic life use designation. These designations are defined in Ohio Administrative Code as:

- *Warm Water Habitat (WWH):* This use designation defines the "typical" warmwater assemblage of aquatic organisms for Ohio rivers and streams; this use represents the principal restoration target for the majority of water resource management efforts in Ohio.

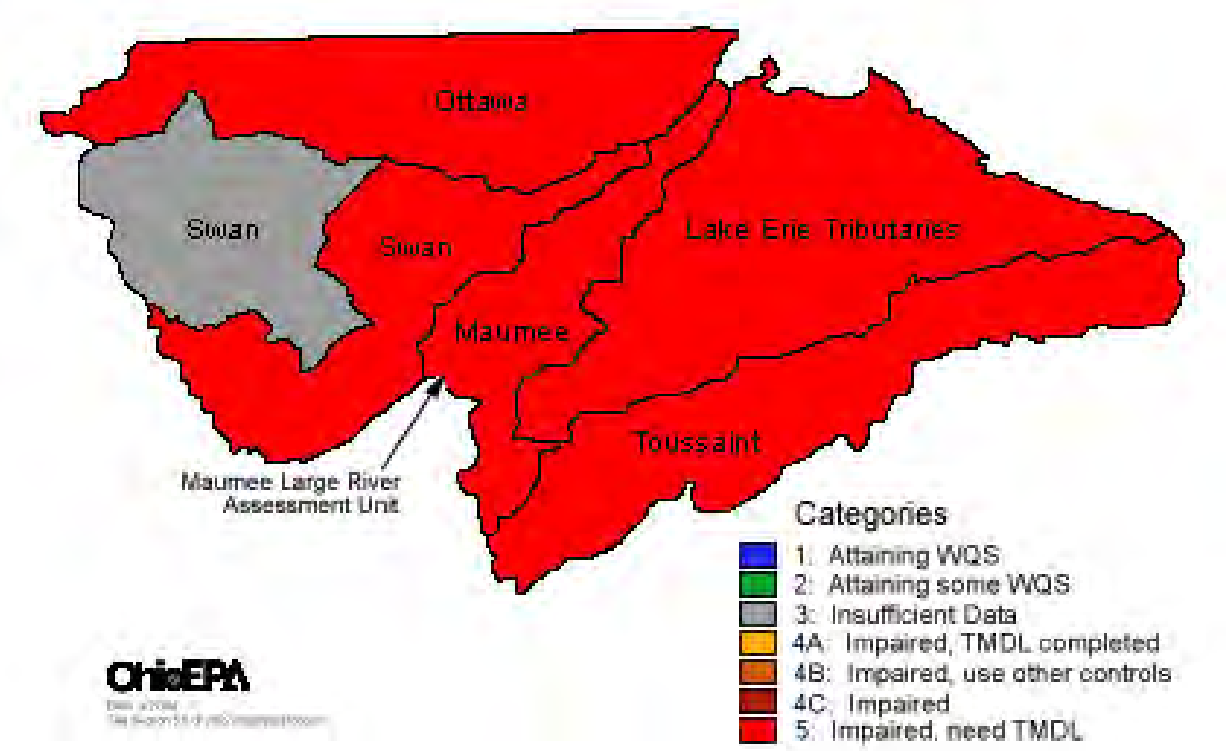
- *Modified Warm Water Habitat (MWH):* This use applies to streams and rivers which have been subjected to extensive, maintained, and essentially permanent hydromodifications such that the biocriteria for the WWH use are not attainable and where the activities have been sanctioned and permitted by state and/or federal law; the representative aquatic assemblages are generally composed of species which are tolerant to low dissolved oxygen, silt, nutrient enrichment, and poor quality habitat. Biological criteria for MWH were derived from a separate set of habitat modified reference sites and are stratified across five ecoregions and three major modification types: channelization, run-of-river impoundments, and extensive sedimentation due to non-acidic mine drainage.

- *Limited Resource Water Habitat (LRW):* This use applies to small streams (usually <3 sq. mi. drainage area) and other water courses which have been irretrievably altered to the extent that no appreciable assemblage of aquatic life can be supported. Such waterways generally include small streams in extensively urbanized areas, those which lie in watersheds with extensive drainage modifications, those which completely lack water on a recurring annual basis (i.e. true ephemeral streams), or other irretrievably altered waterways.

The Ohio EPA 2002 Integrated Report provides statewide maps showing the attainment status of watersheds.[4] The 2004 Integrated Report is available (May 2004), however this information was not

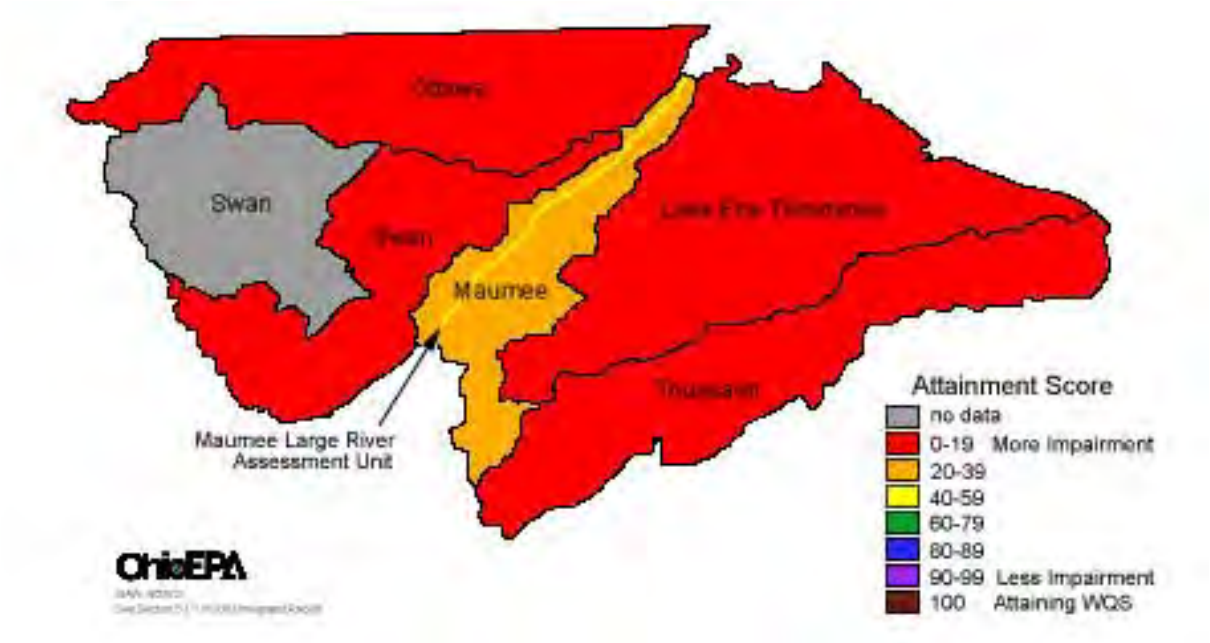
graphically presented because it had not changed. The map below shows whether individual 11-digit HUC areas and the Maumee River Large River Assessment Unit are meeting their overall use attainment standards. Most of the Maumee AOC is either impaired or lacks sufficient data for determination.

Ohio 2002 Integrated Report
Categories of Assessment Units



The next map shows the percentages of streams that meet aquatic life use standards. The majority of streams are less than 20 percent in attainment, but the Maumee HUC and Maumee River Large River Assessment look better.

Ohio 2002 Integrated Report
Aquatic Life Use Status of Assessment Units

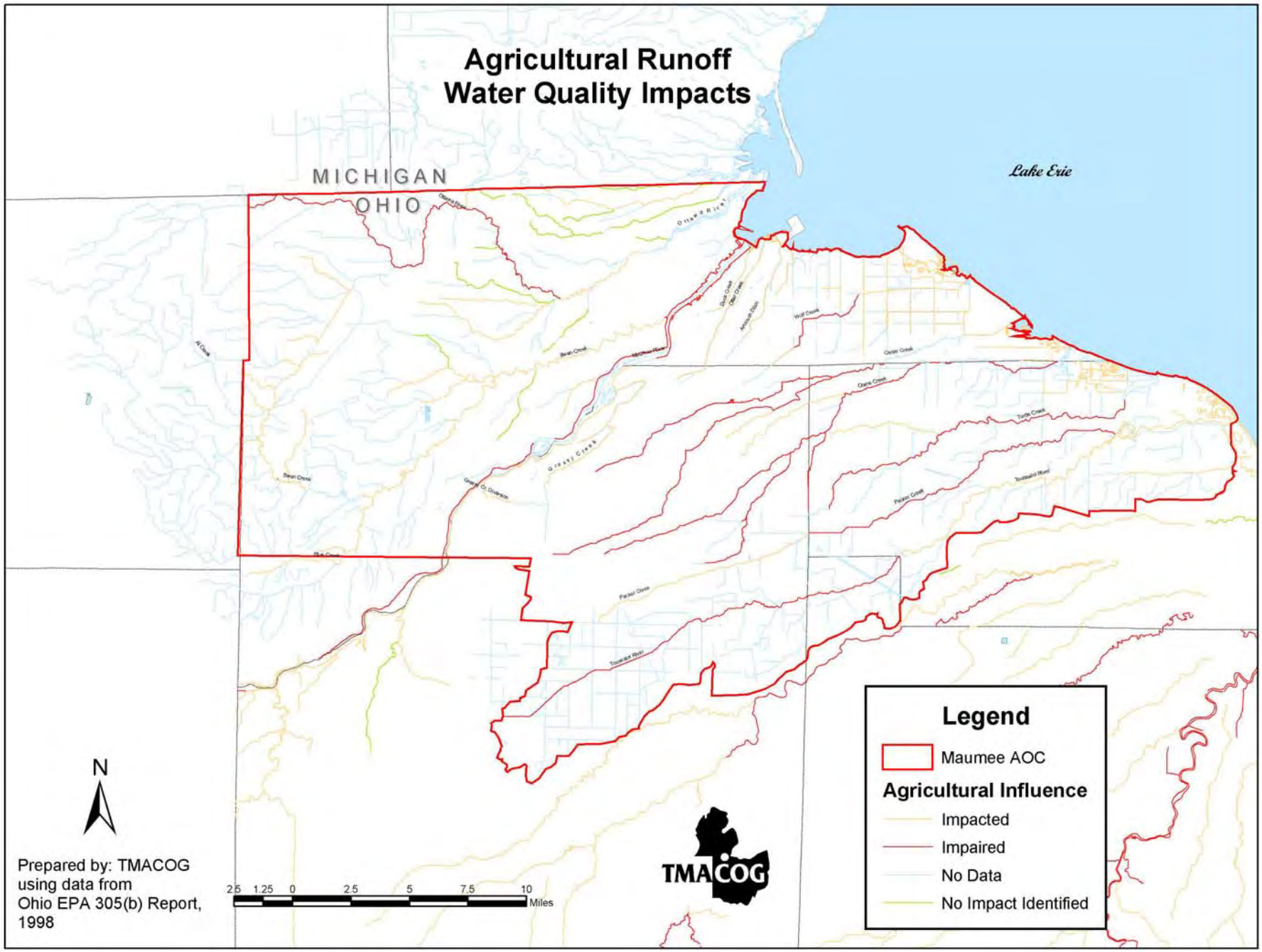


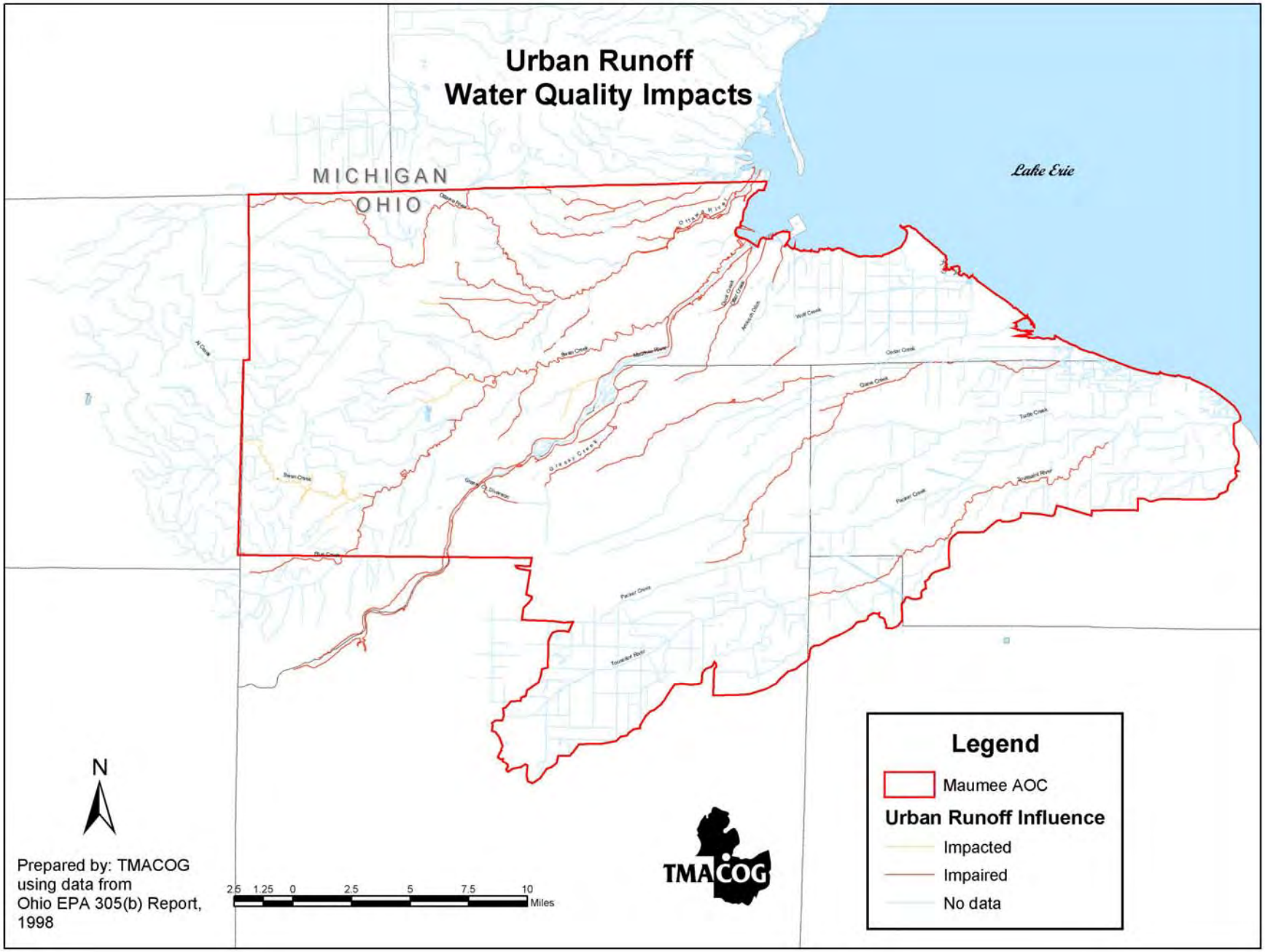
An evaluation by Assessment Unit can be helpful in understanding the overall status of a HUC area, however it is necessary to evaluate individual stream segments to determine the waterways full range of impairments. Only then can the actions needed to restore all segments to fishable and swimmable conditions be determined.

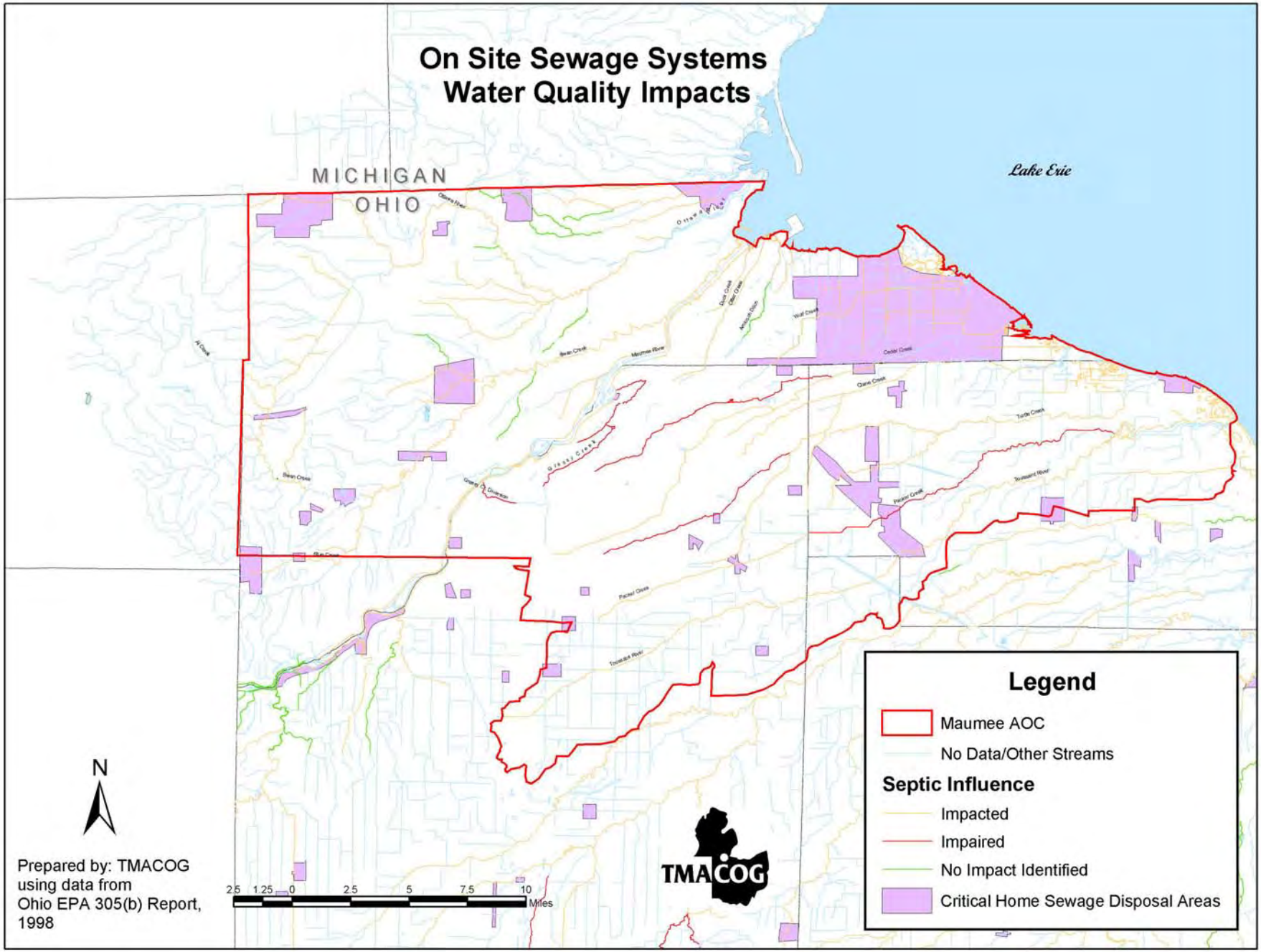
The impact maps below were created by TMACOG based on data from the 1998 Ohio EPA 305(b) Report.[5] These maps do not show attainment, but instead use Ohio EPA's former method of measuring the health of watersheds. These tables refer to segments of each stream as being impacted or impaired. The classifications are defined as:[6]

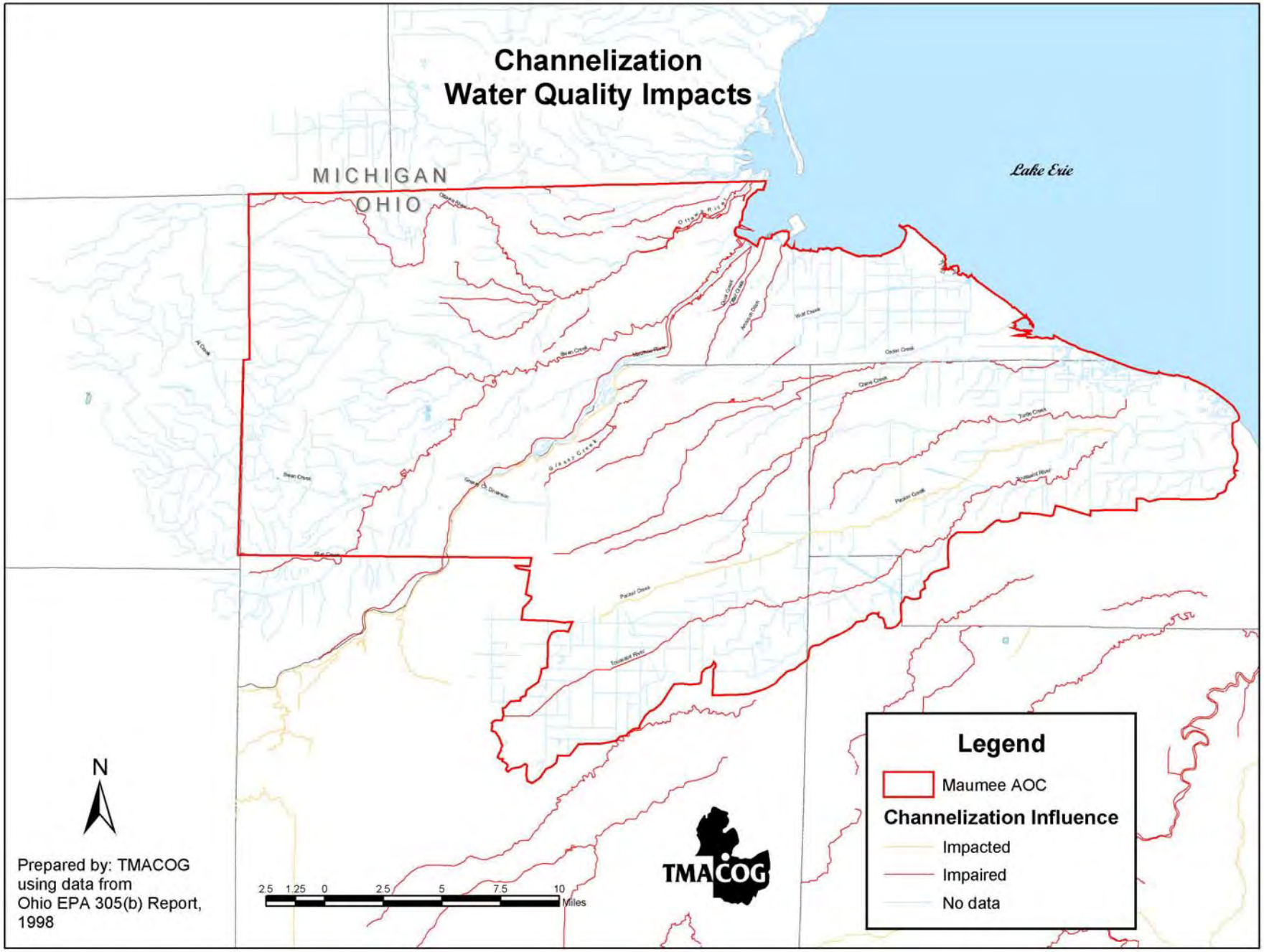
- *Impacted*: This classification refers to the situation where there is a suspected impairment based on the presence of sources (e.g. nonpoint source surveys). In such cases there is evidence that some changes or disturbances have occurred to the stream, but there is not quantitative data to establish whether aquatic life uses are actually being impaired.

- *Impaired*: This classification refers to the situation where there is monitored data that establishes a violation of some water quality or biological criterion, and hence, an impairment of the designated use.


Agricultural Runoff
Water Quality Impacts
MICHIGAN
OHIO
Lake Erie
Legend
Maumee AOC
Agricultural Influence
Impacted
Impaired
No Data
No Impact Identified
N
Prepared by: TMACOG
using data from
Ohio EPA 305(b) Report,
1998
2.5 1.25 0 2.5 5 7.5 10
Miles
TMACOG


Urban Runoff
Water Quality Impacts
MICHIGAN
OHIO
Lake Erie
N
Prepared by: TMACOG
using data from
Ohio EPA 305(b) Report,
1998
2.5 1.25 0 2.5 5 7.5 10
Miles
TMACOG
Legend
Maumee AOC
Urban Runoff Influence
Impacted
Impaired
No data


On Site Sewage Systems
Water Quality Impacts
MICHIGAN
OHIO
Lake Erie
Legend
Maumee AOC
No Data/Other Streams
Septic Influence
Impacted
Impaired
No Impact Identified
Critical Home Sewage Disposal Areas
N
Prepared by: TMACOG
using data from
Ohio EPA 305(b) Report,
1998
2.5 1.25 0 2.5 5 7.5 10
Miles
TMACOG


Channelization
Water Quality Impacts
MICHIGAN
OHIO
Lake Erie
N
Prepared by: TMACOG
using data from
Ohio EPA 305(b) Report,
1998
2.5 1.25 0 2.5 5 7.5 10
Miles
TMACOG
Legend
Maumee AOC
Channelization Influence
Impacted
Impaired
No data

The water quality of the Maumee AOC rivers can be summarized as follows:

- The majority of our streams are impaired and do not meet water quality standards.
- The large river assessment unit rates much better than the small streams.
- The reasons our rivers do not meet use attainment standards are usually due to nonpoint source pollution, siltation, or stream alteration.

Contact and Consumption Advisories

When consumption of fish or contact with a waterway may endanger public health, a regulatory agency may issue an advisory. Fish consumption advisories provide the public with recommended consumption frequencies for different types of fish. Contact advisories recommend which waterbodies the public should not swim in.

In Ohio fish consumption advisories are issued annually by the Ohio Department of Health in cooperation with Ohio EPA and Ohio Department of Natural Resources. Current advisories and additional references are available on the web. They advise not eating certain types of fish from some streams, or limiting how often you eat certain types of fish. A summary of the advisories in the Maumee AOC is given below. Refer to the Ohio EPA website, or the Ohio Sport Fish Consumption Advisory for a current and complete listing.[7]

Ohio's Fish Consumption Advisories for Maumee AOC Waterbodies

Water Body	Area Under Advisory	Species	One Meal Per	Contaminants
Lake Erie	All Waters	Channel Catfish under 16", Lake Trout	2 Months	PCBs
Lake Erie	All Waters	Chinook Salmon (19" and over), Coho Salmon, Common Carp, Freshwater Drum, Smallmouth Bass, Steelhead Trout, Whitefish, Walleye 23" and over, White Bass, White Perch	1 Month	PCBs
Lake Erie	All Waters	Channel Catfish (16" and over)	Do not eat	PCBs
Maumee River	Indiana State Line to Waterville	Common Carp, Smallmouth Bass	1 Month	Mercury, PCBs
Maumee River	Waterville to mouth (Lake Erie)	Common Carp, Smallmouth Bass	1 Month	Mercury, PCBs
Maumee River	Waterville to mouth (Lake Erie) (Lucas, Wood Counties)	Channel Catfish	Do not eat	PCBs
Ottawa River	I-475 north of Wildwood Preserve, Toledo to Maumee Bay, Lake Erie	All Species	Do not eat	PCBs

PAHs = Polycyclic Aromatic Hydrocarbons PCBs = Polychlorinated Biphenyls

Also in the 2004 advisories issued by the Ohio Department of Health were recommendations that all persons should limit consumption of sport fish caught from all waterbodies in Ohio to one meal per week, unless there is a more restrictive advisory. This statewide advisory was issued to protect sensitive populations, including women of childbearing age and children under age 6. The advisory was extended to all persons in 2003 because of the statewide/nationwide mercury advisory for sensitive populations and the increasing number of location-specific one meal per week advisories.[8]

In 1997 Ohio EPA collected snapping turtles at six locations from Lake Erie tributaries and wetlands. They analyzed muscle (meat), liver, and fat tissues for lead, mercury, PCBs and organochlorine pesticides as part of a special monitoring project. Mercury and lead were found in the muscle (meat) samples taken from four water bodies and muscle (meat) from snapping turtles collected at one location had contaminant concentrations below advisory levels of concern.

PCBs in fat bodies and mercury in livers were found at extremely high concentrations in the turtles collected from the turtle advisory locations. Care should be taken to avoid eating fat or liver tissue from any snapping turtle caught in Ohio, particularly from turtles caught at the turtle advisory locations. Refer to the Ohio EPA website, or the Ohio Sport Turtle Consumption Advisory for a current and complete listing.[9]

Ohio's Turtle Consumption Advisories for Maumee AOC Waterbodies

Water Body	Area Under Advisory	Maximum Recommended Meal* Frequency	Contaminants
Maumee River (Defiance, Henry, Lucas, Paulding, Wood Counties)	All Waters	One meal per week	Mercury
Ottawa National Wildlife Refuge	All Waters	One meal per week	Lead
Ottawa River (Toledo)	All Waters	DO NOT EAT	

* Meal size = 4 ounces before cooking

When a river is judged unsafe for swimming or wading, a regulatory agency posts an advisory. It is advice to the public to avoid physical contact with the waters of these streams. Ohio EPA and the Ohio Department of Health jointly issue advisories due to contaminants. These advisories are listed in the table below. Local Boards of Health may also post advisories. Two of these local advisories have been issues in the Maumee AOC including Swan Creek (for bacteria) and Hecklinger Pond (for PCBs).

Ohio's Contact Advisories for Maumee AOC Waterbodies

Water Body Do Not Swim Advisory	Issued by	Reason
Ottawa River (I-475 @ Wildwood to mouth)	Ohio EPA and Ohio Department of Health	PCBs
Ottawa River	Toledo/Lucas County Health Department	Fecal bacteria

The Ohio Department of Health conducts a beach testing program.[10] Public swimming beaches are tested regularly throughout the season for fecal contamination, based on concentrations of fecal coliform or *E. coli*. When bacteria levels at a beach exceed standards, an advisory is posted. The advisory is taken down or re-posted as tests warrant throughout the summer. The Maumee AOC's public bathing beaches are listed below.

Public Beaches in the Maumee AOC

Public Bathing Beach	County
Maumee Bay State Park	Lucas
Crane Creek State Park	Lucas

Storm Water Management

As pollution control measures for point sources were implemented and refined, studies showed that more diffuse sources of water pollution were also significant causes of water quality impairment. Specifically, storm water runoff draining large surface areas, such as urbanized land. In 1987, the Clean Water Act was again amended by Congress to require implementation of a comprehensive national program for addressing problematic non-agricultural sources of storm water discharges. As required by the amended Clean Water Act, the NPDES Storm Water Program has been implemented in two phases.

NPDES- Phase I

In response to the 1987 Amendments to the Clean Water Act, US Environmental Protection Agency (EPA) developed Phase I of the NPDES Storm Water Program. Phase I requires NPDES permits for storm water discharges from:

- "Medium" and "large" municipal separate storm sewer systems (MS4s) serving populations of 100,000 or greater,
- Construction activity disturbing 5 acres of land or greater, and
- Ten additional categories of industrial activity.

In Ohio the regulated entities must obtain coverage under an NPDES storm water permit from Ohio EPA as well as implement storm water pollution prevention plans (SWPPPs) or storm water management programs (SWMPs), both using Best Management Practices (BMPs) that effectively reduce or prevent the discharge of pollutants into receiving waters.

US EPA identified eleven categories of industrial activities that are required to obtain permit coverage under the NPDES Storm Water Program. All categories are guided by a common set of rules and requirements, except construction activities. Any construction activity, including grading, clearing, excavation, or other earth moving process that disturbs greater than five acres requires a separate NPDES storm water permit for construction under the NPDES Storm Water Program.

The City of Toledo was the only entity within the Maumee AOC and headwaters that was affected by the MS4 portion of the Phase I rule. Toledo was issued an NPDES permit for its municipal separate storm sewer systems (MS4) discharges, first effective on September 1, 1997. This permit was revised and reissued in February 2004. These permits are typically renewed every five years. Ohio EPA must assure that the City of Toledo implements the requirements of the City's NPDES storm water permit.

All storm water discharges associated with industrial activity that discharge to waters of the State or through separate storm sewer systems are required to obtain NPDES permit coverage. Ohio EPA needs to aggressively work through education, partnerships, and inspections to identify and permit industrial discharges in the region.

NPDES– Phase II

On December 8, 1999, US EPA promulgated the expansion of the existing NPDES Storm water Program by designating additional sources of storm water for regulation to protect water quality. The expansion regulates small Municipal Separate Storm Sewer Systems (MS4s) located in "urbanized areas" (UA) as defined by the Bureau of the Census, and those small MS4s located outside of a UA that are brought into the program, on a case-by-case basis, by the state NPDES permitting authorities. NPDES Phase II also regulates small construction activities that disturb between 1 and 5 acres.

Phase II of the Storm Water Program is designed to implement programs and practices to control polluted storm water runoff. The rule automatically regulates two classes of storm water dischargers on a nationwide basis:

- Operators of small MS4s located in "urbanized areas" as defined by the Bureau of the Census (termed a "regulated small MS4"). Waivers from coverage are available.
- Operators of small construction activities (disturbing 1-5 acres of land). Waivers from coverage are available, but are mostly applicable to arid regions of the country.

Additional small MS4s (outside of urbanized areas) and construction sites (disturbing less than 1 acre of land), along with other sources which are a significant contributor of pollutants to waters of the United States, may be brought into the NPDES Storm Water Program by the state NPDES Permitting Authority (Ohio EPA). The first permit applications for regulated small MS4s and small construction activities were due March 2003.

Operators of Phase II regulated small MS4s were required to apply for NPDES permit coverage (most under a general rather than an individual permit) and develop an SWMP to implement six Minimum Control Measures (MCMs) to effectively reduce or prevent the discharge of pollutants into receiving waters. The MCMs are:

- Public Education and Outreach
- Public Participation/Involvement
- Illicit Discharge Detection and Elimination
- Construction Site Runoff Control
- Post-Construction Runoff Control
- Pollution Prevention/Good Housekeeping

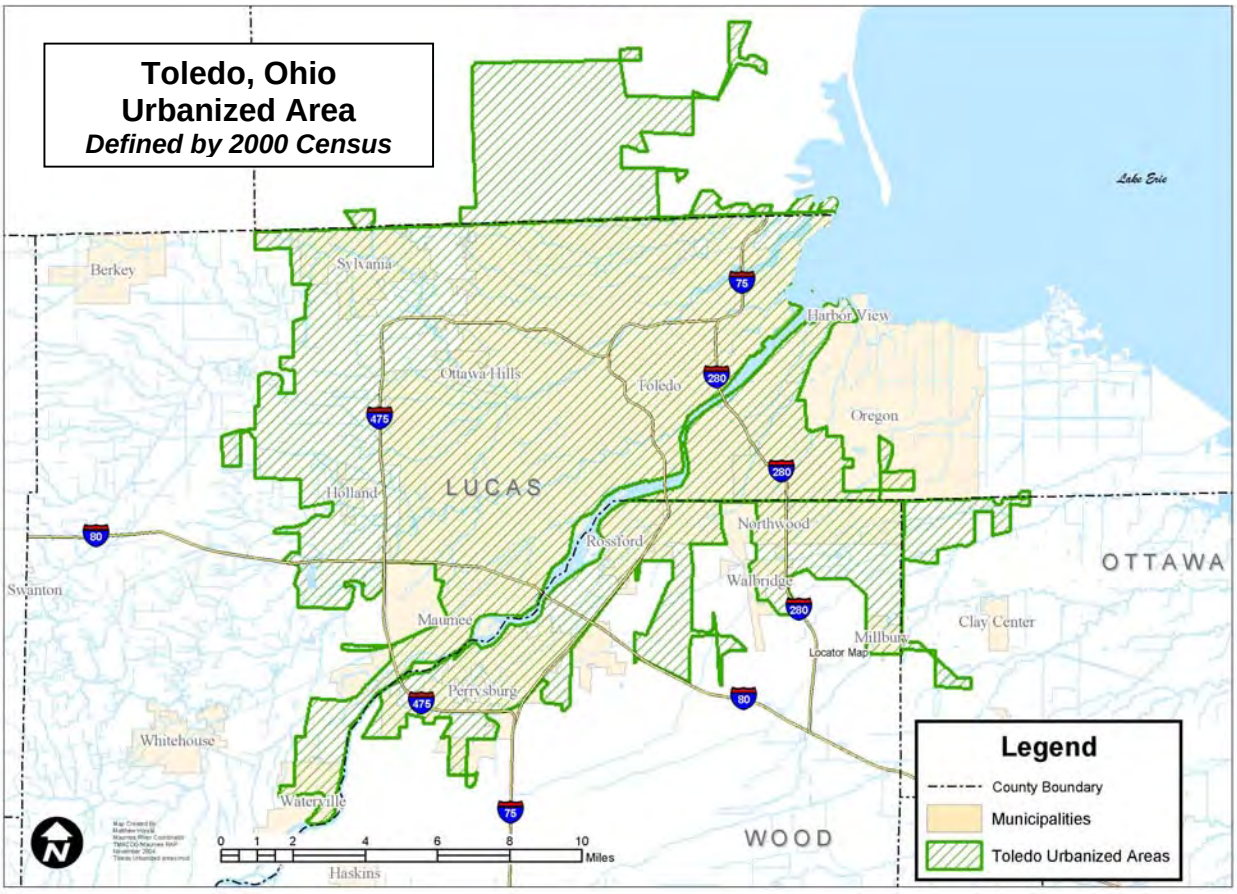
Operators of small construction activities are required to implement Best Management Practices (BMPs) as outlined in a general or individual NPDES permit. The goal of the BMPs is to prevent or minimize discharge of pollutants into receiving waters.

The table lists the communities and non-traditional entities in the Maumee AOC and headwater areas that are identified in the rules as being either automatically designated or designated based on the 2000 Census. Ohio EPA may use their discretion in bringing additional jurisdictions into the program.

Designated Storm Water NPDES Permits

Communities		
Cities	**Villages**	**Townships**
Lucas County		
Oregon	Harbor View	Jerusalem
Sylvania	Holland	Monclova
Maumee	Ottawa Hills	Spencer
Toledo (under Phase I)	Waterville	Springfield
		Sylvania
		Washington
		Waterville
Ottawa County		
		Allen
		Clay
Wood County		
Bowling Green (potentially)	Millbury	Lake
Northwood	Walbridge	Perrysburg
Perrysburg		
Rossford		
Non-Traditional Entities		
Ohio Dept of Transportation	Ohio Turnpike Commission	

Any public entity that operates a separate sewer system in the areas shown on the map below are automatically designated by rule to obtain NPDES permit coverage. The map below illustrates the areas covered under the NPDES Phase I and II programs.



Total Maximum Daily Load Program

The final Total Maximum Daily Load (TMDL) Rule was published in the Federal Register on July 13, 2000 but a Congressional rider prohibited US EPA from implementing this rule until FFY 2002.

By law, each State is required to submit a prioritized list of impaired waters to US EPA for approval (the "303(d) list"). A TMDL must be developed for each of the impaired waters. If sampling analyses indicates an impairment of water quality standards a TMDL Report is created to outline the steps needed to achieve state water quality standards. A TMDL Report is a written, quantitative assessment of water quality problems and contributing sources. It specifies the amount a pollutant needs to be reduced to meet water quality standards, allocates pollutant load reductions in a watershed, and outlines the actions needed to restore a waterbody. It is a watershed approach to quantifying and reducing both point and nonpoint sources of pollution to impaired waterbodies.

TMDLs establish allowable loadings (both point and nonpoint source) necessary to meet water quality standards in a given watershed. Specifically, allowable loadings are equal to the sum of individual wasteload allocations for point sources and the load allocations for both natural inputs and nonpoint sources. In urbanized watersheds, reductions in urban runoff nonpoint pollution can be a significant part of meeting the TMDL allowable loadings.

Ohio's TMDL process is evolving. After benchmarking with other states and US EPA and analyzing Ohio's rules and programs, the Ohio EPA Division of Surface Water developed a 12-step project-management-based TMDL process to accomplish TMDLs. The process builds on existing monitoring, modeling, permitting, and grant programs and works within Ohio EPA's "five-year monitoring strategy." The process calls for increased public involvement in problem solving and decision-making.

The process contains four broad, overlapping phases:

- *Assess* waterbody health: biological, chemical, habitat
- *Develop* a restoration target and a viable scenario
- *Implement* the solution: inside/outside Ohio EPA
- *Validate* to monitor progress: delist or relist.

The important themes of the process include reaching out to involve others - the public and other agencies - and focusing on the goal of bringing waters into attainment. To do this we will build on our past experiences and explore new technology and methods. Finally, we will use a quality improvement process to measure the effectiveness of TMDLs, both administrative and technical decisions, and adjust the process as needed.[11]

The TMDL Report for the Toussaint River Watershed is expected in late 2005. This is the first TMDL for the Maumee AOC. The next TMDL is expected to begin in the Swan Creek watershed in 2006 and the Lake Erie Tributaries in 2008.

Coastal Nonpoint Pollution Control Program[12]

Congress enacted the Coastal Zone Management Act (CZMA), which was signed into law on October 27, 1972. To address more specifically the impacts of nonpoint source pollution on coastal water quality, Congress enacted section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990 (CZARA). Section 6217 requires that each state with an approved coastal zone management program develop and submit for approval a Coastal Nonpoint Pollution Control Program (CNPCP)

to the US EPA and the National Oceanic and Atmospheric Administration (NOAA). The purpose of the program "shall be to develop and implement management measures for nonpoint source pollution to restore and protect coastal waters, working in close conjunction with other State and local authorities." Each State's CNPCP must describes how it will implement nonpoint source pollution controls, known as management measures, that conform with those described in Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters.

Management measures are defined as economically achievable measures to control the addition of pollutants to coastal waters, which reflect the greatest degree of pollutant reduction achievable through the application of the best available nonpoint pollution control practices, technologies, processes, siting criteria, operating methods, or other alternatives.

The ODNR Division of Soil and Water Conservation administers Ohio's Coastal Nonpoint Source Program. Ohio's CNPCP received conditional approval on June 4, 2002. One of the conditions of Ohio's approval was defining and addressing several specific nonpoint pollution sources. This is being accomplish in part by requiring Lake Erie Basin Watershed Plans seeking state endorsement to include which management measures will be used to address applicable nonpoint source pollution causes and sources. The measures to be address (if applicable) include:

- Agriculture
  - (3.3.7) Irrigation Water Management
- Urban
  - (5.3.1) New Development*
  - (5.3.2) Watershed Protection
  - (5.3.3) Site Development
  - (5.5.1) Existing Development*
  - (5.6.1) New On-site Disposal System
  - (5.6.2) Operating On-site Disposal Systems
  - (5.8.1) Planning, Siting, and Developing Roads and Highways (local only)
  - (5.8.2) Bridges (local only)
  - (5.8.5) Road, Highway, and Bridge Operation and Maintenance*
  - (5.8.6) Road, Highway, and Bridge Runoff Systems*
- Hydromodification
  - (7.4.1) Part 3 O&M Program for Existing Modified Channels – protect surface water
  - (7.4.2) Part 3 O&M Program for Existing Modified Channels – restore in-stream & riparian habitat
  - (7.5.3) Dams – Protection of Surface Water Quality and In-stream Riparian Habitat
  - (7.6.1) Eroding Streambanks and Shorelines

** Areas under NPDES Storm Water Phase II permit requirements are exempt*

Included in each Watershed Project Table (WPTs) of Volume 2 is a column that identifies by project which management measures (by number) is being addressed (if applicable).

Public Drinking Water Supply

Drinking water comes from both surface water and ground water. There are three types of public water systems in Ohio. These are:

- *Community public water systems:* These systems have at least 15 service connections used by year-round residents of the area or regularly serve 25 year-round residents. Examples of community systems are municipalities, mobile home parks, homeowners associations and

nursing homes. Ohio has approximately 1,400 community systems serving over 10 million people.

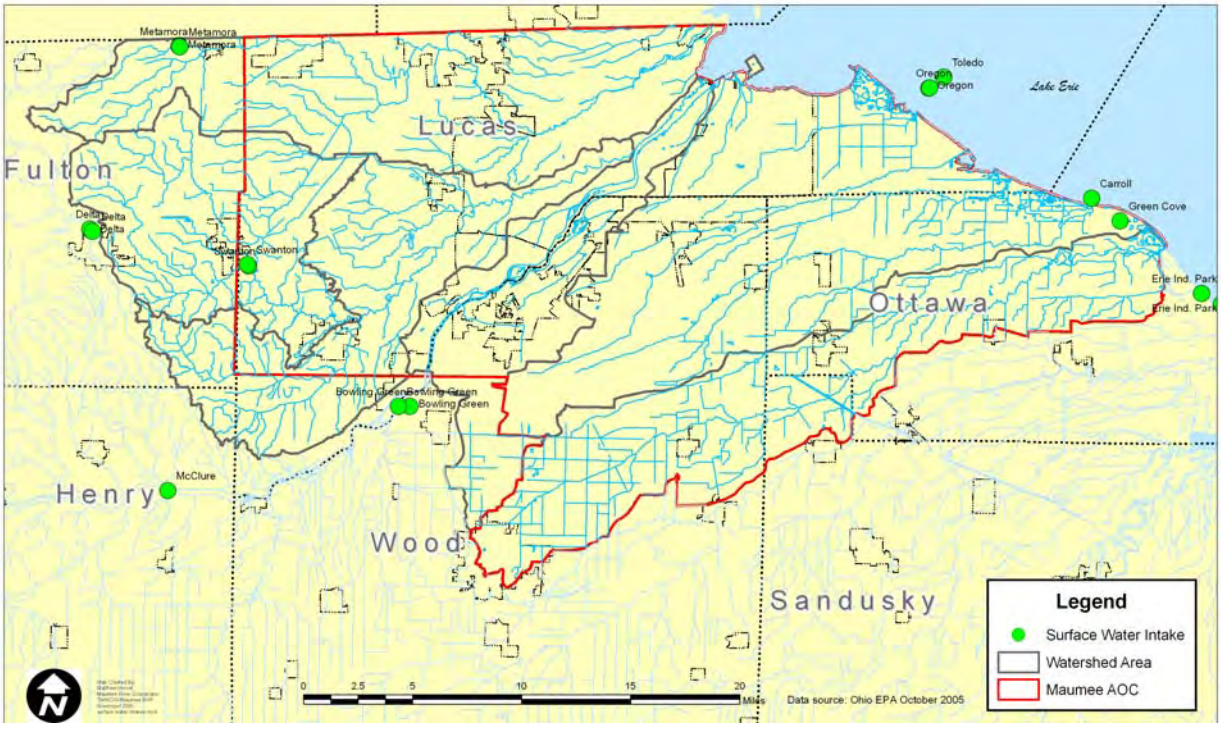
- *Non-Transient Non-Community (NTNC) public water systems:* These systems serve at least 25 of the same persons per day for more than six months of the year. NTNC systems are typically schools, offices, hospitals, churches and factories. Ohio has over 1,100 non-transient non-community systems serving almost 300,000 people.

- *Transient Non-Community (TNC) public water systems:* These systems serve at least 25 persons per day for at least 60 days each year. The TNC systems typically are campgrounds, restaurants, hotels, rest areas, golf courses or large stores. Ohio has almost 3,500 transient non-community systems serving over 500,000 people

Surface water sources include rivers, lakes, and reservoirs. In Lucas County 95 percent of the residents rely on surface water for their drinking water supply.[13] In 2004, the City of Toledo provided water to over 454,000 customers in the greater Toledo area. The City of Oregon served 28,000 customers. These two water plants supply drinking water for over half of the population of the Maumee AOC.

Drinking water from ground water sources supplies 60 percent of Ottawa County residents and 57 percent of Wood County residents with their drinking water.[14] The groundwater of the Maumee AOC is pumped from wells in aquifers located in bedrock or glacial till. Except for the shale of northwest Lucas County, nearly all the bedrock in the area is dolomite, a magnesium-bearing form of limestone. Shallow wells draw water from sand, gravel, or soil overlying the bedrock. This shallow aquifer tends to be softer than water from a bedrock aquifer, but is more susceptible to contamination from the surface. Since most of the bedrock in the region is limestone or dolomite,

Surface Water Intakes for Public Drinking Water Supplies

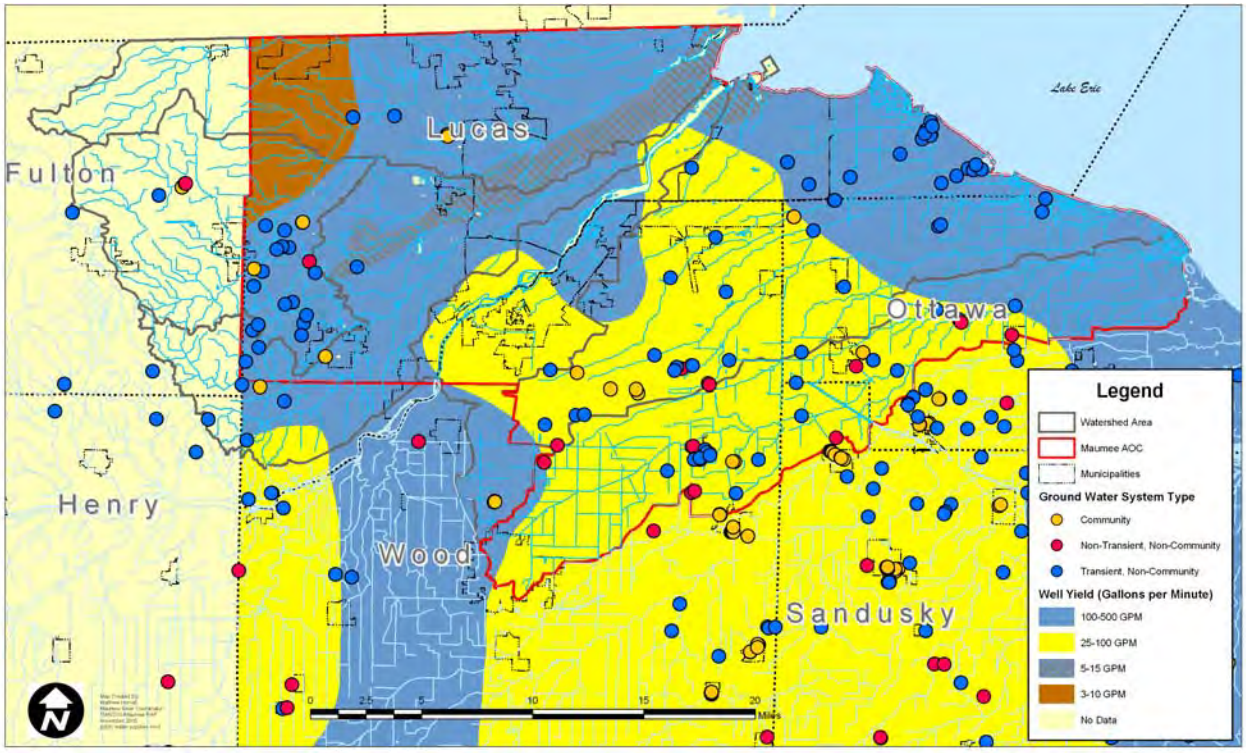


water drawn from it is said to come from the carbonate aquifer. Aquifers are replenished by rain or melted snow that has either filled up a surface water body or seeped into the ground.[15]

Though the number of residents drinking groundwater has declined over the years, it remains an important source of drinking water, both for public systems and private wells. The depth of soil or till to bedrock varies widely. In some buried valleys, the depth to bedrock exceeds 100 feet. In other areas, scattered throughout the region, the bedrock is at the surface.[16]

In general Northwest Ohio's groundwater is safe for drinking. Where wells are contaminated, the contamination is localized. A few of the sources of potential contamination are surface runoff entering the ground through a sinkhole or well casing, septic systems, or underground storage tanks. Generally speaking, pollution on the ground that has a water pathway into the soil has the potential to contaminate drinking water. Safe drinking water is usually measured by concentrations of fecal bacteria, which would indicate the presence of sewage or manure; or nitrate concentrations over 10 mg/l. In many parts of the region raw groundwater is undesirable for drinking and other household uses because of high levels of hardness, iron, and sulfur. Some form of treatment, therefore, is typically necessary when using this important source of water.

Public Drinking Water Supply from Ground Water Sources



Two studies of private well water quality have been conducted. In 1985-1988 the US Geological Survey (USGS) studied groundwater quality in Lucas, Wood, and Sandusky counties by testing 135 wells and 11 springs for 52 parameters. The study found 36 of 125 well samples unsafe based on total coliform bacteria counts (4 or more colonies per 100 ml). Two well samples exceeded the safe nitrate level of 10 mg/l.[17]

The Heidelberg College Water Quality Laboratory surveys private well water quality by offering well tests at an affordable cost. The program started in 1987 and still continues. Tests cover nitrates

and inorganic chemicals, metals, pesticides, and volatile organic compounds. Heidelberg College notes, "The results of the program indicate that the extent of nitrate contamination varies greatly from county to county. Many agricultural counties have very little nitrate contamination in private wells, while other counties have considerable contamination. As of April 2003, 52,700 wells have been tested nationwide. Slightly less than half of the wells tested are from Ohio. No trace of nitrate contamination was found in 65.7 percent of the wells. In 4.2 percent of the wells, nitrate concentrations exceeded the drinking water standard of 10 mg/l (ppm). Atrazine in excess of its drinking water standard of 3.0 ppb was found in only 0.3 percent of the 20,303 wells tested."[18] An older Heidelberg College study[19] analyzed the private well testing by county in Ohio. In some cases septic system failures are believed to have contaminated many private wells in these areas.

Private Well Study

County	Private wells tested (1988)	Percent of wells over 10 mg Nitrate per liter
Lucas	183	2%
Ottawa	184	4%
Wood	81	4%

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[6] *Ohio EPA 305(b) Report*, Ohio EPA, 1998.
[7] An index to Ohio advisories is available at: http://www.epa.state.oh.us/dsw/fishadvisory/index.html with links to fish consumption and swimming advisories, fact sheets, advisory information for sensitive populations, and fish trimming and cooking tips.
[8] An index to Ohio advisories is available at: http://www.epa.state.oh.us/dsw/fishadvisory/index.html with links to fish consumption and swimming advisories, fact sheets, advisory information for sensitive populations, and fish trimming and cooking tips.
[9] An index to Ohio advisories is available at: http://www.epa.state.oh.us/dsw/fishadvisory/turtles.html with links to snapping turtle consumption advisories, trimming and cooking tips.
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Improving Water Quality

- Addressing Rural and Agricultural Issues
- Rural and Agricultural: Agency Responsibilities
- Rural and Agricultural: Project Implementation & BMPs
- Rural and Agricultural: Cost Sharing and Technical Assistance Programs
- Addressing Urban and Storm Water Issues
- Urban and Storm Water: Agency Responsibilities
- Urban and Storm Water: Project Implementation & BMPs
- Urban and Storm Water: Cost Sharing and Technical Assistance Programs

Improving Water Quality *(last updated 12/21/05)*

There are many different approaches that can be taken to improve water quality. The recognized and proven methods are considered best management practices (BMPs). This term "refers to a practice that is determined after examination of alternative practices to be practicable and most effective in preventing or reducing the amount of pollution generated by a nonpoint source to a level compatible with water quality goals."[1] The general criteria for selecting BMPs are:

- A BMP should be effective in reducing water pollution from non-point sources;
- A BMP should be effective in helping waterways meet Clean Water Act "fishable and swimmable" goals;
- A BMP should be practicable.[2]

Protection of water quality requires that we know the region and understand the natural environment's processes. If we understand the limitations and capabilities of the place, and adapt policies to them, we will continue to have an excellent water supply and recreation on Lake Erie that will draw visitors from nationwide.

Addressing Rural and Agricultural Issues

We can reduce impacts from sewage by treating it and discharging clean effluent. Reducing impacts from diffuse nonpoint sources is a matter of prevention through BMPs. A reduction in rural and agricultural runoff can be made through the installation or use of BMPs, and by utilizing funding and resources of the state and federals agencies responsible.

Ohio EPA and ODNR manage Ohio's nonpoint programs. The *Nonpoint Source Assessment*[3] provided background and data on nonpoint source water pollution in Ohio. It was followed by the *Nonpoint Source Management Program*,[4] which identified sources of nonpoint pollution and policies to guide state programs. Ohio DNR developed its Ohio's Coastal Nonpoint Pollution Control Program specifically for the protection and restoration of Lake Erie and its coastal zone.[5]

The Ohio Lake Erie Buffer Team, a coalition of conservation agencies whose goal is to encourage landowners to put conservation buffers into practice and help meet agricultural phosphorus and sediment reduction targets. In particular, the team has made a concerted effort to use cost-share conservation buffer programs. Continued use and expansion of conservation buffers will bring the counties of the Maumee AOC and headwater areas closer to their agricultural phosphorus reduction targets. The acres put into conservation buffers since 1997 are given in the following table.

Acres Placed in Conservation Practices since 1997 [6]

County	Continuous CRP Acres	CREP Acres	319 Watershed Project Acres	Wetland Reserve Acres	Total Agricultural Conservation Buffer Acres
Lucas	119.4	29	0	0	148.40
Ottawa	242.7	93	186.7	636.8	1,159.20
Wood	2,203.6	649	71.4	56	2,980.00
Total	2565.7	771.00	577.1	692.80	4606.6

Rural and Agricultural: Agency Responsibilities

Federal, state, and county agencies have well-established roles and working relationships with agricultural conservation programs. Generally, agencies use a voluntary approach with technical assistance, incentives, and cost-sharing to encourage use of agricultural BMPs. A variety of agencies and organizations have cooperative roles in promoting BMPs.

US Department of Agriculture (USDA)

USDA is the country's largest conservation agency, encouraging voluntary efforts to protect soil, water, and wildlife on the 70 percent of America's lands that are in private hands. In the Maumee AOC and headwater areas USDA commonly provides technical assistance and funding through two agencies: Farm Services Agency (FSA) and the Natural Resources Conservation Service (NRCS)

The mission of FSA is stabilizing farm income, helping farmers conserve land and water resources, providing credit to new or disadvantaged farmers, and helping farm operations recover from the effects of disaster. FSA was set up under a unique system by which Federal farm programs are administered locally. Farmers who are eligible to participate in these programs elect a three- to five-person county committee, which reviews county office operations and makes decisions on how to apply the programs. This grassroots approach gives farmers a much-needed say in how Federal actions affect their communities and their individual operations.[7]

Since 1935, the Natural Resources Conservation Service (originally called the Soil Conservation Service) has provided leadership in a partnership effort to help private landowners and managers conserve their soil, water, and other natural resources. NRCS provides technical & financial assistance for many natural resource conservation activities. Participation in NRCS programs is completely voluntary.[8]

US Environmental Protection Agency (US EPA)[9]

US EPA leads the nation's environmental science, research, education, and assessment efforts. They work to develop and enforce regulations that implement environmental laws enacted by Congress. US EPA is responsible for researching and setting national standards for a variety of environmental programs, and delegates to states and tribes the responsibility for issuing permits and for monitoring and enforcing compliance.

In recent years, between 40 and 50 percent of US EPA's enacted budgets have provided direct support through grants to State environmental programs, like Ohio EPA and ODNR. US EPA also issues competitive and non-competitive grants to States, nonprofits, and educational institutions to support high-quality research that will improve the scientific basis for decisions on environmental issues.

One of the programs under US EPA that benefits the rural and agricultural community is the Nonpoint Source Pollution Program under §319 of the Clean Water Act. Ohio EPA administers these funds in Ohio; a portion of which are distributed through a cost-share grant programs. These nonpoint source grants are often called “319 grants” because they provide cost-share and funding and technical assistance through §319 of the Clean Water Act.

Ohio Environmental Protection Agency (Ohio EPA)
and Ohio Department of Agriculture (ODA)

The role of the Ohio EPA is to protect human health and the environment by establishing and enforcing standards for air quality, drinking water and stream water quality, wastewater treatment, and solid and hazardous waste disposal, and to provide comprehensive environmental education. These roles are carried out through: issuing permits to install and operate facilities; providing oversight through inspections and sampling; monitoring and reporting on environmental quality; providing environmental education and technical assistance to industry and the general public; providing assistance in pollution prevention; and taking enforcement actions against violators. One of Ohio EPA's responsibilities is issuing Permits to Install and NPDES permits for discharges to waters of the state. Ohio EPA administers federal Clean Water Act §319 Nonpoint Source grants to abate nonpoint sources of pollution.[10]

The mission of the ODA is to provide regulatory protection to producers, agribusinesses, and the consuming public; to promote Ohio agricultural products in domestic and international markets; and to educate the citizens of Ohio about our agricultural industry. One of ODA's regulatory programs includes Animal Feeding Operations (AFFs), also known as Animal Feeding Operations (AFOs). These two state agencies, Ohio EPA and ODA, work in tandem to provide technical assistance and regulation to the agricultural industry.[11]

Ohio Department of Natural Resources (ODNR)[12]

ODNR licenses all hunting, fishing, and watercraft in Ohio and is responsible for overseeing and permitting all mineral extraction, monitoring dam safety, managing water resources, coordinating the activity of Ohio's 88 county soil and water conservation districts, mapping the state's major geologic structures and mineral resources, and promoting recycling and litter prevention through grant programs in local communities. As an umbrella organization for such diverse interests, the department pulls all these activities into four fundamental mission components: 1) Resource management, 2) Economic development, 3) Recreation, and 4) Health and safety. The Resource Management mission is most closely related to the projects and activities identified in this plan. Although each of the 11 divisions that address this mission typically has its own mandates and responsibilities, they often combine their efforts, working together on various management projects to achieve similar goals.

Ohio State University Extension[13]

Ohio State University (OSU) Extension fulfills the land-grant mission of The Ohio State University by interpreting knowledge and research developed by the Ohio Agricultural Research and Development Center, The Ohio State University, and other land-grant universities, so that the scientifically based information can be used to better lives, businesses, and communities. The OSU Extension program focuses on four areas including: 1) family and consumer sciences, 2) 4-H youth development, 3) community development, and 4) agriculture and natural resources.

OSU Extension conducts research and educational programs, and provides extensive technical recommendations to the agricultural community. OSU Extension's Agriculture and Natural Resources section is most applicable to the issues, problems, and projects in the Maumee AOC and headwater areas. Through this program farmers, gardeners, landowners, and businesses are encouraged to strengthen their businesses though the adoption of new technology

that can improve efficiency while protecting the environment. Landowners are assisted in the management of woodlands for the protection of area streams and watersheds. They also work with green industries, from turf grass management to landscape and nursery companies to encourage the use of BMPs.

Soil and Water Conservation Districts (SWCDs)
The Soil and Water Conservation Districts are political subdivisions of the state and are organized for all 88 counties. Their primary function is to assist the agricultural community with conservation practices. They provide technical assistance and conduct educational programs at the local level, working directly with landowners. They are the principle implementing agencies for encouraging farmers to adopt BMPs. The SWCDs in Lucas, Ottawa, and Wood counties are very active in the Maumee AOC often partnering with the Maumee RAP to implement projects.

Watershed Councils
The Maumee RAP and Duck and Otter Creeks Partnership, like most watershed councils, provide mechanisms for public involvement with natural resource and water quality issues for river basin areas. They have led the development of several multi-county BMP projects by coordinating agencies at the watershed level.

Rural and Agricultural: Project Implementation & BMPs

Agriculture is a vital part of our region's economy, lifestyle, and tradition. Much of the area is highly productive and classified as prime agricultural land. Productive farming in most of the Maumee AOC and headwater areas requires drainage via field tiles and ditches. Protecting the environment while allowing a prosperous farm community requires stewardship and careful management.

Agricultural runoff is caused by precipitation, which erodes soils and carries nutrients, pesticides, and herbicides away from their point of origin and throughout the watershed. During large storms, the runoff to surface water and infiltration to ground water increases and so does the rate of pollutant movement. Agricultural environmental programs recommend a series of "Best Management Practices" (BMPs) designed to meet Clean Water Act goals. BMPs are implemented through technical assistance, educational outreach, and voluntary incentives.

Rural and agricultural BMPs include ditch maintenance, outlet protection structures, contour farming, floodplain set asides, and grassed waterways to collect and dispose of excessive runoff water at non-erosive velocities. These practices have been and continue to be an important part of erosion control in Northwest Ohio, where drainage is necessary for productive farming.
Some of the possible BMPs for agricultural pollution abatement, are summarized below. Not all of these practices will be useful in all areas of the Maumee AOC. Selection of specific BMPs should be based on site and local conditions for each watershed.

Conservation Tillage
Leaving crop residue on the surface before and during planting protects topsoil and reduces erosion. Pieces of crop residue shield soil particles from rain and wind. No-till and conservation tillage techniques that leave at least 30 percent residue cover are recommended practices. In our region conservation tillage is important because phosphorus attaches to fine silt and clay particles. Techniques that control erosion are therefore also effective in reducing phosphorus loadings that ultimately reach Lake Erie. Conservation tillage is a highly recommended agricultural BMPs.

Nutrient Management
Manure and nutrient management is managing the sources, rates, forms, timings, placements and utilization of manure, other organic by-products, bio-solids, and other nutrients in the soil and residues. The goal is to apply manure to agricultural land at an agronomic rate, efficiently using its nutrients to supply soils and plants to produce food, forage, fiber, and cover while minimizing the transport of nutrients to ground and surface water and environmental degradation.

Comprehensive Nutrient Management Plans (CNMP) plans are highly recommended for livestock operations. A CNMP is a detailed, specific plan designed for a particular farm with guidelines set by NRCS, and may be prepared through county SWCDs. The CNMP is a component of a farm's conservation plan. It is used in conjunction with crop rotations, residue management, pest management, conservation buffer practices, and/or other practices needed on a site-specific basis to address natural resource concerns and landowner objectives. A CNMP helps to reduce or eliminate the amount of manure runoff when applied to cropland, the amount of feedlot runoff from a livestock feeding operation, maximize nutrients from manure, minimize the amount of fertilizer needed, and address aesthetics and odor concerns.

Filter Strips
Vegetative strips along waterways trap a portion of sediment and other pollutants in runoff water that would otherwise flow into neighboring streams, carrying nutrients with it. The term "filter strip" usually refers to a grassed area between the agricultural field and stream. Its purpose is to remove pollutants from field runoff but not necessarily provide riparian habitat. Grassed filter strips should be at least 20 feet wide to be effective. They are recommended wherever possible on both sides of streams and ditches in agricultural areas.

Riparian Buffer Areas
A riparian buffer filters sediment, nutrients, pesticides, and pathogens out of field runoff like a filter strip, but they also provide habitat. Forested riparian areas especially absorb nutrients from field runoff water. Even narrow riparian forest strips on flat land are effective filters. A strip as narrow as 50 feet can remove a significant amount of nitrogen and phosphorus from surface and subsurface runoff. Wider buffer zones are desirable for other benefits, such as wildlife habitat.

Riparian buffers play an important role in aquatic habitat as well. Forested banks help make streams suitable for fish and other aquatic creatures. Tree roots help stabilize streambanks and provide cover for fish and the macroinvertebrates that form the base of the food chain. Leaves that fall into the stream are the primary food source for small aquatic animals such as insect larvae. Branches overhanging streams also helps maintain proper water temperature to support aquatic life. In the summer, the shade keeps water temperature cool; cold water holds more dissolved oxygen, supporting more aquatic life.[14]

Windbreaks
Windbreaks are rows of trees and shrubs protecting fields from wind erosion, while also providing wildlife habitat. Multiple rows of coniferous trees or a combination of coniferous and deciduous trees are planted to protect a farmstead, field, or feedlot from wind and snow. One or two rows of shrubs are also beneficial. An established windbreak slows wind on the downwind side for a distance of 10 times the height of the trees. The rows of trees also act as a snow fence. Windbreaks should be planted on at least the north and west sides of the area to be protected.

The Northwest Ohio Windbreak program is an interagency effort of USDA, ODNR, and county SWCDs to assist landowners in establishing field windbreaks in the area. Applications may be made through the county SWCDs or Ohio DNR Divisions of Forestry or Wildlife. The program provides cost-share funds to landowners for establishing windbreak vegetation. This program covers a total of 15 counties on a rotating basis. The program is available in Ottawa and Sandusky counties during even years, and in Lucas and Wood counties every year.

Wetland Restoration/Enhancement

Although wetlands are often wet, a wetland might not be wet year-round. In fact, some of the most important wetlands are only seasonally wet. Wetlands are the link between the land and the water. They are transition zones where the flow of water, the cycling of nutrients, and the energy of the sun meet to produce a unique ecosystem characterized by hydrology, soils, and vegetation—making these areas very important features of a watershed. Using a watershed-based approach to wetland protection ensures that the whole system, including land, air, and water resources, is protected.[15]

Wetlands filter out nutrients, chemicals, and sediment from runoff water and help keep them out of ground and surface water. Restoration of former wetlands and oxbows and the enhancement of existing wetlands are encouraged, especially along streams and in floodplains. Wetlands control and reduce pollutants from agricultural runoff, provide aquatic and riparian habitat, and can serve as floodplains to reduce flooding problems. Fortunately, wetland restoration is a growing activity that can improve water quality and wildlife habitat in the Maumee AOC and across the nation.

Streambank Protection

Channelization often straightens and deepens a stream. Water flows much faster through the altered channel, resulting in increased erosion and flooding downstream. Channelizing can strip streambanks of vegetation, making them more prone to erosion. Although channelization may appear to solve a problem in the short term, the stream will constantly work to return to its natural shape. This short-term solution can result in long-term problems and high, recurring costs.

Streambanks should be stabilized and protected against scour and erosion by planting vegetation and/or using structural means to reduce sediment loads and pollution. Vegetative methods are preferred over structural means because vegetation provides habitat and some nutrient uptake in addition to protecting streambanks. Livestock should be excluded from streams and streambanks to prevent soil compaction and loss of vegetation. In addition, livestock exclusion will prevent manure deposition in the stream.[16]

Wetland Reservoir Sub-Irrigation

Productive agriculture in northwest Ohio requires drainage to remove excess water, often using a tile system. Conventional practice is to drain the water to a ditch or river, and ultimately Lake Erie. Tile drainage water can be a significant source of nitrates.

Sub-irrigation is an alternative practice that stores runoff water in wetland and reservoirs near the fields. During dry periods, water is pumped back through the tile system. The agricultural benefits are to aid crop production by reducing drought stress, and serving as a source of nitrate. The wetland and reservoir system can reduce the amount of sediment and nitrates that reach streams, and provide wetland habitat. Testing data from Iowa indicates a reduction of nitrates from drainage water from 40 to 98 percent.[17]

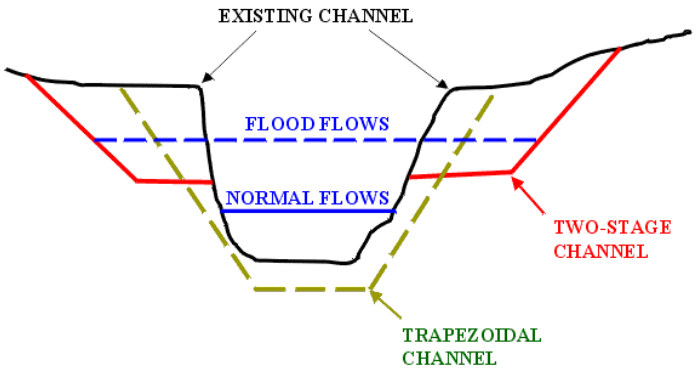
Test data indicates sub-irrigation may be effective in reducing nitrate loadings. Tests were conducted throughout Ohio in 1997 at subsurface drain outlets from February through May. The average

nitrate concentrations in the waters sampled were roughly 50 percent lower when sub-irrigation was used during the previous growing season than when it had not been applied.[18]

Natural Channel Design

Streams naturally tend to form channels based on the amount of flow, the grade, and how much energy the water has. A stream whose channel is straightened may erode its banks as it dissipates energy and seeks to restore a stable flow regime. The result can be sedimentation, requiring future sediment removal.

Research and demonstration projects has been conducted in Northwest Ohio on alternative stream channel designs that may be more stable and do not cause future sedimentation.



Two-Stage Channel

One such technique is the "two-stage ditch design." Conventional ditch design is a trapezoidal cross-section with the stream at the bottom of the channel and straight sloping banks. The two-stage design uses a wider bottom. The normal flow channel takes up only part of it; the rest is a floodplain "bench." The stream may meander across this bench area, but during normal flow, the bench itself is dry. During high flow, the stream overflows onto the bench and may reach bank full flow[19].

The goal of research and demonstration of alternative channel designs is to identify designs that will provide drainage required for productive agriculture, but need less maintenance, and cause less erosion and sedimentation.

Rural and Agricultural: Cost Sharing and Technical Assistance Programs

Many different agencies and organizations cooperate and jointly provide conservation assistance to farmers through a number of programs. Each focuses on a specific aspect of nonpoint pollution control or habitat restoration. These programs use two techniques to implement their goals. One technique is to provide technical expertise from professional staff that advise farmers on what BMPs to use and how to use conservation that will help make farming profitable while protecting the environment. The second technique is providing financial incentives for landowners that voluntarily use BMPs, known as cost-sharing.[20]

Conservation Reserve Program (CRP)

The Conservation Reserve Program is a voluntary program for agricultural landowners. Through CRP farmers can receive annual rental payments and cost-share assistance to establish long-term, resource conservation practices on eligible farmland. This program provides land rental payments to farmers who are willing to sign long-term contracts converting cropland into filter strips, riparian forest buffers, wetland restorations, or windbreaks. USDA Farm Services Agency (FSA) administers the CRP and CREP (see below) contracts in close cooperation with USDA NRCS, Ohio DNR, and the county SWCDs.

Conservation Reserve Enhancement Program (CREP)
The State of Ohio offers an enhanced CRP program, which provides increased incentives to install conservation buffer practices and extending the reserve period. CREP is a special program in Ohio available only in the Lake Erie basin. All of the Maumee AOC is eligible to participate in this program. Practices include filter strips along waterways, wildlife habitat along waterways, wetland restoration, field windbreaks, riparian buffers, and tree plantings.

Wetlands Reserve Program (WRP)
The Wetlands Reserve Program (WRP) is a voluntary program to restore and protect wetlands on private property. It is an opportunity for landowners to receive financial incentives to enhance wetlands in exchange for retiring marginal or sensitive agricultural land. Landowners can establish conservation easements or can enter into restoration cost-share agreements where no easement is involved. In exchange for establishing a permanent easement, the landowner receives payment up to the agricultural value of the land and 100 percent of the wetland restoration cost. The program is administered by USDA FSA with technical support from NRCS through partnerships with state agencies (OEPA, ODNR), US Fish and Wildlife Service (FWS), and Ducks Unlimited.

Clean Water Act §319 Nonpoint Source Grants[21]
The Ohio Nonpoint Source program focus is identifying and supporting implementation of BMPs and measures that reduce pollutant loadings, control pollution added from nonpoint sources, and improve the overall quality of waterways. Without such additional actions to control nonpoint sources of pollution, watersheds cannot reasonably be expected to attain or maintain applicable Ohio water quality standards.

Ohio EPA administers cost-share programs to encourage BMPs with US EPA §319 Nonpoint Source grant funds. These nonpoint source grants are often called "319" because they provide cost share and funding and technical assistance through §319 of the Clean Water Act. The 319 program provides funds projects that will reduce or eliminate nonpoint source pollution such as, two-stage channel ditch conversion, livestock exclusion practices, establishing riparian wetland areas as drainage retention areas, tree planting in riparian buffer areas, and removing drain tile to restore natural drainage and flow and other innovative practices designed to reduce agricultural sources of nonpoint pollution.

Ohio relies heavily on watershed management plans, like this *Stage 2 Watershed Plan*, to identify and outline actions to correct water quality problems caused by nonpoint source pollution. Most watershed management plans are developed locally with input and support from Ohio EPA, Ohio Department of Natural Resources (ODNR), Natural Resources Conservation Service (NRCS), and other agencies.

<u>Addressing Urban and Storm Water Issues</u>
The problem with urban storm water runoff is that the pollution sources are diffuse and not easily identified. Historically, water pollution control has focused on the more obvious point sources: municipal wastewater treatment plants and industrial discharges. The water pollution potential for storm water runoff was not fully appreciated until repeated studies revealed that urban nonpoint sources seriously threaten water quality and can exceed the impact of municipal sewage discharges.

Nonpoint source pollution problems are both water quality and quantity based. In urban areas a variety of created surfaces now cover much of the landscape. Many of these surfaces are impervious and therefore prevent rainwater and snowmelt from following their natural course into the soil. Roofs and pavement prevent infiltration completely, while even suburban lawns absorb far less than

natural areas. Impervious surfaces therefore increase the rate and volume of storm water runoff, resulting in higher flows and more frequent floods. Other negative impacts include increasing the receiving waters temperature, changing habitat, and decreasing stream flow stability.

Most land use activities deposit detrimental and sometimes hazardous materials on the impervious surfaces: sediments, toxic metal particles, pesticides and fertilizers, petroleum products, harmful bacteria, salt, pet waste, and trash. As rainfall and snowmelt move rapidly across this transformed landscape, these pollutants are carried to surface and underground collection systems. Eventually these polluted flows reach waters that we use for drinking, swimming, fishing, and recreation.

Urban and Storm Water: Agency Responsibilities

As storm water regulations have come into place and the awareness of urban nonpoint source pollution increases, the roles and responsibilities of federal, state, and county agencies has become more defined. Unlike the voluntary efforts to reduce agricultural runoff, there is a regulatory effort to reduce many urban runoff impacts that is complimented by voluntary efforts.

US Environmental Protection Agency (US EPA)[22]

US EPA leads the nation's environmental science, research, education and assessment efforts. They work to develop and enforce regulations that implement environmental laws enacted by Congress. US EPA is responsible for researching and setting national standards for a variety of environmental programs, and delegates to states and tribes the responsibility for issuing permits and for monitoring and enforcing compliance.

In recent years, between 40 and 50 percent of US EPA's enacted budgets have provided direct support through grants to State environmental programs, like Ohio EPA and ODNR. US EPA also issues competitive and non-competitive grants to States, nonprofits and educational institutions to support research that will improve the scientific basis for decisions on environmental issues.

The National Pollutant Discharge Elimination System (NPDES) is a part of the Clean Water Act that US EPA has authorized Ohio EPA to implement. As NPDES delegated state, Ohio EPA is currently implementing the federal storm water program in Ohio. US EPA continues to provide technical and financial support to the state agencies responsible for implementing the program.

Ohio Environmental Protection Agency (Ohio EPA)

The role of the Ohio EPA is to protect human health and the environment by establishing and enforcing standards for air quality, drinking water and stream water quality, wastewater treatment, and solid and hazardous waste disposal, and to provide comprehensive environmental education. These roles are carried out through: issuing permits to install and operate facilities; providing oversight through inspections and sampling; monitoring and reporting on environmental quality; providing environmental education and technical assistance to industry and the general public; providing assistance in pollution prevention; and taking enforcement actions against violators.[23]

Ohio EPA's Division of Surface Water is responsible for restoring and maintaining the quality of Ohio's rivers and streams. The Division of Surface Water accomplishes this mission by monitoring the aquatic environment, permitting, enforcing environmental laws, using and refining scientifically sound methods and regulations, planning, coordinating, educating, providing technical assistance and encouraging pollution prevention practices. As a delegated State, Ohio EPA is responsible for

implementing the NPDES federal storm water, TMDL, §319 Nonpoint Pollution, and §401 Water Quality Certifications programs.

Area Wide Water Quality Management
The Areawide Water Quality Management Plan (AWQMP) is a regional document mandated by Congress under Section 208 of the Clean Water Act. Overall, the "208 Plan" is a statement of how Northwest Ohio will restore our waterways to fishable and swimmable conditions. TMACOG is responsible for updating and maintaining this plan for four Counties in Ohio (Lucas, Wood, Ottawa, and Sandusky) and the southern three Townships in Monroe County, Michigan (Whiteford, Bedford, and Erie). Ohio EPA and Michigan DEQ use this plan in reviewing and approving permit applications. The current 208 Plan is available on TMACOG's web site (www.TMACOG.org) and was frequently consulting during the development of this *Stage 2 Watershed Plan*.

Soil and Water Conservation Districts
The Soil and Water Conservation Districts (SWCDs) are political subdivisions of the state, and are organized for all 88 counties. The primary function of SWCDs is to assist the rural and agricultural communities with conservation practices, however Lucas County is a very urbanized county. In light of the large and rapid increase of portions of Lucas County, the Lucas SWCD also has staff to address the urban storm water issues in Lucas County. They provide technical assistance and conduct educational programs at the local level, working directly with landowners, contractors, and developers. They also are able to provide technical and field assistance to governmental agencies relating to storm water issues and work very closely with the Storm Water Coalition.

Watershed Councils
The Maumee RAP and Duck and Otter Creeks Partnership, like most watershed councils, provide mechanisms for public involvement with natural resource and water quality issues as well as project implementation. Both of these organizations are explained in detail in the Introduction chapter and in the Appendices.

The Storm Water Coalition (SWC) was formed in 1997 to voluntarily coordinate storm water management efforts and BMP installation for numerous jurisdictions in the metro-Toledo area. Although the name as changed overtime, the group has continually worked on building regional collaboration for storm water management. Since its creation the SWC has conducted feasibility studies for the formation of a watershed/regional utility, developed a regional storm water standard manual, and created on a regional multi-media educational campaign for residents and businesses.

Urban and Storm Water: Project Implementation & BMPs

In some areas of the Maumee AOC and headwater areas, urban development is rapidly overtaking the agricultural and natural lands. This increase in impervious areas impacts our area's water quality and can diminish the water quantity available for drinking and sustaining natural features such as wetlands.

Urban runoff is caused by precipitation which carries pollutants such as pesticides and herbicides from lawns and golf courses, oils and metals from parking lots, and soils from construction sites, straight to our local streams through storm sewers and ditches, untreated. Whenever possible, best management practices (BMPs) should be implemented to reduce the impact by utilizing technical assistance, educational outreach, and voluntary incentives.

Urban BMPs includes sand or bio-filters, outlet protection structures, low impact development practices, riparian setbacks, floodplain preservation, and extended detention/retention structures to collect and dispose of excessive runoff water at non-erosive velocities. These practices have been and continue to be an important part of runoff control in Northwest Ohio

Some of the BMPs for urban runoff pollution reduction and prevention are summarized below. Not all of these practices will be useful in all areas of the Maumee AOC. Selection of specific BMPs should be based on site and local conditions for each watershed.

Low Impact Development

Low impact development (LID) is an ecologically friendly approach to site development and storm water management that aims to mitigate development impacts to land, water and air. The approach emphasizes the integration of site design and planning techniques that conserve natural systems and hydrologic functions on a site.[24]

Conservation site design or cluster development utilizes these LID concepts. This site design technique concentrates buildings in a compact area in one portion of a development site in exchange for providing open space and natural areas elsewhere on the site. Setbacks and frontage distances are relaxed in order to create additional open space at the site.

Open space designs have many benefits in comparison to the conventional developments. They can reduce impervious cover, storm water pollutants, construction costs, grading, and the loss of natural areas. However, many communities lack zoning ordinances to permit open space development, and even those that have enacted ordinances may need to revise them to achieve greater water quality and environmental benefits.

The more BMPs that are combined, the more low impact a development can be. For example, the benefits of open space design can be amplified when combined with other site design techniques such as narrow streets and alternative turnarounds. This practice involves promoting the use of narrower streets to reduce the amount of impervious cover created by new development, and in turn, reduce the storm water runoff and associated pollutant loads. Currently, many communities require wide residential streets that are 32, 36 and even 40 feet wide. In most residential settings, streets can be as narrow as 22 to 26 feet wide without sacrificing emergency access, on-street parking or vehicular and pedestrian safety. Even narrower access streets or shared driveways can be used when only a handful of homes need to be served.

Developers, however, often have little flexibility to design narrower streets, as most communities require wide residential streets as a standard element of their local road and zoning standards. Revisions to current local road standards are often needed to promote more widespread use of narrower residential streets. Residential street design requires a careful balancing of many competing objectives: design, speed, traffic volume, emergency access, parking, and safety, to name a few. Communities that want to change their road standards to permit narrower streets need to involve all the stakeholders who influence street design in the revision process.

Control the Sources

The primary goal of source control is to reduce the amount of pollutants entering storm water runoff. Although the accumulation of certain contaminants is inevitable, some of pollutants can be controlled at their source. Measures that can improve runoff quality at the source include litter control, street sweeping, silt fencing, roadway deicing alternatives, and good housekeeping. These measures need to be implemented by the communities as well as private citizens.

Since most storm sewers discharge directly into our waterways, runoff usually receives only simple filtering or screening of larger objects. As a result all types of litter that people toss onto sidewalks or streets are carried to ditches, streams, and lakes.

Landscaping practices can be a significant source of pollutants to urban runoff. Turf management chemicals including fertilizers and pesticides used on private lawns, as well as those used on golf courses and public parks, can add high levels of nutrients or dangerous pesticides to the runoff. While each location is unique and the effects on water quality vary, it is clear that the type, quantity, and timing of materials can make a big difference in the runoff. In order to gain public support and cooperation in reducing these pollutants, an educational programs like Give Water a Hand are necessary to inform the public of what they can do and the potential problems if they do not.

Poor housekeeping at commercial, industrial, and municipal sites can lead to contaminated runoff. Rain or melting snow can erode piles of bulk material such as loose topsoil or salt if it is left uncovered. Similarly, precipitation can wash contaminants off of equipment or dirty objects left exposed to the weather. Improperly maintained landfills can allow toxic contaminants to reach the surface of a landfill, allowing storm water to carry these pollutants to nearby waterbodies.

Most highway and street departments use salts and abrasives to keep roads, parking lots, and sidewalks free from ice during the winter. In excess, the salts can be toxic and abrasives can increase sediment loads. While a certain amount of de-icing is necessary to ensure safety, the easiest way to minimize adverse affects is by using less. The following steps can be useful in curbing application rates: 1) decrease application rates on straight, flat sections, 2) train operators of application equipment, and 3) keep accurate records of applications.

Street surfaces receive a large portion of the litter, chemicals, dust fall, and other contaminants that affect urban water resources. The contaminants that remain after source control measures have been implemented can be partially removed by street sweeping. Increasing the frequency of street sweeping operations can minimize the accumulation and runoff of street surface contaminants. Specially designed street sweepers should be used on a regular basis to remove litter and other debris. Vacuum-assisted type sweepers have achieved high removal effectiveness, including the small particle size range of contaminant material.

Illicit or illegal discharges to the storm sewers from homes and businesses can add harmful contaminants to storm sewer systems. The illicit discharges can be the result ignorance, simple negligence or intentional connection of discharge pipes that should be directed to the sanitary sewer. People who don't understand that storm sewers directly discharge to waterbodies have been known to dump oil, old paint, or household chemicals into storm sewer inlets. Floor drains, dry wells, and cesspools are frequent sources of commercial or industrial discharges and connections. Many communities within the Maumee AOC are actively identifying and eliminating these illicit discharges under NPDES Storm Water permits. The NPDES storm water permits in many communities include dry weather screening requirements of storm sewer outfalls. Coordinated collection drives or managed collection centers for hazardous household wastes such as motor oil, old paint, and caustic chemicals are another method for communities to help eliminate illegal dumping.

Erosion and Sediment Control

Some of the highest storm water pollutant loads occur when development is in its initial construction phase. This is when land is cleared of vegetation and graded to create a proper surface for

construction. The removal of natural vegetation and topsoil renders the exposed area susceptible to erosion, causing a transformation of existing drainage areas and a disturbance of sensitive areas. Erosion control is the prevention of soil from being picked up by runoff, usually by establishing a soil cover. Sediment control is the removal of eroded sediment from runoff therefore preventing damage to watercourses and infrastructure. For guidance on how to address these issues refer to the *Regional Storm Water Management Standards Manual* created by TMACOG, Maumee RAP, and the Storm Water Coalition.

Riparian Buffers

Riparian buffers serve as boundaries between local waterways and existing development that help protect water resources by filtering pollutants, providing flood control, reducing streambank erosion, preventing stream warming, and providing room for natural movement of the stream channel. While there is often overlap between the role of buffers and conservation areas, buffers differ in that they are a specific planning tool to protect stream quality and riparian habitat. For more details on the design and applications refer to the *Regional Storm Water Management Standards Manual* created by TMACOG, Maumee RAP, and the Storm Water Coalition.

Runoff Conveyance

The management of storm water runoff from sites after construction is vital in controlling the impacts of development on urban water quality. The increase in impervious surfaces such as rooftops, roads, parking lots, and sidewalks due to land development has a number of effects on aquatic systems. First, increases in imperviousness create a corresponding increase in the total volume of storm water runoff from a site. Without proper conveyance, this increase in runoff volume can lead to erosion, degradation of stream channel habitat, and increases in the occurrence of flooding.

Urban runoff is most commonly directed as quickly as possible to the storm sewer system via curbs and gutters. However, storm sewers do not provide for energy dissipation, volume control, or pollutant removal. Controls are necessary for each of these issues if water quality is to be protected. One BMP to achieve these goals is the use of open grass channels to convey storm water runoff. The grass channels are designed to meet runoff velocity targets for large storms and provide water quality treatment for smaller storms. Grass channels are generally not an option in ultra-urban areas and runoff may still need to be directed to detention or retention facility for further treatment. For more details on the design and applications refer to the *Regional Storm Water Management Standards Manual* created by TMACOG, Maumee RAP, and the Storm Water Coalition.

Runoff Detention/Retention and Treatment

Detention/retention and treatment BMPs can be used to achieve four broad resource protection goals including: flood control, channel protection, groundwater recharge, and pollutant removal. The BMPs should be designed to function together as a system to ensure that the volume, rate, timing, and pollutant load of runoff remains similar to that, which occurred under natural conditions. This can be achieved through a coordinated network of structural and nonstructural methods, designed to provide both source and site control. In such a system, each BMP by itself may not provide major benefits, but when combined with others becomes very effective.

To manage both water quantity and quality, storm water facilities must be designed to capture and treat two different storm events:

1. Large storm events: Flood attenuation
2. The first flush (first ½ to 1-inch of runoff from the watershed): Water quality

Controlling both extremely large events to prevent flooding, and more frequent events to mitigate water quality impacts and control stream erosion, can be achieved through the proper design of detention/retention facilities. Among the alternatives, wet ponds and constructed marsh systems can be effective for achieving control of both storm water volume and quality. Alternative Best Management Practices (BMPs) providing flood attenuation and treatment of the "first flush" and are also acceptable. For more details on the design and applications refer to the *Regional Storm Water Management Standards Manual* created by TMACOG, Maumee RAP, and the Storm Water Coalition.

Public Involvement and Education

For proper storm water management practices to be implemented people need to know about them. The general public and the business community need to understand the importance of good storm water management and how it can benefit them. This won't happen however, if there isn't a significant public involvement and education program about the subject.

The public needs to be educated to accept responsibility for the operation of the storm water management system. Even though they may not have any direct problems, everyone should understand that storm water does flow into the drainage system from their yard, roof, driveway, patio, and sidewalk. Further, they should develop and understanding of how each piece of real estate contributes to water pollution and flooding problems. The Give Water a Hand residential and business campaigns are helping to accomplish this.

An informed and knowledgeable community is crucial to the success of a storm water management program since it helps to ensure greater support and greater compliance. Public support is particularly beneficial when communities attempt to institute new funding initiatives for the program or seek participation and buy-in to help implement the program.

Urban and Storm Water: Cost Sharing and Technical Assistance Programs

There are many types of projects to correct a multitude of urban and storm water pollution issues. How these projects are funded and implemented often depends on the requirements of the funding source, as well as the interest of the implementing agency or organization

The most successful projects are usually those that are conducted in a collaborative and cooperative manner, involving many different agencies and organizations recognizing the strengths and weaknesses of each partner. The funding sources listed below are just a few that could be used by local partners.

Coastal Management Assistance Grants [25]

ODNR's Coastal Management Assistance Grants are funds awarded to help preserve, protect and enhance Ohio's Lake Erie coastal resources. Grants are awarded on a competitive basis, with applicants providing a minimum of 50 percent of the project costs. The Coastal Management Assistance Grant program is a reimbursement grant program whereby the project sponsor is expected to make the initial outlays for the project and then request reimbursement from OCM. The National Oceanic & Atmospheric Administration provides funding for the Coastal Management Assistance Grant Program.

The main goal of the Ohio Coastal Management Program and its grants is to promote a sustainable coast and lake. Comprehensive community planning, watershed planning to address coastal

nonpoint pollution, and balanced growth have been given priority for grant funding. The goal is to promote coastal community and watershed planning that will address enhanced public access, hazard mitigation, natural resource protection and restoration, economic viability and sustainable coastal development issues. If coastal communities and watersheds draining into Lake Erie can develop long-term plans for sustainability, a healthy maintainable coast and lake will result.

Erosion Control Loans[26]

Owners of property in the Coastal Erosion Area (CEA) designated along the shore of Lake Erie may be eligible for a low interest loan to cover the cost of constructing a shore erosion control measure. There are four eligibility requirements for ODNR's Erosion Control Loans including: 1) project area must be in a designated Coastal Erosion Area, 2) project must be constructing an Erosion Control Structure, 3) construction must be after June 1, 1998, and 4) all permits and authorizations must be obtained. Erosion Control Loans can be used to cover the costs of preparing construction documents for the installation of an Erosion Control Structure, costs incurred in obtaining the necessary authorizations, and the costs of materials, earthwork, labor, and equipment needed to construct the Erosion Control Structure.

Ohio Environmental Education Fund (OEEF)[27]

Ohio EPA's Ohio Environmental Education Fund (OEEF) awards approximately $1 million annually in grants for education projects targeting pre-school to university students and teachers, the general public, and the regulated community. OEEF funds projects to enhance the public's awareness and understanding of issues affecting environmental quality in Ohio. The OEEF does not fund projects that are required by permit or enforcement. These highly competitive grants are awarded in amounts of up to $50,000 each. There are two grant cycles annually; deadlines are January 15 and July 15. Monies credited to the Environmental Education Fund consist of half of all penalties collected by Ohio EPA air and water pollution control programs, as well as gifts, grants, and contributions.

Clean Water Act §319 Nonpoint Source Grants

The Ohio Nonpoint Source program focus is identifying and supporting implementation of BMPs and measures that reduce pollutant loadings, control pollution added from nonpoint sources, and improve the overall quality of waterways. Without such additional actions to control nonpoint sources of pollution, watersheds cannot reasonably be expected to attain or maintain applicable Ohio water quality standards.

Ohio EPA administers cost-share programs to encourage BMPs with US EPA §319 Nonpoint Source grant funds. These nonpoint source grants are often called "319" because they provide cost share and funding and technical assistance through §319 of the Clean Water Act. The 319 program provides funds for projects that will reduce or eliminate nonpoint source pollution such as, natural stream channel reconstruction, bio-engineered stream bank stabilization, low-head dam removal and/or modification and/or other projects that restore natural stream ecology, morphology and flow channelization.

Ohio relies heavily on watershed management plans, like this *Stage 2 Watershed Plan*, to identify and outline actions to correct water quality problems caused by nonpoint source pollution. Most watershed management plans are developed locally with input and support from Ohio EPA, Ohio Department of Natural Resources (ODNR), and other agencies.

Water Pollution Control Loan Fund (WPCLF)
Ohio EPA's Water Pollution Control Loan Fund (WPCLF) provides financial and technical assistance for a wide variety of projects to protect or improve the quality of Ohio's rivers, streams, lakes, and other water resources. Planning, design, and construction assistance is available for both public and private applicants. The WPCLF offers below market interest rate loans. Direct loans are made to most public and large private borrowers, while smaller borrowers usually receive indirect loans through the linked deposit program. Special discounted interest rates are available for qualifying projects (see WRRSP section). [28]

The WPCLF offers a variety of funding opportunities to help communities meet the requirements for the NPDES Programs. WPCLF loans for storm water activities are available to public entities - villages, cities, counties, and sewer districts. Storm water activities that directly address water quality problems (rather than water control/flooding problems) are eligible for WPCLF funding. [29]

Water Resource Restoration Sponsor Program (WRRSP)[30]
Ohio EPA has started to focus more money and effort into reducing nonpoint source pollution that jeopardizes the health of Ohio's water resources. This increased focus created the Water Resource Restoration Sponsor Program (WRRSP). This program provides an opportunity for WPCLF funding recipients to finance planning and implementation of additional projects that address nonpoint source pollution. Funding and completion of these projects helps to protect or restore water resources. Restoration activities may range from the preservation and protection to intensive repair and recovery of affected stream and aquatic habitats. WPCLF recipients can initiate projects themselves or sponsor approved projects planned by another group, such as a land trust, park district or other entity with the ability to protect and manage such resources.

The WRRSP project is funded by providing the sponsor with an advance refund of its interest payments on the WPCLF loan for its wastewater treatment facilities. To further encourage participation in the program, the interest rate on the sponsor's loan is discounted by 0.1 percent. In return, the sponsor uses the refunded interest to either implement the project or provide the money through a sponsorship agreement to another entity which implements the project.

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Ottawa River/Ten Mile Creek Watershed

Volume 1

- Background & Water Quality Data for the Ottawa River/Ten Mile Creek Watershed
- Land Use of the Ottawa River/Ten Mile Creek Watershed
- Status of Beneficial Use Impairments
- Watershed Maps (General, 14-digit HUCs, River Mile)

Volume 2

- Ten Mile Creek/Ottawa River Watershed Projects Table
- Silver Creek and Shantee Creek Watershed Projects Table – NOT AVAILABLE

Ottawa River/Ten Mile Creek Watershed *(last updated 12/21/05)*

The Ottawa River/Ten Mile Creek Watershed is Hydrologic Unit 04100001 020. The Ottawa River is 45 miles long with a drainage basin of 220.9 square miles; 146.7 of which are in Ohio.[1] Its average gradient is 4 feet per mile.[2] The watershed begins in northeastern Fulton County where the river is known as Ten Mile Creek. It flows east through Lucas County, where it is joined by North Ten Mile Creek from Lenawee and Monroe counties in Michigan. The river continues to flow through Lucas County until it joins Maumee Bay and Lake Erie in Monroe County. Low lake levels and sedimentation have made the river shallow and difficult to navigate.

Halfway, Silver, and Shantee creeks are also included under this HUC. These creeks flow along similar paths to the Ottawa River; back and forth along the Ohio – Michigan state line, ultimately ending up in north Maumee Bay and Lake Erie. Compared to the Ottawa River, these creeks have relatively small watersheds, draining 18.6 square miles in Ohio and 36.9 in Michigan.[3]

The Ottawa River watershed can be divided into three major reaches, or parts, based on the dominant stream regime within each reach. The upstream Ten Mile Creek reach from the headwaters to the City of Sylvania at RM 20, has a stable channel. The banks are low (15 to 25 feet) with indistinct valleys and floodplains. The headwaters of the North Branch of Ten Mile Creek are the Ottawa Lake Drain originating in Riga Township, Lenawee County, Michigan. This area is very flat with indistinct floodplains. Both headwater areas are primarily in agricultural land use.

In addition to agriculture there is continued residential development within the City of Sylvania, western Sylvania Township, and the Villages of Metamora and Berkey. The gradient here is a gradual 4.3 feet drop per mile. The major tributary to Ten Mile Creek is Prairie Ditch which flows through Secor Metropark.

Upper Reach of
Ottawa River/Ten Mile Creek Watershed Use Attainment Data[4]

River Mile	Sample Year	ICI Score	HELP Ecoregion ICI Criteria	Lacustuary ICI Score*	HELP Ecoregion Lacustuary ICI Criteria*	Modified Index of Well Being Score	HELP Ecoregion Miwb Criteria	IBI Score	HELP Ecoregion IBI Criteria	Lacustuary IBI Score*	HELP Ecoregion Lacustuary IBI Criteria*	QHEI Score	HELP Ecoregion QHEI Criteria
Ten Mile Crk													
0.4	1992	30	34										
0.5	1992					6.52	7.3	24	32			67.5	60
0.5	1993					7.301	7.3	24	32			67	60
1.1	1986					6.121	7.3	30	32				
1.1	1986					6.453	7.3	30	32				
1.1	1986					6.471	7.3	26	32				
1.2	1990					3.35	7.3	18	32			54	60
3	1992	28	34			6.548	7.3	32	32			66.5	60
3	1993					6.645	7.3	26	32			48	60
4.1	1992	30	34			8.4	7.3	34	32			68.5	60
4.1	1993					6.514	7.3	24	32			46.5	60
4.2	1986					5.179	7.3	28	32				
4.2	1986					6.83	7.3	26	32				
4.2	1986					5.405	7.3	22	32				

River Mile	Sample Year	ICI Score	HELP Ecoregion ICI Criteria	Lacustuary ICI Score*	HELP Ecoregion Lacustuary ICI Criteria*	Modified Index of Well Being Score	HELP Ecoregion Miwb Criteria	IBI Score	HELP Ecoregion IBI Criteria	Lacustuary IBI Score*	HELP Ecoregion Lacustuary IBI Criteria*	QHEI Score	HELP Ecoregion QHEI Criteria
Ten Mile Crk													
5.2	1986					6.049	7.3	28	32				
5.2	1986					5.523	7.3	24	32				
6	1992					6.838	7.3	32	32			61.5	60
6	1993					7.597	7.3	30	32			35	60
9.2	1992	30	34										
9.2	1993					6.401	7.3	26	32			51	60
9.3	1992					6.118	7.3	26	32			61	60
North Branch Ten Mile Crk													
0.1	1992					5.57	7.3	26	32			67	60
0.1	1993					3.442	7.3	20	32			47	60

Upper Reach of Ottawa River/Ten Mile Creek Watershed DELT Data[5]

River Mile	Sample Year	Percent DELT Anomalies	Percent Deformities	Percent Eroded Fins	Percent Lesions	Percent Tumors	Relative Number of Fish Collected	Relative Number of Species Collected	Relative Number of Fish Minus Tolerants	Relative Weight of Fish Collected (in grams)
Ten Mile Creek										
0.5	1992	0.6077	0	0.31	0	0	589.53	8	375.95	4.773
0.5	1993	1.6942	0	1.69	0	0	1686.37	12	1105.3	5.667
1.1	1986	0	0	0	0	0	277.5	13	141	2.281
1.1	1986	0	0	0	0	0	562.5	12	317.98	2.865
1.1	1986	0	0	0	0	0	643.5	9	351.03	4.954
1.2	1990	0	0	0	0	0	628.5	8	20.99	41.173
3	1992	0.4505	0	0.45	0	0	289.47	15	152.56	16.308
3	1993	3.0667	0	3.07	0	0	349.5	12	156	8.502
4.1	1992	0.1063	0	0.11	0	0	2403.98	16	1412.03	36.917
4.1	1993	2.8504	0	2.85	0	0	583.95	16	145.42	5.875
4.2	1986	0.5814	0	0.58	0	0	258	14	52.5	8.914
4.2	1986	0.3458	0.35	0	0	0	445.5	11	195	4.153
4.2	1986	1.9231	0	0	1.92	0	156	10	84.01	4.914
5.2	1986	0.5189	0	0	0.52	0	594	15	127.47	10.052
5.2	1986	0	0	0	0	0	870	13	136.5	21.033
6	1992	0.361	0	0	0.36	0	415.5	13	216	4.091
6	1993	1.2173	0	0.86	0.48	0	1804.42	18	407.18	46.418
9.2	1993	0.7194	0	0.72	0	0	736.04	10	310.66	13.907
9.3	1992	0.3012	0	0.3	0	0	586.01	11	195.93	7.409
North Branch Ten Mile Creek										
0.1	1992	0	0	0	0	0	651	9	495	1.299
0.1	1993	0	0	0	0	0	258	8	43.5	2.519

The second, or middle reach, is that area between river miles 20 and 5. The banks are high (35 to 45 feet or more) and unstable and are intermixed with distinct floodplains. However, bedrock can be found in the channel from RM 20 at the confluence of the North Branch of Ten Mile Creek in the City of Sylvania to RM 16 within Wildwood Preserve Metropark. The Ottawa River flows through the Wildwood Preserve Metropark north of the Village of Ottawa Hills. The major activities at the Metropark include wildlife observation and hiking. The park also serves as an important wildlife corridor for animals such as deer. Other recreational areas along the Ottawa River within this reach include Camp Miakonda Boy Scout Reservation and Ottawa Park. The major problems are urbanization with the filling in of the floodplains, urban runoff, and destruction of wetland areas.

The land use in the middle reach is residential, commercial and industrial. Within this reach are a number of open space areas: Wildwood Preserve, the floodplain lands in the Village of Ottawa Hills, Ottawa Park and Joe E. Brown Park. The area from South Cove Boulevard (RM 9) and downstream, however, is primarily industrial. This segment is neither swimmable nor fishable according to public health standards. Contributing to the pollution is two miles of wall-to-wall dumps which filled-in the floodplains and channelized the Ottawa River on both sides years ago.

The water quality of this reach is marginally *good* in the vicinity of Centennial and Old Post Roads, but at Sturbridge Road (RM 18.5) it declines to *fair* downstream from here to Secor Road at the entrance to the University of Toledo (RM 11). Hill Ditch and Heldman Ditch are tributary to the Ottawa River just west of Secor Road. Downstream from the University of Toledo to Stickney Avenue (RM 5) the middle reach water quality is *poor*.

Middle Reach of
Ottawa River/Ten Mile Creek Watershed Use Attainment Data[6]

River Mile	Sample Year	ICI Score	HELP Ecoregion ICI Criteria	Lacustuary ICI Score*	HELP Ecoregion Lacustuary ICI Criteria*	Modified Index of Well Being Score	HELP Ecoregion Miwb Criteria	IBI Score	HELP Ecoregion IBI Criteria	Lacustuary IBI Score*	HELP Ecoregion Lacustuary IBI Criteria*	QHEI Score	HELP Ecoregion QHEI Criteria
Ottawa River													
5.2	2000			16	42								
5.2	1990					4.503	8.6			10	42	43	60
5.3	1996					5.296	8.6			18	42		
5.3	1996			6	42	4.682	8.6			17	42	41.5	60
5.3	2000					5.989	8.6			17	42	35	60
5.3	2000					5.984	8.6			21	42		
5.3	2002					6.371	8.6			21	42	41	60
5.3	2002					6.964	8.6			22	42		
5.4	1986					2.844	8.6			7	42	32	60
5.4	1986					3.321	8.6			16	42		
5.4	1986					4.904	8.6			12	42		
5.5	1996			8	42	5.923	8.6			16	42	41	60
5.5	1996					6.891	8.6			27	42		
5.5	2002					6.086	8.6			18	42		
5.5	2002					7.412	8.6			24	42	34	60
5.7	1996			6	42	6.579	8.6			18	42	44.5	60
5.7	1996					5.966	8.6			25	42		

River Mile	Sample Year	ICI Score	HELP Ecoregion ICI Criteria	Lacustuary ICI Score*	HELP Ecoregion Lacustuary ICI Criteria*	Modified Index of Well Being Score	HELP Ecoregion Miwb Criteria	IBI Score	HELP Ecoregion IBI Criteria	Lacustuary IBI Score*	HELP Ecoregion Lacustuary IBI Criteria*	QHEI Score	HELP Ecoregion QHEI Criteria
Ottawa River													
5.8	1999			10	42						42		
5.8	2001			10	42								
5.8	2002					5.568	8.6			18	42	41.5	60
5.8	2002					6.714	8.6			31	42		
5.9	1999			10	42								
5.9	2000					6.668	8.6			21	42	37	60
5.9	2000					5.827	8.6			26	42		
5.9	2001			20	42								
6	1999			12	42								
6	2001			14	42								
6.1	1999			10	42								
6.1	2000			14	42								
6.1	2001			10	42								
6.2	1992					5.807	8.6			21	42		
6.4	1992			12	42								
6.4	1993											25.5	60
6.4	1986					4.128	8.6			15	42	45	60
6.4	1986					2.995	8.6			10	42		
6.4	1986					4.731	8.6			19	42		
6.9	1986			12	42								
7.2	1990					5.889	8.6	20	34			45.5	60
7.2	2000					6.916	8.6			23	42	42.5	60
7.3	2000			16	42								
7.4	1986			14	42	6.845	8.6	16	34			39	60
7.4	1986					3.431	8.6	12	34				
7.4	1986					5.109	8.6	14	34				
7.9	2000			14	42								
8	2000					6.699	8.6			19	42	49	60
8	2000					6.549	8.6			24	42		
8.7	1986					4.27	8.6	16	34			32.5	60
8.7	1986					4.631	8.6	14	34				
8.7	1986					5.515	8.6	20	34				
8.7	1992					6.713	8.6	14	34				
9	1986	6	34										
9	1992	16	34										
9.8	1986					2.154	8.6	22	34			52	60
9.8	1986					3.897	8.6	24	34				
9.8	1986					3.086	8.6	24	34				
9.8	1990					5.9	8.6	18	34			65.5	60
11	1986	16	34										
11	1993					4.879	7.3	16	32			26.5	60
11.1	1992	22	34										
11.2	1992					5.806	7.3	20	32			30.5	60

River Mile	Sample Year	ICI Score	HELP Ecoregion ICI Criteria	Lacustuary ICI Score*	HELP Ecoregion Lacustuary ICI Criteria*	Modified Index of Well Being Score	HELP Ecoregion Miwb Criteria	IBI Score	HELP Ecoregion IBI Criteria	Lacustuary IBI Score*	HELP Ecoregion Lacustuary IBI Criteria*	QHEI Score	HELP Ecoregion QHEI Criteria
Ottawa River													
11.7	2000	24	34										
11.8	2000					4.891	7.3	14	32			53	60
11.8	2000					5.861	7.3	20	32				
17.7	1992					5.749	7.3	22	32			53.5	60
17.7	1993					5.474	7.3	22	32			29	60
17.8	1986					5.059	7.3	22	32				
17.8	1986					7.172	7.3	26	32				
18.5	1986	22	34										
18.5	1992	30	34										
Sibley Creek													
0.1	1996											36.5	60
0.1	1996					3.034	7.3	18	32				
0.1	1996					2.658	7.3	20	32				
0.1	2002					0.563	7.3	12	32			26	60
0.1	2002							12	32				
0.2	2002					3.154	7.3	22	32			25.5	60
0.2	2002					4.312	7.3	26	32				
0.8	1993							12	32			31	60
0.8	1996							12	32			40	60
0.8	2002							12	32			36.5	60
0.8	2002							12	32				
Haefner Ditch													
1	1993							12	32			30	60
3.3	1993											23	60
Heldman Ditch													
0.2	1993					5.576	7.3	26	32			44.5	60
2.7	1993											39.5	60
5.5	1993											30	60
Hill Ditch													
0.1	1993					4.023	7.3	18	32			35	60
1	1993											33	60
2.6	1993											30	60

** The double horizontal line represents the lacustuary divide of Ottawa River, although it is noted that lacustuary lengths are approximate and fluctuate with lake levels and wind direction.*[7]

Middle Reach of Ottawa River/Ten Mile Creek Watershed DELT Data[8]

River Mile	Sample Year	Percent DELT Anomalies	Percent Deformities	Percent Eroded Fins	Percent Lesions	Percent Tumors	Relative Number of Fish Collected	Relative Number of Species Collected	Relative Number of Fish Minus Tolerants	Relative Weight of Fish Collected (in grams)
Ottawa River										
5.2	1990	6.25	0	6.25	0	0	288	6	186	55.701
5.3	1996	21.25	19.48	0	0	0	128	9	74	36.734
5.3	1996	28.01	27.28	2.5	0	0	272	13	182	63.229
5.3	2000	11.0053	0	4.66	6.35	0	126	9	70	68.212
5.3	2000	1.4545	0.73	0.73	0	0	550	11	414	40.488
5.3	2002	10	1.25	2.5	6.25	0	160	14	88	67.721
5.3	2002	1.0979	0	0.73	0	0	838	13	728	83.31
5.4	1986	13.04	0	4.35	8.7	0	46	5	6	4.554
5.4	1986	0	0	0	0	0	218	4	56	2.959
5.4	1986	0.65	0	0	0.65	0	306	4	222	21.143
5.5	1996	21.38	19.5	0	1.89	0	212	12	90	43.603
5.5	1996	7.09	6.58	0.51	0	0	474	14	368	35.603
5.5	2002	9.6893	0	0	9.69	0	162.5	12	85	35.103
5.5	2002	2.0921	0	0	2.09	0	597.5	14	512.5	38.781
5.7	1996	8.11	6.76	0	1.35	0	164.42	14	75.55	32.529
5.7	1996	0	0	0	0	0	226	11	164	4.208
5.8	2002	8.4746	0	5.08	3.39	0	118	11	54	48.344
5.8	2002	0.5291	0	0.53	0	0	756	14	704	28.922
5.9	2000	16.7925	2.89	1.89	11.07	0	212	11	122	46.039
5.9	2000	0.7117	0.36	0.36	0	0	562	13	492	44.331
6.2	1992	12.75	0.98	1.96	9.8	0	204	15	58	30.095
6.4	1986	6.12	2.04	0	4.08	0	98	10	16	16.512
6.4	1986	0	0	0	0	0	70	3	16	29.554
6.4	1986	0	0	0	0	0	426	6	342	16.19
7.2	1990	1.11	0	0.54	0.57	0	1192	7	908	42.906
7.2	2000	10.4215	1.15	3.07	6.21	0	174	12	82	78.62
7.2	2000	1.6304	0	0.27	1.09	0.27	736	14	646	70.447
7.4	1986	18.02	0.84	0	13.83	3.36	270	12	66	70.616
7.4	1986	11.76	0	0	11.76	0	34	4	16	7.192
7.4	1986	7.26	0	0	7.26	0	468	8	328	45.018
8	2000	13.1579	0	7.89	5.26	0	76	8	46	25.672
8	2000	0.3257	0.33	0	0	0	614	10	550	43.406
8.7	1986	3.37	2.25	1.12	0	0	178	13	14	36.752
8.7	1986	4.99	0	0	3.31	1.68	242	7	194	15.267
8.7	1986	1.7	0	0	0.72	0.98	464	10	252	64.903
8.7	1992	5.57	1.97	0.33	3.28	0	610	9	292	43.556
9.8	1986	0	0	0	0	0	130.5	4	3	1.388
9.8	1986	0	0	0	0	0	139.5	9	12	2.488
9.8	1986	0.56	0	0.56	0	0	268.5	7	13.5	6.979
9.8	1990	0	0	0	0	0	268.5	11	60	1.796
11	1993	0	0	0	0	0	181.41	9	111.85	6.814

River Mile	Sample Year	Percent DELT Anomalies	Percent Deformities	Percent Eroded Fins	Percent Lesions	Percent Tumors	Relative Number of Fish Collected	Relative Number of Species Collected	Relative Number of Fish Minus Tolerants	Relative Weight of Fish Collected (in grams)
Ottawa River										
11.2	1992	1.008	0	0	1.01	0	287.25	14	80.04	3.959
11.8	2000	0.2392	0	0.24	0	0	1194.65	10	190.05	5.79
11.8	2000	0	0	0	0	0	753	13	186	5.227
17.7	1992	0.8196	0.41	0	0.41	0	348.69	13	130.05	11.616
17.7	1993	0	0	0	0	0	117	9	52.5	0.588
17.8	1986	0.4926	0	0	0.49	0	304.5	12	90.01	12.965
17.8	1986	0	0	0	0	0	1155	13	520.44	10.324
Sibley Creek										
0.1	1996	1.2195	0	0	0	0	328	6	32	0
0.1	1996	0	0	0	0	0	528	9	30	0
0.1	2002	0	0	0	0	0	3	1	0	0
0.1	2002	0	0	0	0	0	12	2	0	0
0.2	2002	0	0	0	0	0	153	4	63	0
0.2	2002	0.4525	0	0	0	0	663	8	243	0
0.8	1993	0	0	0	0	0	0	0	0	0
0.8	1996	0	0	0	0	0	0	0	0	0
0.8	2002	0	0	0	0	0	9	1	0	0
0.8	2002	0	0	0	0	0	3	1	0	0
Haefner Ditch										
1	1993	0	0	0	0	0	1.5	1	0	0.014
Heldman Ditch										
0.2	1993	0.7407	0	0.74	0	0	202.5	10	75	1.565
Hill Ditch										
0.1	1993	0.6055	0	0.29	0.31	0	514.5	8	22.5	6.955

** The double horizontal line represents the lacustuary divide of Ottawa River, although it is noted that lacustuary lengths are approximate and fluctuate with lake levels and wind direction.*[9]

The third and last reach, the lower reach, from Stickney Avenue (RM 5) to the mouth, is under the backwater influence from the Maumee Bay. The level of Lake Erie prevents the lower reach from naturally deepening itself. The major problem is extremely poor water quality. This segment is neither swimmable nor fishable according to public health standards.

This segment along the river is in industrial use, but becomes more residential at about RM 3 with marinas above and at the mouth. Like the Maumee River, the Ottawa River is important for non-contact recreation such as sailing and power boating. Boating is mostly restricted to the area downstream from Suder Ave (RM 3.1) due to the difficulty of getting large boats past that point. Smaller boats can make it upstream as far as Stickney Avenue and just beyond. The primary boating lanes are downstream from Suder Avenue to Maumee Bay.

The Ottawa River was one of the most important water skiing areas in the region, however, water skiing and other contact activities no longer occur to any large extent due to water pollution. A state issued contact advisory from I-475 near the Wildwood Preserve Metropark (RM 16.5) to the mouth advise persons to avoid contact with the water, sediment, and fish. The recreational industry

including numerous marinas, fishing charters, and water ski clubs, has been affected by the inability to use these contaminated waters.

Lower Reach of
Ottawa River/Ten Mile Creek Watershed Use Attainment Data[10]

River Mile	Sample Year	ICI Score	HELP Ecoregion ICI Criteria	Lacustuary ICI Score*	HELP Ecoregion Lacustuary ICI Criteria*	Modified Index of Well Being Score	HELP Ecoregion Miwb Criteria	IBI Score	HELP Ecoregion IBI Criteria	Lacustuary IBI Score*	HELP Ecoregion Lacustuary IBI Criteria*	QHEI Score	HELP Ecoregion QHEI Criteria
Ottawa River													
0.1	1996					3.062	8.6			11	42		
0.1	1996					6.776	8.6			28	42		
0.1	1996					6.882	8.6			30	42		
0.1	1996					6.836	8.6			34	42		
0.1	1996					6.24	8.6			34	42		
1	1990					6.929	8.6			23	42	36.5	60
1.6	1986			12	42								
1.6	2000					6.949	8.6			25	42	37.5	60
1.6	2000					7.265	8.6			23	42		
1.7	2000			8	42								
1.8	1986					7.206	8.6			28	42	48	60
1.8	1986					6.165	8.6			17	42		
1.8	1986					7.129	8.6			29	42		
2.9	1990					7.089	8.6			20	42	37	60
3.4	2000					5.59	8.6			17	42	39	60
3.4	2000					6.789	8.6			23	42		
3.5	2000			14	42								
4.7	1986					3.368	8.6			10	42	44	60
4.7	1986					3.429	8.6			15	42		
4.7	1986					4.585	8.6			15	42		
4.7	1992					4.257	8.6			10	42		
4.9	1986			16	42								
4.9	1992			10	42								
5	1993											25	60
5	2002					6.555	8.6			22	42	40	60
5	2002					5.651	8.6			20	42		

** The lacustuary divide of Ottawa River is at RM 6.8, although it is noted that lacustuary lengths are approximate and fluctuate with lake levels and wind direction.*[11]

Lower Reach of
Ottawa River/Ten Mile Creek Watershed DELT Data[12]

River Mile	Sample Year	Percent DELT Anomalies	Percent Deformities	Percent Eroded Fins	Percent Lesions	Percent Tumors	Relative Number of Fish Collected	Relative Number of Species Collected	Relative Number of Fish Minus Tolerants	Relative Weight of Fish Collected (in grams)
Ottawa River										
0.1	1996	0	0	0	0	0	16	3	8	15.542
0.1	1996	0	0	0	0	0	208	12	176	51.808

River Mile	Sample Year	Percent DELT Anomalies	Percent Deformities	Percent Eroded Fins	Percent Lesions	Percent Tumors	Relative Number of Fish Collected	Relative Number of Species Collected	Relative Number of Fish Minus Tolerants	Relative Weight of Fish Collected (in grams)
0.1	1996	0	0	0	0	0	330	9	324	27.074
0.1	1996	0	0	0	0	0	104	10	90	25.7
0.1	1996	0	0	0	0	0	194	8	194	22.368
1	1990	0.31	0.31	0	0	0	1224	10	1158	74.485
1.6	2000	6.2626	2.09	4.18	0	0	198	12	134	134.705
1.6	2000	7.2762	4.19	2.79	0.29	0	1050	13	798	425.516
1.8	1986	2.81	0.45	0.24	2.12	0	954	19	840	55.053
1.8	1986	14.22	0	0	14.22	0	408	12	268	74.415
1.8	1986	3.47	0.34	0.75	2.38	0	588	17	452	113.57
2.9	1990	1.18	0	0.39	0.79	0	1218	12	1078	76.899
3.4	2000	6.9565	0	1.74	5.22	0	230	9	118	105.793
3.4	2000	5.6316	0.26	1.35	4.02	0	760	16	566	160.277
4.7	1986	8.49	1.83	0	6.67	0	124	6	28	60.94
4.7	1986	0.41	0	0	0.41	0	526.58	6	87.76	39.413
4.7	1986	2.12	0	0	2.12	0	460	8	146	87.812
4.7	1992	2.05	1.05	0	1.01	0	398	5	252	27.717
5	2002	9.1954	0	0	9.2	0	174	13	82	53.608
5	2002	0.3922	0.39	0	0	0	510	11	408	116.184

** The lacustuary divide of Ottawa River is at RM 6.8, although it is noted that lacustuary lengths are approximate and fluctuate with lake levels and wind direction.*[13]

Ottawa River/Ten Mile Creek Watershed Impairments
Causes and Sources of Impairments [14]

Segment	Miles Assessed & Aquatic Life Use Designation[#]	Causes of Impairment*	Sources of Impairment*	Comments
Ten Mile Creek	25.47 (RM 0-25.47) WWH	Other habitat alterations-H Pesticides-M Priority organics-M Metals-S Siltation-S	Nonirrigated crop production-H Land development/ Suburbanization-M Removal of riparian Vegetation -S Dam construction-S	305(b)-2000: PCBs, DDT, chlordane isomers, dieldrin, selenium, mercury and lead were found in carp tissue samples; pesticide problem due to ag inputs; stream scores compare to other streams in the ecoregion; nonpoint source pollution inputs are probably the cause of most of the lingering problems.
N. Branch Ten Mile Creek	6.5 (RM 0-6.5) WWH	Flow alteration-H Pesticides-M Priority organics-M Metals-S Other habitat alterations-S	Flow regulation/ Modification-H Land development/ Suburbanization-M Other urban runoff-M Highway/road/bridge/ sewer line-S	305(b)-2000: creek chubs contain significant concentration of pesticides and PCBs; metals, cadmium, mercury, and selenium were also noted; flow seems to be major problem probably due to urbanization; contaminants seem typical for agriculture & suburban sources of pesticides; unknown were PCBs are coming from
Ottawa River	19.75 (RM 0-19.75)	Pesticides-H Priority organics -H Siltation-M Other habitat alterations-M	Major industrial point Sources-M CSOs-M Land development/ Suburbanization-M Other urban runoff-S Landfills-H Channelization-M Removal of riparian Vegetation-M Streambank modification/ Destabilization-M	305(b)-1996: Data in this table
Flieg Ditch	3.75 (RM 0-3.75)	Flow alteration-H Other habitat alterations-M Siltation-M Unknown toxicity-S	Removal of riparian vegetation-H Streambank modification/ Destabilization-H Dredging-M Highway/road/bridge/ sewer line-M Land development/ Suburbanization-M Other urban runoff-M Highway maintenance and Runoff-S	305(b)-1996: Data in this table

Segment	Miles Assessed & Aquatic Life Use Designation[#]	Causes of Impairment*	Sources of Impairment*	Comments
Heldman Ditch	5.5 (RM 0-5.5) MWH-C	Flow alteration-H Other habitat alterations-H Nutrients-M Siltation-M	Removal of riparian Vegetation-H Streambank modification/ Destabilization-H Channelization-M Highway maintenance and Runoff-M Highway/road/bridge/ sewer line-M Land development/ Suburbanization-M Other urban runoff-M	305(b)-2000: stream has been modified for drainage purposes; urban storm water and other inputs impact the stream (i.e. oil, chemicals, silt, variable flow, etc.)
Haefner Ditch	4.4 (RM 0-4.4) LRW	Other habitat alterations-H Siltation-M Unknown toxicity-M	Removal of riparian Vegetation-H Highway maintenance and Runoff-M Land development/ Suburbanization-M Other urban Runoff-M Streambank modification/ Destabilization-M	305(b)-2000: source of pollutants is unknown; could be attributed to urban nonpoint runoff; stream has been modified to conform to city layout and to carry storm water runoff efficiently
Hill Ditch	5.8 (RM 0-5.8) LRW & MWH-C	Flow alteration-H Other habitat alterations-H Siltation-M Nutrients-S Unknown toxicity-S	Removal of riparian Vegetation-H Streambank modification/ Destabilization-H Channelization-M Dredging-M Highway/road/bridge/ sewer line-M Land development/ Suburbanization-M Other Urban Runoff-M Highway Maintenance & runoff-S	305(b)-2000: possibly impacted by urban runoff; stream has been extensively modified to move water away; massive inputs of storm water via drains of all kinds; possible impact from urban storm water components (i.e. oil, chemicals, flashy slow, silt, trash, etc.); possible dumping by nearby business of oil waste in-stream as oil sediments were noted (Note: 2 entries in 2000 report)
Sibley Creek	5.2 (RM 0-5.2) LRW	Priority organics-H Thermal modifications-H	Contaminated sediments-H Landfills-M	305(b)-2000: no fish were captured in upper section; some were present near mouth; strong creosote odor present in the sediments, elevated PCBs in sediments; substrate at RM 0.8 were temperature hot

Segment	Miles Assessed & Aquatic Life Use Designation[#]	Causes of Impairment*	Sources of Impairment*	Comments
Shantee Creek	6.0 (RM 0-6.0) LRW & MWH-C	Other habitat alterations-H Priority organics-H Flow alteration-M Metals-M Oil and grease-M Organic enrichment/DO-M Pesticides-M Unknown toxicity-M	Minor industrial point Source-H Removal of riparian Vegetation-H Channelization-M Contaminated sediment-M Onsite wastewater systems (septic tanks)-M Other urban runoff-M Streambank modification/ Destabilization-M	305(b)-2000: fish tissue contaminated with PCBs, pesticides, and metals; sedimet contains oily material that leave a sheen on surface of water; sources are probably urban runoff, and spills/dumping from industrial plants along the stream
Tifft Ditch	2.05 (RM 0-2.05) LRW	Other habitat alterations-H Flow alteration-M Siltation-M	Land development/ Suburbanization-H Streambank modification/ Destabilization-H Channelization-M Other urban runoff-M Removal of riparian Vegetation-M	305(b)-2000: an urban, channelized ditch with heavy silt, no riparian, no habitat, and high variable flows
Silver Creek	7.3 (RM 0-6.9) LRW	Other habitat alterations-H Priority organics-H Metals-M Nutrients-M Oil and grease-M Organic enrichment/DO-S Pesticides-M Flow alterations-M	Land development/ Suburbanization-H Channelization-M Removal of riparian vegetation-M Streambank modification/ Destabilization-M Contaminated sediment-M	305(b)-2000: channelized with stream relocated in spots; heavy silt; many storm sewers & other pipes discharge to stream; little riparian cover; little in-stream habitat; flow regime highly variable; sediments full of oily residues, fish tissue samples contain PCBs, pesticides, and metals; sources may include urban runoff or illegal dumping
Ketcham Ditch	1.4 (RM 0-1.43) LRW	Other habitat alterations-H Siltation-M Flow alteration-M	Land development/ Suburbanization-H Streambank modification/ Destabilization-H Channelization-M Other urban runoff-M Removal of riparian Vegetation-M	305(b)-2000: urban drainage ditch, heavily silted and channelized with little upstream cover and no riparian corridor

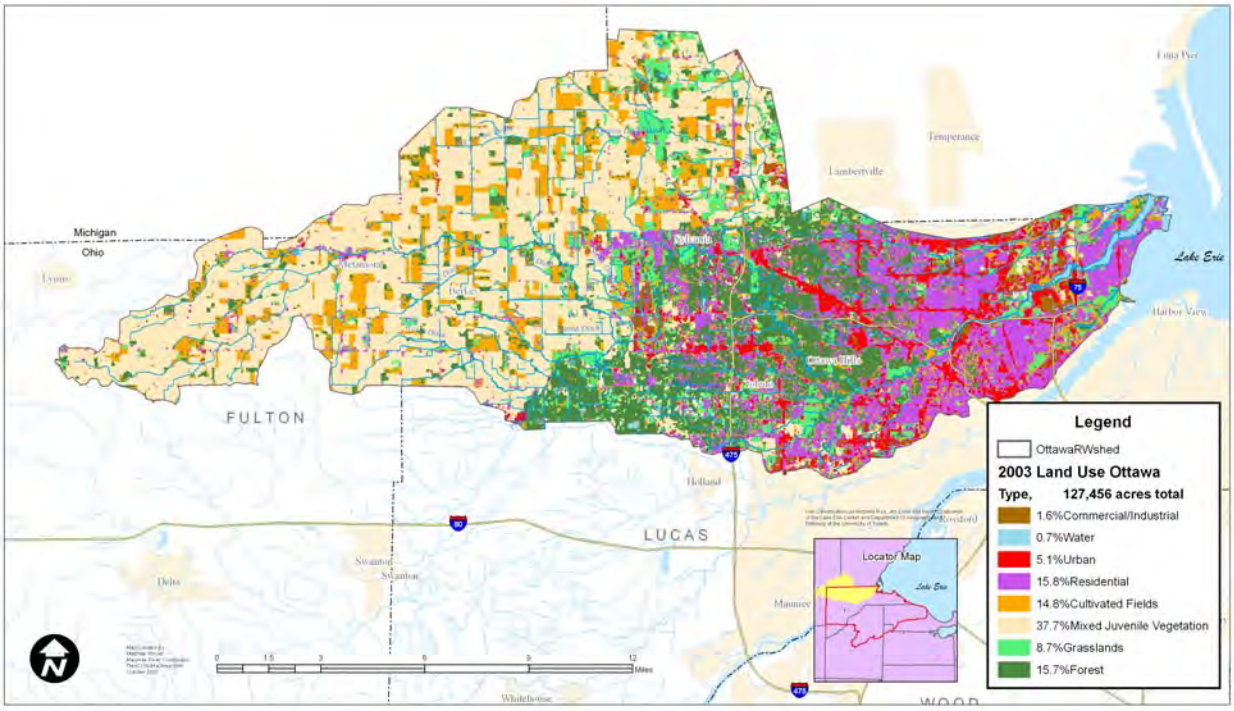
**Magnitude of that cause or source of impairment: H=high, M=moderate, S=slight, T=identifies a threat*

[#]Aquatic Life Use Designation: WWH=Warm Water Habitat, MWH=Modified Warm Water Habitat, LRW=Limited Resource Water

Land Use of the Ottawa River/Ten Mile Creek Watershed

In 2003 land use classifications produced by The University of Toledo for the Ottawa River watershed showed 38 percent of the land used by mixed juvenile vegetation. This vegetation type can be row crops in an early stage of growth, tracts of open space or yards. Forest and grassland account for 16 percent and 9 percent respectively, and 15 percent is in cultivated fields. Approximately 16 percent of the watershed has been developed for residential use, 5 percent for urban uses, and 2 percent for commercial/industrial uses.

2003 Land Use in the Ottawa River/Ten Mile Creek Watershed



Status of Beneficial Use Impairments

When the Maumee Area of Concern was defined in the late 1980s, the Maumee RAP Public Advisory Council determined which beneficial uses were impaired based on the entire AOC. This was done because the only way of delisting an AOC was a comprehensive one; all listed or all delisted. Now that there are alternative methods for incrementally delisting an AOC by watershed or impairment, the Maumee RAP needed to determine the BUIs by watershed. This was done using data and resources that were available before 1990. The two tables below summarize the BUIs impacting the Ottawa River Watershed in 1990 and 2004.

Following the BUI Summary Tables are maps of this watershed, including the jurisdictions, 14-digit HUCs, and custom-digitized river mile maps made specifically for the Maumee AOC watersheds.

The heart of this plan, the Watershed Project Tables (WPTs), is found in Volume 2. As explained in the Introduction, the WPTs are the living portion of the report that will change and grow, as projects are implemented and goals are attained. These tables have been organized by Causes and Sources and include Projects, Potential Project Partners, Funding Sources, Timeline, Status, Performance/ Environmental Measures, HUC/Stream Segment Addressed, and indicate the Beneficial Use Impairment (BUI) that could be effected by the project. Also incorporated into the table (where

applicable) is a reference to the ODNR Coastal Management Measures that may benefit from the implementation of an identified project.

There are differing levels of detail in the WPTs, often depending on how soon a project will be implemented, what source will be funding it, or by the amount of data available for that watershed. The status of projects in the WPTs has been organized and color-coded as follows: **In Progress**, **Planning**, **Concept**, **Ongoing**, and **Complete**.

Beneficial Use Impairments In 1990
for the Ottawa River/Ten Mile Creek Watershed

(as determined in 2002)

Beneficial Use Impairments	Ottawa River	Shantee Crk	Silver Creek	Reasons/Data Source
BUI 1: Restriction on fish and wildlife consumption	Impaired			ODH Fish Advisories
BUI 2: Tainting of fish & wildlife flavor				
BUI 3: Degradation on fish and wildlife populations				
BUI 4: Fish tumors or other deformities	Impaired			1994 305(b) Report
BUI 5: Bird or animal deformities or reproductive problems				
BUI 6: Degradation of benthos				
BUI 7: Restriction on dredging activities	Unknown			
BUI 8: Eutrophication or undesirable algae				
BUI 9: Restrictions on drinking water consumption, or taste and odor	Not Impaired			
BUI 10: Beach closings	Impaired			1990 305(b) Report
BUI 11: Degradation of aesthetics				
BUI 12: Added cost to agriculture and industry				
BUI 13: Degradation of phytoplankton & zooplankton populations				
BUI 14: Loss of fish and wildlife habitat	Impaired			

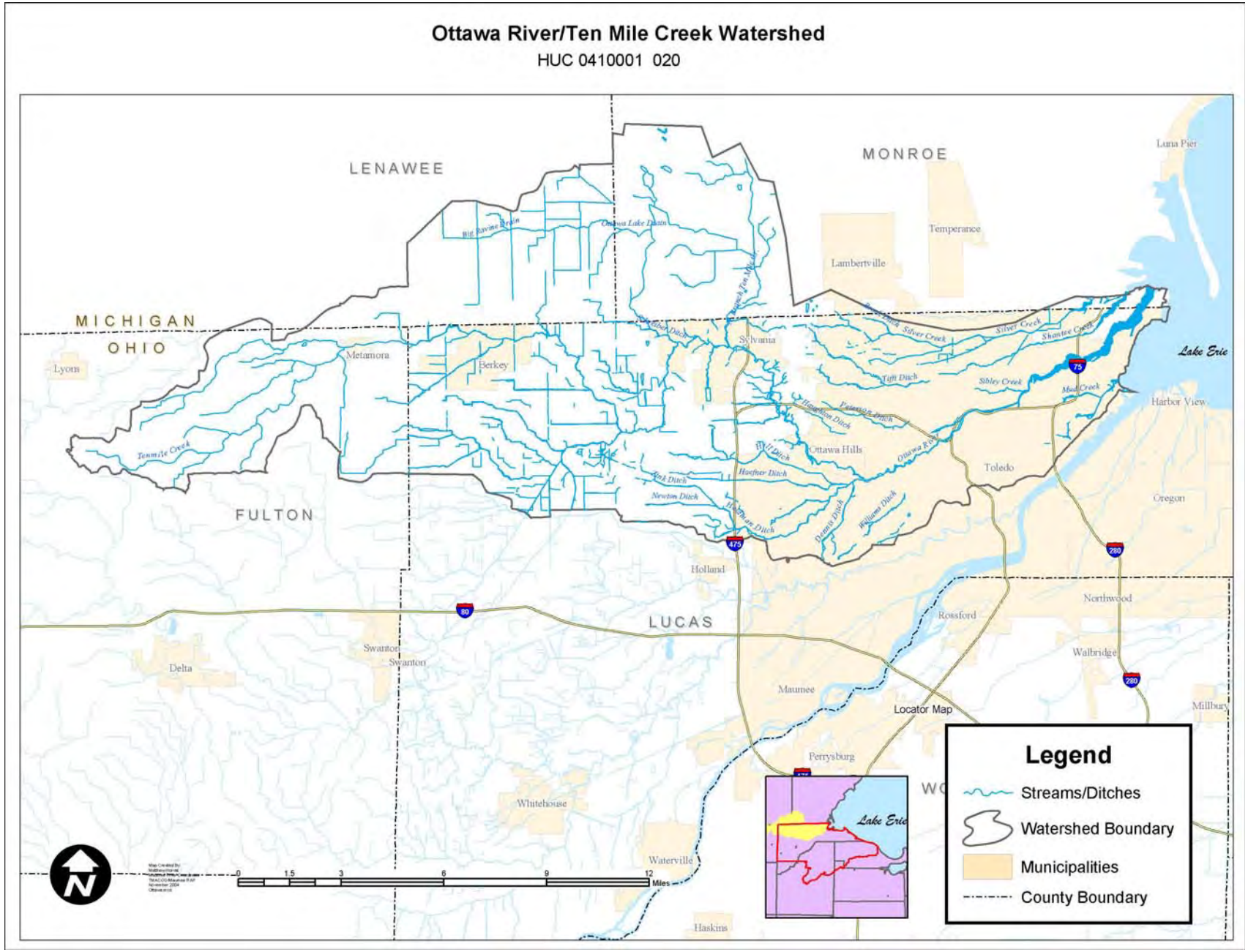
Possible answers – Impaired, Not Impaired, Unknown, Not Applicable

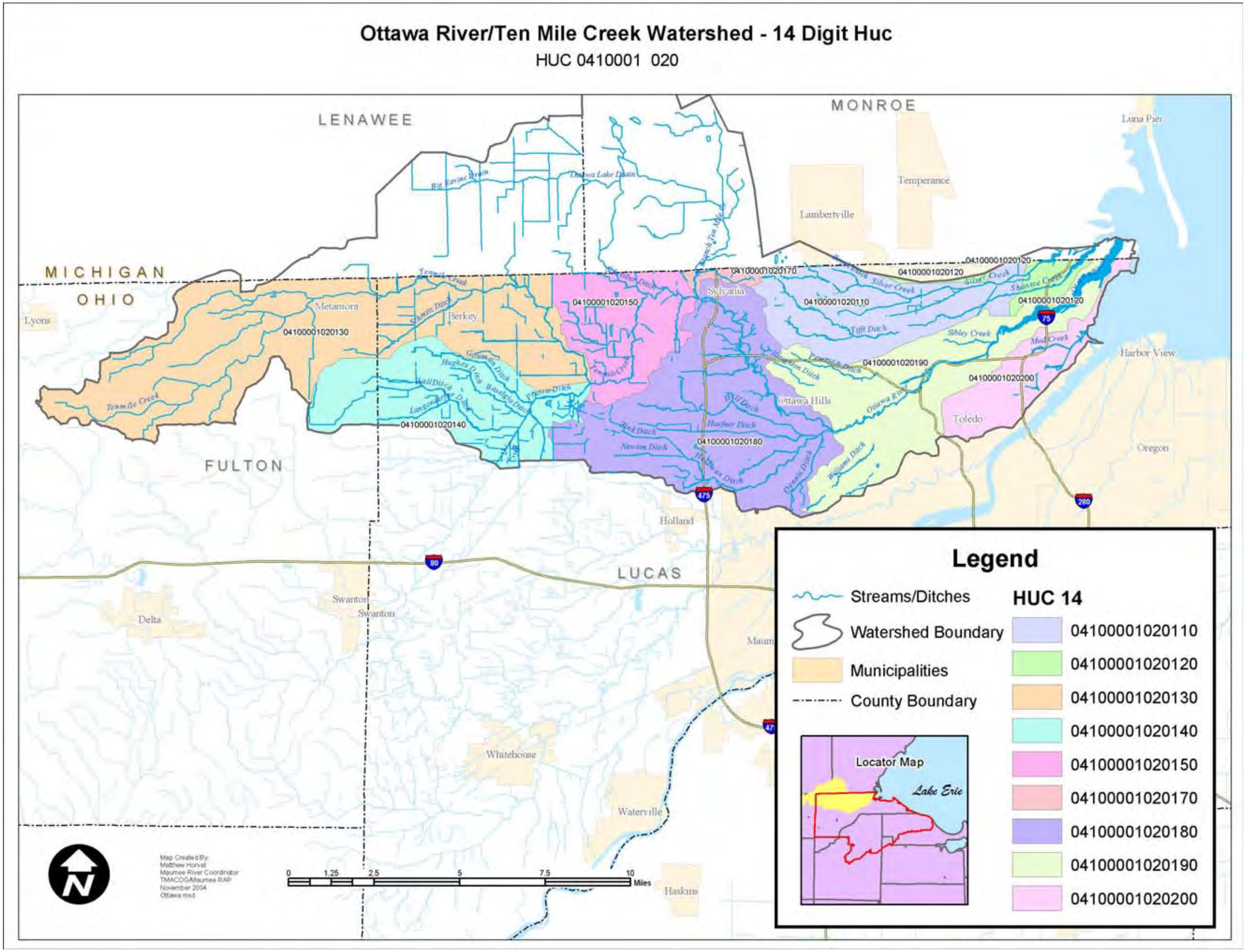
Beneficial Use Impairments In 2005
for the Ottawa River/Ten Mile Creek Watershed

(last updated 12/1/05)

Beneficial Use Impairments	Ottawa River	Shantee Crk	Silver Creek	Reasons/Data Source
BUI 1: Restriction on fish and wildlife consumption	Impaired			Fish Consumption Advisory (FCA) from I-475 in Sylvania Twp to the mouth
BUI 2: Tainting of fish & wildlife flavor	Unknown			
BUI 3: Degradation on fish and wildlife populations	Impaired			Not sustainable populations
BUI 4: Fish tumors or other deformities	Impaired			Data review pending
BUI 5: Bird or animal deformities or reproductive problems	Unknown			
BUI 6: Degradation of benthos	Impaired			
BUI 7: Restriction on dredging activities	Impaired			Sediment contamination PCBs etc
BUI 8: Eutrophication or undesirable algae	Unknown			
BUI 9: Restrictions on drinking water consumption, or taste and odor	Not impaired			Public drinking water system in Metamora draws from a trib of Ten Mile Creek
BUI 10: Beach closings	Impaired			Contact advisory
BUI 11: Degradation of aesthetics	Impaired			CSO discharges
BUI 12: Added cost to agriculture and industry	Impaired			
BUI 13: Degradation of phytoplankton & zooplankton populations	Not applicable			
BUI 14: Loss of fish and wildlife habitat	Impaired			Removal of riparian vegetation - development

Possible answers – Impaired, Not Impaired, Unknown, Not Applicable


Ottawa River/Ten Mile Creek Watershed
HUC 0410001 020
LENAWEE
MONROE
MICHIGAN
OHIO
FULTON
LUCAS
Lana Pier
Temperance
Lambertville
Sylvania
Metamora
Berkey
Lyons
Tenmile Creek
Big Ravine Basin
Ottawa Lake Drain
Silver Creek
Shantee Creek
Lake Erie
Tift Ditch
Sibley Creek
Mud Creek
Harbor View
Hamilton Ditch
Ottawa Hills
Toledo
Oregon
Newton Ditch
Holland
Northwood
Rossford
Swanton
Delta
Maumee
Walbridge
Millbury
Perrysburg
Whitehouse
Waterville
Haskins
Locator Map
Legend
Streams/Ditches
Watershed Boundary
Municipalities
County Boundary
0 1.5 3 6 9 12
Miles


Ottawa River/Ten Mile Creek Watershed - 14 Digit Huc
HUC 0410001 020
LENAWEE
MONROE
MICHIGAN
OHIO
FULTON
LUCAS
Legend
Streams/Ditches
Watershed Boundary
Municipalities
County Boundary
HUC 14
04100001020110
04100001020120
04100001020130
04100001020140
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04100001020170
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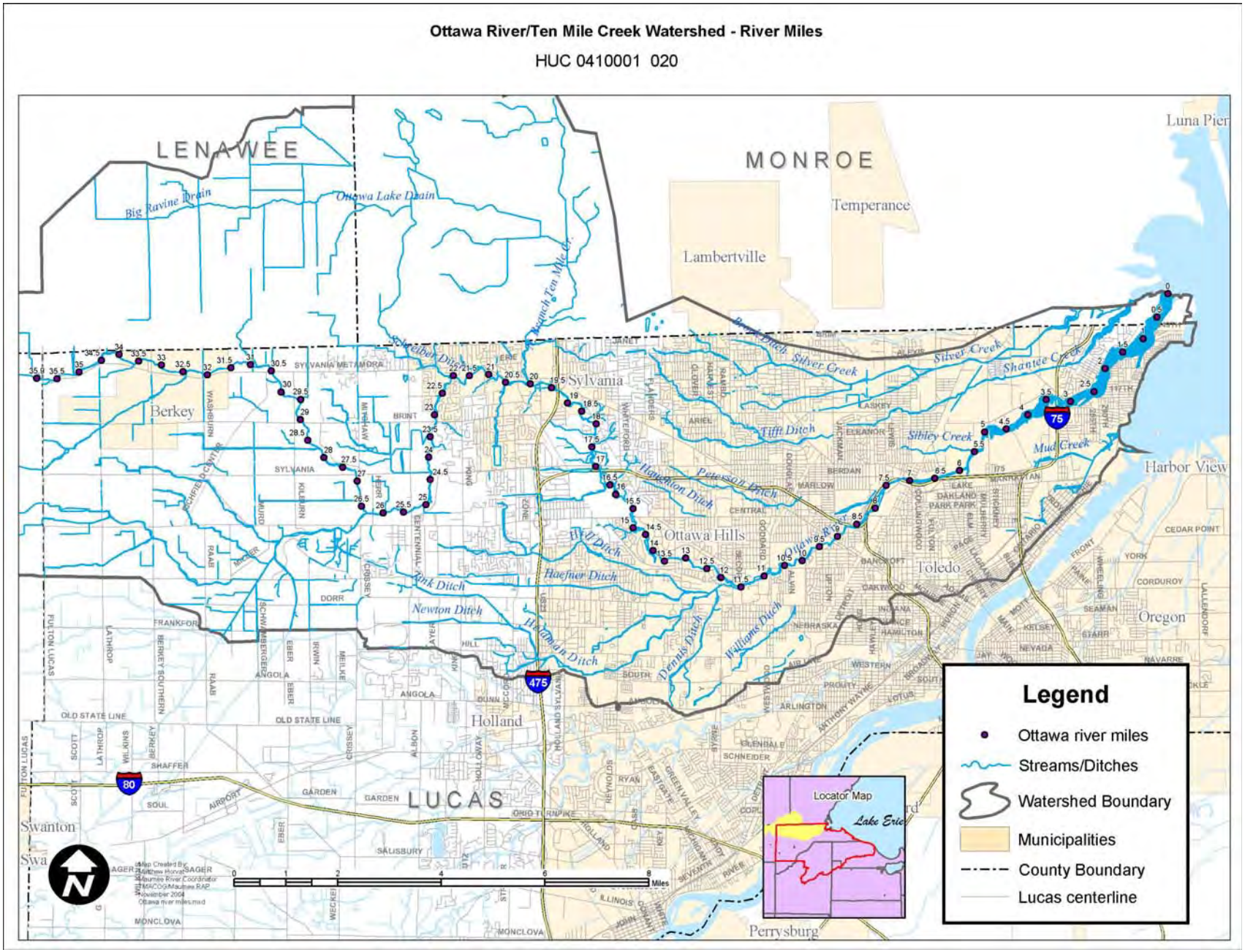
04100001020190
04100001020200
Locator Map
Lake Erie
Miles


Ottawa River/Ten Mile Creek Watershed - River Miles
HUC 0410001 020
LENAWEE
MONROE
LUCAS
Berkey
Sylvania
Lambertville
Temperance
Luna Pier
Harbor View
Ottawa Hills
Toledo
Oregon
Holland
Swanton
Perrysburg
Big Ravine Drain
Ottawa Lake Drain
Ten Mile Dr.
Silver Creek
Shantee Creek
Tiffin Ditch
Sibley Creek
Mud Creek
Hamilton Ditch
Peterson Ditch
Hull Ditch
Haefner Ditch
Rink Ditch
Newton Ditch
Hoffman Ditch
Williams Ditch
Dennis Ditch
Legend
Ottawa river miles
Streams/Ditches
Watershed Boundary
Municipalities
County Boundary
Lucas centerline
Locator Map
Lake Erie
Miles

See Volume 2 for the:

- Ten Mile Creek/Ottawa River Watershed Projects Table
- Silver Creek and Shantee Creek Watershed Projects Table – NOT AVAILABLE

References

[1]USDA Natural Resource Conservation Service website: http://www.oh.nrcs.usda.gov/technical/
[2] *A Study of Physical Features for the Toledo Regional Area*, Bowling Green State University Geology Department, Dr. Jane Forsyth, March 1968, pp 23-24.
[3] USDA Natural Resource Conservation Service website: http://www.oh.nrcs.usda.gov/technical/
[4] Ohio EPA, STORET Data, April 2004.
[5] Ohio EPA, STORET Data, April 2004.
[6] Ohio EPA, STORET Data, April 2004.
[7] *Delisting Targets for Ohio Areas of Concern*, Ohio EPA, June 2005.
[8] Ohio EPA, STORET Data, April 2004.
[9] *Delisting Targets for Ohio Areas of Concern*, Ohio EPA, June 2005.
[10] Ohio EPA, STORET Data, April 2004.
[11] *Delisting Targets for Ohio Areas of Concern*, Ohio EPA, June 2005.
[12] Ohio EPA, STORET Data, April 2004.
[13] *Delisting Targets for Ohio Areas of Concern*, Ohio EPA, June 2005.
[14] *Ohio EPA 305b Report*, Ohio EPA, 1996 and 2000.

Swan Creek Watershed

Volume 1

- Background & Water Quality Data for the Swan Creek Watershed
- Land Use of the Swan Creek Watershed
- Status of Beneficial Use Impairments
- Watershed Maps (General, 14-digit HUCs, River Mile)

Volume 2

- Swan Creek/Blue Creek Watershed Projects Table
- Ai Creek Watershed Projects Table – NOT AVAILABLE

Swan Creek Watershed *(last updated 12/21/05)*

The Swan Creek Watershed is comprised of Hydrologic Units 04100009 070 and 04100009 080. The drainage area of Swan Creek is 203.9 square miles. Its headwaters rise in Henry, Fulton and western Lucas counties. Over 200 miles of creeks and ditches drain this watershed. Swan Creek itself is only about 40 miles long.[1] Swan Creek's gradient is similar to the Maumee River with a drop of 2.1 feet per mile. Swan Creek is the only major tributary to the Maumee River that is located within the Maumee AOC. The major streams that feed Swan Creek are Ai Creek, Blue Creek, and Blystone Ditch.

The majority of the Swan Creek watershed is located within the Maumee Area of Concern. Due to water pollution problems and the physical characteristics of Swan Creek, contact and non-contact recreational use of Swan Creek is uncommon.

The Swan Creek watershed can be divided into three major reaches based on the dominant stream characteristics within each reach. In the upstream reach from river mile 19 in Monclova Township to the headwaters the channel is stable. The banks are low with indistinct valleys and floodplains. This reach is primarily in agricultural use. The upper reach of Swan Creek has important aesthetic value as it flows through the Oak Openings Preserve Metropark in western Lucas County.

Upper Reach of
Swan Creek Watershed Use Attainment Data[2]

River Mile	Sample Year	ICI Score	HELP Ecoregion ICI Criteria	Lacustuary ICI Score*	HELP Ecoregion Lacustuary ICI Criteria*	Modified Index of Well Being Score	HELP Ecoregion Miwb Criteria	IBI Score	HELP Ecoregion IBI Criteria	Lacustuary IBI Score*	HELP Ecoregion Lacustuary IBI Criteria*	QHEI Score	HELP Ecoregion QHEI Criteria
Swan Creek													
21.6	1985					4.348	7.3	30	32				
21.6	1993					6.76	7.3	36	32			47	60
22.1	1992					6.906	7.3	28	32			50.5	60
24.7	1989					6.412	7.3	30	32				
24.7	1989					5.902	7.3	32	32				
28.6	1989					4.118	7.3	24	32				
28.6	1989					4.653	7.3	30	32				
31.7	1989					4.967	7.3	30	32				
31.7	1989					5.342	7.3	32	32				
33.7	1989					6.469	7.3	26	32				
33.7	1989					5.84	7.3	24	32				
Blue Creek													
0.7	1985					3.735	7.3	20	32				
0.7	1992					7.151	7.3	38	32			54	60
0.7	1993					7.791	7.3	30	32			46	60
1.6	1985					4.928	7.3	28	32				
1.6	1993											21.5	60

Upper Reach of
Swan Creek Watershed DELT Data[3]

River Mile	Sample Year	Percent DELT Anomalies	Percent Deformities	Percent Eroded Fins	Percent Lesions	Percent Tumors	Relative Number of Fish Collected	Relative Number of Species Collected	Relative Number of Fish Minus Tolerants	Relative Weight of Fish Collected (in grams)
Swan Creek										
21.6	1985	0	0	0	0	0	284	17	148	0
21.6	1993	1.677	0.25	0.92	0.5	0	841.96	19	476.6	59.736
22.1	1992	0.93	0	0.46	0.46	0	427.55	16	181.91	19.059
24.7	1989	2.1053	0	1.05	1.05	0	142.5	15	64.5	5.199
24.7	1989	1.1628	0	0	1.16	0	129	11	69	3.598
28.6	1989	1.8862	0	1.89	0	0	75.76	8	38.6	10.295
28.6	1989	0	0	0	0	0	58.6	7	31.45	2.399
31.7	1989	0	0	0	0	0	214	10	86.01	5.51
31.7	1989	0.9434	0	0	0.94	0	212	9	122.01	4.668
33.7	1989	0	0	0	0	0	492	12	188.98	7.086
33.7	1989	0	0	0	0	0	633	11	170.97	16.145
Blue Creek										
0.7	1985	0	0	0	0	0	286	11	70.01	0
0.7	1992	2.0099	0	1	1	0	351.27	14	203	5.013
0.7	1993	0.7997	0.26	0.54	0	0	723.78	16	346.9	7.467
1.6	1985	0	0	0	0	0	972	15	474.04	0

The middle reach is the area that lies between river miles 19 and 6, where the creek is actively eroding its channel. The banks are high (35 to 45 feet or more) and unstable and are intermixed with detached floodplains. Bedrock in the channel at river mile 19 prevents the extension of this erosion upstream. The land use in the middle reach is primarily residential and is one of the fastest developing areas in Northwest Ohio. Land areas included are Monclova and Springfield townships in Lucas County and the western edge of the City of Toledo. Tributaries to Swan Creek that have extensive floodplain lands are Wolf Creek, Blystone Ditch, Stone Ditch, Cairl Creek, Drennan Ditch and Heilman Ditch.

The Swan Creek Preserve Metropark is located in the middle reach within the western portion of the City of Toledo. This is a developed urban area that is still exhibiting some residential and commercial growth. Swan Creek flows through this park and is its primary natural feature. The park is an important resource for the area not only because of its location, but also because it is probably the best example of flood plain habitat in the region.

The major problems of the middle reach are urbanization with the filling in of the floodplains and destruction of wetland areas. The water quality is *fair* but does not meet the goals of the Clean Water Act. The cause of quality impairment is ill-functioning septic tank systems, storm runoff, agricultural runoff, and the erosive forces of the stream itself.

Middle Reach of Swan Creek Watershed Use Attainment Data[4]

River Mile	Sample Year	ICI Score	HELP Ecoregion ICI Criteria	Lacustuary ICI Score*	HELP Ecoregion Lacustuary ICI Criteria*	Modified Index of Well Being Score	HELP Ecoregion Miwb Criteria	IBI Score	HELP Ecoregion IBI Criteria	Lacustuary IBI Score*	HELP Ecoregion Lacustuary IBI Criteria*	QHEI Score	HELP Ecoregion QHEI Criteria
Swan Creek													
10.2	1986	26	34			5.604	7.3	24	32				
10.2	1986					4.151	7.3	24	32				
10.2	1986					6.898	7.3	28	32				
10.2	1992	30	34										
10.4	1992					4.403	7.3	24	32			62	60
13.8	1993					5.952	7.3	30	32			40	60
15.3	1993					7.034	7.3	38	32			53.5	60
18.5	1989					6.329	7.3	34	32				
18.5	1989					6.53	7.3	36	32				
18.5	1993					6.655	7.3	40	32			63	60
Cairl Creek													
0.5	1993											51	60
Wolf Creek													
0.5	1992	14	34			5.266	7.3	18	32			68	60
0.5	1993					4.781	7.3	20	32			49.5	60
2	1993											38	60

Middle Reach of Swan Creek Watershed DELT Data[5]

River Mile	Sample Year	Percent DELT Anomalies	Percent Deformities	Percent Eroded Fins	Percent Lesions	Percent Tumors	Relative Number of Fish Collected	Relative Number of Species Collected	Relative Number of Fish Minus Tolerants	Relative Weight of Fish Collected (in grams)
Swan Creek										
10.2	1986	1.4085	0	0	1.41	0	213	13	70.5	12.772
10.2	1986	0	0	0	0	0	69.6	11	25.8	10.221
10.2	1986	1.5385	0	0	1.54	0	97.5	12	58.5	9.972
10.4	1992	2.27	0.76	1.52	0	0	152.3	18	48.45	38.704
13.8	1993	7.3169	0	6.1	1.22	0	111.85	10	80.48	7.358
15.3	1993	0	0	0	0	0	123	16	97.5	8.133
18.5	1989	0.6211	0	0.62	0	0	241.5	14	137.99	4.888
18.5	1989	4.2553	0	1.06	2.13	0	141	12	94.5	4.696
18.5	1993	1.2893	0	1.29	0	0	589.5	13	477	3.831
Wolf Creek										
0.5	1992	1.59	1.2	0.39	0	0	426.75	12	56.68	16.058
0.5	1993	2.06	0	1.65	0.41	0	347.26	11	27.16	6.424

The lower reach, from river mile 6 to the mouth in downtown Toledo, is actively silting in its channel. The banks are as high as 35 to 45 feet and are intermixed with floodplain areas. This lower reach is under the seiche effect from the Maumee River and Lake Erie. The level of Lake Erie prevents the lower reach from naturally deepening itself. The major problem is extremely poor water quality, due to storm runoff, hydromodification, and urban development.

The lower reach is highly urbanized with little vacant land left to build upon. The land use is residential, commercial, and industrial. Within this reach are two major open space areas. The first is Highland Park between South Avenue and the creek (RM 4.0), with the second being Sterling Field. This playing field is within an ox bow in the creek and lies between two major streets, Hawley and Collingwood (RM 1.5-2.5).

This lower reach is neither swimmable nor fishable according to public health standards. From the area of the Swan Creek Preserve Metropark (RM 7.25-10.5) to the mouth, the Toledo Department of Health has posted warnings for no body contact. Contributing to the pollution are the combined sewer overflows, industrial discharges to the sanitary sewer system, storm sewers, and urban storm water runoff. All of this can and does reach the creek, degrading water quality.

Fish tissue sampling conducted on carp taken at St. Clair Street in 1986 showed 5.9 parts per million (ppm) of PCBs from the body composite. The U.S. Food and Drug Administration Health Standards for PCBs in fish is 2.0 ppm for the edible portion. Polychlorinated biphenyls (PCBs) are highly stable man-made organic substances and are acutely toxic to organisms. PCBs are banned today as they are carcinogenic.

From Champion Street (RM 3.9) to the mouth the water quality is rated as *poor*. Heavy metals have the largest impact between Hawley Street (RM 2.6) to Collingwood Boulevard (RM 1.2) with zinc, lead, arsenic, nickel, and chromium found in the water and the bottom sediments. Fish in this lower reach, especially the bottom feeders such as catfish and carp, were found to have external abnormalities such as lesions, eroded fins, blackspots and other deformities. The worst area is near Collingwood Boulevard where creosote was found in the sediments at Hawley Street.

Lower Reach of
Swan Creek Watershed Use Attainment Data[6]

River Mile	Sample Year	ICI Score	HELP Ecoregion ICI Criteria	Lacustuary ICI Score*	HELP Ecoregion Lacustuary ICI Criteria*	Modified Index of Well Being Score	HELP Ecoregion Miwb Criteria	IBI Score	HELP Ecoregion IBI Criteria	Lacustuary IBI Score*	HELP Ecoregion Lacustuary IBI Criteria*	QHEI Score	HELP Ecoregion QHEI Criteria
Swan Creek													
0.4	1993											24	60
0.5	1986					6.669	7.3			19	42		
0.5	1986					7.066	7.3			23	42		
0.5	1986					3.369	7.3			20	42		
0.5	1992					7.968	7.3			32	42	43.5	60
0.6	1986			16	42								
0.6	1992			22	42								
1.2	1986			22	42								
1.2	1986					4.417	7.3			6	42		
1.2	1986					3.196	7.3			13	42		

River Mile	Sample Year	ICI Score	HELP Ecoregion ICI Criteria	Lacustuary ICI Score*	HELP Ecoregion Lacustuary ICI Criteria*	Modified Index of Well Being Score	HELP Ecoregion Miwb Criteria	IBI Score	HELP Ecoregion IBI Criteria	Lacustuary IBI Score*	HELP Ecoregion Lacustuary IBI Criteria*	QHEI Score	HELP Ecoregion QHEI Criteria
Swan Creek													
2.5	1992											55	60
2.5	1992					7.254	7.3			30	42		
2.6	1986			16	42	5.238	7.3			11	42		
2.6	1986									7	42		
2.6	1986					3.506	7.3			8	42		
2.6	1992			28	42								
2.6	1993											26.5	60
3.9	1986	4	34			4.263	7.3	16	32				
3.9	1986					4.496	7.3	14	32				
3.9	1986					5.009	7.3	16	32				
4.2	1992	22	34			7.576	7.3	36	32				
4.2	1993											29.5	60
4.4	1986					5.315	7.3	24	32				
4.4	1986					5.204	7.3	24	32				
4.4	1986					5.883	7.3	26	32				
4.9	1986	18	34										

** The double horizontal line represents the lacustuary divide of Swan Creek, although it is noted that lacustuary lengths are approximate and fluctuate with lake levels and wind direction.*[7]

Lower Reach of Swan Creek Watershed DELT Data[8]

River Mile	Sample Year	Percent DELT Anomalies	Percent Deformities	Percent Eroded Fins	Percent Lesions	Percent Tumors	Relative Number of Fish Collected	Relative Number of Species Collected	Relative Number of Fish Minus Tolerants	Relative Weight of Fish Collected (in grams)
Swan Creek										
0.5	1986	6.98	0	0	6.98	0	86	10	82	22.896
0.5	1986	0	0	0	0	0	228	11	202	40.526
0.5	1986	0	0	0	0	0	192	3	186	8.62
0.5	1992	2.44	0	1.22	1.22	0	328	15	260	34.22
1.2	1986	20	0	0	20	0	40	2	26	21.216
1.2	1986	0	0	0	0	0	0	0	0	0
1.2	1986	0	0	0	0	0	90	3	68	27.139
2.5	1992	0	0	0	0	0	130	14	80	38.69
2.6	1986	3.85	0	0	3.85	0	52	7	22	32.262
2.6	1986	0	0	0	0	0	2	0	0	1.32
2.6	1986	2.5	0	2.5	0	0	80	3	58	16.708
3.9	1986	6.8966	3.45	0	3.45	0	58	7	20	14.432
3.9	1986	9.2157	0	0	9.22	0	68	8	22	3.917
3.9	1986	3.1624	0	3.16	0	0	156	9	90	6.032
4.2	1992	0.6	0	0.6	0	0	296.57	15	195.94	3.521

River Mile	Sample Year	Percent DELT Anomalies	Percent Deformities	Percent Eroded Fins	Percent Lesions	Percent Tumors	Relative Number of Fish Collected	Relative Number of Species Collected	Relative Number of Fish Minus Tolerants	Relative Weight of Fish Collected (in grams)
Swan Creek										
4.4	1986	2.5532	0	1.28	1.28	0	174.09	12	57.41	89.961
4.4	1986	3.2468	1.59	1.66	0	0	126	9	40	31.579
4.4	1986	3.0769	3.08	0	0	0	130	10	68	31.836

** The double horizontal line represents the lacustuary divide of Swan Creek, although it is noted that lacustuary lengths are approximate and fluctuate with lake levels and wind direction.*[9]

Swan Creek Watershed Impairments
Causes and Sources of Impairments [10]

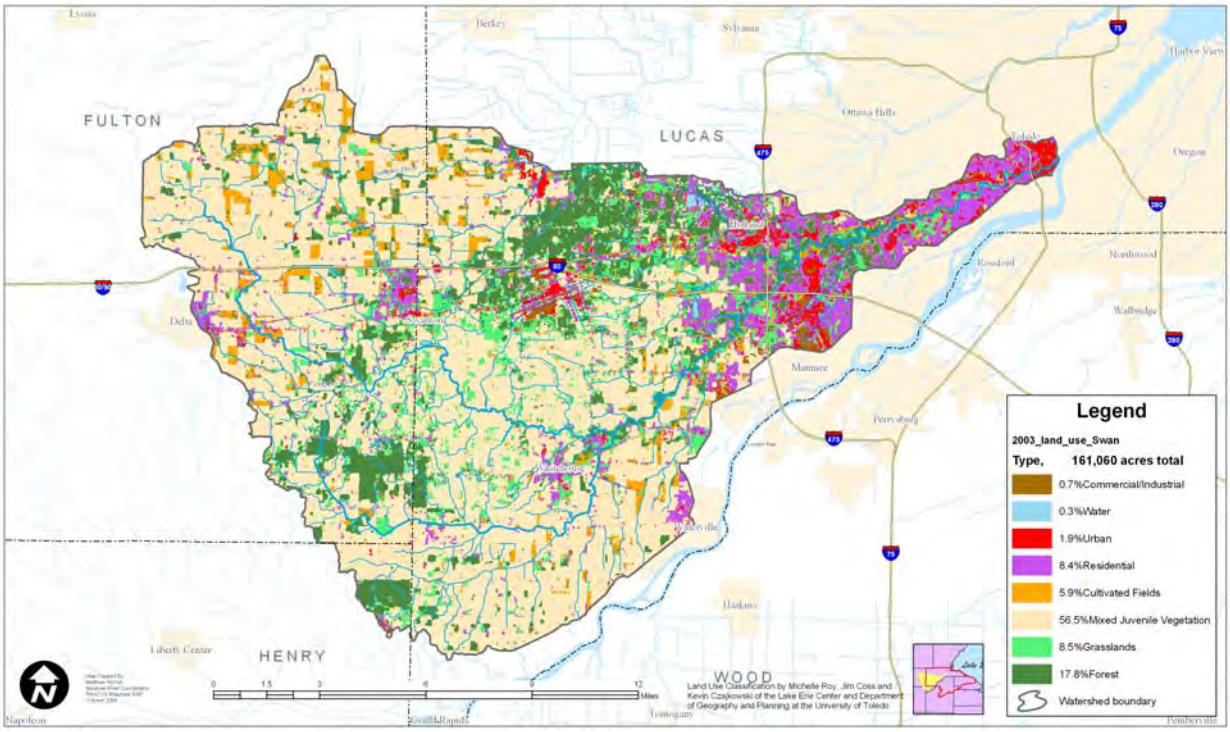
Segment	Miles Assessed & Aquatic Life Use Designation[#]	Causes of Impairment*	Sources of Impairment*	Comments
Swan Creek (Headwaters to Ai Crk)	12.90	Siltation-H	Agriculture-H	305(b)-1996: Data in this table
Swan Creek (Ai to Blue Creek)	8.4 (RM 22.17-30.57) WWH	Siltation-H	Nonirrigated crop production-H	305(b)-2000: no comments
Swan Creek (Blue Creek to Maumee River)	22.17 (RM 0-22.17) WWH	Siltation-H Metals-M Other habitat alterations-M Pesticides-M Priority organics-M	Other urban runoff-H Channelization-M Land development/ Suburbanization-M	305(b)-2000: Swan Creek has potential if certain problems can be overcome including polluted urban runoff, removal of trash, reducing silt inputs and restoring habitat; PCBs and pesticides are a problem in fish tissue.
Heilman Ditch	3.81 (RM 0-3.81) LRW	Other habitat alterations-H Flow alteration-M Unknown toxicity-M	Other urban runoff-H Highway maintenance and runoff-M	305(b)-2000: stream habitat was good, but not many fish; highly variable flow and impacts from urban NPS probably keep this stream from performing higher.
Wolf Creek	7.0 (RM 0-7.0) WWH	Total toxics-H Siltation-M Flow alteration-S Other habitat alterations-S	Other urban runoff-H Land development/ Suburbanization-M Highway/road/bridge/ sewer line-S Streambank modification/ Destabilization-S	305(b)-2000: habitat and riparian cover were good; fish and macroinvertebrate communities were poor; appears to be a problem with the urbanized nature of the watershed (i.e. toxic inputs, variable flow, etc.)
Blue Creek	11.9 (RM 0-11.9) WWH	Other habitat alterations-H Flow alteration-M Siltation-M Pesticides-S Metals-S Priority organics-S Other habitat alterations-T	Land development/ Suburbanization-M Other urban runoff-H Removal of riparian Vegetation-M Streambank modification/ Destabilization-M	305(b)-2000: stream seems to be on borderline of supporting attainment; fish are slightly contaminated with PCBs, pesticides and metals; probably a whole stream problem, only documented in lower reaches.

**Magnitude of that cause or source of impairment: H=high, M=moderate, S=slight, T=identifies a threat*
[#]Aquatic Life Use Designation: WWH=Warm Water Habitat, MWH=Modified Warm Water Habitat, LRW=Limited Resource Water

Land Use of the Swan Creek Watershed

In 2003 land use classifications produced by The University of Toledo for the Swan Creek watershed showed 57 percent of the land used by mixed juvenile vegetation. This vegetation type can be row crops in an early stage of growth, tracts of open space or yards. Forest and grassland account for 18 percent and 9 percent respectively, and 6 percent is in cultivated fields. Approximately 8 percent of the watershed has been developed for residential use, 2 percent for urban uses, and less than 1 percent for commercial/industrial uses.

2003 Land Use in the Swan Creek Watershed



Status of Beneficial Use Impairments

When the Maumee Area of Concern was defined in the late 1980s, the Maumee RAP Public Advisory Council determined which beneficial uses were impaired based on the entire AOC. This was done because the only way of delisting an AOC was a comprehensive one; all listed or all delisted. Now that there are alternative methods for incrementally delisting an AOC by watershed or impairment, the Maumee RAP needed to determine the BUIs by watershed. This was done using data and resources that were available before 1990. The two tables below summarize the BUIs impacting the Swan Creek Watershed in 1990 and 2004.

Following the BUI Summary Tables are maps of this watershed, including the jurisdictions, 14-digit HUCs, and custom-digitized river mile maps made specifically for the Maumee AOC watersheds.

The heart of this plan, the Watershed Project Tables (WPTs), is found in Volume 2. As explained in the Introduction, the WPTs are the living portion of the report that will change and grow, as projects are implemented and goals are attained. These tables have been organized by Causes and Sources and include Projects, Potential Project Partners, Funding Sources, Timeline, Status, Performance/ Environmental Measures, HUC/Stream Segment Addressed, and indicate the Beneficial Use Impairment (BUI) that could be effected by the project. Also incorporated into the table (where

applicable) is a reference to the ODNR Coastal Management Measures that may benefit from the implementation of an identified project.

There are differing levels of detail in the WPTs, often depending on how soon a project will be implemented, what source will be funding it, or by the amount of data available for that watershed. The status of projects in the WPTs has been organized and color-coded as follows: **In Progress, Planning, Concept, Ongoing,** and **Complete.**

Beneficial Use Impairments In 1990
for the Swan Creek/Blue Creek Watershed

(as determined in 2002)

Beneficial Use Impairments	Swan Cr./Blue Cr.	Ai Creek	Reasons/Data Source
BUI 1: Restriction on fish and wildlife consumption			
BUI 2: Tainting of fish & wildlife flavor			
BUI 3: Degradation on fish and wildlife populations			
BUI 4: Fish tumors or other deformities			
BUI 5: Bird or animal deformities or reproductive problems			
BUI 6: Degradation of benthos			
BUI 7: Restriction on dredging activities			
BUI 8: Eutrophication or undesirable algae			
BUI 9: Restrictions on drinking water consumption, or taste and odor			
BUI 10: Beach closings			
BUI 11: Degradation of aesthetics			
BUI 12: Added cost to agriculture and industry			
BUI 13: Degradation of phytoplankton & zooplankton populations			
BUI 14: Loss of fish and wildlife habitat			

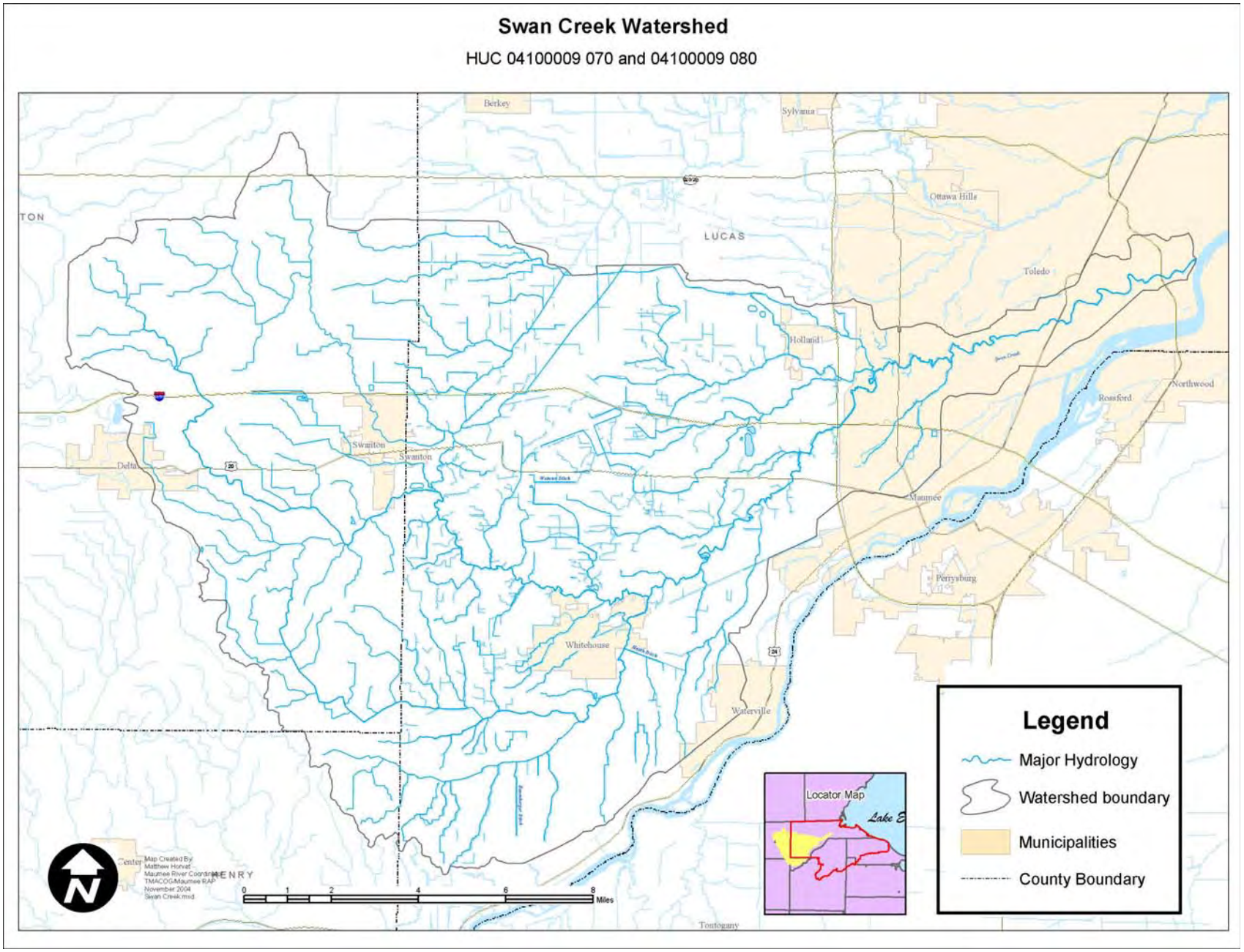
Possible answers – Impaired, Not Impaired, Unknown, Not Applicable

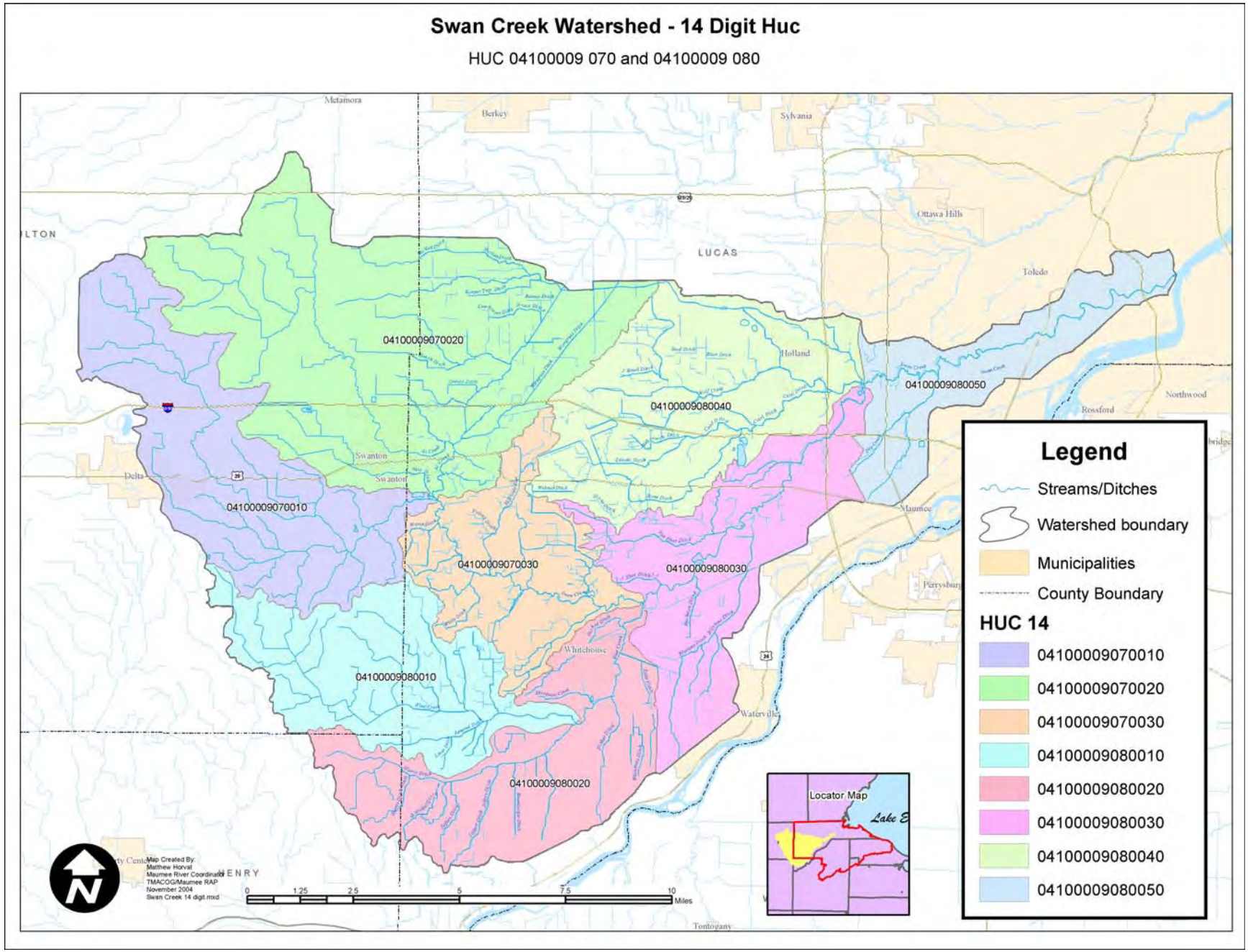
Beneficial Use Impairments In 2005
for the Swan Creek/Blue Creek Watershed

(last updated 11/7/05)

Beneficial Use Impairments	Swan Cr./Blue Cr.	Ai Creek	Reasons/Data Source
BUI 1: Restriction on fish and wildlife consumption	Not impaired		
BUI 2: Tainting of fish & wildlife flavor	Not impaired		
BUI 3: Degradation on fish and wildlife populations	Impaired		
BUI 4: Fish tumors or other deformities	Impaired		
BUI 5: Bird or animal deformities or reproductive problems	Unknown		
BUI 6: Degradation of benthos	Impaired		
BUI 7: Restriction on dredging activities	Not impaired		
BUI 8: Eutrophication or undesirable algae	Unknown		
BUI 9: Restrictions on drinking water consumption, or taste and odor	Not impaired		Public drinking water system in Metamora draws from a trib of Ten Mile Creek
BUI 10: Beach closings	Impaired		
BUI 11: Degradation of aesthetics	Impaired		
BUI 12: Added cost to agriculture and industry	Not impaired		
BUI 13: Degradation of phytoplankton & zooplankton populations	Not applicable		
BUI 14: Loss of fish and wildlife habitat	Impaired		

Possible answers – Impaired, Not Impaired, Unknown, Not Applicable


Swan Creek Watershed
HUC 04100009 070 and 04100009 080
Berkey
Sylvania
Ottawa Hills
LUCAS
Toledo
Holland
Northwood
Rossford
Swanton
Delta
Maumee
Perrysburg
Whitehouse
Waterville
Tontogany
Legend
Major Hydrology
Watershed boundary
Municipalities
County Boundary
Locator Map
Map Created By:
Matthew Horvat
Maumee River Coordinator
TMACOG/Maumee RAP
November 2004
Swan Creek.mxd
HENRY
0 1 2 4 6 8
Miles


Swan Creek Watershed - 14 Digit Huc
HUC 04100009 070 and 04100009 080
Metamora
Berkey
Sylvania
LUCAS
Ottawa Hills
Toledo
Holland
Northwood
Rossford
Swanton
Delta
Maumee
Perrysburg
Whitehouse
Waterville
Tontogany
04100009070020
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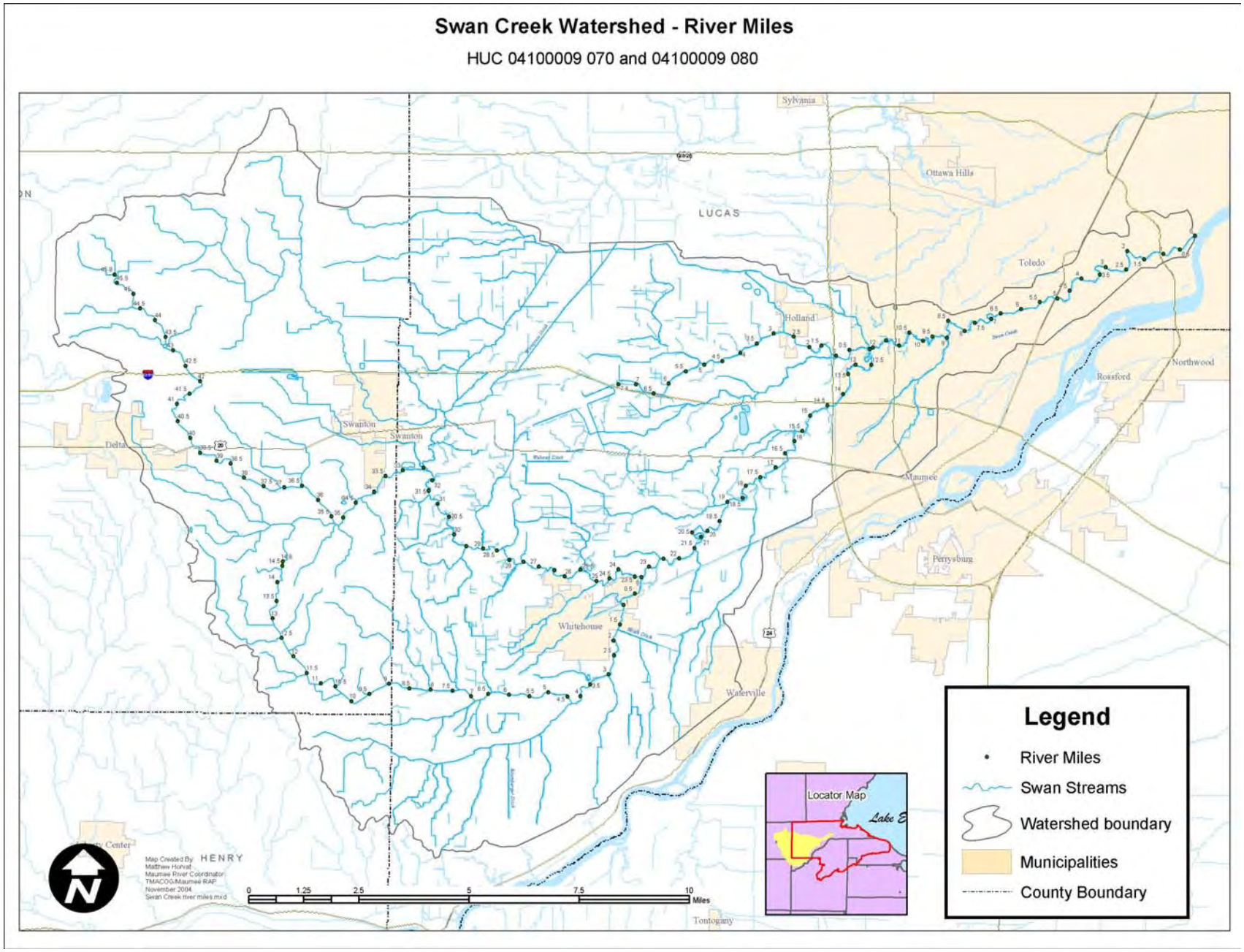
04100009080050
04100009070010
04100009070030
04100009080030
04100009080010
04100009080020
Legend
Streams/Ditches
Watershed boundary
Municipalities
County Boundary
HUC 14
04100009070010
04100009070020
04100009070030
04100009080010
04100009080020
04100009080030
04100009080040
04100009080050
Locator Map
Map Created By:
Matthew Horvat
Maumee River Coordinator
TMACOG/Maumee RAP
November 2004
Swan Creek 14 digit.mxd
0
1.25
2.5
5
7.5
10
Miles


Swan Creek Watershed - River Miles
HUC 04100009 070 and 04100009 080
LUCAS
Sylvania
Ottawa Hills
Toledo
Holland
Northwood
Rossford
Maumee
Perrysburg
Swanton
Delta
Whitehouse
Waterville
Tontogany
Legend
River Miles
Swan Streams
Watershed boundary
Municipalities
County Boundary
Locator Map
Map Created By HENRY
Matthew Horvat
Maumee River Coordinator
TMACOG/Maumee RAP
November 2004
Swan Creek river miles.mxd
0 1.25 2.5 5 7.5 10
Miles

See Volume 2 for the:

- Swan Creek/Blue Creek Watershed Projects Table
- Ai Creek Watershed Projects Table – NOT AVAILABLE

Bibliography

Maumee River Basin Area of Concern Remedial Action Plan Recommendations for Implementation Vol. 4, TMACOG, July 1991.

"208" *Areawide Water Quality Management Plan*, TMACOG, 2003-2004.

References

[1] *Swan Creek Watershed Plan of Action*, Maumee RAP/TMACOG, April 2001.
[2] Ohio EPA, STORET Data, April 2004.
[3] Ohio EPA, STORET Data, April 2004.
[4] Ohio EPA, STORET Data, April 2004.
[5] Ohio EPA, STORET Data, April 2004.
[6] Ohio EPA, STORET Data, April 2004.
[7] *Delisting Targets for Ohio Areas of Concern*, Ohio EPA, June 2005.
[8] Ohio EPA, STORET Data, April 2004.
[9] *Delisting Targets for Ohio Areas of Concern*, Ohio EPA, June 2005.
[10] *Ohio EPA 305b Report*, Ohio EPA, 1996 and 2000.

Maumee River Watershed

Volume 1

- Background & Water Quality Data for the Lower Maumee River Watershed
- Land Use of the Lower Maumee River Watershed
- Status of Beneficial Use Impairments
- Watershed Maps (General, 14-digit HUCs, River Mile)

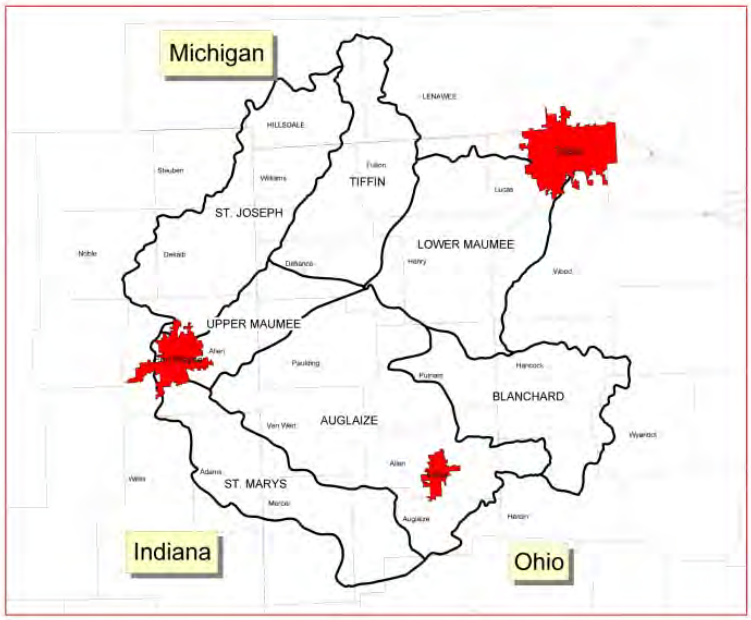
Volume 2

- Maumee River Watershed Projects Table
- Grassy Creek Watershed Projects Table
- Duck Creek Watershed Projects Table

Maumee River Watershed *(last updated 12/21/05)*

The Maumee River Watershed chapter addresses Hydrologic Unit 04100009 090. Although, the Ohio EPA addresses the Maumee River mainstem as an independent Large River Unit, for the purposes of this report information on the Maumee River is included under this Hydrologic Unit along with Grassy Creek and Duck Creek.

The Maumee River is the largest Great Lakes tributary, draining all or part of 17 Ohio counties, two Michigan counties, and five Indiana counties. The total river basin covers 8,316 square miles. The mainstem of the Maumee River is approximately 130 miles in total length with 105 miles in Ohio. Only the lower 22.8 miles of the Maumee River is included in the Maumee AOC, therefore only this lower portion is addressed by the *Stage 2 Watershed Plan.*



The river drains about 6,586 square miles, of which about 85 percent is agricultural. Daily average discharge ranges from a high of 94,000 cubic feet per second (cfs) to a low of 32 cfs, and contributes about 25 percent of the total tributary discharge into Lake Erie, exclusive of the Detroit River. The average annual rainfall on the river basin is 34.5 inches.[1]

The Maumee River begins in Fort Wayne at the confluence of the St. Joseph and St. Mary's rivers. It flows through Defiance and Napoleon, and then into Toledo. Along the way several major tributaries join the Maumee: the Tiffin, Auglaize, and Blanchard rivers. In Wood and Lucas counties, several smaller streams flow into the Maumee: Beaver Creek and Tontogany Creek from the south; and Swan Creek, which join the Maumee in downtown Toledo. The area in Wood and Lucas counties draining directly into the Maumee River is comparatively small. Most drainage flows to the tributaries, which then flow into the Maumee River. Most of the Oak Openings Region is in the Maumee River Basin and the Great Black Swamp in the area formerly covers a large part of the basin south of the river.

The Maumee River was designated a State Scenic River on July 18, 1974 from the Ohio/Indiana state line to the US Route 24 bridge west of Defiance. This Scenic River designation includes 43 miles of the Maumee River. It also designated as a State Recreational River in July 1974 from the US Route 24 bridge west of Defiance to the Maumee/Perrysburg Bridge (State Route 25/US Route 20) at RM 15.1. This Recreational River segment includes 53 miles of the Maumee River. These two designated areas have special restrictions on development, permitted discharged, etc. within them.

Fishing on the Maumee River normally occurs upstream from the Maumee-Perrysburg Bridge. Sailing and power boating occur from Perrysburg to the mouth of the Maumee River, as do the other water-based activities. Canoeing is popular both upstream and downstream from the

Maumee-Perrysburg Bridge, with the upstream area being the most important. The lower portion of the River (RM 7) including areas just below RM 5, at the Swan Creek confluence near Promenade park, is considered polluted. This also happens to be one of the areas most impacted by combined sewer overflows (CSO). Despite the pollution, people swim, ski and sailboard in this area.

The highest elevations of 1,100 feet above mean sea level occur in the Michigan portion of the watershed. At the Ohio/Indiana border the elevation of the Maumee River is 707 feet above mean sea level. While at its mouth at Maumee Bay, the river is 573 feet above mean sea level, dropping an average of 1.3 feet per mile.[2] The steepest section is between Waterville and Maumee, at 5 feet per mile.[3] Below Rossford, the Maumee is at the same elevation as Lake Erie.[4]

Lower Maumee River Watershed Use Attainment Data[5]

River Mile	Sample Year	ICI Score	HELP Ecoregion ICI Criteria	Lacustuary ICI Score*	HELP Ecoregion Lacustuary ICI Criteria*	Modified Index of Well Being Score	HELP Ecoregion Miwb Criteria	IBI Score	HELP Ecoregion IBI Criteria	Lacustuary IBI Score*	HELP Ecoregion Lacustuary IBI Criteria*	QHEI Score	HELP Ecoregion QHEI Criteria
Maumee River													
0.6	1986											54	60
0.6	1993			36	42								
0.6	1996					6.671	8.6			26	42		
0.6	1996					6.323	8.6			32	42		
0.6	1996					5.493	8.6			16	42		
0.6	1996					6.507	8.6			27	42		
0.6	1996					5.555	8.6			30	42		
0.6	1996					6.687	8.6			30	42		
0.7	1986					5.475	8.6			18	42	54.5	60
0.7	1986					6.041	8.6			22	42		
0.7	1986					6.289	8.6			20	42		
0.7	1993					5.928	8.6			20	42	51.5	60
0.7	1993					7.336	8.6			25	42		
0.7	1993					7.735	8.6			30	42		
0.7	1996					3.606	8.6			16	42		
0.7	1996					6.266	8.6			27	42		
0.7	1996					6.403	8.6			27	42		
0.7	1996					5.452	8.6			27	42		
0.7	1996					6.793	8.6			29	42		
0.8	1986			24	42								
1.4	1986											49.5	60
1.4	1993											26.5	60
1.4	1986					6.183	8.6			20	42		
1.4	1986					6.619	8.6			32	42		
1.4	1986					5.608	8.6			21	42		
1.4	1993					6.502	8.6			16	42		
1.4	1993					6.331	8.6			22	42		
1.5	1986			14	42	4.944	8.6			20	42	49.5	60
1.5	1986					6.221	8.6			28	42		
1.5	1993			24	42	7.181	8.6			28	42	55.5	60
1.5	1993					7.689	8.6			36	42		

River Mile	Sample Year	ICI Score	HELP Ecoregion ICI Criteria	Lacustuary ICI Score*	HELP Ecoregion Lacustuary ICI Criteria*	Modified Index of Well Being Score	HELP Ecoregion Miwb Criteria	IBI Score	HELP Ecoregion IBI Criteria	Lacustuary IBI Score*	HELP Ecoregion Lacustuary IBI Criteria*	QHEI Score	HELP Ecoregion QHEI Criteria
Maumee River													
1.5	1993					8.056	8.6			35	42		
1.5	1996					5.468	8.6			13	42		
1.5	1996					7.699	8.6			25	42		
1.5	1996					7.151	8.6			17	42		
1.5	1996					7.772	8.6			31	42		
1.5	1996					6.742	8.6			21	42		
1.5	1996					7.253	8.6			33	42		
1.6	1998			26	42	7.289	8.6			28	42	37	60
1.6	1998					7.011	8.6			22	42		
2.1	1998			28	42	7.198	8.6			23	42	38	60
2.1	1998					7.266	8.6			22	42		
2.6	1998			30	42	6.134	8.6			16	42	37.5	60
2.6	1998					7.478	8.6			23	42		
3.1	1986			22	42								
3.1	1993					5.961	8.6			20	42	57	60
3.1	1993					6.482	8.6			26	42		
3.1	1993					6.629	8.6			26	42		
3.1	1996					5.464	8.6			17	42		
3.1	1996					3.015	8.6			13	42		
3.1	1996					4.605	8.6			24	42		
3.1	1996					5.486	8.6			27	42		
3.1	1996					6.153	8.6			28	42		
3.3	1986					7.128	8.6			24	42	46.5	60
3.3	1986					6.293	8.6			21	42		
3.3	1986					6.137	8.6			24	42		
3.3	1986					6.368	8.6			22	42		
3.3	1996					6.257	8.6			23	42		
3.3	1996					6.563	8.6			34	42		
3.3	1996					7.955	8.6			31	42		
3.3	1996					5.554	8.6			24	42		
3.3	1996					5.357	8.6			28	42		
3.6	1986			28	42	6.682	8.6			17	42	49	60
3.6	1986					6.799	8.6			14	42		
3.6	1986					5.441	8.6			13	42		
3.6	1986					6.604	8.6			25	42		
4.5	1986			20	42								
4.5	1993					7.671	8.6			19	42	37.5	60
4.5	1993					7.298	8.6			23	42		
4.5	1993					7.464	8.6			27	42		
4.5	1996					5.831	8.6			30	42		
4.5	1996					6.64	8.6			29	42		
4.5	1996					5.099	8.6			17	42		
4.5	1996					8.193	8.6			38	42		

River Mile	Sample Year	ICI Score	HELP Ecoregion ICI Criteria	Lacustuary ICI Score*	HELP Ecoregion Lacustuary ICI Criteria*	Modified Index of Well Being Score	HELP Ecoregion Miwb Criteria	IBI Score	HELP Ecoregion IBI Criteria	Lacustuary IBI Score*	HELP Ecoregion Lacustuary IBI Criteria*	QHEI Score	HELP Ecoregion QHEI Criteria
Maumee River													
4.5	1996					6.019	8.6			23	42		
4.5	1996					6.93	8.6			20	42		
4.6	1993					8.064	8.6			30	42	42.5	60
4.6	1993					6.663	8.6			20	42		
4.6	1993					6.756	8.6			24	42		
4.7	1986					7.599	8.6			23	42	36	60
4.7	1986					7.523	8.6			25	42		
4.7	1986					6.61	8.6			32	42		
4.7	1986					7.252	8.6			27	42		
5.8	1993					7.504	8.6			23	42	59	60
5.8	1993					6.259	8.6			24	42		
5.8	1993					7.453	8.6			30	42		
5.8	1996					5.882	8.6			16	42		
5.8	1996					4.705	8.6			24	42		
5.8	1996					4.791	8.6			15	42		
5.8	1996					7.471	8.6			30	42		
5.8	1996					5.696	8.6			26	42		
5.8	1996					6.595	8.6			30	42		
7.2	1986			18									
7.3	1986			24		8.612	8.6			21	42	61	60
7.3	1986					7.056	8.6			22	42		
7.3	1986					6.519	8.6			25	42		
7.3	1986					7.264	8.6			18	42		
7.3	1986					7.279	8.6			27	42		
7.4	1986					7.997	8.6			23	42	58.5	60
7.4	1986					7.444	8.6			14	42		
7.4	1986					6.672	8.6			16	42		
7.4	1986					5.202	8.6			22	42		
7.4	1986					6.239	8.6			26	42		
7.4	1993					7.453	8.6			22	42	46	60
7.4	1993					6.261	8.6			20	42		
7.4	1993					7.752	8.6			22	42		
7.5	1993					6.346	8.6			21	42	59.5	60
7.5	1993					7.232	8.6			23	42		
7.5	1996					6.978	8.6			21	42		
7.5	1996					5.53	8.6			19	42		
7.5	1996					6.781	8.6			18	42		
7.5	1996					7.05	8.6			21	42		
7.5	1996					6.471	8.6			22	42		
7.5	1996					5.656	8.6			22	42		
8.8	1986			24	42								
9.4	1986					7.206	8.6			22	42	61	60
9.4	1986					6.189	8.6			16	42		

River Mile	Sample Year	ICI Score	HELP Ecoregion ICI Criteria	Lacustuary ICI Score*	HELP Ecoregion Lacustuary ICI Criteria*	Modified Index of Well Being Score	HELP Ecoregion Miwb Criteria	IBI Score	HELP Ecoregion IBI Criteria	Lacustuary IBI Score*	HELP Ecoregion Lacustuary IBI Criteria*	QHEI Score	HELP Ecoregion QHEI Criteria
Maumee River													
9.4	1986					6.471	8.6			13	42		
9.4	1986					8.072	8.6			32	42		
9.4	1993					5.983	8.6			22	42	54	60
9.4	1993					7.223	8.6			20	42		
12	1996					5.374	8.6			21	42		
12	1996					6.758	8.6			22	42		
12	1996					6.764	8.6			25	42		
12	1996					8.187	8.6			29	42		
12	1996					5.933	8.6			28	42		
12	1996					7.481	8.6			27	42		
13.3	1986			22	42								
13.6	1986			26	42								
13.7	1986					7.124	8.6			28	42	47	60
13.7	1986					6.674	8.6			21	42		
13.7	1986					7.484	8.6			21	42		
13.7	1993					7.976	8.6			29	42	58.5	60
13.7	1993					8.162	8.6			31	42		
13.7	1993					7.054	8.6			28	42		
14.1	1986					8.963	8.6			38	42	45	60
14.1	1986					7.315	8.6			25	42		
14.1	1986					7.641	8.6			26	42		
14.2	1986					7.066	8.6			21	42		
14.7	1993					8.297	8.6			27	42	50.5	60
14.7	1993					7.586	8.6			32	42		
14.7	1993					8.128	8.6			29	42		
14.8	1986					7.588	8.6			28	42	64	60
14.8	1986					7.802	8.6			30	42		
14.8	1986					8.259	8.6			24	42		
15	1986			30	34								
16	1986					6.467	8.6	34	34				
17.2	1986					8.786	8.6	28	34			71.5	60
17.2	1986					7.461	8.6	28	34				
17.2	1997					8.858	8.6	38	34			77.5	60
17.2	1997					9.195	8.6	38	34				
17.9	1997	54											
18.3	1997	50											
19.1	1997					6.992	8.6	36	34			70.5	60
19.1	1997					9.131	8.6	46	34				
19.8	1986					8.263	8.6	24	34			78	60
19.8	1986					8.798	8.6	30	34				
Delaware Crk													
1	1993											39.5	60

** The double horizontal line represents the lacustuary divide of the Maumee River, although it is noted that lacustuary lengths are approximate and fluctuate with lake levels and wind direction.*[6]

Lower Maumee River Watershed DELT Data[7]

River Mile	Sample Year	Percent DELT Anomalies	Percent Deformities	Percent Eroded Fins	Percent Lesions	Percent Tumors	Relative Number of Fish Collected	Relative Number of Species Collected	Relative Number of Fish Minus Tolerants	Relative Weight of Fish Collected (in grams)
Maumee River										
0.6	1996	0	0	0	0	0	48	10	36	32.948
0.6	1996	0	0	0	0	0	34	10	28	10.318
0.6	1996	0	0	0	0	0	82	6	64	44.556
0.6	1996	0	0	0	0	0	696	12	670	66.23
0.6	1996	0	0	0	0	0	344	11	316	45.884
0.6	1996	0	0	0	0	0	258	14	250	22.457
0.7	1986	3.23	0	3.23	0	0	62	7	56	10.501
0.7	1986	1.94	0	0	1.94	0	118	10	96	31.241
0.7	1986	0	0	0	0	0	1172	5	1156	42.316
0.7	1993	7.5	0	5.08	2.42	0	1102	11	1016	216.724
0.7	1993	0.11	0	0	0.11	0	1790	11	1758	68.339
0.7	1993	1.29	0	0.94	0.09	0.13	2290	18	2232	124.933
0.7	1996	0	0	0	0	0	20	4	12	23.468
0.7	1996	0	0	0	0	0	92	8	70	88.168
0.7	1996	0	0	0	0	0	628	13	590	85.751
0.7	1996	0	0	0	0	0	594	10	576	70.49
0.7	1996	0	0	0	0	0	1782	14	1734	114.193
1.4	1986	0	0	0	0	0	71.72	7	67.38	16.373
1.4	1986	0	0	0	0	0	108	11	94	16.372
1.4	1986	0	0	0	0	0	364	6	360	13.057
1.4	1993	0.42	0	0.42	0	0	2365	4	2310	99.429
1.4	1993	5.58	0	3.14	1.05	0	956.55	12	873.24	122.691
1.5	1986	0	0	0	0	0	144	7	124	23.504
1.5	1986	0	0	0	0	0	370	13	336	45.35
1.5	1993	4.8	0	2.99	1.81	0	650	21	542	202.856
1.5	1993	3.5	0	2.26	1.24	0	1688	25	1592	158.626
1.5	1993	3.41	0	2.15	0.18	1.07	2204	26	2024	344.425
1.5	1996	0	0	0	0	0	22	4	16	24.018
1.5	1996	0	0	0	0	0	78	11	58	86.97
1.5	1996	0	0	0	0	0	156	5	138	91.852
1.5	1996	0	0	0	0	0	1098	20	1072	82.694
1.5	1996	0	0	0	0	0	132	7	116	39.914
1.5	1996	0	0	0	0	0	312	17	288	96.659
1.6	1998	2.38	0	0	2.38	0	93.31	12	77.76	37.862
1.6	1998	0.3	0.3	0	0	0	746.58	8	733.25	52.88
2.1	1998	5.56	1.85	0	3.7	0	108	11	102	27.823
2.1	1998	0.91	0.91	0	0	0	658	15	652	35.349
2.6	1998	3.33	0	3.33	0	0	60	9	44	50.947
2.6	1998	0.34	0.17	0.17	0	0	1168	11	1150	74.01
3.1	1993	5.35	0	4.27	1.08	0	542	10	486	133.001
3.1	1993	0	0	0	0	0	1364	10	1346	66.048
3.1	1993	5.04	0	0.34	3.7	1.01	1348	17	1276	179.347

River Mile	Sample Year	Percent DELT Anomalies	Percent Deformities	Percent Eroded Fins	Percent Lesions	Percent Tumors	Relative Number of Fish Collected	Relative Number of Species Collected	Relative Number of Fish Minus Tolerants	Relative Weight of Fish Collected (in grams)
Maumee River										
3.1	1996	0	0	0	0	0	26	5	20	33.432
3.1	1996	0	0	0	0	0	24	4	10	23.156
3.1	1996	0	0	0	0	0	278	7	248	82.282
3.1	1996	0	0	0	0	0	694	14	688	23.078
3.1	1996	0	0	0	0	0	292	8	274	44.246
3.1	1996	0	0	0	0	0	206	13	198	20.288
3.3	1986	2.82	1.41	0	1.41	0	142	13	104	17.25
3.3	1986	1.41	0	0	1.41	0	142	7	128	23.977
3.3	1986	3.92	0	0	3.92	0	102	9	70	31.314
3.3	1986	0	0	0	0	0	616	9	604	25.273
3.3	1996	0	0	0	0	0	116	9	98	47.142
3.3	1996	0	0	0	0	0	232	17	212	51.68
3.3	1996	0	0	0	0	0	1998	18	1962	92.163
3.3	1996	0	0	0	0	0	262	11	228	72.102
3.3	1996	0	0	0	0	0	176	12	154	17.578
3.6	1986	10.27	0	0	10.27	0	146	10	126	36.449
3.6	1986	2.38	0	0	2.38	0	84	8	68	28.888
3.6	1986	5.26	0	1.75	3.51	0	114	7	108	7.022
3.6	1986	0.34	0	0	0.34	0	590	11	574	30.296
4.5	1993	17.43	0	14.43	3	0	280	15	206	106.233
4.5	1993	0.74	0	0.65	0.08	0	2404	13	2356	78.884
4.5	1993	2.85	0	0.29	1.43	1.14	1450	17	1368	131.87
4.5	1996	0	0	0	0	0	30	7	28	8.44
4.5	1996	0	0	0	0	0	54	8	46	19.478
4.5	1996	0	0	0	0	0	88	5	72	38.09
4.5	1996	0	0	0	0	0	620	18	582	122.915
4.5	1996	0	0	0	0	0	224	11	194	56.988
4.5	1996	0	0	0	0	0	104	8	78	118.76
4.6	1993	4.07	0.81	1.63	0.81	0	246	16	204	83.819
4.6	1993	0.31	0	0	0.31	0	1294	9	1290	19.376
4.6	1993	0.78	0	0.41	0.37	0	2438	15	2396	108.855
4.7	1986	5.13	0	1.28	3.85	0	156	13	118	23.922
4.7	1986	0	0	0	0	0	104	11	76	21.19
4.7	1986	0	0	0	0	0	1012	9	990	18.025
4.7	1986	0	0	0	0	0	1156.56	9	1143.23	23.839
5.8	1993	6.29	0.63	2.52	2.52	0	318	15	288	50.118
5.8	1993	0.5	0	0	0.5	0	806	9	788	25.019
5.8	1993	0.55	0.11	0	0.22	0	2042	16	2020	51.105
5.8	1996	0	0	0	0	0	20	5	16	27.586
5.8	1996	0	0	0	0	0	38	9	28	19.354
5.8	1996	0	0	0	0	0	50	5	34	21.732
5.8	1996	0	0	0	0	0	422	15	410	61.817
5.8	1996	0	0	0	0	0	366	10	326	94.861

River Mile	Sample Year	Percent DELT Anomalies	Percent Deformities	Percent Eroded Fins	Percent Lesions	Percent Tumors	Relative Number of Fish Collected	Relative Number of Species Collected	Relative Number of Fish Minus Tolerants	Relative Weight of Fish Collected (in grams)
Maumee River										
5.8	1996	0	0	0	0	0	168	16	142	48.43
7.3	1986	4.47	1.71	1.2	1.55	0	576	16	484	232.65
7.3	1986	0.4	0	0.4	0	0	498	11	468	180.528
7.3	1986	0	0	0	0	0	84	11	58	28.143
7.3	1986	2.49	1.11	0	1.38	0	434	12	380	93.398
7.3	1986	0.29	0	0	0.29	0	692	13	666	29.958
7.4	1986	7.2	2.35	0	4.85	0	176	14	140	68.825
7.4	1986	6.78	0	0	6.78	0	118	10	88	28.568
7.4	1986	5.68	1.14	2.27	2.27	0	176	11	142	13.884
7.4	1986	0	0	0	0	0	402	7	384	25.739
7.4	1986	0	0	0	0	0	580	10	572	4.638
7.4	1993	1.82	0	0.4	1.42	0	988	11	960	64.766
7.4	1993	0.11	0	0	0.11	0	1828	8	1824	19.474
7.4	1993	0.12	0	0.04	0	0.04	5144	10	5140	55.323
7.5	1993	10.03	0	1.04	8.65	0	578	11	520	83.108
7.5	1993	7.92	1.32	0.32	6.29	0	632	20	488	230.818
7.5	1996	0	0	0	0	0	48	7	40	41.13
7.5	1996	0	0	0	0	0	52	6	34	17.454
7.5	1996	0	0	0	0	0	120	7	100	51.132
7.5	1996	0	0	0	0	0	376	11	318	99.886
7.5	1996	0	0	0	0	0	182	10	154	57.556
7.5	1996	0	0	0	0	0	118	11	96	41.364
9.4	1986	2.5	0	0	2.5	0	160	16	118	47.678
9.4	1986	2.27	0	0	2.27	0	88	10	62	22.318
9.4	1986	11.11	0	2.22	8.89	0	90	9	70	18.616
9.4	1986	0	0	0	0	0	374	17	348	18.217
9.4	1993	6.2	0	2.89	3.31	0	484	11	446	29.721
9.4	1993	0.16	0	0.08	0.08	0	2488	9	2460	52.075
12	1996	0	0	0	0	0	36	6	28	4.678
12	1996	0	0	0	0	0	104	11	68	37.08
12	1996	0	0	0	0	0	310	10	304	38.851
12	1996	0	0	0	0	0	1190	14	1166	70.114
12	1996	0	0	0	0	0	492	9	466	57.187
12	1996	0	0	0	0	0	768	12	750	48.176
13.7	1986	4.46	0	0	4.46	0	262	12	250	62.604
13.7	1986	0	0	0	0	0	92	10	78	13.636
13.7	1986	1.35	0	0.68	0.68	0	296	11	272	19.538
13.7	1993	10.73	0.43	5.75	4.55	0	488	20	284	137.914
13.7	1993	0.88	0	0.48	0.4	0	1502	18	1404	98.175
13.7	1993	0.77	0.17	0.17	0.43	0	1556	18	1494	118.42
14.1	1986	1.41	0	0	1.41	0	142	22	116	39.856
14.1	1986	0	0	0	0	0	114	15	52	14.988
14.1	1986	1.46	0.49	0	0.98	0	410	15	372	33.646

River Mile	Sample Year	Percent DELT Anomalies	Percent Deformities	Percent Eroded Fins	Percent Lesions	Percent Tumors	Relative Number of Fish Collected	Relative Number of Species Collected	Relative Number of Fish Minus Tolerants	Relative Weight of Fish Collected (in grams)
Maumee River										
14.2	1986	0	0	0	0	0	68	6	60	80.268
14.7	1993	8.6	0.41	3.3	4.49	0	490	19	370	89.089
14.7	1993	1.29	0	0.39	0.9	0	886	21	778	91.922
14.7	1993	2.6	0	0.95	1.45	0.2	992	17	878	66.428
14.8	1986	1.16	0	0.39	0.77	0	507.89	16	466.71	193.486
14.8	1986	0.83	0	0	0	0.83	237.25	16	149.01	21.117
14.8	1986	1.61	0	0	1.61	0	625.55	16	556.92	46.345
16	1986	0	0	0	0	0	141.24	14	90.04	5.208
17.2	1986	6.75	0.65	4.79	1.31	0	306	19	210	51.02
17.2	1986	0	0	0	0	0	6020	11	5974	107.847
17.2	1997	1.96	0.98	0.98	0	0	204	14	184	95.6
17.2	1997	1.16	0	0.58	0.58	0	344	17	330	99.081
19.1	1997	3.57	0	3.57	0	0	112	8	106	39.65
19.1	1997	0.43	0	0.43	0	0	466	14	458	115.431
19.8	1986	4.5368	1.03	0	3.51	0	215.5	12	193.28	44.714
19.8	1986	1.5617	0.98	0	0.58	0	1016	18	896.01	213.422

**The double horizontal line represents the lacustuary divide of the Maumee River, although it is noted that lacustuary lengths are approximate and fluctuate with lake levels and wind direction.*[8]

Maumee River Assessment[9]

Assessment Unit Description			**Watershed Size (sq. mi.)**
Maumee River Mainstem (Indiana border to Lake Erie)			6,586
Aquatic Life Use Assessment			
Sampling Year(s) 1992, 1993, 1996, 1997	AU Total Length (miles):		107.87
	AU Monitored Miles		94.35
Aquatic Life Use(s): WWH (Warmwater Habitat)	# Sites Sampled:		51
	# Miles Full Attainment:		44.00
Impairment? Yes	# Miles Partial Attainment:		13.15
	# Miles Non-Attainment:		37.20
	% Attainment (Monitored Miles)		
	Full	Partial	Non
Large River AU Attainment Status:	46.7%	13.9%	39.4%
High Magnitude Causes:	High Magnitude Sources:		
Flow Alteration	Nonirrigated Crop Production		
Other Habitat Alterations	Channelization - Agriculture		
Turbidity	Combined Sewer Overflow		
Nutrients	Major Municipal Point Source		
Unionized Ammonia			
Siltation			
Total Toxics			

Duck Creek is 3.27 miles long and begins at Hecklinger Pond in East Toledo. It flows northeasterly back and forth over the Toledo/Oregon city limits. Duck Creek is the last stream to join with the Maumee River (RM 0.25) before it enters Maumee Bay. This watershed has limited residential areas near the headwaters. However, most of it is in commercial or industrial use, including rail yards and the Toledo/Lucas County Port Authority docks.

Duck Creek Watershed Use Attainment Data[10]

River Mile	Sample Year	ICI Score	HELP Ecoregion ICI Criteria	Lacustuary ICI Score*	HELP Ecoregion Lacustuary ICI Criteria*	Modified Index of Well Being Score	HELP Ecoregion Miwb Criteria	IBI Score	HELP Ecoregion IBI Criteria	Lacustuary IBI Score*	HELP Ecoregion Lacustuary IBI Criteria*	QHEI Score	HELP Ecoregion QHEI Criteria
0.3	1993					5.703	8.6			23	42		
0.4	1986			22	42								
0.4	1993					4.481	8.6			17	42	13	60
0.5	1986					4.975	8.6			19	42		
0.5	1986					6.67	8.6			22	42		
0.5	1986					5.958	8.6			24	42		
0.5	1993			16	42								
1.4	1993			10	42	6.288	7.3			21	42	18	60
1.4	1993					9.364	7.3			37	42		
1.4	1997			18	42	5.508	7.3			38	42	30.5	60
1.6	1997			20	42	5.698	7.3			34	42	31	60
2.1	1986	10	34			0.767	7.3	16	32				
2.1	1986					3.123	7.3	16	32				
2.1	1986					0	7.3	12	32				
2.1	1993	8	34			6.063	7.3	20	32			20	60
2.1	1997					3.305	7.3	18	32			23	60
2.8	1993					3.858	7.3	20	32			13.5	60
2.9	1993	8	34										
3	1986	2	34			0.263	7.3	18	32				
3	1986					2.746	7.3	22	32				
3	1986					1.469	7.3	18	32				

** The double horizontal line represents the lacustuary divide of Duck Creek, although it is noted that lacustuary lengths are approximate and fluctuate with lake levels and wind direction.*[11]

Duck Creek Watershed DELT Data[12]

River Mile	Sample Year	Percent DELT Anomalies	Percent Deformities	Percent Eroded Fins	Percent Lesions	Percent Tumors	Relative Number of Fish Collected	Relative Number of Species Collected	Relative Number of Fish Minus Tolerants	Relative Weight of Fish Collected (in grams)
0.3	1993	0	0	0	0	0	1293.19	8	1289.86	13.679
0.4	1993	25	0	25	0	0	24	6	14	6.122
0.5	1986	4	0	4	0	0	50	8	16	5.03
0.5	1986	2.3256	0	0	2.33	0	86	13	50	16.156
0.5	1986	0	0	0	0	0	344	11	280	35.065
1.4	1993	0.9132	0	0.91	0	0	1095	11	615	4.837
1.4	1993	1.5106	0	0.15	1.36	0	3310	17	1670	30.456

River Mile	Sample Year	Percent DELT Anomalies	Percent Deformities	Percent Eroded Fins	Percent Lesions	Percent Tumors	Relative Number of Fish Collected	Relative Number of Species Collected	Relative Number of Fish Minus Tolerants	Relative Weight of Fish Collected (in grams)
1.4	1997	0.7895	0	0	0	0	2111.28	17	1689.03	0
1.6	1997	0.3086	0	0	0	0	3600.29	15	1205.65	0
2.1	1986	0	0	0	0	0	234.39	4	0	0.547
2.1	1986	0.1517	0.15	0	0	0	988.5	9	30	3.197
2.1	1986	0	0	0	0	0	0	0	0	0
2.1	1993	1.282	0	1.28	0	0	739.01	13	113.71	4.703
2.1	1997	0	0	0	0	0	127.53	7	106.88	0
2.8	1993	1.1765	0	1.18	0	0	1417.5	3	171	1.113
3	1986	0	0	0	0	0	254	2	0	0.599
3	1986	0	0	0	0	0	305	4	15	0.814
3	1986	0	0	0	0	0	208	2	6	0.23

** The double horizontal line represents the lacustuary divide of Duck Creek, although it is noted that lacustuary lengths are approximate and fluctuate with lake levels and wind direction.*[13]

Grassy Creek is one of the tributaries that joins the Maumee River within the Maumee AOC and is included in this HUC. Grassy Creek combined with the Grassy Creek Diversion have a drainage basin of 38.6 square miles.[14] Grassy Creek flows parallel to the Maumee River starting in Perrysburg and flowing toward Rossford where it joins with the Maumee River at RM 9.2.

Grassy Creek Watershed Use Attainment Data[15]

River Mile	Sample Year	ICI Score	HELP Ecoregion ICI Criteria	Lacustuary ICI Score*	HELP Ecoregion Lacustuary ICI Criteria*	Modified Index of Well Being Score	HELP Ecoregion Miwb Criteria	IBI Score	HELP Ecoregion IBI Criteria	Lacustuary IBI Score*	HELP Ecoregion Lacustuary IBI Criteria*	QHEI Score	HELP Ecoregion QHEI Criteria
0.7	1993											55.5	60
1	1993											47	60
2.2	1993											59.5	60
2.9	1993											68.5	60
2.9	1993					6.919	7.3	38	32				
2.9	1993					7.462	7.3	26	32				
3.9	1993											63	60
4.9	1993											65	60
4.9	1993					5.548	7.3	20	32				
6.2	1993											57.5	60

Grassy Creek Watershed DELT Data[16]

River Mile	Sample Year	Percent DELT Anomalies	Percent Deformities	Percent Eroded Fins	Percent Lesions	Percent Tumors	Relative Number of Fish Collected	Relative Number of Species Collected	Relative Number of Fish Minus Tolerants	Relative Weight of Fish Collected (in grams)
2.9	1993	0	0	0	0	0	404.25	15	216.33	5.911
2.9	1993	2	0	1.14	0.29	0	525	14	196.5	14.016
4.9	1993	0	0	0	0	0	604.5	10	160.5	7.529

Maumee River Watershed
Causes and Sources of Impairments [17]

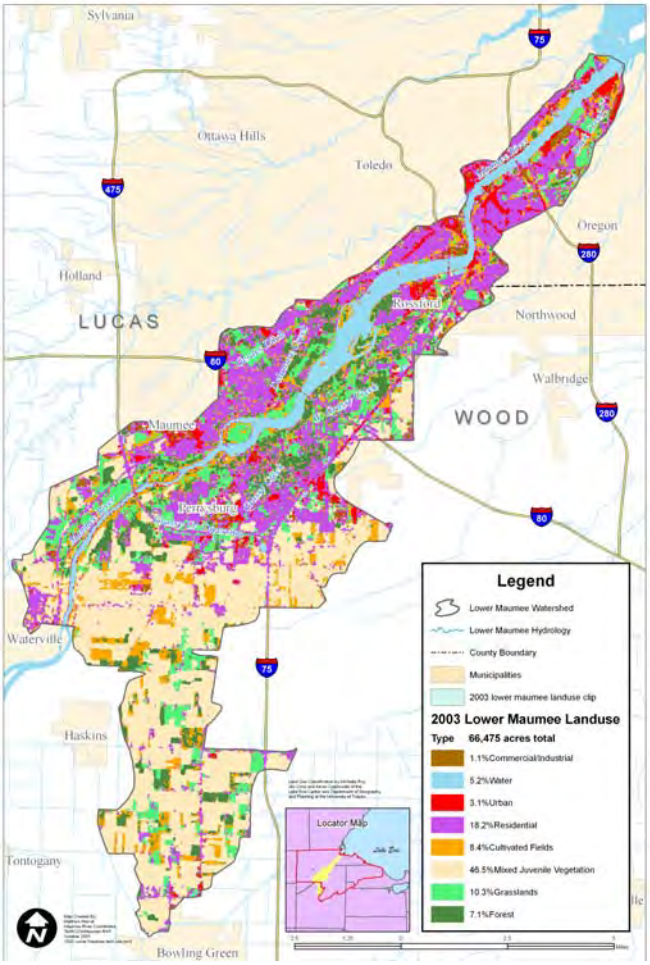
Segment	Miles Assessed & Aquatic Life Use Designation[#]	Causes of Impairment*	Sources of Impairment*	Comments
Maumee River (Waterville to Swan Creek)	15.46 (RM 5.22-20.68) WWH	Other habitat alterations-H Siltation-H Pesticides-M Priority organics-M Metals-M Nutrients-M Total toxics-M	CSOs-H Agriculture-M Other urban runoff-M Hydromodification-M	305(b)-1996: Data in this table 305(b)-2000: No data, just these comments - River flows down the BG escarpment in this reach; wide shallow limestone base w/ aquatic community influenced downstream by Lake Erie and upstream by ag drainage; water is turbid year round, Lucas Co WWTP is a source of ammonia
Maumee River (Swan Creek to Lake Erie)	15.46 (RM 0-5.22) WWH	Total toxics-H Pesticides-M Priority organics-M Metals-M Nutrients-M Siltation-M	Major municipal point source-H CSOs-H Agriculture-H Other urban runoff-M Removal of riparian vegetation-M Streambank modification/ destabilization-M Drainage/filling of wetlands-M Spills-M	305(b)-1996: Data in this table
Duck Creek	3.56 (RM 0-3.56) WWH	Other habitat alterations-H Pesticides-M Priority organics-M Metals-M Siltation-M Salinity /TDS /chlorides-M Flow alteration-M Oil and grease-M	Other urban runoff-M Sludge-S Channelization-H Removal of riparian vegetation-M Streambank modification/ Destabilization-H Spills-M Contaminated sediments-M	305(b)-1996: Data in this table
Grassy Creek	5.5 (RM 0-5.5) WWH	Other habitat alterations-H Pesticides-M Metals-M Nutrients-M Priority organics-M Siltation-M Organic enrichment /DO-S	Habitat Modifications o/than Hydromod.-H Land development/ Suburbanization-M Other urban runoff-M Onsite wastewater systems (septic tanks)-S	305(b)-2000: PCBs and pesticides were found in fish tissue samples probably from urban runoff & spills; generally a good stream; could improve if urban problems remedied; descent riparian was present in many places.

**Magnitude of that cause or source of impairment: H=high, M=moderate, S=slight, T=identifies a threat*
[#]Aquatic Life Use Designation: WWH=Warm Water Habitat, MWH=Modified Warm Water Habitat, LRW=Limited Resource Water

Land Use of the
Lower Maumee River Watershed

In 2003 land use classifications produced by The University of Toledo for the Lower Maumee River watershed showed 47 percent of the land used by mixed juvenile vegetation. This vegetation type can be row crops in an early stage of growth, tracts of open space or yards. Forest and grassland account for 7 percent and 10 percent respectively, and 8 percent is in cultivated fields. Approximately 18 percent of the watershed has been developed for residential use, 3 percent for urban uses, and 1 percent for commercial/industrial uses.

2003 Land Use in the Lower Maumee River Watershed



Status of Beneficial Use Impairments

When the Maumee Area of Concern was defined in the late 1980s, the Maumee RAP Public Advisory Council determined which beneficial uses were impaired based on the entire AOC. This was done because the only way of delisting an AOC was a comprehensive one; all listed or all delisted. Now that there are alternative methods for incrementally delisting an AOC by watershed or impairment, the Maumee RAP needed to determine the BUIs by watershed. This was done using data and resources that were available before 1990. The two tables below summarize the BUIs impacting the Maumee River Watershed in 1990 and 2004.

Following the BUI Summary Tables are maps of this watershed, including the jurisdictions, 14-digit HUCs, and custom-digitized river mile maps made specifically for the Maumee AOC watersheds.

The heart of this plan, the Watershed Project Tables (WPTs), is found in Volume 2. As explained in the Introduction, the WPTs are the living portion of the report that will change and grow, as projects are implemented and goals are attained. These tables have been organized by Causes and Sources and include Projects, Potential Project Partners, Funding Sources, Timeline, Status, Performance/ Environmental Measures, HUC/Stream Segment Addressed, and indicate the Beneficial Use Impairment (BUI) that could be effected by the project. Also incorporated into the table (where applicable) is a reference to the ODNR Coastal Management Measures that may benefit from the implementation of an identified project.

There are differing levels of detail in the WPTs, often depending on how soon a project will be implemented, what source will be funding it, or by the amount of data available for that watershed. The status of projects in the WPTs has been organized and color-coded as follows: **In Progress**, **Planning**, **Concept**, **Ongoing**, and **Complete.**

Beneficial Use Impairments In 1990
for the Lower Maumee River (Waterville to mouth)

(as determined in 2002)

Beneficial Use Impairments	Maumee River	Grassy Creek	Duck Creek	Reasons/Data Source
BUI 1: Restriction on fish and wildlife consumption			Impaired	Duck - ODH data re: LE and MR
BUI 2: Tainting of fish & wildlife flavor				
BUI 3: Degradation on fish and wildlife populations			Impaired	Duck - OEPA data, historical data
BUI 4: Fish tumors or other deformities			Impaired	Duck - OEPA data but have Phyllis review/confirm
BUI 5: Bird or animal deformities or reproductive problems				
BUI 6: Degradation of benthos			Impaired	Duck - OEPA data
BUI 7: Restriction on dredging activities			Not applicable	Duck -? Needs clarification?
BUI 8: Eutrophication or undesirable algae			N/A or Not Impaired	Duck - No info
BUI 9: Restrictions on drinking water consumption, or taste and odor			Not applicable	Duck - BPJ
BUI 10: Beach closings			Not applicable	Duck - No designated beaches present in subwatersheds
BUI 11: Degradation of aesthetics			Impaired	Duck - BPJ
BUI 12: Added cost to agriculture and industry				
BUI 13: Degradation of phytoplankton & zooplankton populations				
BUI 14: Loss of fish and wildlife habitat			Impaired	Duck - Historical info, photos, and BPJ

Possible answers – Impaired, Not Impaired, Unknown, Not Applicable

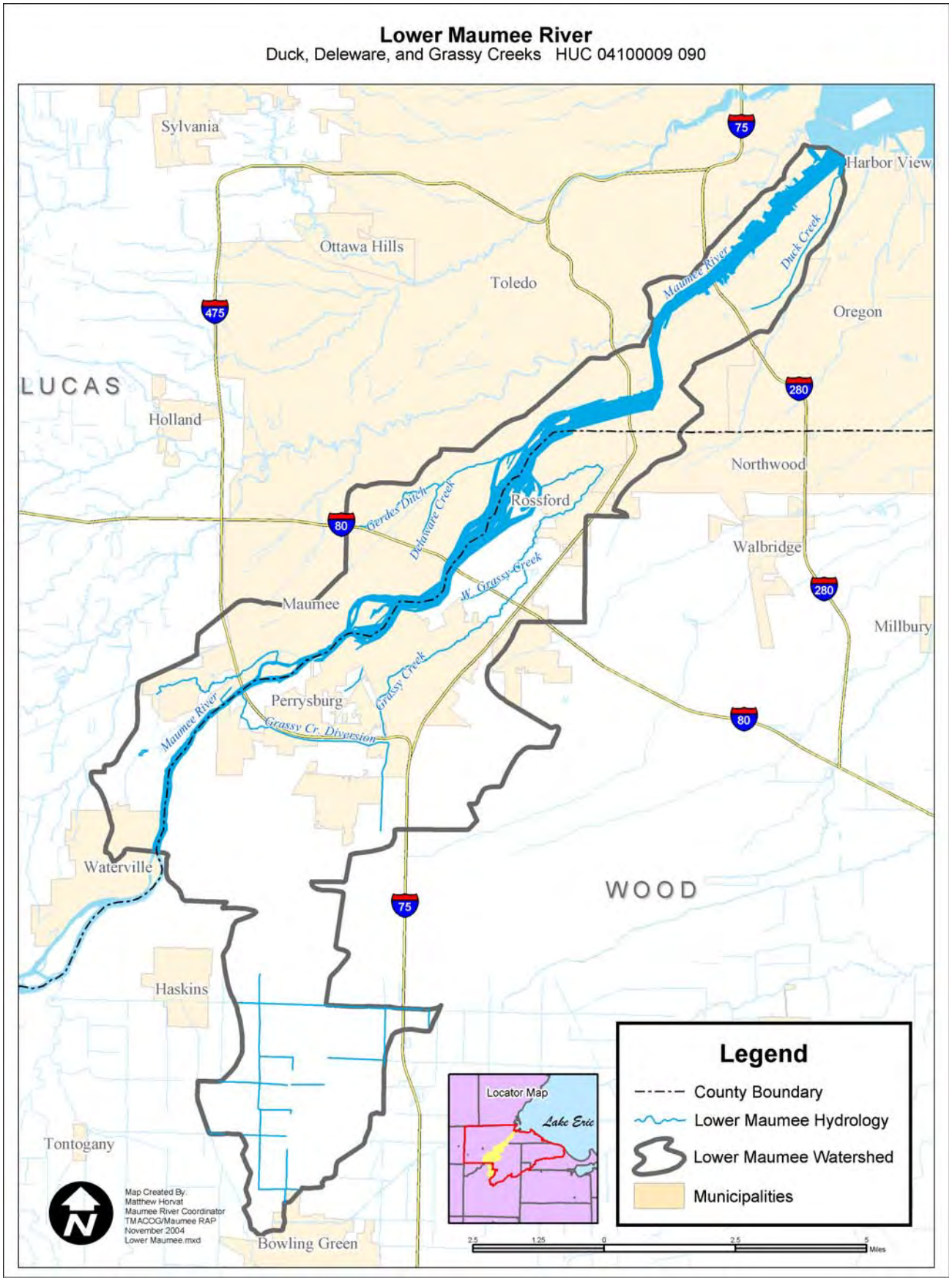
Beneficial Use Impairments In 2005
for the Lower Maumee River (Waterville to mouth)

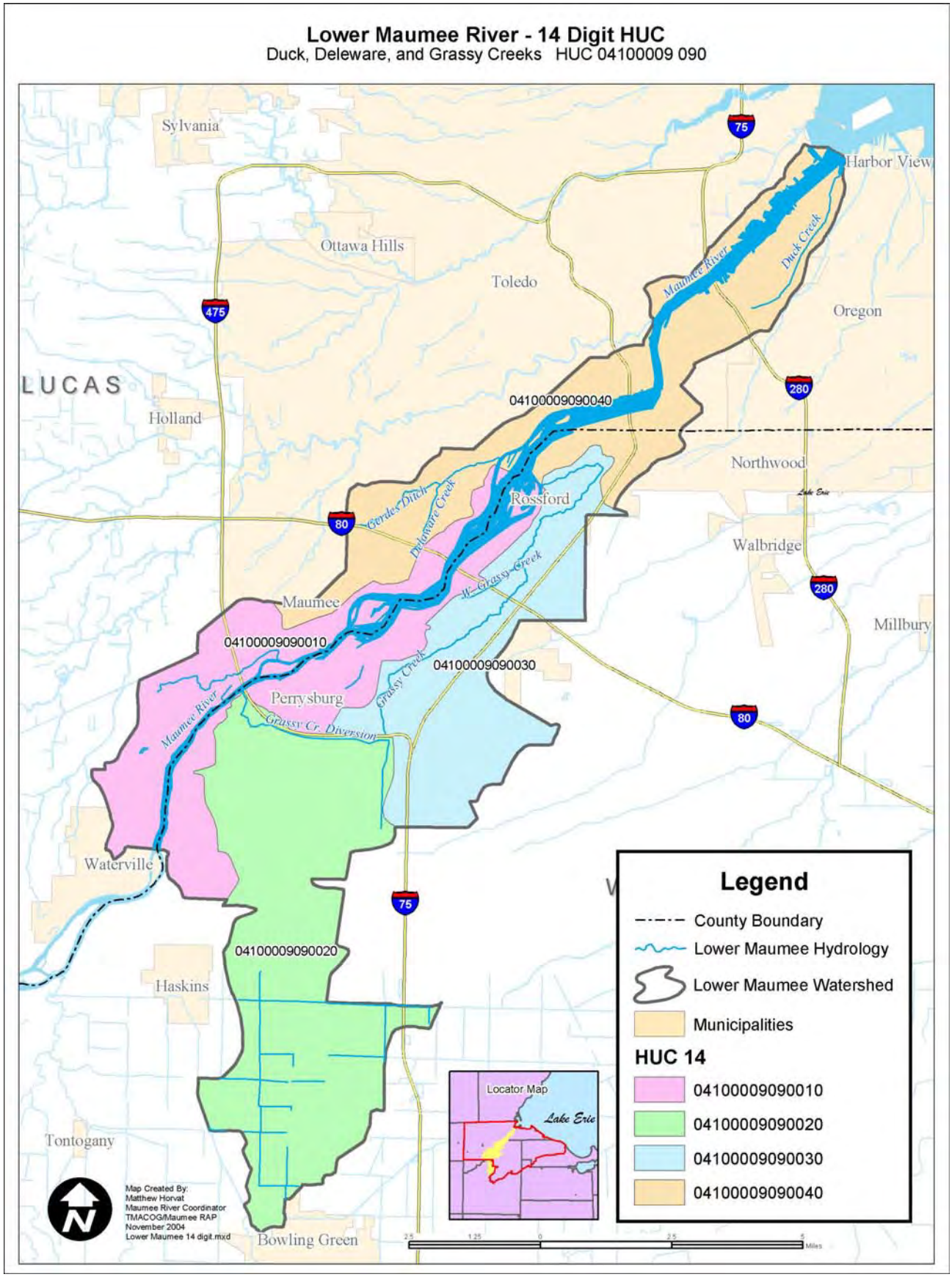
(last updated 11/5/05)

Beneficial Use Impairments	Maumee River	Grassy Creek	Duck Creek	Reasons/Data Source
BUI 1: Restriction on fish and wildlife consumption	Impaired	Not Impaired	Impaired	**Duck**: If health dept. LE-wide notices apply to creeks—no creek specific advisory **Maumee River:** Mouth to Waterville – Do not eat channel catfish (2005 fishing season advisory[18]). Statewide – No more than one fish per week due to mercury[19]. 2005 Ohio Snapping Turtle Consumption Advisory (mercury[20]). **Grassy Creek:** Ohio EPA DSW website does not list any impairments for the creek.
BUI 2: Tainting of fish & wildlife flavor	Unknown	Not Impaired	Unknown	**Maumee River & Duck and Grassy Creeks:** No known reports of tainting of fish and wildlife flavor; no known sources of phenols and related compounds.
BUI 3: Degradation on fish and wildlife populations	Impaired	Impaired	Impaired	**Maumee River:** In most cases, for ICI, Miwb, and IBI the Maumee River scores below the designated criteria. (See data table in Volume 1) **Grassy Creek:** 1993 data for RMs 2.9 (6.919 & 7.462) and 4.9 (5.548) fall below criteria. No ICI scores. 1993 data for RMs 2.9 is conflicting (38 & 26) and 4.9 (20) is below criteria. No data or determination of degradation of wildlife populations; Unknown **Duck**: OEPA 305b reports; data from Dennis Minshke
BUI 4: Fish tumors or other deformities	Impaired	Impaired	Impaired	**Duck**: OEPA DELT data- fish sampling in 1986, 1993, 1997 **Maumee River:** Data from 1986, 1993, 1996, 1997, and 1998 indicate that there are DELTS from RM 0.6 to RM 19.8. **Grassy Creek:** Data from 1993 are for RMs 2.9 and 4.9. Eroded fins and lesions recorded at RM 2.9.
BUI 5: Bird or animal deformities or reproductive problems	Unknown	Not impaired	Not Impaired	This BUI was not indicated for the Maumee AOC for its RAP designation.
BUI 6: Degradation of benthos	Impaired	Impaired	Impaired	**Maumee :** Average 1986 ICI score for RMs 0.8 - 15: 0. Average 1997 ICI score for RMs 17.9 to 18.3: 26. Average 1998 ICI score for RMs 1.6 & 2.6: 0. **Grassy:** No data available. BPJ assumes impaired **Duck**: OEPA 305b report data

Beneficial Use Impairments	Maumee River	Grassy Creek	Duck Creek	Reasons/Data Source
BUI 7: Restriction on dredging activities	Impaired	Not applicable	Not applicable	**Maumee River:** commercially navigable waterbody with dredging activities is the Maumee River. **Grassy & Duck Creek:** No navigational dredging occurs on Grassy Creek.
BUI 8: Eutrophication or undesirable algae	Unknown	Unknown	Unknown	**Maumee & Grassy:** Status of this BUI is unknown. No data available on dissolved oxygen or nuisance growths of algae. **Duck**: Occasionally; not toxic algae
BUI 9: Restrictions on drinking water consumption, or taste and odor	Not applicable	Not applicable	Not applicable	**Grassy & Duck**: Does not apply- no known drinking water supplies
BUI 10: Beach closings	Impaired	Impaired	Not Impaired	**Maumee River:** Local fishing spots along the river. Because work is scheduled on CSOs, BPJ would be to indicate impairment. ODH only has information on Lake Erie.[21] **Grassy Creek:** No information available on use of this creek. **Duck**: Review e.coli data; work w/Health Dept
BUI 11: Degradation of aesthetics	Impaired	Impaired	Impaired	**Maumee & Grassy:** Public health nuisances associated with raw or poorly treated sewage can be a problem in these streams due to number, density of units (homes), age, poor maintenance, and no monitoring of septic systems. **Duck**: Clean Your Streams day events, surveys of watershed during WIRP project and tours; past reports of sheens to OEPA and Coast Guard
BUI 12: Added cost to agriculture and industry	Unknown	Unknown	Not impaired	**Duck**: No known ag or industrial users present
BUI 13: Degradation of phytoplankton & zooplankton populations	Not applicable	Not applicable	Not applicable	Ohio EPA has determined that this BUI does not apply to these waters.
BUI 14: Loss of fish and wildlife habitat	Impaired	Impaired	Impaired	Ohio EPA QHEI scoring in 1986, 1993, 1997 & 1998 indicate that **Maumee** is impaired. Ohio EPA 1993 QHEI scoring indicate that **Grassy Creek** is slightly below the desired score.

Possible answers – Impaired, Not Impaired, Unknown, Not Applicable


Lower Maumee River
Duck, Deleware, and Grassy Creeks HUC 04100009 090
Sylvania
Harbor View
Ottawa Hills
Toledo
Oregon
LUCAS
Holland
Northwood
Rossford
Walbridge
Maumee
Millbury
Perrysburg
Waterville
WOOD
Haskins
Tontogany
Bowling Green
Maumee River
Duck Creek
Gerdes Ditch
Delaware Creek
W. Grassy Creek
Grassy Creek
Grassy Cr. Diversion
75
475
80
280
Legend
County Boundary
Lower Maumee Hydrology
Lower Maumee Watershed
Municipalities
Locator Map
Lake Erie
Map Created By:
Matthew Horvat
Maumee River Coordinator
TMACOG/Maumee RAP
November 2004
Lower Maumee.mxd
Miles


Lower Maumee River - 14 Digit HUC
Duck, Deleware, and Grassy Creeks HUC 04100009 090
Sylvania
Harbor View
Ottawa Hills
Toledo
Oregon
LUCAS
Holland
Northwood
Rossford
Walbridge
Maumee
Millbury
Perrysburg
Waterville
Haskins
Tontogany
Bowling Green
Maumee River
Duck Creek
Gerdes Ditch
Delaware Creek
W. Grassy Creek
Grassy Creek
Grassy Cr. Diversion
Lake Erie
04100009090040
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04100009090030
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75
475
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80
Locator Map
Legend
County Boundary
Lower Maumee Hydrology
Lower Maumee Watershed
Municipalities
HUC 14
04100009090010
04100009090020
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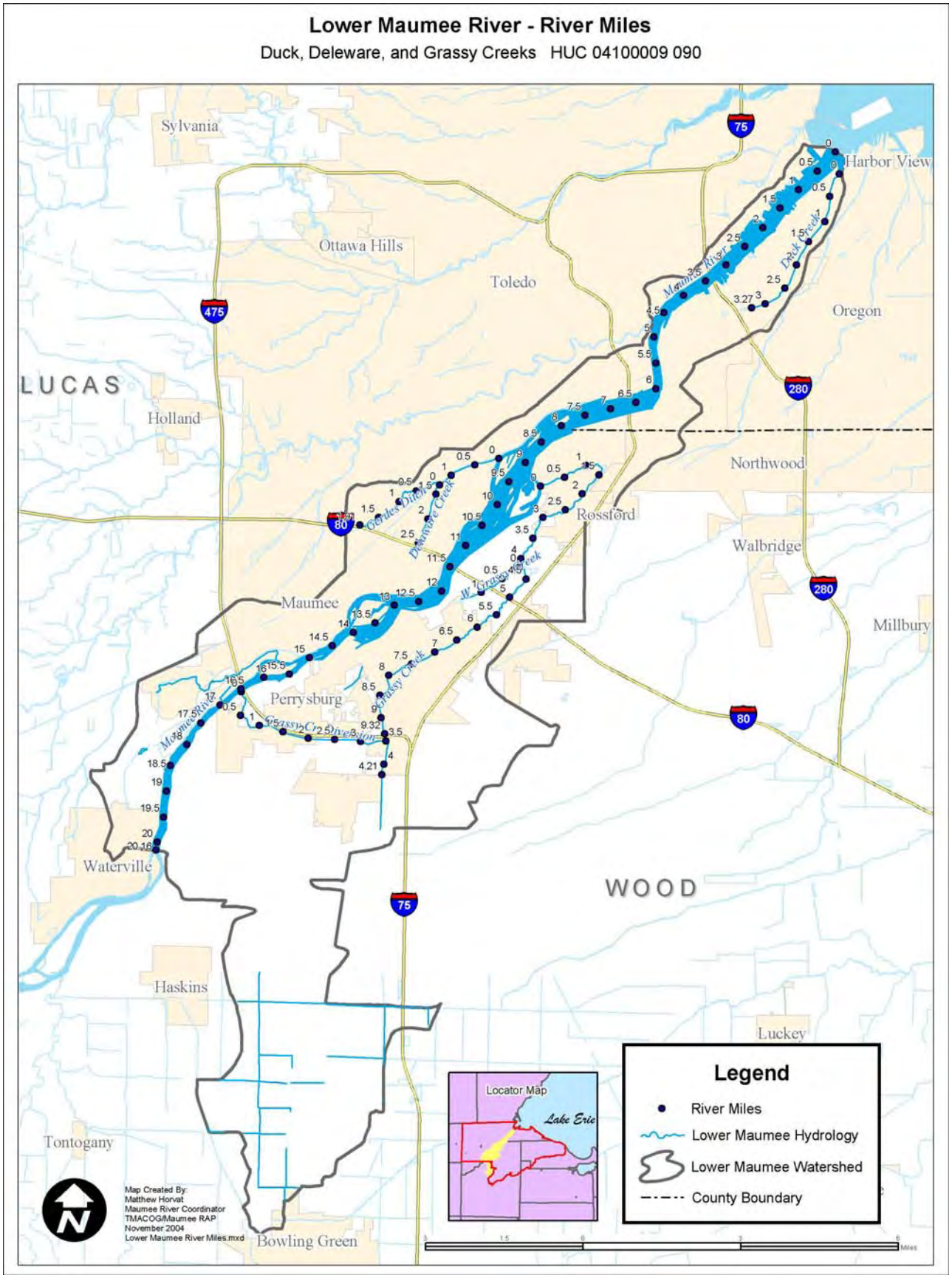
Matthew Horvat
Maumee River Coordinator
TMACOG/Maumee RAP
November 2004
Lower Maumee 14 digit.mxd
Miles


Lower Maumee River - River Miles
Duck, Deleware, and Grassy Creeks HUC 04100009 090
Sylvania
Ottawa Hills
Toledo
Harbor View
Oregon
LUCAS
Holland
Northwood
Rossford
Walbridge
Maumee
Millbury
Perrysburg
Waterville
WOOD
Haskins
Luckey
Tontogany
Bowling Green
Maumee River
Duck Creek
Grassy Creek
Delaware Creek
Legend
River Miles
Lower Maumee Hydrology
Lower Maumee Watershed
County Boundary
Locator Map
Lake Erie
Map Created By:
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TMACOG/Maumee RAP
November 2004
Lower Maumee River Miles.mxd

See Volume 2 for the:

- Maumee River Watershed Projects Table
- Grassy Creek Watershed Projects Table
- Duck Creek Watershed Projects Table

References

[1] *Maumee River Basin Area of Concern Remedial Action Plan Recommendations for Implementation Vol. 4*, TMACOG/Maumee RAP, July 1991. p 3-1.
[2] *Gazetter of Ohio Streams*, Ohio Department of Natural Resources, 1960.
[3] *A Study of Physical Features for the Toledo Regional Area*, Bowling Green State University Geology Department, Dr. Jane Forsyth, March 1968, pp 23-24.
[4] *A Study of Physical Features for the Toledo Regional Area*, Bowling Green State University Geology Department, Dr. Jane Forsyth, March 1968, pp 23-24.
[5] Ohio EPA, STORET Data, April 2004.
[6] *Delisting Targets for Ohio Areas of Concern*, Ohio EPA, June 2005.
[7] Ohio EPA, STORET Data, April 2004.
[8] *Delisting Targets for Ohio Areas of Concern*, Ohio EPA, June 2005.
[9] *Ohio 2002 Integrated Water Quality Monitoring and Assessment Report prepared to fulfill the requirements of Sections 305(b) and 303(d) of the Clean Water Act* Ohio EPA Division of Surface Water, October 2002; Table 1 and Appendix C.
[10] Ohio EPA, STORET Data, April 2004..
[11] *Delisting Targets for Ohio Areas of Concern*, Ohio EPA, June 2005.
[12] Ohio EPA, STORET Data, April 2004.
[13] *Delisting Targets for Ohio Areas of Concern*, Ohio EPA, June 2005.
[14] USDA Natural Resource Conservation Service website: http://www.oh.nrcs.usda.gov/technical/.
[15] Ohio EPA, STORET Data, April 2004.
[16] Ohio EPA, STORET Data, April 2004.
[17] *Ohio EPA 305b Report*, Ohio EPA, 1996 and 2000.

Watershed Projects Table Bibliography

Sediment Quality Assessment for Duck and Otter Creeks Toledo, Ohio; McLaren/Hart for Duck and Otter Creeks Stakeholders Partnership, March 31, 1999.
Screening Analysis Sediment Quality Assessment Study of the Maumee River Area of Concern, USEPA-GLNPO,1995-1996.
OEPA 305(b) Report, Ohio EPA, 1998.
[18] Ohio EPA web site: http://www.epa.state.oh.us/dsw/fishadvisory/2005%20fish%20advisory%20card.pdf
[19] Ohio EPA web site: http://www.epa.state.oh.us/dsw/fishadvisory/limitmeals.html#Grand
[20] Ohio EPA web site: http://www.epa.state.oh.us/dsw/fishadvisory/turtles.html
[21] Ohio Dept of Health web site: http://www.odh.ohio.gov/odhPrograms/eh/bbeach/beachmon.aspx

Lake Erie Tributary Watersheds

Volume 1

- Background & Water Quality Data for the Lake Erie Tributary Watersheds
- Land Use of the Lake Erie Tributary Watersheds
- Status of Beneficial Use Impairments
- Watershed Maps (General, 14-digit HUCs, River Mile)

Volume 2

- Otter Creek Watershed Projects Table
- Wolf Creek/Berger Ditch Watershed Projects Table
- Cedar Creek Watershed Projects Table
- Crane Creek Watershed Projects Table
- Turtle Creek Watershed Projects Table

Lake Erie Tributary Watersheds *(last updated 12/21/05)*

The Lake Erie Tributary Watersheds are Hydrologic Unit 04100010 010. This series of watersheds flows in a northeasterly direction directly to Maumee Bay or Lake Erie. Otter Creek is 7.98 miles long. It flows northeasterly from Northwood through Oregon and Toledo towards Maumee Bay. Otter Creek is the first stream after the Maumee River to discharge into the south side of Maumee Bay. An early 1800s map of the Maumee River shows that Otter Creek was once connected to Grassy Creek via a marshland, ten miles from Maumee Bay.[1]

Otter Creek Use Attainment Data[2]

River Mile	Sample Year	ICI Score	HELP Ecoregion ICI Criteria	Lacustuary ICI Score*	HELP Ecoregion Lacustuary ICI Criteria*	Modified Index of Well Being Score	HELP Ecoregion Miwb Criteria	IBI Score	HELP Ecoregion IBI Criteria	Lacustuary IBI Score*	HELP Ecoregion Lacustuary IBI Criteria*	QHEI Score	HELP Ecoregion QHEI Criteria
0.3	1986			6	42								
0.4	1993			28	42								
0.5	1986					1.322	8.6			4	42	37.5	60
0.5	1986									7	42		
0.5	1993					5.439	8.6			12	42	21.5	60
0.5	1993					4.255	8.6			12	42		
2	1986									13	42	24.5	60
2.1	1993	6	34			1.587	8.6	12	34			14.5	60
2.1	1993					5.816	8.6	22	34				
2.1	1997					4.725	8.6	36	34			38.5	60
2.2	1997					4.452	8.6	44	34			33	60
2.4	1997					4.533	8.6	34	34			35.5	60
3.1	1993					1.369	7.3	12	32			16	60
3.2	1993	6	34										
3.8	1993											25.5	60
4	1986							12	32			37.5	60
4	1986							12	32				
4	1986							12	32				
4.4	1993											33	60
4.6	1993	6	34										
4.7	1993					2.335	7.3	14	32			27.5	60
4.9	1993											34.5	60
5.6	1993											37.5	60
5.8	1986							12	32			35.5	60
5.8	1986							12	32				
5.8	1986							12	32				
5.9	1993	4	34			1.397	7.3	14	32			19	60
6	1993	2	34										
7.2	1986											19	60
7.2	1993	2	34									14	60
7.2	1993											27.5	60

** The double horizontal line represents the lacustuary divide of Otter Creek, although it is noted that lacustuary lengths are approximate and fluctuate with lake levels and wind direction.*[3]

Otter Creek DELT Data[4]

River Mile	Sample Year	Percent DELT Anomalies	Percent Deformities	Percent Eroded Fins	Percent Lesions	Percent Tumors	Relative Number of Fish Collected	Relative Number of Species Collected	Relative Number of Fish Minus Tolerants	Relative Weight of Fish Collected (in grams)
0.5	1986	50	0	50	0	0	4	1	0	0.722
0.5	1986	0	0	0	0	0	0	0	0	0
0.5	1986	0	0	0	0	0	2	0	0	0.44
0.5	1993	12	0	12	0	0	50	4	38	13.79
0.5	1993	2.8302	0	2.83	0	0	212	4	198	16.191
2	1986	0	0	0	0	0	0	0	0	0
2	1986	0	0	0	0	0	3.64	1	0	0.011
2	1986	0	0	0	0	0	0	0	0	0
2.1	1993	50.01	0	50.01	0	0	30	3	1.67	5.667
2.1	1993	17.7778	0	17.78	0	0	180	8	134	0.804
2.1	1997	0	0	0	0	0	1601.99	14	1520.31	0
2.2	1997	0.0997	0	0	0	0	1672.02	13	1580.33	0
2.4	1997	0.1894	0	0	0	0	990.03	12	930.02	0
3.1	1993	33.3333	0	33.33	0	0	13.5	2	0	0.092
4	1986	0	0	0	0	0	0	0	0	0
4	1986	0	0	0	0	0	0	0	0	0
4	1986	0	0	0	0	0	0	0	0	0
4.7	1993	100	0	95.65	0	0	34.5	4	0	0.519
5.8	1986	0	0	0	0	0	3	1	0	0.044
5.8	1986	0	0	0	0	0	2	1	0	0.002
5.8	1986	0	0	0	0	0	0	0	0	0
5.9	1993	29.4118	0	23.53	0	5.88	25.5	3	0	3.425
7.2	1986	0	0	0	0	0	4.5	1	0	0.008
7.2	1986	0	0	0	0	0	0	0	0	0
7.2	1986	0	0	0	0	0	3	1	0	0.012
7.2	1993	0	0	0	0	0	0	0	0	0

** The double horizontal line represents the lacustuary divide of Otter Creek, although it is noted that lacustuary lengths are approximate and fluctuate with lake levels and wind direction.*[5]

Wolf Creek is the watershed immediately east of Otter Creek with Cedar, Crane, and Turtle creeks following. Wolf Creek (a.k.a. Berger Ditch) has a drainage area of 15.9 square miles.[6] Wolf Creek also begins in Northwood flowing through Oregon where it joins with Berger Ditch, then emptying into Lake Erie at Maumee Bay State Park marina.

Wolf Creek Use Attainment Data[7]

River Mile	Sample Year	ICI Score	HELP Ecoregion ICI Criteria	Lacustuary ICI Score*	HELP Ecoregion Lacustuary ICI Criteria*	Modified Index of Well Being Score	HELP Ecoregion Miwb Criteria	IBI Score	HELP Ecoregion IBI Criteria	Lacustuary IBI Score*	HELP Ecoregion Lacustuary IBI Criteria*	QHEI Score	HELP Ecoregion QHEI Criteria
2.7	1993					4.767	7.3	24	32			15.5	60

Wolf Creek DELT Data[8]

River Mile	Sample Year	Percent DELT Anomalies	Percent Deformities	Percent Eroded Fins	Percent Lesions	Percent Tumors	Relative Number of Fish Collected	Relative Number of Species Collected	Relative Number of Fish Minus Tolerants	Relative Weight of Fish Collected (in grams)
2.7	1993	3.6585	0	3.66	0	0	123	10	63	14.548

Cedar, Crane, and Turtle creeks flow in a similar northeasterly direction and are each 20 to 25 miles in length. The headwaters of all of three of these watersheds are in Wood County. Each of these waterways flows through mostly agricultural lands and small villages, such as Walbridge, Millbury, and Clay Center.

The Cedar Creek drainage area when combined with Big Cooley Creek, and Reno Side Cut (a.k.a. Cooley Canal) is 58.3 square miles.[9] Cedar Creek is 23.39 miles long with an average fall of 0.9 feet per mile.[10] The two main tributaries to Cedar Creek are Little Cedar Creek and Dry Creek. Little Cedar Creek is 2.63 miles in length with an average fall is 3 feet per mile.[11] Dry Creek has an average fall of 3 feet per mile.[12] Wards Canal is located at the mouth of Cedar Creek. These two 14-digit HUCs include the Cedar Point National Wildlife Refuge, Metzger Marsh Boat Launch at Wards Canal, and Metzger Marsh State Wildlife Area. Nonpoint pollutants such as agricultural crop production, silviculture, and on-site waste treatment systems impact the Cedar Creek watershed.[13]

Cedar Creek Watershed Use Attainment Data[14]

River Mile	Sample Year	ICI Score	HELP Ecoregion ICI Criteria	Lacustuary ICI Score*	HELP Ecoregion Lacustuary ICI Criteria*	Modified Index of Well Being Score	HELP Ecoregion Miwb Criteria	IBI Score	HELP Ecoregion IBI Criteria	Lacustuary IBI Score*	HELP Ecoregion Lacustuary IBI Criteria*	QHEI Score	HELP Ecoregion QHEI Criteria
Cedar Creek													
6.5	1993	34	34										
6.6	1993					4.872	7.3	22	32			26.5	60
6.6	1993					5.836	7.3	22	32				
14.4	1993					5.517	7.3	20	32			23.5	60
14.5	1993	34	34										
15.5	1993	16	34			6.302	7.3	18	32			44.5	60
15.5	1993					4.98	7.3	18	32				
17.2	1993	12	34			5.638	7.3	20	32			18	60
18.3	1993	10	34										
18.5	1993					2.389	7.3	20	32			26.5	60
20.8	1986	34	34										
Dry Creek													
0.1	1993											40.5	60
2.2	1993											29	60
3	1993											45.5	60
4	1993											46	60
4.8	1993					1.436	7.3	18	32			20.5	60
4.8	1993					3.801	7.3	18	32				
7	1993					2.559	7.3	16	32			27	60
7.9	1993					2.633	7.3	20	32			21.5	60

Cedar Creek Watershed DELT Data[15]

River Mile	Sample Year	Percent DELT Anomalies	Percent Deformities	Percent Eroded Fins	Percent Lesions	Percent Tumors	Relative Number of Fish Collected	Relative Number of Species Collected	Relative Number of Fish Minus Tolerants	Relative Weight of Fish Collected (in grams)
Cedar Creek										
6.6	1993	1.2422	0.62	0.62	0	0	241.5	11	51	2.885
6.6	1993	1.2012	0	1.2	0	0	475.86	17	107.18	3.524
14.4	1993	0	0	0	0	0	904.5	9	127.5	3.127
15.5	1993	3.3842	0.31	3.08	0.31	0	609.45	16	153.79	32.068
15.5	1993	5.2205	0	4.82	0.4	0.4	439.52	14	65.33	22.328
17.2	1993	0.1212	0	0.12	0	0	1237.5	10	195	3.437
18.5	1993	0.2257	0	0	0	0	664.5	6	25.5	0
Dry Creek										
4.8	1993	10.5689	0	2.17	5.42	0	175.77	5	0	82.856
4.8	1993	10.0366	0	10.04	0.37	0	409.5	7	61.5	54.359
7	1993	1.6949	0	1.69	0	0	265.5	5	0	2.419
7.9	1993	0.2217	0	0.22	0	0	676.5	6	1.5	2.52

Crane Creek drainage area is 55.5 square miles[16] with an average fall is 1.9 feet per mile.[17] There are four tributaries to Crane Creek including, Ayers Creek, Little Crane Creek, Henry Creek, with the latter two being intermittent streams. Ayers Creek has an average fall is only 1.76 feet per mile.[18] Little Crane Creek is 3.74 miles long with an average fall is 5.7 feet per mile.[19] Henry Creek is 9.74 miles long with an average fall is 3.9 feet per mile.[20] This 14-digit HUC includes some of the most extensive coastal wetland areas in Ohio, including Ottawa National Wildlife Refuge, Magee Marsh State Wildlife Area, and Crane Creek State Park. Nonpoint pollutants such as agricultural crop production and on-site waste treatment systems impair the Crane Creek watershed.[21]

Crane Creek Watershed Use Attainment Data[22]

River Mile	Sample Year	ICI Score	HELP Ecoregion ICI Criteria	Lacustuary ICI Score*	HELP Ecoregion Lacustuary ICI Criteria*	Modified Index of Well Being Score	HELP Ecoregion Miwb Criteria	IBI Score	HELP Ecoregion IBI Criteria	Lacustuary IBI Score*	HELP Ecoregion Lacustuary IBI Criteria*	QHEI Score	HELP Ecoregion QHEI Criteria
Crane Creek													
0.2	2001					6.947	8.6			26	34		
7.4	1993					4.25	7.3	20	32			34	60
7.5	1993	22	34										
13.1	1993					3.146	7.3	18	32			49	60
13.1	1993					4.277	7.3	16	32				
Henry Creek													
0.1	1993											38.5	60
0.9	1993											26	60
2.1	1993											21.5	60
2.9	1993											23	60
3.7	1993					3.816	7.3	18	32			37.5	60
3.7	1993					3.927	7.3	12	32				
4.4	1993					2.005	7.3	16	32			17	60
5.6	1993											24	60
6.6	1993											15	60
Little Crane Ck													
1.1	1993					3.056	7.3	16	32			17.5	60

** The double horizontal line represents the lacustuary divide of Crane Creek, although it is noted that lacustuary lengths are approximate and fluctuate with lake levels and wind direction.*[23]

Crane Creek Watershed DELT Data[24]

River Mile	Sample Year	Percent DELT Anomalies	Percent Deformities	Percent Eroded Fins	Percent Lesions	Percent Tumors	Relative Number of Fish Collected	Relative Number of Species Collected	Relative Number of Fish Minus Tolerants	Relative Weight of Fish Collected (in grams)
Crane Creek										
0.2	2001	0.7093	0.24	0.47	0	0	288.47	13	225.05	1.284
7.4	1993	0	0	0	0	0	480	12	49.5	15.297
13.1	1993	1.4189	0	1.42	0	0	1980	8	54	14.349
13.1	1993	1.0017	0	0.33	0.67	0	898.5	6	61.5	4.895
Henry Creek										
3.7	1993	0.1383	0.14	0	0	0	1276.13	7	10.6	5.073
3.7	1993	4.4639	0	4.46	0	0	282	5	6	1.308
4.4	1993	1.02	0	1.02	0	0	150	3	0	0.279
Little Crane Ck										
1.1	1993	1.3333	0	1.33	0	0	337.5	5	0	0.509

** The double horizontal line represents the lacustuary divide of Crane Creek, although it is noted that lacustuary lengths are approximate and fluctuate with lake levels and wind direction.*[25]

Turtle Creek drainage area is 41.5 square miles.[26] Turtle Creek is 12.59 miles long and begins at the confluence of the North and South Branches. Its average fall is only 1.8 feet per mile, with the land use primarily in agricultural production. This watershed includes the Turtle Creek Fishing Access and is adjacent to the Magee Marsh State Wildlife Area.

Turtle Creek Watershed Use Attainment Data[27]

River Mile	Sample Year	ICI Score	HELP Ecoregion ICI Criteria	Lacustuary ICI Score*	HELP Ecoregion Lacustuary ICI Criteria*	Modified Index of Well Being Score	HELP Ecoregion Miwb Criteria	IBI Score	HELP Ecoregion IBI Criteria	Lacustuary IBI Score*	HELP Ecoregion Lacustuary IBI Criteria*	QHEI Score	HELP Ecoregion QHEI Criteria
Turtle Creek													
0.1	1995					7.1	8.6			22	42	45.5	60
0.1	1995					7.904	8.6			38	42		
0.2	1995			38	42								
0.3	1995			38	42								
1	1995					6.788	8.6			22	42	42	60
1	1995					9.031	8.6			31	42		
3	1995			4	42								
3.2	1995					5.561	8.6			6	42	20	60
3.2	1995					5.312	8.6			6	42		
8.9	1993					5.408	7.3	26	32			15.5	60
South Branch Turtle Creek													
1.4	1993					4.387	7.3	12	32			16	60
North Branch Turtle Creek													
0.8	1993											18.5	60

** The double horizontal line represents the lacustuary divide of Turtle Creek, although it is noted that lacustuary lengths are approximate and fluctuate with lake levels and wind direction.*[28]

Turtle Creek Watershed DELT Data[29]

River Mile	Sample Year	Percent DELT Anomalies	Percent Deformities	Percent Eroded Fins	Percent Lesions	Percent Tumors	Relative Number of Fish Collected	Relative Number of Species Collected	Relative Number of Fish Minus Tolerants	Relative Weight of Fish Collected (in grams)
Turtle Creek										
0.1	1995	9.15	0.65	0	8.5	0	306	13	186	108.069
0.1	1995	1.74	0.27	0.54	0.81	0.13	1490	19	1180	238.949
1	1995	26.08	1.14	5.06	19.87	0	316	13	174	167.702
1	1995	4.7	0.47	0	4.24	0	1086	20	852	131.135
3.2	1995	36.09	0	0	31.17	0	128	6	60	22.717
3.2	1995	13.64	0	0	13.64	0	132	7	72	44.956
8.9	1993	1.5464	0.52	0.52	0	0.52	291	15	79.5	3.855
South Branch Turtle Creek										
1.4	1993	8.012	0	8.01	0	0	334.5	6	15	2.224

** The double horizontal line represents the lacustuary divide of Turtle Creek, although it is noted that lacustuary lengths are approximate and fluctuate with lake levels and wind direction.*[30]

Lake Erie Tributary Watersheds Impairments
Causes and Sources of Impairments [31]

Segment	Miles Assessed & Aquatic Life Use Designation[#]	Causes of Impairment*	Sources of Impairment*	Comments
Otter Creek	10.23 (RM 0-10.23) LRW & MWH-C	Oil and grease-H Siltation-H Flow alteration-M Other habitat alterations-M Total toxics-M Unknown toxicity-M	Major industrial point Source-H Minor industrial point Source-S Urban runoff/Storm sewers (NPS)-M Landfills-H Hazardous waste-S Channelization-M Removal of riparian Vegetation-M Streambank modification/ Destabilization-M	305(b)-1996: Data in this table
Driftmeyer Ditch	2.43 (RM 0-2.43)	Other habitat alterations-H Nutrients-M Siltation-M Organic enrichment/DO-S	Channelization-H Nonirrigated crop production-H Removal of riparian vegetation-M Streambank modification/ Destabilization-M Land development/ Suburbanization-S Onsite wastewater systems (septic tanks)-S	305(b)-2000: stream is an agricultural drainage ditch; channelization and Siltation severely limit the potential of the stream; poorly performing septic systems notes along end of segment; nutrient enrichment is obvious from upstream farms.

Segment	Miles Assessed & Aquatic Life Use Designation[#]	Causes of Impairment*	Sources of Impairment*	Comments
Wolf Creek	8.25 (RM 0-8.25) WWH	Flow alteration-H Nutrients-H Other habitat alterations-H Siltation-M	Channelization-H Dredging-H Nonirrigated crop production-H Removal of riparian Vegetation-H Streambank modification/ Destabilization-H Land development/ Suburbanization-M Highway/road/bridge/ sewer line-S	305(b)-2000: stream is a channelized ditch, containing a tolerant fish community; farm runoff probably has th emost direct impact with lack of habitat a second cause.
Dry Creek	11.5 (RM 0-1.5) WWH	Flow alteration-H Other habitat alterations-H Pesticides-M Priority organics-M Metals-M Siltation-M Organic enrichment/DO-S	Nonirrigated crop Production-H Removal of riparian Vegetation-H Streambank modification/ Destabilization-H Channelization-M Dredging-M Land development/ Suburbanization-M Onsite wastewater systems (septic tanks)-S Other Urban Runoff-S	305(b)-2000: PCBs and pesticides are apparent in carp tissue samples; source could be runoff from railroad yard operations and ag; probably exists throughout the stream, but not documented; habitat is destroyed; runoff is most likely toxic; sedimentation is filling stream; much trash was present.
Cedar Creek	23.95 (RM 0-23.95) WWH	Flow alteration-H Other habitat alterations-H Metals-M Pesticides-M Priority organics-M Siltation-M	Channelization-M Flow regulation/ Modification-M Removal of riparian Vegetation-H Streambank modification/ Destabilization-H Nonirrigated crop production-M Minor industrial point Source-S	305(b)-2000: PCBs and pesticides were detected in fish tissue samples; contamination was significant; probable sources are the railroad yards, village of Walbridge, and ag sources; habitat degradation, probable toxic inputs via NPS runoff, and point sources; much trash and other materials; fish community was poor, with better macro-invertebrates in some spots; there may be a PAH problem due to the many railroad ties found in the stream.
Henry Creek	9.0 (RM 0-9.0) WWH	Other habitat alterations-H Flow alteration-H Organic enrichment/DO-M Siltation-M	Nonirrigated crop production-H Channelization/ag-H Removal of riparian Vegetation-H Streambank modification/ Destabilization/Ag-H Channelization/ag-M Package Plants-M Onsite wastewater systems (septic systems)-S	305(b)-2000: sewage sludge and grey water impacts are significant pollutant inputs; poor habitat and evidence of wide variation in flow, large amounts of trash

Segment	Miles Assessed & Aquatic Life Use Designation[#]	Causes of Impairment*	Sources of Impairment*	Comments
Little Crane Creek	3.5 (RM 0-3.5) WWH	Other habitat alterations-H Flow alteration-H Siltation-M	Nonirrigated crop production-H Channelization/ag-H Removal of riparian Vegetation-M Streambank modification/ Destabilization/Ag-M	305(b)-2000: this is a typical northwest Ohio drainage ditch; flow regime is quite variable to dry; ag inputs probably impact the stream, either toxic or otherwise.
Ayers Creek	5.77 (RM 0-5.77)	Organic enrichment/DO-H Metals-M	Nonirrigated crop production-S Onsite wastewater systems (septic systems)-S	305(b)-1996: Data in this table
Crane Creek	28.07 (RM 0-28.07) WWH	Other habitat alterations-H Siltation-M Flow alteration-S Metals-S Pesticides-S Priority organics-S	Nonirrigated crop production-H Removal of riparian Vegetation-M Land development/ Suburbanization-S	305(b)-2000: PCBs and pesticides were reported in fish tissue samples at significant concentrations; source is probably agricultural or railroad yard; ag runoff probably contributes chemical contaminants found in fish; consistent flow is a problem.
Turtle Creek	9.5 (RM 0-9.5) WWH	Flow alteration-H Other habitat alterations-H Nutrients-M Siltation-M	Channelization/ag-H Dredging-M Nonirrigated crop production-H Removal of riparian Vegetation-M Streambank modification/ Destabilization/Ag-M	305(b)-1996: Data in this table
South Branch Turtle Creek	6.4 (RM 0-6.4) WWH	Other habitat alterations-H Flow alteration-M Organic enrichment/DO-M Siltation-M	Channelization/ag-H Nonirrigated crop Production-M Removal of riparian Vegetation/Ag-M Streambank modification/ Destabilization/Ag-M Unknown source-M	305(b)-2000: sewage sludge is present in the stream with unknown source; little to no habitat due to dredging and channelization; no riparian zone; ag inputs and Siltation limit the stream community

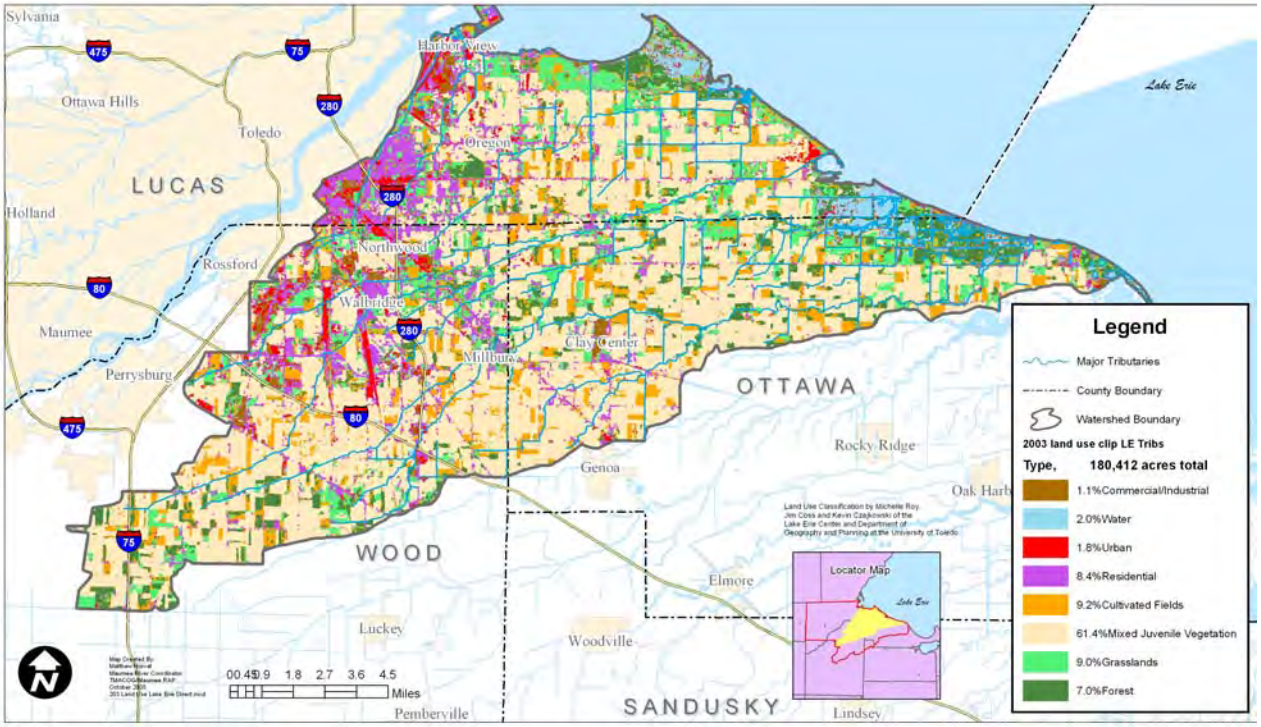
**Magnitude of that cause or source of impairment: H=high, M=moderate, S=slight, T=identifies a threat*

[#]Aquatic Life Use Designation: WWH=Warm Water Habitat, MWH=Modified Warm Water Habitat, LRW=Limited Resource Water

Land Use of the Lake Erie Tributary Watersheds

In 2003 land use classifications produced by The University of Toledo for the Lake Erie Tributary watersheds showed 61 percent of the land used by mixed juvenile vegetation. This vegetation type can be row crops in an early stage of growth, tracts of open space or yards. Forest and grassland account for 7 percent and 9 percent respectively, and 9 percent is in cultivated fields. Approximately 8 percent of the watershed has been developed for residential use, 2 percent for urban uses, and 1 percent for commercial/industrial uses.

2003 Land Use in the Lake Erie Tributary Watersheds



Status of Beneficial Use Impairments

When the Maumee Area of Concern was defined in the late 1980s, the Maumee RAP Public Advisory Council determined which beneficial uses were impaired based on the entire AOC. This was done because the only way of delisting an AOC was a comprehensive one; all listed or all delisted. Now that there are alternative methods for incrementally delisting an AOC by watershed or impairment, the Maumee RAP needed to determine the BUIs by watershed. This was done using data and resources that were available before 1990. The two tables below summarize the BUIs impacting the Lake Erie Tributary Watersheds in 1990 and 2004.

Following the BUI Summary Tables are maps of this watershed, including the jurisdictions, 14-digit HUCs, and custom-digitized river mile maps made specifically for the Maumee AOC watersheds.

The heart of this plan, the Watershed Project Tables (WPTs), is found in Volume 2. As explained in the Introduction, the WPTs are the living portion of the report that will change and grow, as projects are implemented and goals are attained. These tables have been organized by Causes and Sources and include Projects, Potential Project Partners, Funding Sources, Timeline, Status, Performance/ Environmental Measures, HUC/Stream Segment Addressed, and indicate the Beneficial Use Impairment (BUI) that could be effected by the project. Also incorporated into the table (where

applicable) is a reference to the ODNR Coastal Management Measures that may benefit from the implementation of an identified project.

There are differing levels of detail in the WPTs, often depending on how soon a project will be implemented, what source will be funding it, or by the amount of data available for that watershed. The status of projects in the WPTs has been organized and color-coded as follows: **In Progress**, **Planning**, **Concept**, **Ongoing**, and **Complete.**

Beneficial Use Impairments In 1990
For the Lake Erie Tributaries

(as determined in 2002)

Beneficial Use Impairments	Otter Creek	Wolf Creek	Cedar Creek	Crane Creek*	Turtle Creek	Reasons/Data Source
BUI 1: Restriction on fish and wildlife consumption	Impaired		Not Impaired	Unknown	Unknown	Otter - ODH data re: LE and MR Others – PCB and pesticides in fish tissue
BUI 2: Tainting of fish & wildlife flavor	Unknown		Unknown	Unknown	Unknown	Others - No data to indicate
BUI 3: Degradation on fish and wildlife populations	Impaired		Not Impaired	Unknown	Unknown	Otter - OEPA data, historical data
BUI 4: Fish tumors or other deformities	Impaired		Not Impaired	Unknown	Unknown	Otter - OEPA data but have Phyllis review/confirm
BUI 5: Bird or animal deformities or reproductive problems	Unknown		Not Impaired	Impaired	Impaired	Others – 1991 total reproduction failure in gulls along LE/Maumee Bay coastline
BUI 6: Degradation of benthos	Impaired		Not Impaired	Impaired	Impaired	Otter - OEPA data Others – failed septic systems in Clay Center and Genoa CSO issues
BUI 7: Restriction on dredging activities	Not Applicable		Not Impaired	Unknown	Unknown	Otter -? Needs clarification? Others – no data to indicate
BUI 8: Eutrophication or undesirable algae	Not Impaired		Not Impaired	Unknown	Unknown	Otter - No info Others – Organic enrichment, ag runoff
BUI 9: Restrictions on drinking water consumption, or taste and odor	Not Applicable		Not Impaired	Impaired	Unknown	All – no drinking water intakes in these creeks
BUI 10: Beach closings	Unknown		Not Impaired	Not Applicable	Not Applicable	Otter - No beaches, need more data on chemical concerns that could limit recreational contact
BUI 11: Degradation of aesthetics	Impaired		Not Impaired	Unknown	Unknown	Otter - BPJ
BUI 12: Added cost to agriculture and industry	Not Applicable		Not Impaired	Unknown	Unknown	Otter - no known ag or industrial users
BUI 13: Degradation of phytoplankton & zooplankton populations	Unknown		Not Impaired	Unknown	Unknown	
BUI 14: Loss of fish and wildlife habitat	Impaired		Not Impaired	Unknown	Unknown	Otter - Historical info, photos, and BPJ

*Note: In 1990 all of Cedar Creek was surveyed and determined to be in full attainment of WWH designation

Possible answers – Impaired, Not Impaired, Unknown, Not Applicable

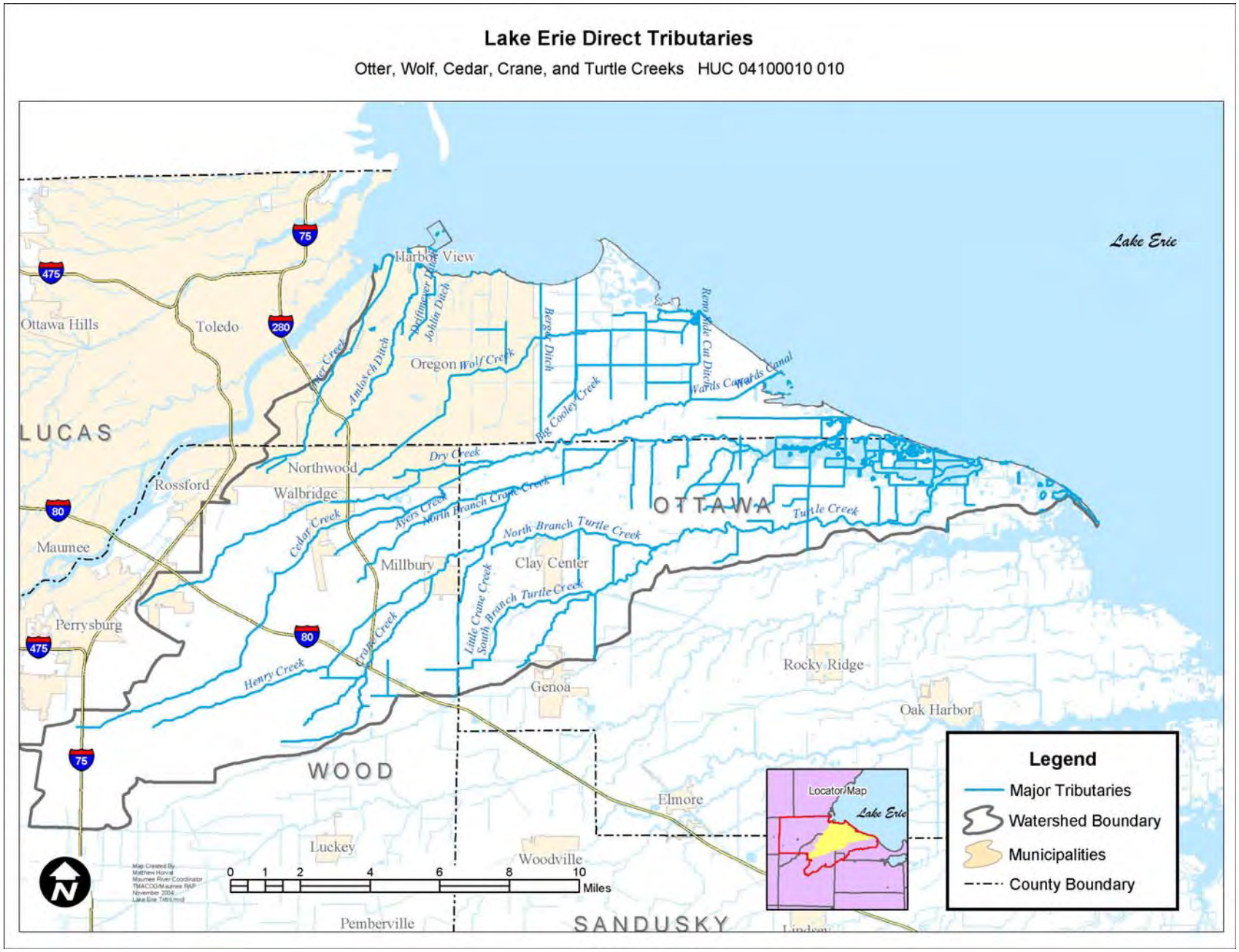
Beneficial Use Impairments In 2005
For the Lake Erie Tributaries

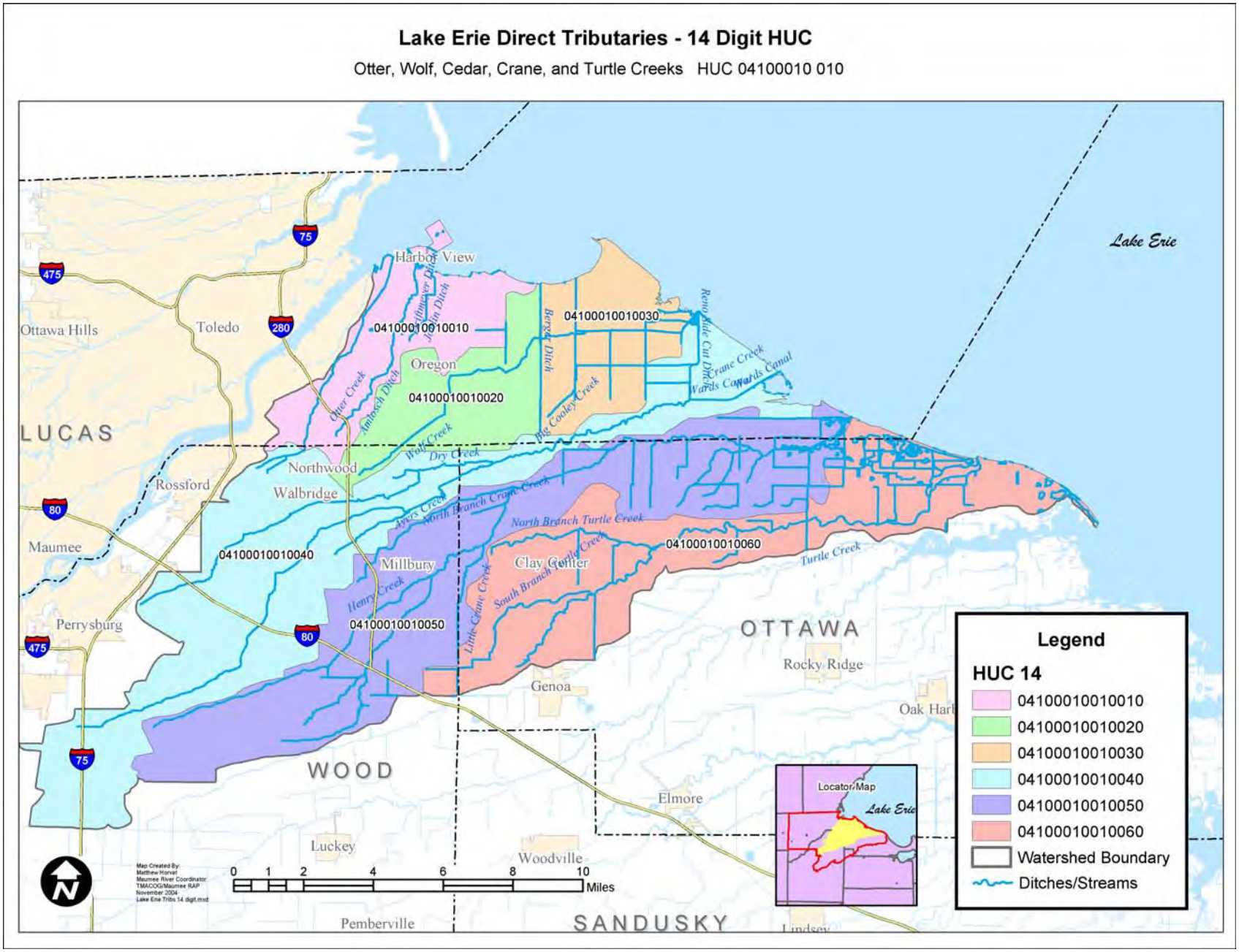
(last updated 12/1/05)

Beneficial Use Impairments	Otter Creek	Wolf Creek	Cedar Creek	Crane Creek	Turtle Creek	Reasons/Data Source
BUI 1: Restriction on fish and wildlife consumption	Impaired	Impaired	Not Impaired	Impaired	Impaired	2004 Ohio Snapping Turtle Consumption Advisory for PCBs and mercury: Ottawa National Wildlife Refuges, Ottawa County: Turtle and Crane Creeks 2004 Ohio Sport Fish Consumption Advisory: Lake Erie/Channel Catfish (PCBs)
BUI 2: Tainting of fish & wildlife flavor	Unknown	Not Impaired	Not Impaired	Not Impaired	Not Impaired	no known reports of tainting of fish and wildlife flavor; no known sources of phenols and related compounds, but further research and studies may be required for Otter Creek because of potential historical industrial
BUI 3: Degradation on fish and wildlife populations	Impaired	Impaired	Impaired	Impaired	Impaired	Otter riverine IBI 17.1; lac.IBI 6 (poor) Crane riverine IBI 19.2 (poor); Cedar riverine IBI 20 (poor); Turtle riverine IBI 19; lac.IBI 20.8(poor) Miwb scores: Otter 1.432 (poor); Cedar 5.076 (poor); Crane 4.335 (poor); Turtle 6.436(fair)No data or determination of degradation of wildlife populations
BUI 4: Fish tumors or other deformities	Impaired	Impaired	Impaired	Not Impaired	Impaired	Otter Creek: 63 DELTS = 2.25% Cedar Creek: 32 DELTS = 1.08% Crane Creek: 12 DELTS = 0.487% Turtle Creek: 134 DELTS = 6.24%
BUI 5: Bird or animal deformities or reproductive problems	Not Impaired	Not Impaired	Not Impaired	Not Impaired	Not Impaired	No known data sources or studies
BUI 6: Degradation of benthos	Impaired	Impaired	Impaired	Impaired	Impaired	Otter riverine ICI 2 (poor);lac.ICI 17 (fair) Crane riverine ICI 5.5 (poor), Cedar riverine 23.3 (fair): Turtle lacustuary 26.6 (fair)
BUI 7: Restriction on dredging activities	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	no navigational dredging activities on these streams

Beneficial Use Impairments	Otter Creek	Wolf Creek	Cedar Creek	Crane Creek	Turtle Creek	Reasons/Data Source
BUI 8: Eutrophication or undesirable algae	Unknown	Unknown	Unknown	Unknown	Unknown	status of this BUI is unknown dissolved O2 data?? Meet OWQS? No TMDL available
BUI 9: Restrictions on drinking water consumption, or taste and odor	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	no treated drinking water supplies in these streams
BUI 10: Beach closings	Not Impaired	Impaired	Not Impaired	Impaired	Not Impaired	no data for recreational contact for Cedar and Turtle
BUI 11: Degradation of aesthetics	Impaired	Impaired	Impaired	Impaired	Impaired	public health nuisances associated with raw or poorly treated sewage can be a problem in these streams. due to number, density of units (homes), age, poor maintenance, and no monitoring of septic systems
BUI 12: Added cost to agriculture and industry	Not Impaired	Unknown	Unknown	Unknown	Unknown	Status of this BUI is unknown
BUI 13: Degradation of phytoplankton & zooplankton populations	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	
BUI 14: Loss of fish and wildlife habitat	Impaired	Impaired	Impaired	Impaired	Impaired	loss of wildlife habitat is unknown; stream modification has resulted in some loss of fish habitat in streams (best professional judgment), but no comprehensive studies or inventories completed to date QHEI scores: Otter 27.97; Crane 33.5; Cedar 27.8; Turtle 26.25.

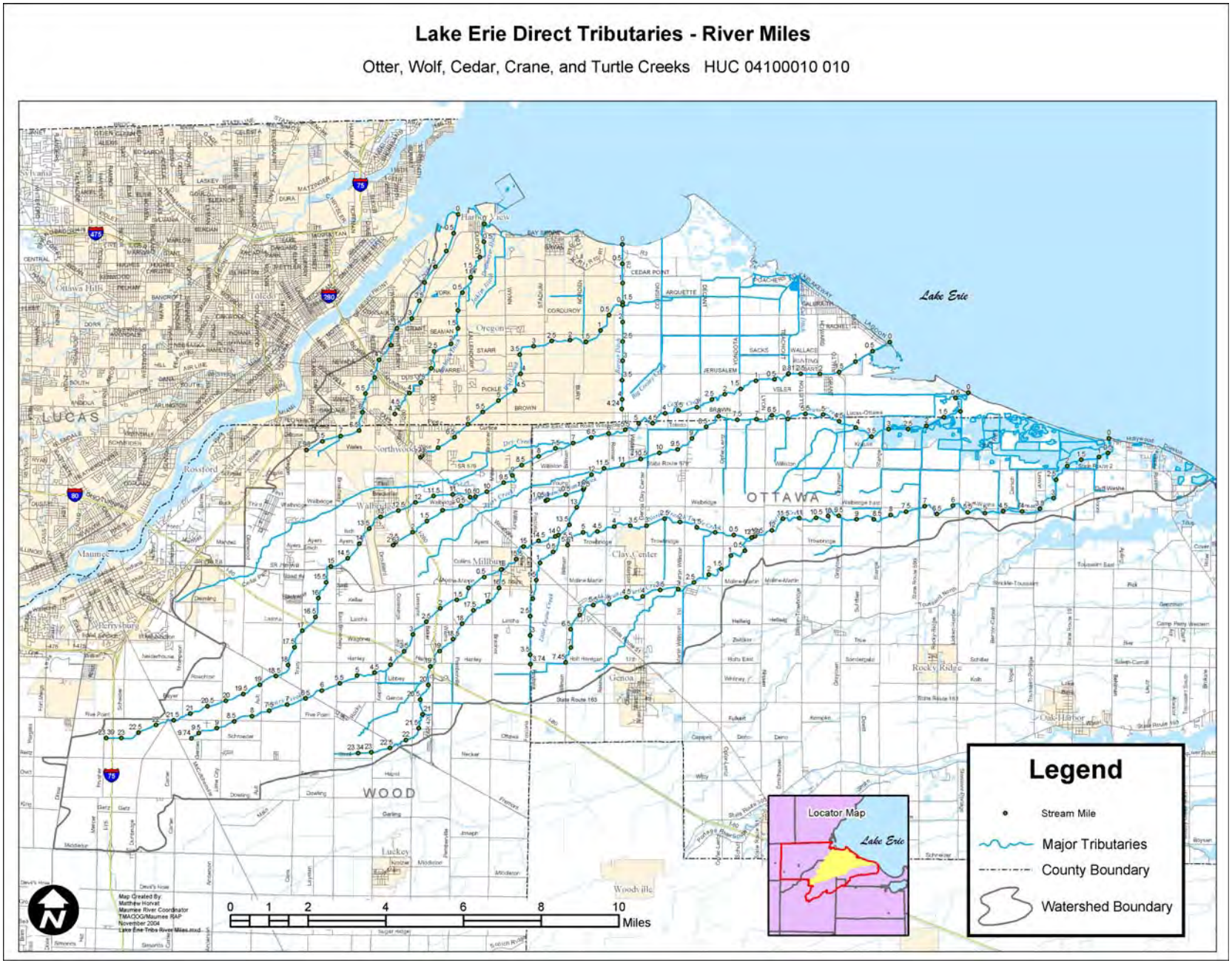
Possible answers – Impaired, Not Impaired, Unknown, Not Applicable


Lake Erie Direct Tributaries
Otter, Wolf, Cedar, Crane, and Turtle Creeks HUC 04100010 010
Lake Erie
Harbor View
Ottawa Hills
Toledo
Oregon
LUCAS
OTTAWA
WOOD
SANDUSKY
Rossford
Northwood
Walbridge
Maumee
Millbury
Clay Center
Perrysburg
Genoa
Rocky Ridge
Oak Harbor
Elmore
Luckey
Woodville
Pemberville
Lindsey
Wolf Creek
Dry Creek
Cedar Creek
Ayers Creek
North Branch Crane Creek
North Branch Turtle Creek
Turtle Creek
South Branch Turtle Creek
Little Crane Creek
Crane Creek
Henry Creek
Big Cooley Creek
Bergen Ditch
Amlosch Ditch
Johlin Ditch
Wards Canal
Remmelde Cut Ditch
0 1 2 4 6 8 10
Miles
Locator Map
Legend
Major Tributaries
Watershed Boundary
Municipalities
County Boundary


Lake Erie Direct Tributaries - 14 Digit HUC
Otter, Wolf, Cedar, Crane, and Turtle Creeks HUC 04100010 010
Lake Erie
Harbor View
Ottawa Hills
Toledo
Oregon
04100010010010
04100010010020
04100010010030
LUCAS
Northwood
Rossford
Walbridge
Maumee
Millbury
04100010010040
04100010010050
04100010010060
Perrysburg
OTTAWA
Rocky Ridge
Genoa
Oak Harbor
WOOD
Elmore
Luckey
Woodville
Pemberville
SANDUSKY
Lindsey
Otter Creek
Ambach Ditch
Wolf Creek
Dry Creek
Berger Ditch
Big Cooley Creek
Crane Creek
Wards Canal
Reno Side Cut Ditch
Ayers Creek
North Branch Crane Creek
North Branch Turtle Creek
Clay Center
South Branch Turtle Creek
Little Crane Creek
Henry Creek
Turtle Creek
Locator Map
Lake Erie
Legend
HUC 14
04100010010010
04100010010020
04100010010030
04100010010040
04100010010050
04100010010060
Watershed Boundary
Ditches/Streams
0 1 2 4 6 8 10
Miles
Map Created By:
Matthew Horvat
Maumee River Coordinator
TMACOG/Maumee RAP
November 2004
Lake Erie Tribs 14 digit.mxd

Lake Erie Direct Tributaries - River Miles

Otter, Wolf, Cedar, Crane, and Turtle Creeks HUC 04100010 010



See Volume 2 for the:

- Otter Creek Watershed Projects Table
- Wolf Creek/Berger Ditch Watershed Projects Table
- Cedar Creek Watershed Projects Table
- Crane Creek Watershed Projects Table
- Turtle Creek Watershed Projects Table

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[6] USDA Natural Resource Conservation Service website: http://www.oh.nrcs.usda.gov/technical/.
[7] Ohio EPA, STORET Data, April 2004.
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[9] USDA Natural Resource Conservation Service website: http://www.oh.nrcs.usda.gov/technical/.
[10] *Maumee River Basin Area of Concern Remedial Action Plan Recommendations for Implementation Vol. 4*, TMACOG, July 1991, p 6-1.
[11] *Maumee River Basin Area of Concern Remedial Action Plan Recommendations for Implementation Vol. 4*, TMACOG, July 1991, p 6-1.
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[13] *Ohio EPA 305(b) Report*, Ohio EPA, 1988.
[14] Ohio EPA, STORET Data, April 2004.
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[16] USDA Natural Resource Conservation Service website: http://www.oh.nrcs.usda.gov/technical/.
[17] *Maumee River Basin Area of Concern Remedial Action Plan Recommendations for Implementation Vol. 4*, TMACOG, July 1991, p 6-1.
[18] *Maumee River Basin Area of Concern Remedial Action Plan Recommendations for Implementation Vol. 4*, TMACOG, July 1991, p 6-1.
[19] *Maumee River Basin Area of Concern Remedial Action Plan Recommendations for Implementation Vol. 4*, TMACOG, July 1991, p 6-1.
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[21] *Ohio EPA 305(b) Report*, Ohio EPA, 1988.
[22] Ohio EPA, STORET Data, April 2004.
[23] *Delisting Targets for Ohio Areas of Concern*, Ohio EPA, June 2005.
[24] Ohio EPA, STORET Data, April 2004.
[25] *Delisting Targets for Ohio Areas of Concern*, Ohio EPA, June 2005.
[26] USDA Natural Resource Conservation Service website: http://www.oh.nrcs.usda.gov/technical/.
[27] Ohio EPA, STORET Data, April 2004.
[28] *Delisting Targets for Ohio Areas of Concern*, Ohio EPA, June 2005.
[29] Ohio EPA, STORET Data, April 2004.
[30] *Delisting Targets for Ohio Areas of Concern*, Ohio EPA, June 2005.
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OEPA 305(b) Report, Ohio EPA, 1998.

Toussaint River Watershed

Volume 1

- Background & Water Quality Data for the Toussaint River Watershed
- Land Use of the Toussaint River Watershed
- Status of Beneficial Use Impairments
- Watershed Maps (General, 14-digit HUCs, River Mile)

Volume 2

- Packer Creek Watershed Projects Table
- Toussaint Creek/Toussaint River/Rusha Creek Watershed Projects Table

Toussaint River Watershed *(last updated 3/9/06)*

The Toussaint River Watershed is Hydrologic Unit 04100010 020. The Toussaint Creek/River is a small Black Swamp river that flows from northern Bowling Green in Wood County, through Luckey, Genoa, and Rocky Ridge, and into Lake Erie in Carroll Township of Ottawa County. The entire drainage area covers 143.1 square miles. Toussaint Creek is 96.3 square miles of the total drainage area. Packer Creek is the Toussaint's primary tributary with 34 square miles of drainage. Rusha Creek enters the Toussaint River near the mouth with a drainage area of 12.8 square miles.[1]

Above its confluence with Packer Creek, the Toussaint is considered a creek; below it, the Toussaint widens to become a river as it reaches lake level. In this lower reach, there are two important natural areas. One is the Toussaint Creek Wildlife Area, managed by Ohio Department of Natural Resources, Division of Wildlife. Additional coastal marsh areas are located on private property owned by Toledo Edison at the Davis Besse Nuclear Power Station. More than 700 of the 900 acres of the station is dedicated as a wildlife preserve; an important migration route for waterfowl, including mallard ducks and Canada Geese.[2]

The Toussaint River watershed is a highly agricultural area; the largest town is Genoa, with a population of 2,230 in 2000. The watershed includes dolomite limestone quarries near Woodville, Genoa, Clay Center, and Rocky Ridge. The former Brush Beryllium plant site in Luckey is planned for a clean-up of contaminated soil by the US Army Corps of Engineers.[3] The Davis Besse Nuclear Power Station is located near the mouth of the Toussaint River.

Toussaint River Watershed Use Attainment Data[4]

River Mile	Sample Year	ICI Score	HELP Ecoregion ICI Criteria	Lacustuary ICI Score*	HELP Ecoregion Lacustuary ICI Criteria*	Modified Index of Well Being Score	HELP Ecoregion Miwb Criteria	IBI Score	HELP Ecoregion IBI Criteria	Lacustuary IBI Score*	HELP Ecoregion Lacustuary IBI Criteria*	QHEI Score	HELP Ecoregion QHEI Criteria
Toussaint River/Creek													
0.3	1995			30	42								
0.3	1995											44	60
0.3	2003					8.2	8.6			38	42		
0.6	1996			28	42								
1.4	1996			10	42								
1.7	2003					6.2	8.6			22.5	42		
2.5	1995											53	60
3.4	1995			12	42								
4.4	1995											34	60
4.7	2003			12	42								
10.45	2003	36	34			8.2	7.3	25	32			51.5	60
12.5	2003	32	34			5.7	7.3	28	32			34	60
13.9	1993											35	60
14	2003	24	34			5.9	7.3	27	32			50.4	60
18.4	2003	32	34			6.4	7.3	29	32			42	60
18.9	1993											56	60
19.7	2003	42	34			7.3	7.3	34	32			71.5	60
20	1987											44	60

River Mile	Sample Year	ICI Score	HELP Ecoregion ICI Criteria	Lacustuary ICI Score*	HELP Ecoregion Lacustuary ICI Criteria*	Modified Index of Well Being Score	HELP Ecoregion Miwb Criteria	IBI Score	HELP Ecoregion IBI Criteria	Lacustuary IBI Score*	HELP Ecoregion Lacustuary IBI Criteria*	QHEI Score	HELP Ecoregion QHEI Criteria
20	1999	24	34										
20.2	2003	42	34			6.9	7.3	33	32			57.5	60
20.3	1987											41	60
20.3	1993											51.5	60
28.55	2003					8	7.3	27	32			49.5	60
29.37	2003											42.5	60
29.4	2003	32	34			7.2	7.3	28	32			59	60
33.52	2003	38	34					30	28			42.5	60
36.46	2003												
36.5	2003							20	28			25.5	60
Gust Ditch													
2.8	2003							16	28			44.5	60
Martin Ditch													
0.2	2003							24	28			27.5	60
Packer Creek													
0.2	2002					7.4	8.6			23	42	26.5	60
3.45	2003	44	34			9.1	8.6	36	32			42	60
3.5	1993	36	34										
4.6	2003	36	34									51	60
4.7	1993	45	34										
6	1993	12	34										
6.9	1993	31	34										
11.3	1993	28	34										
11.3	2003	30	34									28	60
14.7	2003							32	28			27	60
15.6	2003							18	28			29	60
21.2	2003							21	28				
Rusha Creek													
4	2003					4.8	8.6			21	42	16	60
5	2003							18	28			29	60

** The double horizontal line represents the lacustuary divide of the Toussaint River/Creek, although it is noted that lacustuary lengths are approximate and fluctuate with lake levels and wind direction.*[5]

Toussaint River Watershed DELT Data[6]

River Mile	Sample Year	Percent DELT Anomalies	Percent Deformities	Percent Eroded Fins	Percent Lesions	Percent Tumors	Relative Number of Fish Collected	Relative Number of Species Collected	Relative Number of Fish Minus Tolerants	Relative Weight of Fish Collected (in grams)
0.3	1995	6.45	1.08	1.08	4.3	0	186	17	144	42.142
0.3	1995	3.23	0	0	3.23	0	434	19	416	22.142
2.5	1995	9.68	0	0	9.68	0	62	9	22	58.926
2.5	1995	0.66	0	0.33	0.33	0	604	17	566	43.329
4.4	1995	8.64	0	0	7.41	1.23	162	14	92	92.603
4.4	1995	2.62	0.36	0.25	2.02	0	794	17	608	153.08

River Mile	Sample Year	Percent DELT Anomalies	Percent Deformities	Percent Eroded Fins	Percent Lesions	Percent Tumors	Relative Number of Fish Collected	Relative Number of Species Collected	Relative Number of Fish Minus Tolerants	Relative Weight of Fish Collected (in grams)
13.9	1993	17.0588	0	17.06	0	0	127.5	11	42	4.148
18.4	1987	0	0	0	0	0	156	10	88.5	0.518
18.4	1987	0	0	0	0	0	688.5	11	255.02	1.806
18.9	1993	5.929	0	5.93	0	0	459	16	154.5	70.28
19.8	1987	3.3019	0.24	0	3.07	0	636	18	259.49	33.824
19.8	1987	0	0	0	0	0	667.5	16	259.52	44.868
20	1979	0	0	0	0	0	198	8	65.99	34.315
20	1987	1.3072	0	0	1.31	0	229.5	14	100.5	56.981
20	1987	1.2766	0.3	0.65	0	0.32	493.5	17	293.98	21.169
20.2	1979	0	0	0	0	0	375	13	282	0.609
20.3	1987	0.3521	0	0	0.18	0.18	852	8	366.02	7.459
20.3	1993	2.3473	0	2.35	0	0	304.39	10	114.32	0.879

** The double horizontal line represents the lacustuary divide of the Toussaint River/Creek, although it is noted that lacustuary lengths are approximate and fluctuate with lake levels and wind direction.*[7]

Toussaint River/Creek Watershed Impairments
Causes and Sources of Impairments [8]

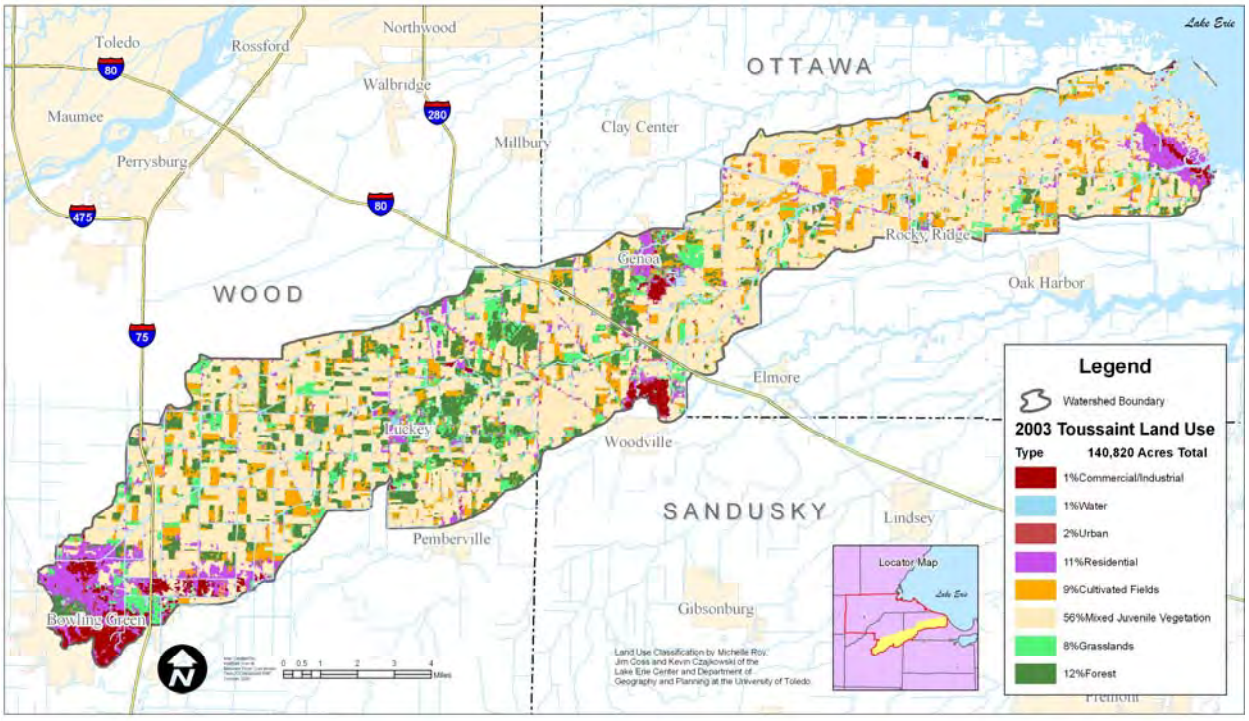
Segment	Miles Assessed & Aquatic Life Use Designation[#]	Causes of Impairment*	Sources of Impairment*	Comments
Packer Creek	21 (RM 0.2-21.2)	Siltation Nutrient and Organic enrichment	Ag-row crop Ag-NPS runoff Channelization Failing septic systems	Toussaint TSD 2005: RM 0.2, 15.6, and 21.2 were classified in non-attainment; RM 3.5, 4.6, 11.3, and 14.7 were in full attainment
Toussaint Creek	26 (RM 10.5-36.5) WWH	Channelization Habitat alterations Nutrient and Organic enrichment Siltation	Ag-row crop Channelization Failing septic systems Genoa Quarry Luckey WWTP Riparian removal Unknown source	Toussaint TSD 2005: RM 12.5, 13.9, 28.6, 36.5 were classified in non-attainment; RM 18.4 was in partial attainment; RM 10.5, 19.7, 20.2, 29.4, and 33.5 were in full attainment
Toussaint River	4.4 (RM 0.3-4.7) WWH	Siltation Nutrient enrichment	Ag-row crop	Toussaint TSD 2005: RM 1.7 and 4.7 were classified in non-attainment; RM 0.3 was in full attainment
Rusha Creek	2 (RM 3-5) MWH	Siltation Nutrient enrichment	Ag-row crop Channelization	Toussaint TSD 2005: RM 3.0 and 5.0 were in non-attainment

**Magnitude of that cause or source of impairment: H=high, M=moderate, S=slight, T=identifies a threat*
[#]Aquatic Life Use Designation: WWH=Warm Water Habitat, MWH=Modified Warm Water Habitat, LRW=Limited Resource Water

Land Use of the Toussaint River Watershed

In 2003 land use classifications produced by The University of Toledo for the Toussaint River watershed showed 56 percent of the land used by mixed juvenile vegetation. This vegetation type can be row crops in an early stage of growth, tracts of open space or yards. Forest and grassland account for 12 percent and 8 percent respectively, and 9 percent is in cultivated fields. Approximately 11 percent of the watershed has been developed for residential use, 2 percent for urban uses, and 1 percent for commercial/industrial uses.

2003 Land Use in the Toussaint River Watershed



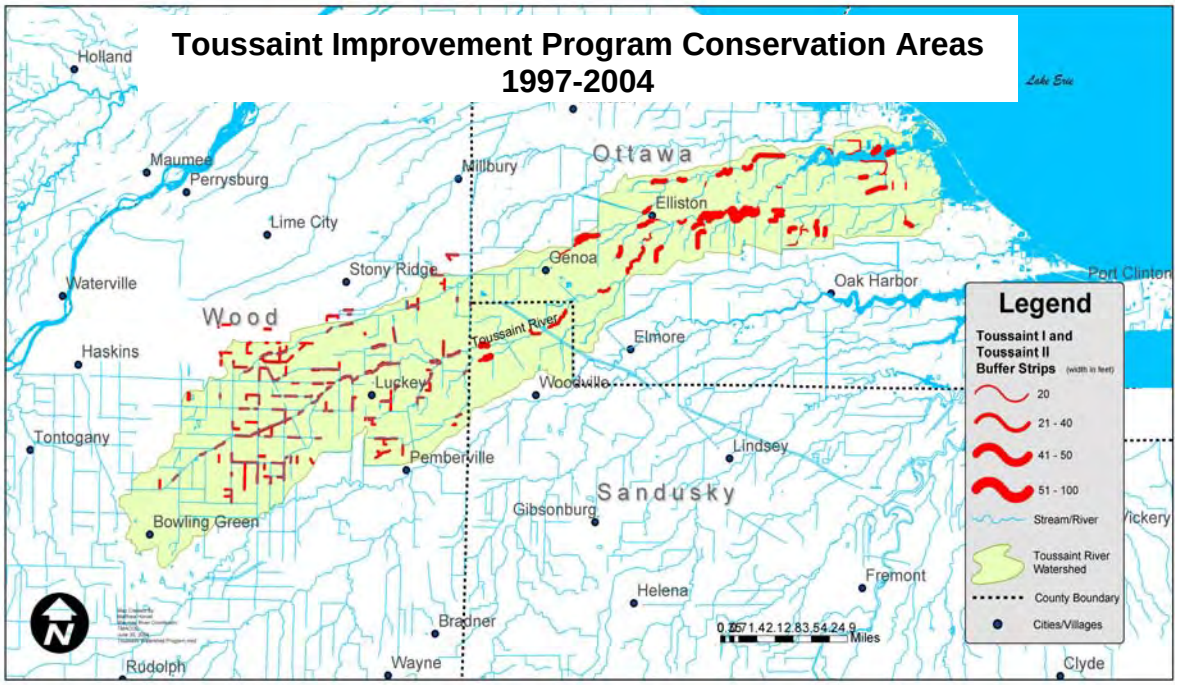
There have been two Clean Water Act Section 319 watershed implementation grants that positively changed the land use and agricultural practices in the Toussaint and Packer watersheds.

The TMACOG, Ottawa, Wood and Sandusky Soil and Water Conservation Districts, and Maumee RAP worked to restore the riparian corridor in the Toussaint River watershed. Phase I of the Toussaint Incentive Improvement Program began in 1997 with a concentrated focus on land adjacent to the main stem of the Toussaint River. Landowners were offered financial incentives to adopt agricultural conservation practices such as conservation tillage, setting aside flood plains, and establishing buffers in concentrated flow areas and along stream banks along the 37 mile corridor.

Phase II of the Program continued these conservation buffer incentives, extending the project area to include all streams in the Toussaint watershed including Packer Creek and Rusha Creek. This second grant provided funds for the Wood and Ottawa County health departments to develop Home Sewage Treatment System (HSTS) Plans to identify critical areas for repair and replacement of rural septic systems that degrade water quality. The grant also offered homeowner education on maintenance of HSTSs, and partial rebates on septic tank pumping for over 100 households.

Over the course of the seven years of grant activities, nearly 75 miles of stream bank in the watershed have been protected with buffers that will reduce sediment and nutrient runoff and improve the water quality and instream habitat. Over 300 contracts for conservation practices were

signed with landowners in Ottawa, Wood, and Sandusky counties. The majority of flood plain set aside was accomplished on the lake plains alluvial soils in Ottawa County. Landowners in the small tributaries and headwaters of the Toussaint and Packer installed filter strips along nearly 346,000 lineal feet of stream bank. In Wood County, the Commissioners offered an additional one time



incentive of $20 per acre to landowners who signed up for other state and Federal buffer programs in 2001. In addition to the 319 filter strips, there was a good response to Conservation Reserve Enhancement Program (CREP), which was introduced in the Western Basin Lake Erie in 2000 and the ongoing CRP buffer programs in all three counties.

Status of Beneficial Use Impairments

When the Maumee Area of Concern was defined in the late 1980s, the Maumee RAP Public Advisory Council determined which beneficial uses were impaired based on the entire AOC. This was done because the only way of delisting an AOC was a comprehensive one; all listed or all delisted. Now that there are alternative methods for incrementally delisting an AOC by watershed or impairment, the Maumee RAP needed to determine the BUIs by watershed. This was done using data and resources that were available before 1990. The two tables below summarize the BUIs impacting the Toussaint River Watershed in 1990 and 2004.

Following the BUI Summary Tables are maps of this watershed, including the jurisdictions, 14-digit HUCs, and custom-digitized river mile maps made specifically for the Maumee AOC watersheds.

The heart of this plan, the Watershed Project Tables (WPTs), is found in Volume 2. As explained in the Introduction, the WPTs are the living portion of the report that will change and grow, as projects are implemented and goals are attained. These tables have been organized by Causes and Sources and include Projects, Potential Project Partners, Funding Sources, Timeline, Status, Performance/ Environmental Measures, HUC/Stream Segment Addressed, and indicate the Beneficial Use Impairment (BUI) that could be effected by the project. Also incorporated into the table (where

applicable) is a reference to the ODNR Coastal Management Measures that may benefit from the implementation of an identified project.

There are differing levels of detail in the WPTs, often depending on how soon a project will be implemented, what source will be funding it, or by the amount of data available for that watershed. The status of projects in the WPTs has been organized and color-coded as follows: **In Progress, Planning, Concept, Ongoing,** and **Complete.**

Beneficial Use Impairments In 1990
for the Toussaint River/Packer Creek/Rusha Creek

(as determined in 2002)

Beneficial Use Impairments	Toussaint River	Packer Creek	Rusha Creek	Reasons/Data Source
BUI 1: Restriction on fish and wildlife consumption	Impaired	Impaired	Impaired	PCB & mercury throughout Lake Erie from RAP '93 rpt
BUI 2: Tainting of fish & wildlife flavor	Not Impaired	Not Impaired	Not Impaired	RAP rpt '93 page 7-6
BUI 3: Degradation on fish and wildlife populations	Unknown	Unknown	Unknown	RAP rpt '93 page 7-7. Could see residual contamination in coastal marshes from bay sediments
BUI 4: Fish tumors or other deformities	Impaired	Unknown	Unknown	RAP rpt '93 page 7-7, 1994 305(b) rpt – appendix E DELT table
BUI 5: Bird or animal deformities or reproductive problems	Impaired	Unknown	Unknown	RAP rpt '93 page 7-7, isolated eagle hatch problems along coastal nesting zone in 91-92
BUI 6: Degradation of benthos	Impaired	Impaired	Not applicable	Contamination in sediments likely fro Luckey and Genoa CSO
BUI 7: Restriction on dredging activities	Not Impaired	Not applicable	Not applicable	RAP rpt '93 page 7-8, ordinance hazards at mouth of river
BUI 8: Eutrophication or undesirable algae	Impaired	Impaired	Impaired	RAP rpt '93
BUI 9: Restrictions on drinking water consumption, or taste and odor	Not Impaired	Not Impaired	Not Impaired	RAP rpt '93, not a source of public drinking water
BUI 10: Beach closings	Not applicable	Not applicable	Not applicable	
BUI 11: Degradation of aesthetics	Impaired	Impaired	Impaired	High debris and turbidity after storms, RAP rpt '93 page 7-9
BUI 12: Added cost to agriculture and industry	Unknown	Unknown	Unknown	
BUI 13: Degradation of phytoplankton & zooplankton populations	Unknown	Unknown	Unknown	Davis Besse uses Lake Erie for cooling water source and steam generation. Intake may be affected by sedimentation
BUI 14: Loss of fish and wildlife habitat	Impaired	Impaired	Impaired	RAP rpt '93 page 7-9. Channel straightening, loss of riparian buffers

Possible answers – Impaired, Not Impaired, Unknown, Not Applicable

Beneficial Use Impairments In 2005
for the Toussaint River/Packer Creek/Rusha Creek

(last updated 12/1/05)

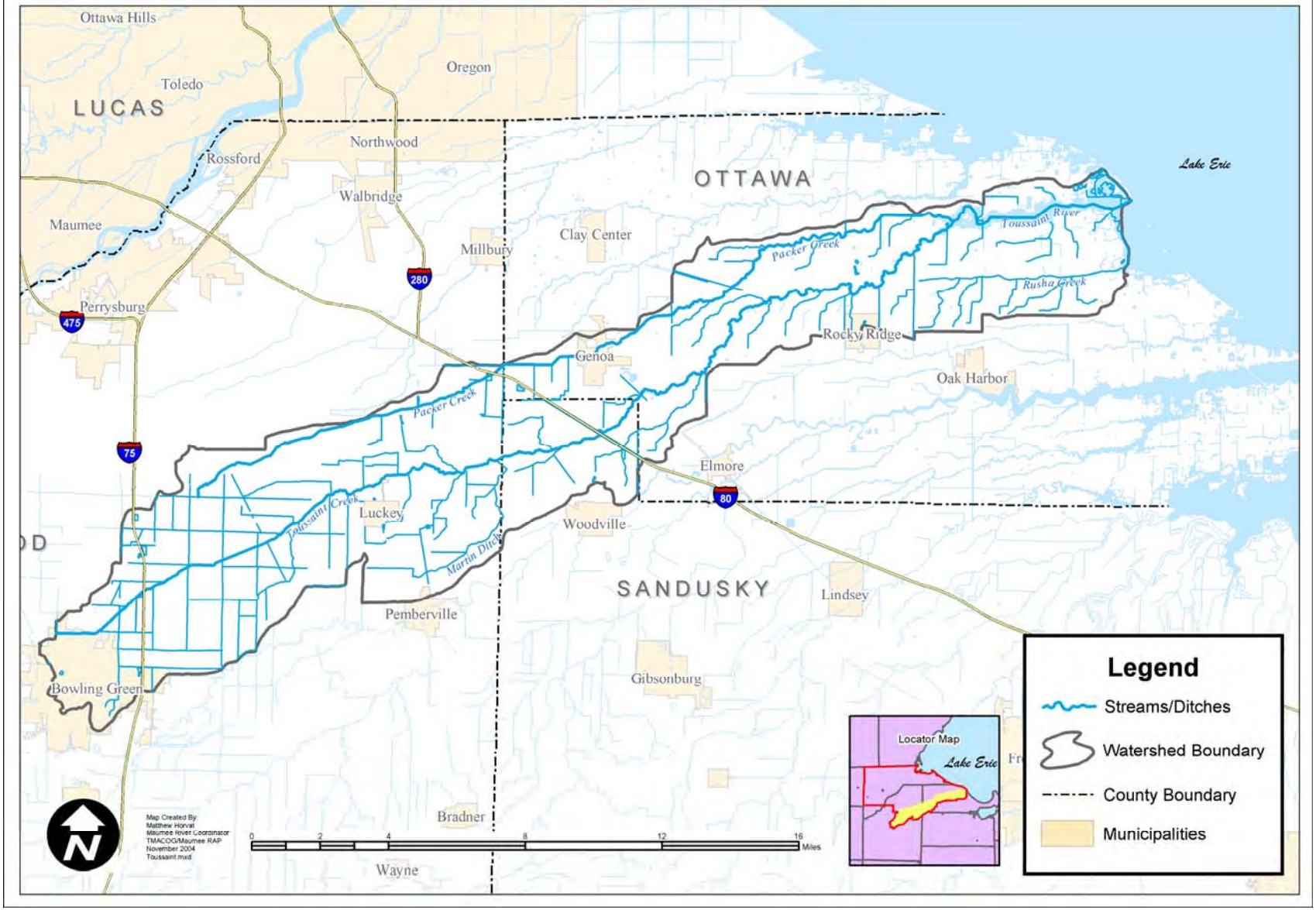
Beneficial Use Impairments	Toussaint River	Packer Creek	Rusha Creek	Reasons/Data Source
BUI 1: Restriction on fish and wildlife consumption	Impaired	Impaired	Impaired	No new data since RAP '93 report
BUI 2: Tainting of fish & wildlife flavor	Not impaired	Not impaired	Not impaired	No data reported
BUI 3: Degradation on fish and wildlife populations	Impaired	Impaired	Unknown	2003 IBI / QHEI data for Toussaint: RM 36.5 = 20/ 25.5 ; RM 28.6 = 27/ 49.5 ; RM 13.9 = 27/ 50.5 ; RM 12.5 = 28/ 34 ; RM 1.7 = 22.5/ -- Rusha Ck @ RM 5.0 = 18/ 29.0 1979 IBI data for RM 20.3 = 36 1987 IBI data for RM 20.3 = 24 1993 IBI data for RM 20.3 = 16
BUI 4: Fish tumors or other deformities	Impaired	Unknown	Unknown	DELTs for Toussaint only 1979 DELT for RM 20.3 = 0.0(5) 1987 DELT for RM 20.3 = 0.4(3) 1993 DELT for RM 20.3 = 2.3(1)
BUI 5: Bird or animal deformities or reproductive problems	Impaired	Unknown	Unknown	
BUI 6: Degradation of benthos	Impaired	Impaired	Impaired	2003 ICI / QHEI data for Toussaint: RM 36.5 = Fair/ 25.5 ; RM 29.4 = 32/ 59.0 RM 13.9 = 24/ 50.5 ; RM 4.7 = 12/ -- Rusha Ck @ RM 5.0 = Fair/ 29.0 2003 ICI / QHEI data for Packer: All values were above 34 or in Good range
BUI 7: Restriction on dredging activities	Impaired	Not applicable	Not applicable	ACOE 2002-3 safety investigation
BUI 8: Eutrophication or undesirable algae	Impaired	Impaired	Impaired	2003 TMDL study – Nutrient enrichment from agricultural fertilizers and failed septic systems.
BUI 9: Restrictions on drinking water consumption, or taste and odor	Not applicable	Not applicable	Not applicable	Not a public drinking water supply
BUI 10: Beach closings	Not impaired	Not impaired	Not impaired	No bacteria impairments in 2003 TMDL assessment, however there are isolated locations with elevated bacteria levels.

Beneficial Use Impairments	Toussaint River	Packer Creek	Rusha Creek	Reasons/Data Source
BUI 11: Degradation of aesthetics	Impaired	Impaired	Impaired	2003 TMDL study - Raw sewage CSOs on Toussaint near Luckey. Failed HSTSs throughout both watersheds
BUI 12: Added cost to agriculture and industry	Unknown	Unknown	Unknown	Davis Besse uses Lake Erie for cooling water source and steam generator. Quality of intake water may be degraded by sediment
BUI 13: Degradation of phytoplankton & zooplankton populations	Not applicable	Not applicable	Not applicable	
BUI 14: Loss of fish and wildlife habitat	Impaired	Impaired	Impaired	Target still being determined

Possible answers – Impaired, Not Impaired, Unknown, Not Applicable

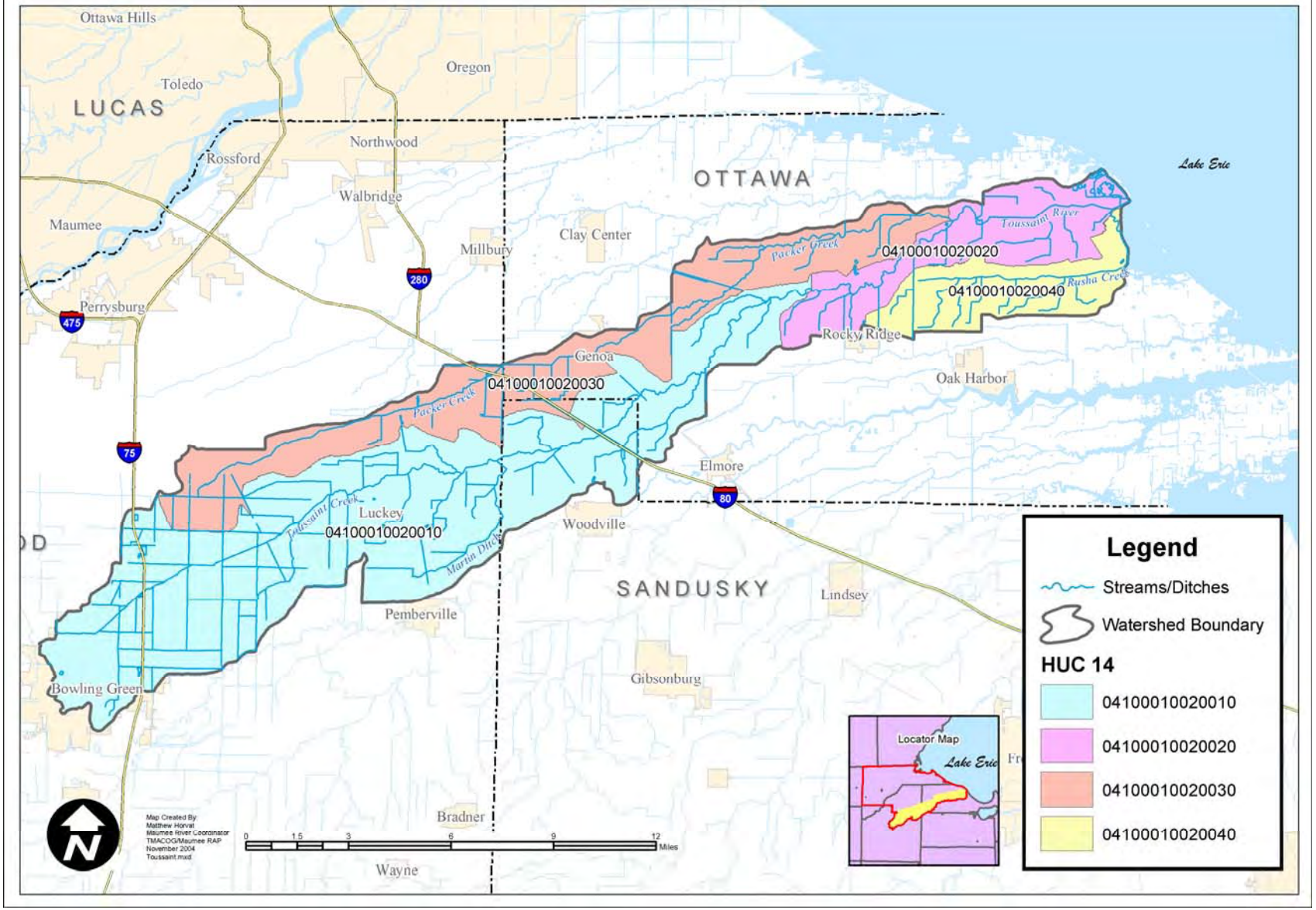
Toussaint River Watershed including Rusha Creek and Packer Creek

HUC 04100010 020



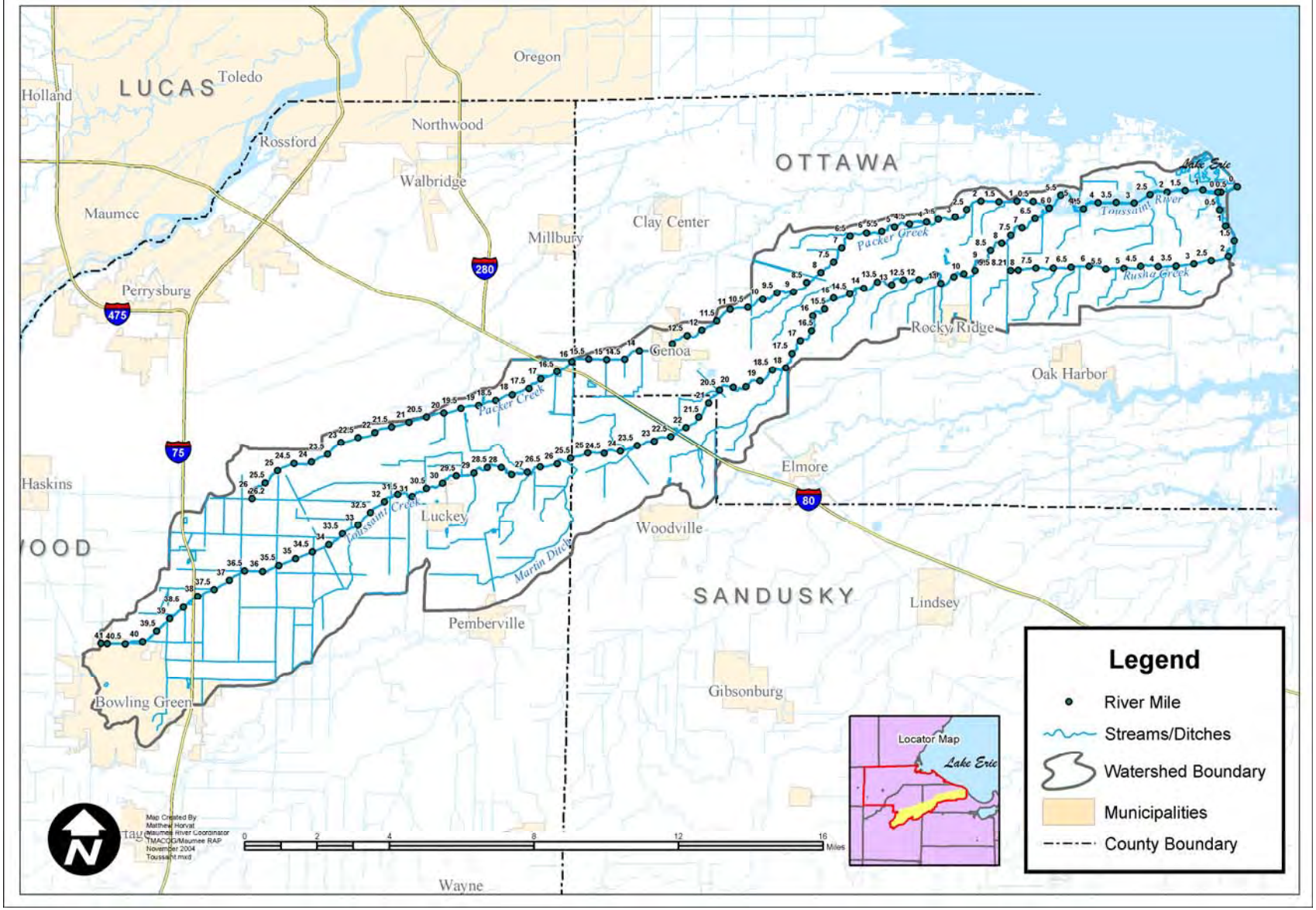
Toussaint River Watershed including Rusha Creek and Packer Creek - 14 Digit Huc

HUC 04100010 020



Toussaint River Watershed including Rusha Creek and Packer Creek - River Miles

HUC 04100010 020



See Volume 2 for the:

- Packer Creek Watershed Projects Table
- Toussaint Creek/Toussaint River/Rusha Creek Watershed Projects Table

References

[1] USDA Natural Resource Conservation Service website: http://www.oh.nrcs.usda.gov/technical/.
[2] "Davis-Besse Nuclear Power Station," brochure Toledo Edison/Centerior Energy Corporation, no date, p 13.
[3] "Beryllium Cleanup Planned," *Sentinel-Tribune*, June 14, 2003.
[4] Ohio EPA, STORET Data, April 2004.
[5] *Delisting Targets for Ohio Areas of Concern*, Ohio EPA, June 2005.
[6] Ohio EPA, STORET Data, April 2004.
[7] *Delisting Targets for Ohio Areas of Concern*, Ohio EPA, June 2005.
[8] *Biological and Water Quality Study of the Toussaint River and Rusha Creek Basins*, Ohio EPA, April 2005.

Appendix A

Acronyms and Abbreviations

This Appendix includes a listing of acronyms and abbreviations used throughout this *Stage 2 Watershed Plan*. If an acronym or abbreviation is not explained within the plan, it should be referenced in this section.

A

ACOE	Army Corps of Engineers
AFO	Animal Feeding Operations
AOC	Area of Concern
AWQMP	Areawide Water Quality Management Plan

B

BGSU	Bowling Green State University
BMP	Best Management Practice
BOD	Biological Oxygen Demand
BUI	Beneficial Use Impairment
BUSTR	Bureau of Underground Storage Tank Regulation

C

CAFO	Confined Animal Feeding Operations
CDF	Confined Disposal Facility
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CNMP	Comprehensive Nutrient Management Plans
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
CSO	Combined Sewer Overflow
CSP	Conservation Security Program
CZM	Coastal Zone Management

D

DEFA	Division of Environmental and Financial Assistance (Ohio EPA)
DELT	Deformities, Eroded Fins, Lesions & Tumors
DNR	Department of Natural Resources

E

EPA	Environmental Protection Agency
EQIP	Environmental Quality Improvement Program

F

FEMA	Federal Emergency Management Agency
FFA	Future Farmers of America
FSA	Farm Services Agency

G

GIS	Geographical Information Systems
GLC	Great Lakes Commission
GLNPO	Great Lakes National Program Office
GLPF	Great Lakes Protection Fund
GLWQA	Great Lakes Water Quality Agreement
GM	General Motors
GREEN	Global Rivers Environmental Education Network
GWAH	Give Water a Hand

H

HELP	Huron/Erie Lake Plains (ecoregion)
HSTS	Home Sewage Treatment System
HU	Hydrologic Unit
HUC	Hydrologic Unit Code

I

IBI	Index of Biotic Integrity
ICI	Invertebrate Community Index
IJC	International Joint Commission

J

K

L

LAMP	Lake Erie Management Plan
LEPF	Lake Erie Protection Fund
LERC	Lake Erie Research Center (University of Toledo)
LRW	Limited Resource Water Habitat
LWD	Low Water Datum

M

MAOC	Maumee Area of Concern
MGD	Million Gallons per Day
mg/l	milligram per liter
MDEQ	Michigan Department of Environmental Quality
MDNR	Michigan Department of Natural Resources
MiWB	Modified Index of Well-Being
MRIC	Maumee RAP Implementation Committee
MRRSWC	Maumee River Regional Storm Water Coalition
MS4	Municipal Separate Storm Sewer System
MWH	Modified Warm Water Habitat

N

NGO	Non-governmental Organization
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service (f.k.a. USDA - Soil Conservation Service)
NWI	National Wetlands Inventory

O

ODA	Ohio Department of Agriculture
ODNR	Ohio Department of Natural Resources
ODOT	Ohio Department of Transportation
OEEF	Ohio Environmental Education Fund
OEPA	Ohio Environmental Protection Agency
O/M	Operation/Maintenance
ORKA	Ottawa River Kleanup Association
ORR-Team	Ottawa River Remediation Team
OSU	Ohio State University

P

PAH	Polyaromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PRP	Potentially Responsible Party
PTI	Permits to Install

Q

R

RAP	Remedial Action Plan
RCRA	Resource Conservation & Recovery Act
RD/RA	Remedial Design/Remedial Action
RI/FS	Remedial Investigation/ Feasibility Study
RM	River Mile

S

SACM	Superfund Accelerated Cleanup Model
SCS	Soil Conservation Service (currently USDA-NRCS)
SDS	Storm Drain Stenciling
SEP	Supplemental Environmental Project
SSES	Sewer System Evaluation Survey
SSI	Screening Site Investigation
SSO	Sanitary Sewer Overflow
SWC	Storm Water Coalition
SWCD	Soil and Water Conservation District

T

TESD	Toledo Environmental Services Division
TLCPA	Toledo-Lucas County Port Authority
TMACOG	Toledo Metropolitan Area Council of Governments
TMDL	Total Maximum Daily Load Limits
TSCA	Toxic Substance Control Act

U

USDA	United States Department of Agriculture
US EPA	United States Environmental Protection Agency
US F&W	United States Fish and Wildlife Service
USGS	United States Geological Survey
UST	Underground Storage Tank
UT	University of Toledo

V

VAP	Voluntary Action Program

W

WIRP	Wetland Identification and Restoration Plan
WPCLF	Water Pollution Control Loan Fund (Ohio EPA)
WPT	Watershed Projects Table
WQS	Water Quality Standards
WRDA	Water Resources Development Act
WRP	Wetland Reserve Program
WRRSP	Water Resource Restoration Sponsorship Program
WWH	Warm Water Habitat
WWTP	Waste Water Treatment Plant

X

Y

Z

Appendix B

Maumee RAP

This Appendix includes organizational documents
and reference materials regarding the Maumee RAP.

(last updated 12/16/05)

MAUMEE RAP COMMITTEE OPERATING PROCEDURES

(as approved by the Maumee RAP on February 10, 2005)

The Maumee RAP is an agreement between federal, state, and local governments with the support of citizens to restore area waters to "fishable and swimmable" conditions. The Maumee RAP Committee has developed a detailed report on present water quality conditions *(Stage 1 Report - 1990)*. The Maumee RAP Committee has also developed a list of what needs to be done to clean up the pollution from the many sources, who needs to do it, how much it will cost, and where the money should come from *(Recommendations Report - 1991)*. Many of those recommendations have been implemented and are documented *(Activities & Accomplishments in the Maumee AOC - 2002).* The Maumee RAP Committee is evaluating its progress and developing a new list of what needs to be done, when, and by whom.

PURPOSE

The Maumee RAP is a community effort to restore the health and beauty of the Maumee River Ecosystem for the benefit of all who live here. The Maumee RAP Committee will coordinate the surveillance and monitoring, evaluation and education, and involvement of the community. It will advise and consult as needed with the TMACOG Board of Trustees and the District Chief of the Ohio Environmental Protection Agency regarding implementation of the recommendations.

COMMITTEE AUTHORIZATION

The Toledo Metropolitan Area Council of Governments, TMACOG, in Article X of the Operating Procedures of the Environmental Council has provided for the Maumee RAP Committee as a standing committee responsible to the TMACOG Environmental Council to assist TMACOG in performance of its duties. The Maumee RAP Committee shall appoint a representative to serve on the Environmental Council.

ORGANIZATION

The Maumee RAP Committee reports directly to the TMACOG Environmental Council. The Maumee RAP Committee will issue an Annual Report on the progress toward restoration of beneficial uses of our natural resources.

MEMBERSHIP

The Maumee RAP Committee is composed of voting members and non-voting ex-officio members. The Chair of the TMACOG Board of Trustees will appoint voting members based upon the nominations made by the existing Maumee RAP Committee. The Maumee RAP Committee will accept nominations and vote on new/renewing members in December of each year. Appointments will be for two year terms commencing in January. Maumee RAP Committee vacancies will be filled within two meetings of the vacancy occurring or the position will be left open until the December nomination/voting period.

In order to ensure representation of all interests, category representation of voting members should be as follows:

Voting Membership Goal	Recommended	Category Representation
7	5	Government Representatives
7	5	Citizen/At Large Representatives
7	5	Business Representatives
21 Total Voting Members		

The Maumee RAP Committee officers are included as representatives of a category, however the Chair of the meeting does not vote, except to break a tie.

Seven members representing each category is the goal. It is recommended that none of the categories have fewer than five voting members. Category memberships are defined as:

Government Members	- Representatives of counties, cities, townships, villages, public school districts, public universities, and special districts and authorities.
Citizen/At Large Members	- Residents, landowners, concerned citizens, including representatives of private non-profit corporations, private schools, and private universities or colleges.
Business Members	- Representatives of industry, commerce, business and other for-profit organizations

One voting member must represent each action group unless the action group does not have enough activity. This will be determined by the Chair.

Individual members may be represented by alternates, but alternates do not have voting privileges, unless designated in writing as a proxy. (See Voting Section)

The RAP coordinators of TMACOG, Ohio EPA, and US EPA; a representative of Ohio DNR appointed by the ODNR Director, and a representative of the Ohio Lake Erie Commission appointed by the Executive Director of the Ohio Lake Erie Commission Office will each have a non-voting ex-officio membership on the Maumee RAP Committee.

Ex-Officio Membership Goal	Ex-Officio Members
1	TMACOG
1	Ohio EPA
1	US EPA
1	Ohio DNR
1	Ohio Lake Erie Commission

MEMBER RESPONSIBILITIES

The members of the Maumee RAP Committee are the decision-making body of the organization. Members are responsible for helping the organization to move toward delisting the Maumee Area of Concern, making operational and fiscal decisions, and engaging the community in improving the water quality of the region. Specific responsibilities include, but are not limited to:

- Active participation at scheduled meetings (bi-monthly) of the Maumee RAP Committee;
- Additional participation in Maumee RAP Action Groups is highly recommended;
- Assistance in cultivating financial contributions are encouraged when possible; and
- Participation in community-wide events to improve water quality.

APPOINTMENT OF OFFICERS

The Maumee RAP Steering Committee will make nominations for the Chair, Vice Chair, and Treasurer positions when those positions are open due to expiring terms or departure from that office. The Steering Committee will then present the nominations to the Maumee RAP Committee for their input. The Maumee RAP Committee will vote on the Chair, Vice Chair, and Treasurer and

will formally send nominations to the TMACOG Environmental Council. Upon appointment by the TMACOG Environmental Council and acceptance by those who are nominated, the positions will be filled for a two year term.

OFFICER RESPONSIBILITIES

The officers of the Maumee RAP Committee are responsible for maintaining the organization's operation and progress. Specific responsibilities include, but are not limited to:

Chair
- Prepare Maumee RAP Committee and Steering Committee meeting agendas;
- Run meetings of the Maumee RAP Committee and Steering Committee;
- Breaking all voting ties; and
- Perform generally all the duties usually incident to such office; and
- Other duties as may be requested by the Maumee RAP Committee.

Vice Chair
- Member of the Finance Committee;
- Assist the Maumee RAP Committee Chair, as needed;
- Perform the Chair's responsibilities when the Chair cannot be available; and
- Perform other duties as may be requested by the Maumee RAP Committee.

Treasurer
- Chair the Finance Committee;
- Act as liaison between TMACOG and Maumee RAP Committee for financial accounting;
- Oversee the development of the annual operating budget and implementation of the fund raising program;
- Present a fiscal report to the Maumee RAP Committee at least semi-annually; and
- Other fiscal duties as may be requested by the Maumee RAP Committee.

Past Chair
- Lend advice, assistance and expertise to other officers and members as needed; and
- Other duties as may be requested by the Maumee RAP Committee.

VOTING

The Maumee RAP Committee is divided into voting and non-voting ex-officio memberships. Any decisions must be approved by a majority of the quorum. Voting by proxy shall be permitted by one assigned alternate for each voting member. Alternates must be assigned in writing (i.e. fax, e-mail) prior to the meeting to vote but only on a specified agenda issues for that meeting. Individuals, including Maumee RAP Committee members, may serve as only one proxy.

An emergency vote can be held at the request of a Maumee RAP Committee officer when an action is needed prior to the next regularly scheduled meeting. Any necessary information will be disseminated to members and a response must be received in writing (i.e. fax, e-mail). Phone votes are not acceptable.

ATTENDANCE
Attendance for all Maumee RAP Committee meetings by voting members is expected. If a voting member cannot attend, an alternate is encouraged to attend so that member may be informed of the meeting proceedings. Alternates may vote if they are the member's assigned proxy. After three consecutive unexcused absences the Chair of the Maumee RAP Committee may remove a member.

QUORUM
A quorum shall consist of 50% of the current RAP voting membership +1.

MEETINGS
The Maumee RAP Committee Chair shall schedule meetings bi-monthly or more frequently as needed. The Maumee RAP Committee Chair, Vice-Chair, a majority of the Steering Committee, or at least five members of the Maumee RAP Committee may call emergency meetings of the Maumee RAP Committee. The Maumee RAP Committee will comply with TMACOG policy on the Ohio Open Meeting Act, thus all meetings are open to the public.

MEETING PROCEDURES
The meetings shall be conducted in an orderly manner at the direction of the Maumee RAP Committee Chair. The Committee may institute Robert's Rules of Order upon a majority vote. The minutes shall include motions made, actions taken, votes, and attendance.

The Chair, in cooperation with the Steering Committee, shall prepare the agenda. Notice of all meetings and materials to be considered shall be mailed to each member at least 7 days prior to the meeting. An annual meeting schedule for the coming year will be established by the last meeting of the year.

SUBCOMMITTEES
The Maumee RAP Committee shall establish the Steering Committee as a standing subcommittee that is responsible for the overall direction of the RAP process and the Maumee RAP. This Committee will be called upon to further analyze particular subjects or issues on an *as needed* basis. It will be composed of the officer of the Maumee RAP Committee and the Chair of each Action Group. The Steering Committee will also include the non-voting ex-officio representatives from US EPA, the Ohio EPA, Ohio DNR, and TMACOG. The Maumee RAP Committee Chair may appoint additional people to the Steering Committee.

The Maumee RAP Committee shall establish the Finance Committee as a standing subcommittee that is responsible for the overall financial matters of the Maumee RAP. This committee will be called upon to develop and monitor an annual operating budget, to develop and implement a fund raising program, and to track and evaluate receipts and disbursements. It will be composed of the Maumee RAP Committee Treasurer (Finance Committee Chair), plus the current Maumee RAP Vice-Chair and three other individuals selected at large that do not have to be voting members of the Maumee RAP Committee. All members will serve for a renewable two year term. The three at large Finance Committee members are to be appointed by the Maumee RAP Committee Chair with the endorsement of the Maumee RAP Committee. The Finance Committee will also include ex-officio representatives from the Ohio EPA and TMACOG. The Finance Committee may have additional resource members to assist with Finance Committee responsibilities.

The Maumee RAP Committee may also establish Action Groups and other subcommittees as necessary for the conduct of its business. Such Action Groups may include individuals who are not

members of the Maumee RAP Committee and who are helpful in conducting the business of the Action Group. The Maumee RAP Committee Chair shall appoint the Chair of each Action Group based upon the recommendations of the Action Group.

ACTION GROUP CHAIR RESPONSIBILITIES

The Chairs of the Maumee RAP Action Groups are the responsible for moving the Maumee RAP towards delisting the Area of Concern through projects conducted by their Action Group. Specific responsibilities include, but are not limited to:

- Coordinate the operations of their action group (i.e. organize and announce meetings, maintain records of attendance and minutes, facilitate the development and implementation of projects and activities);
- Participate as an active membership on the Maumee RAP Committee and Maumee RAP Steering Committee; and
- Facilitate the sharing of information and resources between the various levels and committees of the Maumee RAP.

OPERATING BUDGET

The Maumee RAP will conduct fiscal business based on a calendar year. The Maumee RAP's proposed Annual Operating Budget for the upcoming fiscal year will be presented by the Finance Committee to the Maumee RAP Committee in October of each year. A formal vote for adoption will be held in December each year.

All Maumee RAP receipts must pass through the Finance Committee for their allocation to the appropriate Maumee RAP account. The Finance Committee will consult with the Maumee RAP Steering Committee to determine the appropriate allocation for any receipt over $10,000.

FISCAL APPROPRIATIONS

Approved Operating Budget Expenditures:

TMACOG may disburse funds as outlined in the Maumee RAP Approved Operating Budget without consulting the Maumee RAP Committee. Direct Project Expenditures (as outlined in the approved Operating Budget) are contingent upon meeting fund raising goals. All project disbursements should be verified with the Maumee RAP Treasurer to ensure the availability of funds. Prior to purchasing any items or services, a purchase order must be obtained from TMACOG.

It may be necessary to change approved budget allocations based on program/project needs and/or funding availability. The Finance Committee is responsible for monitoring the status of receipts and disbursements and making recommendations for budgetary changes. All Operating Budget changes must be approved by a majority vote of the Maumee RAP Committee.

Restricted Account Expenditures:

Only the Maumee RAP Committee has the authority to approve Restricted Account expenditures over $500. If an expenditure request is $500 or more, it should be presented in writing to the Finance Committee. The Finance Committee will review and make a recommendation to the Maumee RAP Committee. The Maumee RAP Committee will consider the Finance Committee's recommendation and vote to approve/disapprove the request.

The Finance Committee has the authority to approve any expenditures less than $500, or they may defer it to the Maumee RAP Committee. If an expenditure request is less than $500, it should be

presented in writing to the Finance Committee for their review and approval/disapproval. The Finance Committee's decision may be appealed to the Maumee RAP Committee.

All expenditures less than $200 may be approved by the Treasurer (or their assigned alternate), or they may defer it to the Maumee RAP Committee. If an expenditure request is less than $200, it should be presented to the Treasurer (or their assigned alternate) for their review and approval/disapproval. The Treasurer's decision can be appealed to the Finance Committee.

All expenditures $500 or less must be reported to the Maumee RAP Committee at the next regularly scheduled meeting.

REVIEW & AMENDMENTS

These Operating Procedures should be reviewed at least every two years, however they may be amended at any time by a 2/3 majority vote of the voting members. They must be ratified by the TMACOG Environmental Council and adopted by the TMACOG Executive Committee.

CONSTRUCTION AND SEPARABILITY

Each provision herein set forth shall be construed, if possible, in a manner consistent with the laws of the United States of America and the States of Ohio and Michigan and the Bylaws of the Toledo Metropolitan Area Council of Governments. If, and to the extent that any provision shall be deemed in conflict with any such law or bylaw, such provision shall be void, but each provision shall be deemed separable from every other provision, and its invalidity shall not affect any other.

Approved:
Maumee RAP Committee

_____
Paul Hotz, Chair
Date: February 10, 2005

Approved:
TMACOG Environmental Council

_____
Kenneth Fallows, Chair
Date: _____

Approved:
TMACOG Board of Trustees

_____
Ken Fallows, Chair
TMACOG Executive Committee
Date: _____

Approved:
TMACOG

_____
Anthony Reams, President
Toledo Metropolitan Area Council of Gov'ts
Date: _____

Maumee RAP
Graphic and Publication Standards

(As approved 6/12/03)

The Graphic and Publication Standards for the Maumee RAP has been created utilizing the standards of Ohio EPA, TMACOG and several other Maumee RAP Partners. A common message among the graphic and publication standards of Maumee RAP Partners was the need for clear, consistent, and simple messages. These Maumee RAP standards have been created to achieve this. This document describes how the Maumee RAP logo, letterhead, and publications should be created, reviewed, and released. These standards should be followed by all partners of the Maumee RAP.

Logo and Tag Line

The Maumee RAP logo was redesigned in 1998 to better reflect the commonly used acronym "RAP," rather than "remedial action plan." Elements were included to reflect the mission of the Maumee RAP. The waves and cattail illustrated the interest in water and land related issues. The tag line highlights the Maumee RAP as a collaborative organization that works with all sectors to improve water quality.

The logo may be used without the tag line. However, the preferred use of the Maumee RAP Logo is with the tag line in the two-color format. Due to often limited resources, it is expected that the one-color format will be most commonly used.

Two-Color Logo Specifications:

The only two official colors to be used for the Maumee RAP logo are PMS #293 and Process Blue. (PMS stands for Pantone Matching System and is used by print house and graphic firms to match inks.)

PMS #293 is to be used for the words "Maumee RAP." "Maumee RAP" is a text element of the logo and is not to be used as a logo without the other graphic elements.

Process Blue is to be used for the graphic elements of water, land, and the cattail. These graphic elements may be used as design pieces separate from the logo.

PMS #293 is to be used for the tag line "Partnering for Clean Streams". The words "Partnering for Clean Streams" may be used as a part of the logo or separate. If used graphically, they are to be in all capitals and in Arial regular.

The image below shows the 2-color logo, its elements, and how they should be positioned relative to each other. The size of the logo can change, however the proportions should always remain the same. The logo should not be distorted or stretched.

One –Color Logo Specification:
When the Maumee RAP logo is used in the one color format it is preferred to be in PMS #293, Process Blue, Black or White (for use on a dark background).

All elements (text and graphics), including tag line, are to be used in the same color. If it is possible to use a screen of the selected color, then a 20% screen should be used for the graphic elements and the 100% screen for the text elements.

All other font and format requirements for the logo and tag line are the same as described under the Two-Color Use Specifications.

The images below show several two-color and one-color logo options and how the elements should be colored and positioned relative to each other.

Publications

For purposes of this manual, publications include pamphlets/brochures, leaflets, fact sheets, slide shows, all newsletters, reports and executive summaries produced for the public or which may be widely read by the public, including general and regulated audiences. Publications may be developed for print, computer-based presentations or Internet usage. Publications do not include press releases, letters, memos or papers submitted to scientific journals. Publications can be created

by any Maumee RAP Partner for use by the Maumee RAP, provided the standards in this document are followed.

Design of Publications
In order to allow for creative and exciting publications to be produced, there are very few restrictions on publication layout. Maumee RAP publications should be to inform, invite, educate, involve and/or explain the issues, problems, activities and projects in the Maumee Area of Concern. If the content or design of any publication is considered questionable, it may need to be reviewed of the Maumee RAP Committee before it can be duplicated or released.

The Maumee RAP logo and contact information should be on all publications. At a minimum the web address (www.maumeerap.org) and a contact phone number should be included.

Any publication with significant* monetary or in-kind support from another Maumee RAP Partner may also reference the partner(s) by name or by logo, as appropriate. If a publication was supported by a grant, then all contract requirements for funding source recognition must be followed.

The Ohio EPA and TMACOG logos should appear on all official Maumee RAP documents that are published to meet the requirements of the RAP Process (i.e. Stage 1 Report, Stage 2 Report, Progress Reports, etc.) Additionally, these agencies should be represented by name or logo whenever it is possible with out distracting the focus from the Maumee RAP or the involvement of other Maumee RAP Partners.

Any Maumee RAP Partner, including Ohio EPA and TMACOG, may request to have their organization name or logo omitted from any publication for any reason.

* For purposes of these standards, “significant” is considered to be 20 percent or more of the total project costs including cash, materials and in-kind services or donations.

Review and Release of Publications
When creating publications, it is preferable to have either the Ohio EPA or TMACOG (Maumee RAP/River Coordinators) review any materials being mass distributed for content and design accuracy. To expedite this review, contact Ohio EPA and TMACOG in the planning and development process of any publication project. If the content or design of any publication is considered questionable, then it may require the approval of the Maumee RAP Committee before it can be duplicated or released.

At least one copy of all mass distributed publications should be provided to Ohio EPA and TMACOG for historical recordkeeping.

All publications produced by the Maumee RAP are consider “public domain” and may be reproduced without permission. When possible the organization(s) reprinting the publication should be asked to cite the Maumee RAP as the source, however this is not required.

Maumee RAP Letterhead
The Maumee RAP has two forms of official letterhead; one for general use and one for financial use.

Design and Use of General Letterhead
The Maumee RAP General Letterhead should prominently include the Maumee RAP logo. It should also include mailing address, phone, web page URL, etc. The Ohio EPA and TMACOG logos will also be on the Maumee RAP letterhead to show the lead support and responsibility of these agencies. These logos should be displayed in a less prominent manner than the Maumee RAP logo.

Maumee RAP General Letterhead can be used for official Maumee RAP correspondence that represents the position of the Maumee RAP Committee or one of its action groups. It is not to be used to express personal opinions or positions.

Design and Use of Financial Letterhead
The Maumee RAP Financial Letterhead should prominently include the Maumee RAP logo. It should also include mailing address, phone, web page URL, etc. The TMACOG logo will also be on the Maumee RAP letterhead to show their fiscal and 501(c)3 support.
The Ohio EPA logo does not appear on this or any other fiscal publications. The TMACOG logo should be displayed in a less prominent manner than the Maumee RAP logo.

Maumee RAP Financial Letterhead can be used for official Maumee RAP financial correspondence, such as fundraising, solicitation of sponsors or services, or any other similar activity.

Ohio EPA/TMACOG/Maumee RAP
Relationship Report

(As approved June 2003)

Background: As the Maumee RAP process matured and moved more into an implementation mode, questions began to arise concerning the identity of the Maumee RAP and the nature of the structure under which it was functioning. The Ohio Environmental Protection Agency (Ohio EPA), the Toledo Metropolitan Area Council of Governments (TMACOG), and the Maumee RAP Implementation Committee (now called the Maumee RAP Committee) discussed these issues and concerns at length at a meeting held on March 30, 1998 with representatives from all three groups. We agreed at the conclusion of that meeting that representatives from each of the three groups would meet to clarify the relationship of these organizations with the goal of making the Maumee RAP more effective. Two to three representatives from Ohio EPA, TMACOG, and the Maumee RAP met monthly from April 1998 through August 1998 and submitted a report (*Ohio EPA/TMACOG/Maumee RAP Report to the Ohio Environmental Protection Agency, the Toledo Metropolitan Council of Governments Executive Committee, and the Maumee RAP Implementation Committee*, Dec. 7, 1998) that outlined recommendations which were subsequently approved by all three organizations in December, 1998.

In September 2002 this group met to further discuss issues relating to the relationship of Ohio EPA, TMACOG and the Maumee RAP. After reviewing the previous relationship document, the Relationship Committee has made changes that reflect the current status of the relationships and would like to submit for approval the following recommendations:

1. Identity

   The Maumee RAP is not well known in the community and needs to strengthen and clarify its image.

   A. Promote the term "Maumee RAP" to make it a household word.
   B. Whenever possible utilize a statement that describes the partnership aspects of the Maumee RAP in the context of its goals to improve water quality. For example, "Maumee RAP is a community based partnership involving citizens, businesses, and governmental agencies to restore the health and beauty of our local waterways."
   C. The Public Outreach and Education Action Group of the Maumee RAP should develop a set of graphic and other standards for the Maumee RAP newsletter, publications, brochures, etc. to uphold high standards of readability, professionalism and consistency that can be used by and with Maumee RAP members.

2. Communication

   All organizations should continue to assess Ohio EPA/TMACOG/Maumee RAP relations. Communication between the Maumee RAP, Ohio EPA and the TMACOG will be a shared responsibility.

   A. TMACOG should recognize Maumee RAP volunteers.
   B. Maumee RAP members should be encouraged to attend TMACOG General Assemblies and other TMACOG activities to seek opportunities to discuss Maumee RAP issues.
   C. Members of the TMACOG Board, Executive Committee and Environmental Council should be encouraged to attend Maumee RAP activities.
   D. The Maumee RAP, Ohio EPA, and TMACOG should encourage participation by elected officials in Maumee RAP activities.

3. Interaction

   As the Maumee RAP, Ohio EPA and TMACOG work together to fulfill the Maumee RAP mission, the interactions of the many groups of the organizations should follow prescribed procedure.

   A. The organizations (their boards, councils, committees and actions groups) should comply with the methods of interaction that are detailed in the most recently approved Maumee RAP Operating Procedures.

B. TMACOG and Ohio EPA will share responsibilities for staffing Maumee RAP committees and action groups. The division and extent of these shared responsibilities should be reviewed as necessary.

4. Decision Making

The Maumee RAP can be faced with difficult issues. The Maumee RAP, Ohio EPA and TMACOG recognize that there are different ways to deal with these issues.

A. Independent Actions:

I. Maumee RAP action groups are able to and encouraged to undertake any activity or support any position when it is consistent with the goals, purposes and actions of the Maumee RAP as outlined in any Maumee RAP approved document.

II. Action groups should keep the Maumee RAP Committee informed about activities of the group.

B. Partnered Actions:

I. There are at least three ways to handle a controversial issue:

i. Hold an educational meeting with presentations/discussions of varying opinions about the issue.

ii. Work toward consensus with all parties involved. This will result in the action group, the Maumee RAP Committee, and/or TMACOG and Ohio EPA taking joint action.

iii. Take a firm position and, if appropriate, initiate a resolution in accordance with Maumee RAP documents and operating procedures.

II. The Maumee RAP Steering Committee should act as a Quick Response Team (QRT) to manage an issue on short notice that is sensitive or politically difficult.

5. Funding

TMACOG will be the fiscal agent for the Maumee RAP and representatives from Ohio EPA and TMACOG will be ex-officio members of the Maumee RAP Finance Committee.

A. Budgeting:

I. The Maumee RAP Finance Committee will be responsible for financial issues as outlined in the most recently approved Maumee RAP Operating Procedures.

II. Ohio EPA and TMACOG should report their financial support of staffing for Maumee RAP to the Maumee RAP Finance Committee annually.

B. Fund Raising

I. Ohio EPA staff time and the Ohio EPA logo and name may not be used for fund raising purposes. The logo will not appear on any fundraising literature.

II. The TMACOG logo will appear on fundraising literature to verify the fact that TMACOG provides 501(c)3 status for the Maumee RAP.

Finally, the current Ohio EPA/TMACOG/Maumee RAP Relationship Committee will meet as needed to review progress of this agreement and to resolve any relationship issue.

2006 Maumee RAP Committee Members

Business (5)	
Expires Dec. 31, 2006	Frank Beodray, Weston Solutions Jeff Culver, Eastman & Smith Ltd. Amy Joyce, DaimlerChrysler Rod Miller, Pilkington
Expires Dec. 31, 2007	Paul Hotz, TolTest, Inc.
Government (7)	
Expires Dec. 31, 2006	Tim Bollin, Toledo Public Schools Jim Carter, Wood Soil and Water Conservation District *- Chair, Rural and Agricultural Runoff Action Group* Jeff Garbarkiewicz, Lucas Soil and Water Conservation District *- Chair, Swan Creek Action Group* Sue Horvath, Toledo Area Metroparks/Duck & Otter Creeks Partnership Scott Sibley, City of Toledo, Dept. of Public Utilities *- Chair, Urban Runoff Action Group*
Expires Dec. 31, 2007	Michelle Grigore, City of Bowling Green Parks and Recreation Patrick Lawrence, The University of Toledo
Citizens & At-Large (6)	
Expires Dec. 31, 2006	Sandy Bihn Lou Glatzer Jennifer Huber *- Chair, Public Outreach and Education Action Group* Terry Shankland Don Yark
Expires Dec. 31, 2007	Kristina Patterson, Duck and Otter Creeks Partnership
Chair (1)	Patrick Lawrence, The University of Toledo
Term expires	Dec. 31, 2007
Vice-Chair (1)	Michelle Grigore, City of Bowling Green Parks and Recreation
Term expires	Dec. 31, 2007
Treasurer (1)	Michelle Grigore, City of Bowling Green Parks and Recreation
Term expires	Dec. 31, 2007
Ex-Officio	Dave Barna, Maumee RAP Liaison, US EPA - Cleveland Office Cherie Blair, Maumee RAP Coordinator, Ohio EPA - NWDO Matt Adkins, Coastal Nonpoint Program Coordinator, Ohio DNR Matt Horvat, Lower Maumee River Watershed Coordinator, TMACOG Ed Hammett, Executive Director, Ohio Lake Erie Commission
Env. Council Rep .	Lou Glatzer
Term expires	Dec. 31, 2006

(updated 12/16/05)

Appendix C

Duck and Otter Creeks Partnership, Inc

This Appendix includes organizational documents and reference materials regarding the Duck and Otter Creeks Partnership, Inc.

(last updated 1/20/06)

Duck and Otter Creeks Partnership Charter

The Duck and Otter Creeks Partnership promotes human and ecological health through education, protection, and restoration of these watersheds with diverse collaborative efforts dedicated to building community stewardship.

In striving to implement this mission, the Partnership has developed this Charter which outlines the premise of the Partnership and indicates the commitment of all the involved Partners to achieve the stated purpose, within their respective constraints.

The Partnership is a voluntary non-profit organization whose members include citizens, local businesses, industries, government agencies, institutions, and public organizations, formed to address the mission and purpose stated above.

The signatories are a consensus-based partnership and have established the following objectives intended to fulfill the mission and purpose of the Partnership:

* Define the issues to be addressed to achieve the stated mission of the Partnership. This will be done utilizing the existing data and any additional data that may be obtained in the future.

* Develop a detailed (dynamic) plan of action to address the issues identified. To devise this plan, the Partnership will explore various potential options, which are environmentally sound and balanced with economic considerations.

* Identify resource needs for the implementation of the action plan. An undertaking of this magnitude may be expansive and require significant resources.

* Generate a sequence of activities for implementation of the action plan. This will provide a framework for the Partners to evaluate the effectiveness of the project.

The following by signing this Charter, agree to volunteer their available time, resources, knowledge, technical skills, and efforts, to advance the mission, purpose, and objectives of the Partnership. This commitment will include attending meetings, participating in document development, and planning for the implementation of the Partnership objectives. This Charter is a public statement of intent designed to foster good faith among the parties. It is understood and agreed by the undersigned that this Charter shall not legally bind any one or any organization to this or any other agreement. This agreement does not limit or in any way restrict the statutory or contractual obligations of the signatories in carrying out their private and/or public responsibilities nor does it commit to any particular participation absent separate written agreement thereto.

Charter Organization: _____

Charter Member Signature: _____

Charter Member Name (please print): _____ *Date:* _____

Duck and Otter Creeks Partnership, Inc.

BYLAWS

ARTICLE I
Name and Purpose

This nonprofit organization will be known as the Duck and Otter Creeks Partnership, Inc. The Partnership has been formed for the purpose of promoting human and ecological health through education, protection, and restoration of these watersheds with diverse collaborative efforts dedicated to building community stewardship

ARTICLE II
Membership

The Duck and Otter Creeks Partnership, Inc. hereinafter referred to as the "Partnership," shall be composed of representatives who have a common interest in accomplishing the mission of the Partnership as defined in its Charter. Signing the charter and paying dues is a condition of voting membership and each individual and/or organization signing the Charter will have one membership vote. Individuals and/or organizations that do not sign the Charter may participate in the Partnership as non-voting members. Any resignations shall be in writing and acknowledged for documentation in the minutes at the next regularly scheduled Partnership meeting. Membership entitles the individual and/or organization to attend all meetings and/or events of the Partnership. Any request for financial support from a member may be approved or disapproved by the member for each specific funding request. Under no circumstances will a financial obligation for the requested funds be made by the Partnership prior to obtaining the necessary approval from the individual and/or organization being solicited.

Individuals or organizations that do not wish to vote can join the Partnership with limited rights under the status of Friends of Duck and Otter Creeks Partnership. They will not have a vote and will have reduced membership dues. Friends of Duck and Otter Creeks Partnership are eligible, but not required, to attend meetings and serve on committees.

ARTICLE III
Leadership

All officers of the Partnership must be voting members. The officers of the Partnership (Chair, Vice-Chair, Treasurer and Secretary) shall manage the Partnership assisted by the staff of the Partnership.

Election of the Partnership officers shall take place at a regular committee meeting in January of every other year for a two-year term. Any vacancy of a Partnership office shall be filled by a vote of the Partnership members for the remainder of the unexpired term.

The Partnership Chair shall preside at all meetings of the Partnership, sign the records thereof, and perform generally all the duties usually incident to such office, and such other duties as shall be from time to time required by the Partnership.

The Vice-Chair shall perform the Chair's responsibilities when the Chair cannot be available, report to Partnership Chair and perform other responsibilities required by the Partnership.

The Treasurer shall maintain all financial records and administer fiscal matters of the organization. The treasurer shall receive and disburse all funds for the Partnership activities, file all necessary reports for the expenditures made, and prepare draft operating budgets for the following year. The Treasurer shall prepare a fiscal report to be submitted to the Partnership at least quarterly, and shall generally perform such other fiscal duties as may be required by the members. At the expiration date of the term of office the Treasurer shall deliver all books, records, and property of the Partnership to the successor or to the Chair of the Partnership.

The Staff shall be responsible for preparing and distributing all external communications of the Partnership. The Staff shall keep minutes of all Partnership proceedings and make a proper record of the same, which shall be reviewed and approved by the Secretary and sent to the members of the Partnership at least one week prior to the next regular meeting. The Secretary shall generally perform such other duties as may be required by the members. At the expiration of the term of office, the Secretary shall deliver all books, records, and property of the Partnership to the successor or to the Chair of the Partnership.

ARTICLE IV
Committees

It is anticipated that, from time to time, ad hoc committees and standing committees will be appointed and approved by the Partnership. Such committees may consist of Charter signing (voting) and non-Charter signing (non-voting) members. Each operating committee shall be responsible for submitting and attesting minutes and status reports of their respective committee meetings to the Partnership at the next regularly scheduled meeting.

The Steering Committee shall be a standing committee of the Partnership.

The finances of the Partnership will be supervised by the Steering Committee.

The Steering Committee shall be comprised of: the Chair and/or Vice-Chair, the Treasurer and representatives from business and individual members for a total of five (5) members. Steering Committee meetings are open for all members to participate at-will. The duties of the Steering Committee shall include, but are not limited to:

- advise the staff, as needed, pertaining to administration issues
- guide the staff activities so they support the mission of the Partnership
- provide performance reviews for the staff at least semi-annually
- determine merit increases for the staff
- give approval for the pursuit of alternative funding opportunities for projects previously approved by the Partnership
- give authority for staff to undertake leadership positions in other organizations
- Steering Committee members will be appointed with approval by the full board for a term of two-years. Terms can be renewed.
- approve all proposals for expenditures over $ 500.00 and less than $ 5000.00.

ARTICLE V
Meetings

Notice of all Partnership meetings, including the Steering Committee, shall be given at least seven (7) days before the date of such meeting to each member by mail, fax or E-mail at their last known address, and all such notices shall state the time, place and purpose of the meeting. Partnership meetings and committee meetings shall be held at a frequency to ensure schedules and goals of the

Partnership are met, but not less than semi-annually for the Partnership and quarterly for committees. Any member may waive any notice required under these regulations, and by attendance at meetings, shall be deemed to have waived notice thereof.

Special meetings may be called from time to time in accordance with notification, exclusive of the seven (7) day advance notice with the concurrence of the Partnership officers.

A quorum at Partnership meetings shall consist of 50% or 9 of the voting memberships, whichever is less, with a majority vote required for approval.

Attendance by voting members is expected because each voting member's opinion is important in gaining a consensus. However, if a voting member can not attend, the member may send a written proxy to vote on specific agenda items prior to the conclusion of the meeting.

All interested individuals may participate in all Partnership meetings, but Partnership decisions requiring membership input shall be made by a majority vote of voting members, each having one vote.

Committee members, regardless of Partnership voting status, may vote on committee issues as necessary with majority vote ruling. An affirmative committee vote may require a corresponding recommendation to the Partnership, which may then vote to accept or reject the committee recommendation with a majority vote ruling.

The Steering Committee is responsible for approving all proposals for expenditures over $ 500.00 and less than $ 5000.00. All expenditures $ 500.00 or less shall be approved by the Treasurer and the authorized checking account signer. The Steering Committee will recommend approval or disapproval of all proposed expenditures of more than $ 5000.00 to the membership. Proposed expenditures over $ 5000.00 require approval of 75% or more of the voting members.

Minutes shall be recorded and voted on for approval in the next regular meeting. Minutes shall serve as an official record of the Partnership.

Meetings shall be conducted in general accordance with Robert's Rules of Order: The Modern Edition, except where otherwise stated in the bylaws.

ARTICLE VI
Amendment of Bylaws

These Bylaws will be reviewed at least biennially and may be amended, suspended, repealed, or superseded, in whole or in part, only by a majority vote of no less than two-thirds of the members.

Revised – July 15, 2004
(Mission statement updated January 19, 2006)

Duck and Otter Creeks Partnership, Inc.

Leadership and Membership

(as of November 2005)

Board Officers
Susan Horvath, Chair (citizen)
Vice-Chair, Eric Montgomery (Sunoco)
Sandy Bihn, Treasurer (citizen)
Paul Fletcher, Secretary (Jones & Henry Engineers)

Steering Committee
Eric Montgomery
Susan Horvath
Tom Kiger
Sandy Bihn
Lynn Ackerson

Charter Signing/Voting Members
City of Oregon
City of Toledo
City of Northwood
Bowser-Morner, Inc.
The Mannik and Smith Group
Hull & Associates, Inc.
Jones & Henry Labs
Jones & Henry Engineers
GEC, Inc. (The Geoenvironmental Consortium, Inc.)
University of Toledo Lake Erie Research Center
Envirosafe Services of Ohio
Evergreen Recycling and Disposal Facility
BP Amoco
Sunoco
Pilkington North America
Susan Horvath (private citizen)
Frank Reynolds (private citizen)
Bill Katakis (private citizen)
Sandra Bihn (private citizen)
Don Scherer, Ph. D. (private citizen)
Lynn Ackerson (private citizen)
Phil Blosser (private citizen)
Steve Bartha (private citizen)

Non-Voting Participants*
Ohio EPA
US EPA
Ohio Department of Natural Resources
The Ohio State University Extension
CSX Transportation represented by ARCADIS
Toledo-Lucas County Health Department
Toledo Metropolitan Area Council of Governments (TMACOG)
Maumee RAP

**Note: This is only a partial list*