Upper Maumee River
Watershed Management Plan
HUC 04100005

Prepared in Cooperation With:

Allen County Soil and Water
Conservation District
3718 New Vision Drive
Fort Wayne, IN 46845
260.484.5848 ext.3
Greg.Lake@allenswcd.org

Defiance County Soil and Water
Conservation District
06879 Evansport Road Suite C
Defiance, OH 43512
419.782.1794
swcd@defiance-county.com

Prepared By:

SNRT, Inc
Natural Resource Group

With Guidance from the Upper Maumee River Watershed Project Steering Committee

Principle Author: Kyle Quandt
5000 E 100 S
LaGrange, IN 46761

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Greg Lake	District Director	Allen County SWCD
Sharon Partridge-Domer	Watershed Project Manager	Allen County SWCD
Jill Krause	Watershed Project Manager	Allen County SWCD
Jason Roehrig	District Administrator	Defiance County SWCD
Stephanie Singer	Upper Maumee Watershed Coordinator	Defiance County SWCD
Jennifer English	Urban Stormwater Specialist	City of Defiance
Tim Bomba	Allen County, District Conservationist	Natural Resource Conservation Service
Jennifer Thum	Former Watershed Project Manager	Allen County SWCD
Nicole Grindley	Former Upper Maumee Watershed Coordinator	Defiance County SWCD
Hicksville Community Hospital	Provided Meeting Space	
Village of Hicksville	Provided Meeting Space	
Greg Nageotte	Watershed Program Manager	ODNR Divison of Soil and Water Resources
Joe Schmees	Watershed Specialist	IDEM, Office of Water Quality Watershed Planning and Restoration Section
George Warnock	Grand River Watershed Coordinator	Western Reserve Land Conservancy
Rick Wilson	Program Staff	Ohio EPA, CWA§319 NPS Grant Program
Tyler Miller	District Technician	Defiance County SWCD

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ACE	Army Corp of Engineers
AFOs	Animal feeding operations
AU	Assessment Unit
BMPs	Best Management Practices
BUSTR	Bureau of Underground Storage Tank Regulations
CAFF	Confined Animal Feeding Facility
CAFOs	Concentrated Animal Feeding Operations
CFOs	Confined Feeding Operations
cfu	Colony-Forming Unit
CNPCP	Coastal Nonpoint Pollution Control Plan
CPWSS	Community Public Water Supply Systems
CSO	Combined Sewer Overflow
CWA	Clean Water Act
DMR	Discharge Monitoring Report
DNR	Department of Natural Resources
DO	Dissolved oxygen
DRP	Dissolved Reactive Phosphorus
FCAs	Fish Consumption Advisory
HEL	Highly Erodible Land
HUC	Hydrologic Unit Codes
IDEM	Indiana Department of Environmental Management
IFM	Industrial Fluids Management
IN	Indiana
INDOT	Indiana Department of Transportation
IPFW	Indiana University-Purdue University, Fort Wayne
IR	Integrated Report

LTCP	Long Term Control Plan
LUSTs	Leaky underground storage tanks
MCL	Maximum Contaminant Level
MCM	Minimum Control Measures
mg/L	Milligram per Liter
MGD	Million gallons per day
mIBI	Macroinvertebrate Index of Biotic Integrity
MRBC	Maumee River Basin Commission
MS4	Municipal Separate Storm Sewer System
MWWH-C	Modified Warm Water Habitat-Channelized
NFA	No Further Action
NGOs	Non-governmental Organizations
NOAA	National Oceanic and Atmospheric Administration
NPDESP	National Pollution Discharge Elimination System Permits
NRCS	Natural Resource Conservation Service
NPS	Nonpoint source pollution
NTUs	Nephelometric Turbidity Units
NWI	National Wetland Inventory
ODOT	Ohio Department of Transportation
OEPA	Ohio Environmental Protection Agency
OH	Ohio
OSDS	On-site Disposal System
PCBs	Polychlorinated biphenyls
PHEL	Potentially Highly Erodible Land
ppb	Parts Per Billion
RC&D	Resource Conservation and Development
SWCD	Soil and Water Conservation District
SWPP	Source Water Protection Plans
SWQMP	Storm Water Quality Management Plan

TDS	Total Dissolved Solids
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
UDO	Unified Development Ordinance
UMRW	Upper Maumee River Watershed
UMWP	Upper Maumee Watershed Partnership
US EPA	United States Environmental Protection Agency
USDA	United States Department of Agriculture
USFWS	United States Fish & Wildlife Service
USGS	United States Geological Survey
USTs	Underground storage tanks
VOCs	Volatile Organic Compounds
WHPP	Wellhead Protection Plan
WLEB	Western Lake Erie Basin
WMP	Watershed Management Plan
WTP	Water Treatment Plant
WWH	Warm Water Habitat
WWTP	Waste Water Treatment Plant

1.0 Introduction

The United States has over 3.5 million miles of streams stretching across a diverse landscape which provide many eco-services to the citizens of the US such as recreational activities, sustenance, and transportation. However, rapid population growth, urban sprawl, industrial discharges, and unsustainable farming techniques pose many threats to the health of this valuable resource. The Maumee River Watershed is no exception to the problems affecting water quality mentioned above. The Maumee River, which begins at the confluence of the St. Joseph and St. Marys Rivers in Fort Wayne, IN, is 137 miles in length and stretches across a variety of landscapes before it outlets into Lake Erie in Toledo, OH. With over 430 miles of tributary perennial streams located within the Upper Maumee watershed alone, the Maumee River is the largest contributor to Lake Erie, and is a major source of sediment and nutrients entering the lake which has contributed to the growing bluegreen algal blooms and hypoxic zone in the Western Lake Erie Basin.

The local Soil and Water Conservation Districts (SWCD) located within the Upper Maumee River watershed recognized the growing concern of high nutrient levels entering Lake Erie through the Maumee River causing massive algal blooms. Therefore, the Allen County, Indiana SWCD and Defiance County, Ohio SWCD applied for, and were awarded, grants from the Indiana Department of Environmental Management (IDEM) and the Ohio Department of Natural Resources (ODNR), respectively, to help mediate the problem of pollutants entering the Maumee River, and thus, Lake Erie.

The purpose of this document, a comprehensive watershed management plan (WMP), is to identify areas of concern in the watershed and develop an action register, guided by local stakeholders, to reduce the amount of pollution entering the river system, and improve overall water quality and the quality of life for those that live around and rely on the river. This WMP will meet the requirements set by the Indiana and Ohio regulating agency; the IDEM, ODNR and Ohio Environmental Protection Agency (OEPA), respectively.

1.1 The Upper Maumee Watershed Partnership

Growing concern over the expanding bluegreen algal bloom and hypoxic zone in Lake Erie spawned the creation of the Upper Maumee Watershed Partnership (UMWP) in 2009. Concerned board members of the Defiance County SWCD applied for, and were awarded a grant from the Maumee Valley Resource Conservation and Development (RC&D) organization to form a community based watershed group by holding public education and outreach events, conducting surveys to learn the public’s concerns regarding the Maumee River, and recruiting support from other political and private members from surrounding counties and states located within the Upper Maumee River watershed.

The effort put forth by the Defiance County SWCD from the Maumee Valley RC&D grant was a success as a formal steering committee consisting of individuals from the Allen County, Defiance County and Paulding County SWCDs, Town of Woodburn, academia, landowners, and business owners has formed and meets bi-monthly to guide the actions of the UMWP. Table 1.1 lists the UMWP members, their affiliation, and which stakeholder group they represent.

Table 1.1: Upper Maumee Watershed Partnership Members

Name	Affiliation	Stakeholder Group
Tim Derck (Vice Chairman)	Producer	Agriculture
Joe Sukup	Paulding Crane Twp. Trustee	Agriculture
Dave Voors	1st Source Bank – New Haven, IN	Business
Tom Miller	Agriculture Plus	Business
Mike Maringer	IFM	Business
Rodney Mobley	Archbold Equipment	Business
Adam Scheiderer		Construction
Matt Schlatter		Conservation
Abigail King (Treasurer)	Save Maumee Grassroots Organization	Conservation
Bill Beckman	Paulding County SWCD, OH	Conservation
Jason Roehrig (Secretary)	Defiance County SWCD, OH	Conservation
Greg Lake (Chairman)	Allen County SWCD, IN	Government
Ron Clinger	Defiance County Health Dept.	Government
Doug Kane Ph.D.	Defiance College	Academia
Donn Werling Ph.D.		Academia
Don Rekeweg	Producer	Landowner
Ben Clinger		Landowner
Shannon Watson	Landowner	Landowner
Roger Clayton	Landowner/New Haven	Landowner/Urban

1.2 Upper Maumee River Watershed Management Plan Steering Committee

This project began in February of 2012 and the partnership between the Allen County SWCD and Defiance County SWCD was described to the UMWP at their meeting held in March, 2012. Members of the UMWP were asked to be a part of the project's steering committee, in addition to their duties as a member of the UMWP. Several accepted and have played an integral role in the development of this WMP. Other key stakeholders in the watershed were also asked to join the Upper Maumee River Watershed (UMRW) steering committee, and several accepted. Table 1.2 below is a list of all steering committee members and their affiliation.

Table 1.2: Upper Maumee River Watershed Project Steering Committee

Name	Affiliation	Stakeholder Group
Doug Kane	Defiance College - Ecology/GIS	Academia
Abigail King-Frost	Save Maumee Grassroots Organization	Environment/Conservation
Mike Maringer	Industrial Fluid Management	Waste Water Treatment/Landowner
Roger Clayton	Land owner/New Haven	Landowner/Urban
Jim Harris	Defiance County Commissioner	Government
Adam McDowell	Defiance City Water Superintendent	City Utilities
Shannon Watson	Contractor / Landowner	Landowner
Kristen Buell	Arcadis Consulting Firm	Environment/Storm Water
Don Reckewig	Producer	Landowner/Agriculture
Christina Kuchle	Ohio DNR Scenic Rivers	Environment
Ron Clinger	Defiance Health Department	Government
Tim Racster	Paulding County Soil and Water Conservation District	Government/Conservation

Since the watershed is so large, passing through two states and four counties, and comprising 24% of all surface water entering Lake Erie, a diverse group of steering committee members, dedicated to improving the water quality within the Upper Maumee River Watershed, and the greater Western Lake Erie Basin was needed. As can be seen in the above table, the UMRW project was able to gain support and participation from a broad group of stakeholders, thus most everyone's concerns can be addressed through this WMP.

The UMRW steering committee met on a quarterly basis, at a minimum and more often toward the latter half of the WMP development, starting in March, 2012. The meetings were typically held at the Hicksville Community Hospital, which was determined to be the most convenient location for all steering committee members. All background information for the watershed including historical data, land uses, water quality, and pollutant loading was gathered by SNRT, Inc. and Allen County and Defiance County SWCD staff. The information was then presented to the steering committee at each meeting and through e-mail communication. All problems, goals, and suggested management measures represented in this document were decided upon by discussion and general consensus of the steering committee. Final decisions were made in person at the steering committee meetings, as well as through on-line surveys.

The UMRW steering committee does not have legal status of any kind and is comprised of a group of concerned organizations and individuals who are working together to protect and restore the UMRW. The Steering Committee meetings were facilitated primarily by the Watershed Coordinator from Allen County SWCD, with assistance from the Defiance County SWCD Watershed Coordinator and a Senior Project Manager from SNRT, Inc. The UMRW Steering Committee does not have specific operational procedures or bylaws, and as mentioned above, all decisions were made by general consensus after in-depth discussions.

1.3 Stakeholder Concerns

Through several public meetings held between 2009 and 2012, and the steering committee, a list of concerns regarding land use and water quality in the UMRW was devised, and is the basis for this WMP. Table 1.3 is a comprehensive list of concerns as expressed by stakeholders in the Upper Maumee River Watershed.

Table 1.3: Stakeholder Concerns

Concerns	Relevance	Potential Problems
Flooding	Flooding can be caused by streambank modification, an increase in water volume due to an increase in impervious surfaces, and decrease in wetlands. Floods can cause severe damage or loss of property, pollution runoff to surface water, and will divert water from its normal course and cause stream bank erosion	Sedimentation, impaired biotic community, heavy metals and other toxic chemicals, and nutrients
Log Jams	Many large log jams have been noted throughout the Upper Maumee River watershed. Log jams will divert water from its normal course and cause stream bank erosion and flooding	Sedimentation and flooding
Stream Bank Erosion	An increase in surface runoff and stream channel modification can increase the potential for streambank erosion	Sedimentation, turbidity, and impaired biotic community
Lack of Riparian Buffer	Ditches and streambanks are often denuded to increase the size of farm fields to make more profitable farm land or increase the size of urban lawns or make room for other structures to be built along streambanks. This practice increases the potential for streambank erosion and stream temperatures, and limits essential wildlife habitat	Sedimentation, turbidity, temperature, and impaired biotic community
Recreational Opportunities and Safety	There are a limited number of drop in sites for boats along the Maumee River thus limiting accessibility to the river to recreate. There is also concern over how safe the water is to swim in and fish from. This takes the river system out of the public eye, thus limiting overall concern over the health of the river	Lack of action to conserve and preserve the river.
Segmented/Lack of Forested Areas	Forests are often fragmented due to agriculture expansion, urban sprawl, or other development. This practice limits essential wildlife habitat. It also poses a threat to animals that attempt to move between fragmented forest land as they are exposed to predators, as well as roads	Impaired Biotic Community, and decreased wildlife habitat, including endangered and threatened species

Concerns	Relevance	Potential Problems
Lack of Water Education/Outreach	Until 2009 there was little education for the public on water quality and best management practices in the Upper Maumee River Watershed. The UMWP has significantly increased outreach to educate the public	Increase in nonpoint source pollution
Rural legal drains	Legal drains provide a direct conduit for pollution to enter the streams/rivers. Many ditches lack a vegetative buffer as well and are often the outlet point for most field tiles which can carry agricultural nonpoint source pollution	Nutrients, pesticides, sediment, turbidity, impaired biotic community
Combined Sewer Overflows	During heavy rain events the local Waste Water Treatment Plants cannot process both the residential and storm water. Therefore, both sources of waste may be discharged into a waterway without any treatment. Hicksville, Ohio and Fort Wayne and New Haven, Indiana have CSOs	Sedimentation, *E. coli*, impaired biotic community, turbidity, nutrients
Need for Wetland Protection / Restoration	Part of the Great Black Swamp was located within the Upper Maumee River Watershed and today many of the wetlands have been tiled/drained for use as agricultural land which decreases the lands capability to absorb flood waters and pollutants prior to them reaching surface water	Sedimentation, impaired biotic community, turbidity, nutrients, flooding
Increase in Impervious Surfaces	As the urban areas in the watershed expand, so do the impervious surfaces which increase stormwater runoff and will potentially carry pollutants to open water	Oil and grease, sediment, nutrients, increase in combined sewer overflows
Urban Contamination Sites	The urban landscape consists of many potential threats to land, water, and air. Many industrial sites, gas stations, dry cleaners, and other businesses use materials that can be very dangerous to human and animal health. Therefore, those potential threats, including brownfields, Underground, and Leaky Underground storage tanks (USTs and LUSTs), and Superfund sites must be watched closely	oil and grease, heavy metals, and other toxic chemicals, impaired biotic community
Need for More Water Quality Studies/Planning Efforts	While several studies have been done within the greater Western Lake Erie Basin, relatively few have been conducted strictly within the Upper Maumee to narrow potential pollution sources down and develop an action register to mitigate those sources	Lack of action to conserve and preserve the river.
Increasing Hypoxic Zone in WLEB	The hypoxic zone in the WLEB is due to an influx in dissolved reactive phosphorus and sedimentation coming from the Maumee River, the largest contributor to Lake Erie	Dissolved Reactive Phosphorus (DRP), sedimentation, impaired biotic community, blue green algal blooms

Concerns	Relevance	Potential Problems
Increase in Dissolved Reactive Phosphorus	DRP can be discharged into surface water from either point or non-point sources. DRP is readily available for plant uptake and results in algal blooms	Increase in WLEB hypoxic zone and algal blooms, and impaired biotic community
Fish and Wildlife Habitat	Fish and wildlife rely on adequate habitat for survival, which is especially important to those species listed as threatened or endangered. Many species of aquatic life including fish, insects, and mussels rely on the Maumee River for their home. Increased sedimentation, dams, and chemicals threaten the safety of their aquatic habitat	Lack of vegetative stream buffers and riparian corridors, fragmented landscape, and an increase in pollution entering the water
Soil Erosion and Sedimentation	Conventionally tilled farm land located on potentially or highly erodible land increases the potential for soil erosion. Also, unbuffered streambanks, and tile inlets allow for sediment to discharge directly into surface water. Urban areas contribute to soil erosion and sedimentation as construction significantly disturbs the land, and impervious surfaces collect sediment that runs into storm drains or directly in surface water during heavy rain events	Sedimentation, turbidity, and impaired biotic community
Unbuffered Tile Inlets	Tile inlets are used in agricultural fields to drain the field and keep it from getting over saturated, and to divert water from structures such as roads and buildings. The inlet provides a direct conduit for sediment and other pollutants to flow to the tile drain without being filtered by the soil, and if unbuffered there is no filter for the water before entering the tile system	Sediment, nutrients, pesticides
Structures within Floodplain	When structures are flooded any contaminant located within that structure has the potential to enter surface water. Also, a significant threat is posed to property and life when a structure is located within a flood prone area which can also have a profound impact on the economics of an area	*E. coli*, heavy metals, other toxic chemicals, sediment
Failing or Straight pipe Septic Systems	Septic systems, if not properly maintained, can leak effluent into ground water or leach into surface waters. There have been many advances in the area to improve sewage treatment.	*E. coli*, nutrients, sediment, turbidity
Storm Water Control	Increased imperviousness throughout the watershed has increased the amount of stormwater entering surface water, thus contributing to flooding, more CSO events, and excess pollutants	Sediment, turbidity, nutrients, *E. coli*, flooding

Concerns	Relevance	Potential Problems
Decrease in Desirable Fish Species	As water quality decreases the desirable fish decrease as the less desirable, more pollutant tolerant species increase	Impaired Biotic Community
Rivers / Streams / Watershed Listed as "impaired" by Regulating State Agency	Each state is required to report impaired waters to the U.S. Environmental Protection Agency every two years. States conduct water quality analysis to determine those waters that are impaired.	*E. coli,* nutrients, sediment, impaired biotic community
Barnyard Runoff into Surface Water	Stormwater will pick up pollutants from barnyards and carry them to open water if it is not properly contained or diverted from ditches, streams, rivers, and ponds	*E. coli*, nutrients, sediment
Livestock Access to Open Water	It has been found that livestock have access to open water for drinking water or to move between adjacent pastures within the Upper Maumee River Watershed which causes streambank erosion and allows for discharge and runoff of pollutants	*E. coli,* nutrients, sedimentation, turbidity, impaired biotic community

The UMWP members carefully reviewed the concerns voiced by local stakeholders, and after determining the relevance of each of the concerns to the UMRW, they devised a mission statement to reflect those concerns in 2012. The mission statement will be the guiding philosophy of the UMWP. The UMRW steering committee agrees that the mission statement of the UMWP should also be the guiding philosophy of this Watershed Management Plan.

"To protect and restore the Upper Maumee River Watershed through public education and participation via planning and implementation of best management practices with the goal of improving local and regional water quality, increasing habitat quality, promoting sustainable land use practices and providing recreational opportunities that improve the ecological health of the region.

2.0 Description of the Watershed

2.1 Watershed Location

A watershed is an area with defined boundaries such that all land and waterways drain into a particular point. Watersheds are given "addresses" called Hydrologic Unit Codes (HUC) that identify where they are located within the United States and into which point they drain. The largest HUC is a two digit and defines a particular region. The more digits to a HUC the more specific the drainage area is. The Upper Maumee River Watershed (UMRW) is an eight digit HUC, 04100005, and is comprised of two 10 digit HUCs, Headwaters Maumee River (0410000501) and Gordon Creek-Maumee River (0410000502), respectively. There are also fourteen 12 digit HUCs located within the UMRW; Trier Ditch (041000050101), Bullerman Ditch (0410000050102), Sixmile Creek (0410000050103), Black Creek (041000050104), Bottern Ditch (041000050105), Marsh Ditch (0410000050106), Zuber Ditch (041000050201), N. Chaney Ditch (041000050202), Marie DeLarme Ditch (041000050203), Gordon Creek (041000050204), Sixmile Cutoff (041000050205), Platter Creek (041000050206), Sulphur Creek (041000050207), Snooks Run (041000050208).

The Maumee River begins in Fort Wayne, IN at the confluence of the St. Joseph and St. Marys Rivers. It then flows northeast through Defiance, OH to Toledo, OH where it empties into Lake Erie. The Upper Maumee River Watershed is located in Allen and DeKalb Counties in IN and Defiance and Paulding Counties in OH and is split almost evenly between Indiana and Ohio, 51% and 49% respectively (Figures 2.1 and 2.2). The UMRW encompasses 247,913 acres (387 sq. miles) of land and the predominant land use, encompassing 78% of the watershed, is agriculture including row crops and pasture/hay land. However, there are several incorporated areas located within the watershed totaling 14% of the watershed, including Fort Wayne, New Haven, and Woodburn Indiana, and Antwerp, Hicksville, Sherwood, Cecil, and the most western edge of Defiance, Ohio.

Figure 2.1: Upper Maumee River Watershed Percentage of Area per County

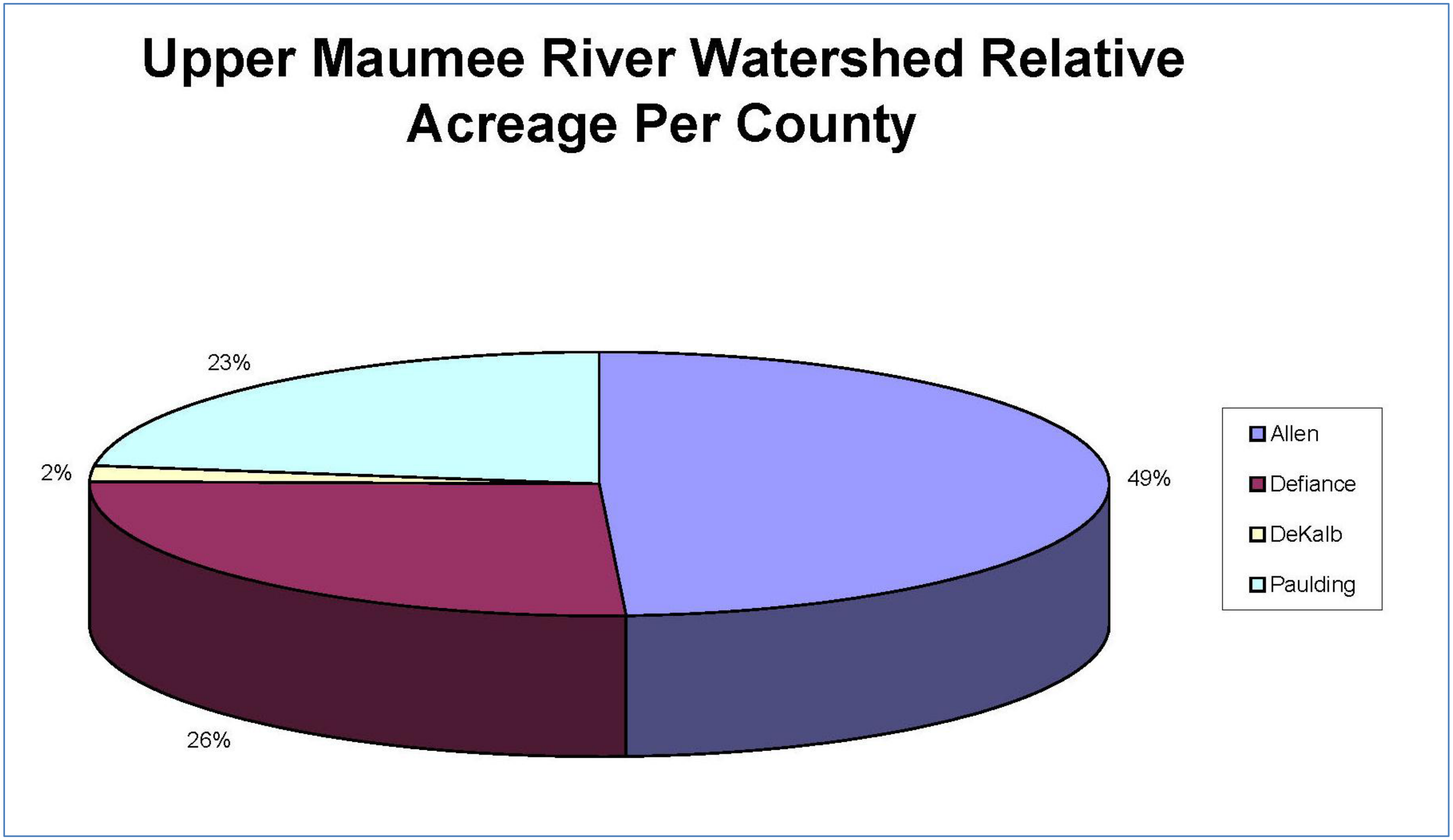
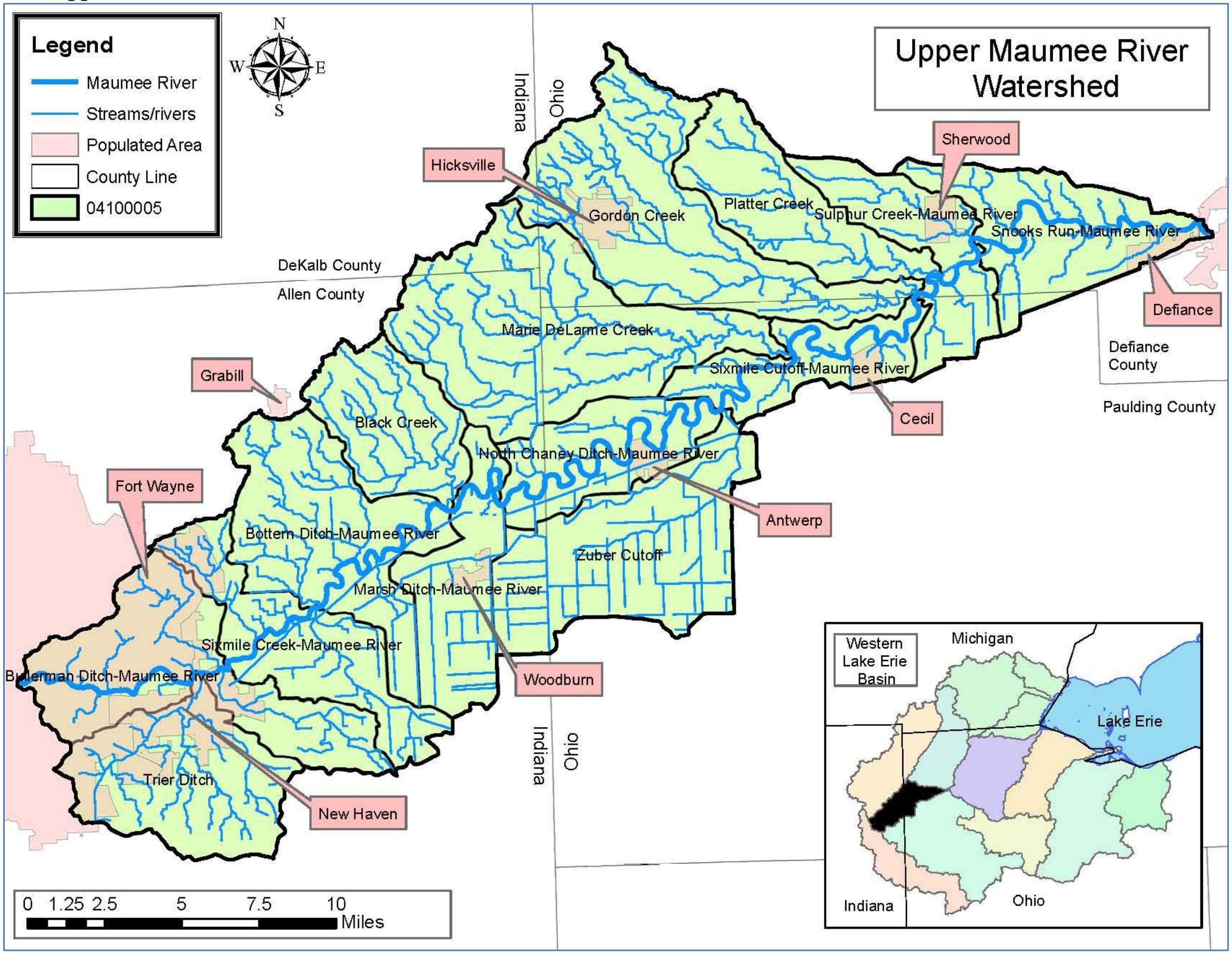


Figure 2.2: Upper Maumee River Watershed Boundaries



2.2 Geology, Topology, Soils

The landscape of northern Indiana and Ohio is directly influenced by the last great glaciation which occurred over 14,000 years ago; the Wisconsin glaciation. The glaciers significantly changed the landscape of the project area, filling and damming rivers which created lakes (including Lake Erie), as well as flattening the rolling hills that were present before the glaciers. The Wisconsin glaciation extended as far south as Terre Haute and Richmond, Indiana and follows the line from Ashtabula County in northeast Ohio down to Hamilton County in southwest Ohio. As the glaciers melted they deposited rock, dirt and sand that they picked up while traveling across the landscape from east to west. In the project area of northern Indiana and Ohio, where the glaciers melted relatively rapidly, glacial till ridges, called moraines, were left.

The bedrock of the watershed area was deposited during the Devonian Period, some 400 million years ago. The rocks deposited during the Devonian Age mostly consist of sedimentary rocks such as siltstone, shale, and sandstone. As can be seen in Figure 2.3, the predominant bedrock of the project area is black shale, shale, dolomite, and limestone. The last lobe of the Wisconsin glaciation, the Erie Lobe, left a sequence of deposits known as the Largo Formation, which is responsible for the clay-rich composition of the soils present in the watershed today. The surficial geology overlaying the bedrock consists of a mostly silt and clay mixture and is between 20 and 100 feet deep. The overlaying surficial outwash is relatively thin as it is typically less than 50 feet thick and is sandy and/or gravelly.

The project area is located within the Maumee Lake Plain physiographic region in Indiana and Ohio (Indiana Geological Survey) with a subdivision down to the Paulding Clay Basin in the eastern portion of the watershed in Ohio (ODNR). The topography of the area is relatively homogenous. The average elevation is between 700 and 760 feet above sea level. There are some areas where the slope of the land may exceed 2% slightly, but overall the landscape of the project area is unremarkable.

The project area is comprised of 22 soil associations. Table 2.1 is a list of the soil associations present in the project area and a description of each association. Soil association descriptions were taken from the Allen, DeKalb, Defiance, and Paulding county United States Department of Agriculture (USDA) soil surveys. The soil associations found throughout much of the Upper Maumee River watershed are exceptionally productive soils, when properly drained and managed, which accounts for the heavy agriculture production present within the watershed.

Figure 2.3: Upper Maumee River Watershed Geology

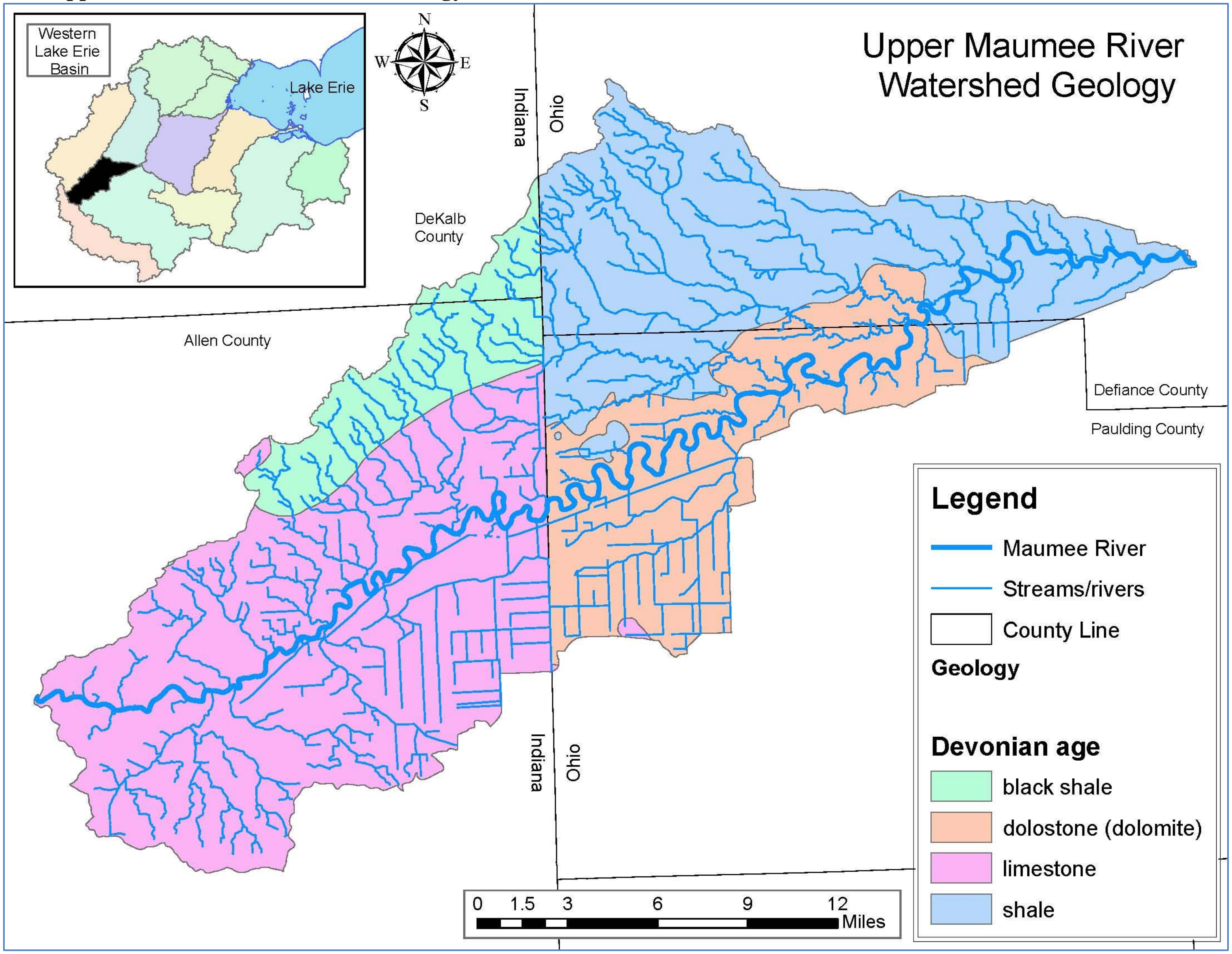


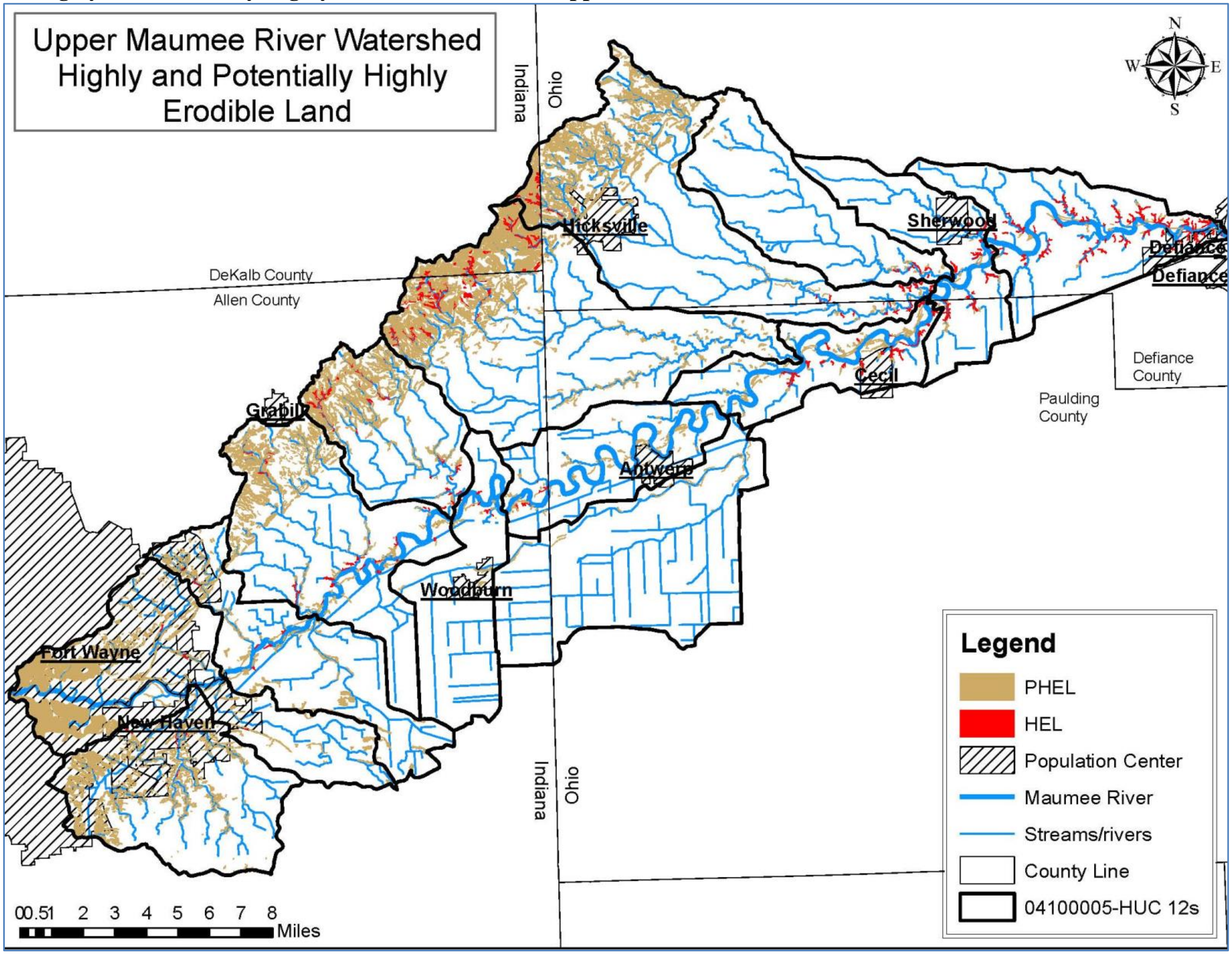
Table 2.1 Soil Associations

County	Soil Association	Association Description
Allen	Eel-Martinsville-Genesee	Deep, well drained and moderately well drained, nearly level to moderately sloping, medium-textured and moderately fine textured soils on bottom lands and stream terraces
	Martinsville-Belmore-Fox	Deep, well-drained, nearly level to moderately sloping, medium-textured and moderately coarse textured soils on stream terraces and beach ridges
	Blount-Pewamo	Deep, somewhat poorly drained to very poorly drained, nearly level and gently sloping, medium-textured and moderately fine textured soils on uplands
	Morley-Blount	Deep, moderately well drained and somewhat poorly drained, nearly level to steep, medium-textured soils on uplands
	Hoytville-Nappanee	Deep, somewhat poorly drained to very poorly drained, nearly level, medium-textured to fine -textured soils on uplands
	Lenawee-Montgomery-Rensselaer	Deep, very poorly drained, nearly level, medium-textured to fine-textured soils on uplands, in drainageways, and on stream terraces
	Rensselaer-Whitaker	Deep, somewhat poorly drained to very poorly drained, nearly level and gently sloping, moderately coarse textures to moderately fine textured on uplands and stream terraces
DeKalb	Glynwood-Pewamo-Morley	Deep, moderately well drained, very poorly drained, and well drained, nearly level to steep, loamy, clayey, and silty soils; on till plains and moraines
	Blount-Pewamo-Glynwood	Deep, moderately well drained to very poorly drained, nearly level and gently sloping, silty, clayey, and loamy soils; on till plains and moraines
	Boyer-Landes-Sebewa	Deep, well drained, moderately well drained, and very poorly drained, nearly level to moderately sloping, loamy soils underlain by sand and gravel; on terraces, outwash plains, and moraines
Defiance	Paulding-Roselms	Level and nearly level, very poorly drained and somewhat poorly drained soils formed in fine textured lacustrine sediment
	Glynwood-Blount	Sloping to nearly level, moderately well drained and somewhat poorly drained soils formed in moderately fine textured glacial till
	Latty-Fulton	Level and nearly level, very poorly drained and somewhat poorly drained soils formed in fine textured and moderately fine textured lacustrine sediment

County	Soil Association	Association Description
Defiance	Lanawee-Del Rey	Level and nearly level, very poorly drained and somewhat poorly drained soils formed in medium textured to fine textured lacustrine sediment
	Hoytville-Nappanee	Level and nearly level, very poorly drained and somewhat poorly drained soils formed in moderately fine textured and fine textured glacial till modified by water action
	Mermill-Haskins-Millgrove	Level and nearly level, very poorly drained and somewhat poorly drained soils formed in moderately coarse textured to moderately fine textured glacial outwash and the underlying glacial till, lacustrine sediment, or glacial outwash
	Kibbie-Colwood	Nearly level and level, somewhat poorly drained and very poorly drained soil formed in moderately fine textured to coarse textured glaciofluvial deposits
	Genesee-Sloan	Level and nearly level, well drained and very poorly drained soils formed in medium textured and moderately fine textured recent alluvium
	Blount-Glynwood-Pewamo	Level to sloping, somewhat poorly drained, moderately well drained, and very poorly drained soils formed in moderately fine textured glacial till
Paulding	Paulding-Roselms	Very deep, nearly level and gently sloping, very poorly drained and somewhat poorly drained soils that formed in lacustrine deposits
	Latty-Nappanee	Very deep, nearly level and gently sloping, very poorly drained and somewhat poorly drained soils that formed in lacustrine deposits and/or in till
	Hoytville-Nappanee	Very deep, nearly level and gently sloping, very poorly drained and somewhat poorly drained soils that formed in till

The UMRW steering committee and stakeholders expressed concern about soil erosion and sedimentation of streams and rivers. The erosion issues present in the watershed may be due to unsustainable farming practices on land that is considered to be highly or potentially highly erodible. The Natural Resource Conservation Service (NRCS) maintains a database of highly erodible (HEL), potentially highly erodible land (PHEL), and hydric soils for each county. The soils that have been determined to be highly erodible are so designated by dividing their average rate of erosion by the soil loss tolerance, which is the maximum amount of soil loss that can occur before a long term reduction in productivity will be seen. Soils are determined potentially highly erodible based on the slope and length of the slope. Paulding County released a new soil survey in 2012 which did not include the designation of HEL or PHEL. Working with the county District Conservationist it was determined that soils labeled with a slope of B or C in the soil survey should be considered PHEL and soils labeled with a slope of D or E should be considered HEL. The presence of HEL and PHEL in farmland can contribute significantly to nonpoint source pollution (NPS) by increasing the amount of sediment carrying other pollutants such as, nutrients and pesticides, to open water. Less than 1% of the soils in the watershed are considered HEL and 8.9% of the soils are considered PHEL. Figure 2.4 is a map of the project area showing the location of HEL and PHEL in the watershed.

Figure 2.4 Highly and Potentially Highly Erodible Land in the Upper Maumee River Watershed

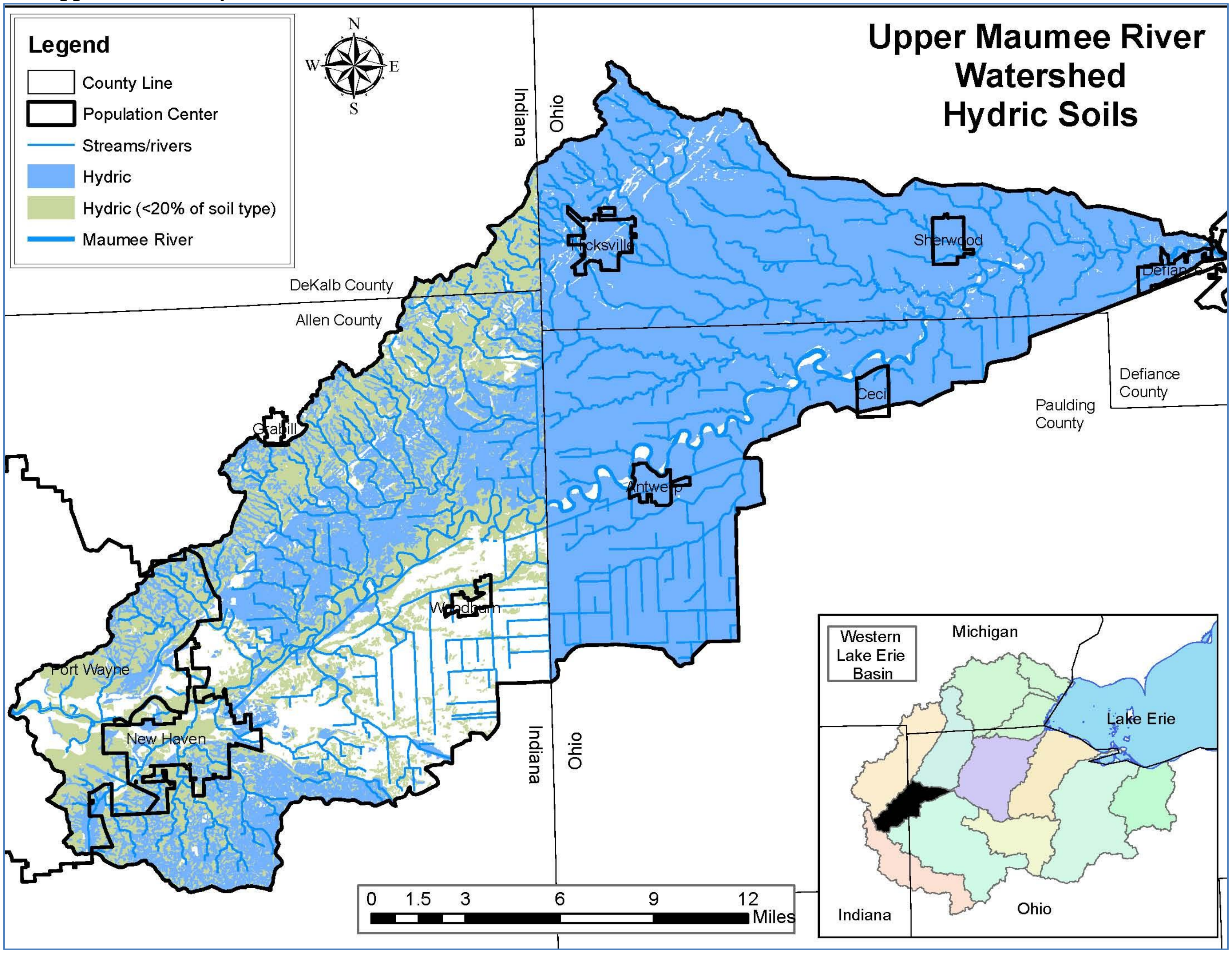


Hydric soils are present where wetlands are, or were. Several soils present within the project area are classified by the local Natural Resource Conservation Service (NRCS) as hydric as can be seen in the following Figure 2.5. Each state classifies the soils present within their jurisdiction differently, while the NRCS is in the process of standardizing classifications throughout the country, Indiana and Ohio currently classify their soils differently. OH classifies all their major soil types as either hydric or not hydric while IN classifies their soils as hydric based on the dominant soil type and its associations. As can be seen in Figure 2.5, many of IN soils that have been classified as hydric, are only hydric when a typically non-dominant soil is associated with a soil that is hydric. Those associations are labeled on the map as less than 20% of that soil type present in the watershed is actually hydric and is depicted in the map as a pale yellow color. Hydric soils can pose threats to surface water when farmed due to excessive runoff of fertilizers, pesticides, and manure. Farmland located on hydric soils often requires the installation of field tiles to keep the fields from flooding or ponding. The UMRW steering committee expressed concern regarding unbuffered tile inlets because field tiles can provide a direct conduit for water polluted with fertilizer, land applied manure, and sediment to reach surface waters. Hydric soils are also not suitable soils for septic usage as they do not allow for proper filtration of the septic leachate and may result in surface and/or groundwater contamination. Soils that are considered hydric are so classified for several reasons. The following explanation of hydric soils was taken from the NRCS, Field Office Technical Guide.

1) All Histols except for Folistels, and Histosols except for Folists.
2) Soils in Aquic suborders, great groups, or subgroups, Albolls suborder, Historthels great group, Histoturbels great group, Pachic subgroups, or Cumulic subgroups that.
    a) Are somewhat poorly drained and have a water table at the surface (0.0 feet) during the growing season, or
    b) Are poorly drained or very poorly drained and have either:
        i) Water table at the surface (0.0 feet) during the growing season if textures are coarse sand, sand, or fine sand in all layers within a depth of 20 inches, or
        ii) Water table at a depth of 0.5 feet or less during the growing season if permeability is equal to or greater than 6.0 in/hr in all layers within a depth of 20 inches, or
        iii) Water table at a depth of 1.0 foot or less during the growing season if permeability is less than 6.0 in/hr in any layer within a depth of 20 inches.
    c) Soils that are frequently ponded for long/very long duration at the growing season.
    d) Soils that are frequently flooded for long/very long duration at the growing season.

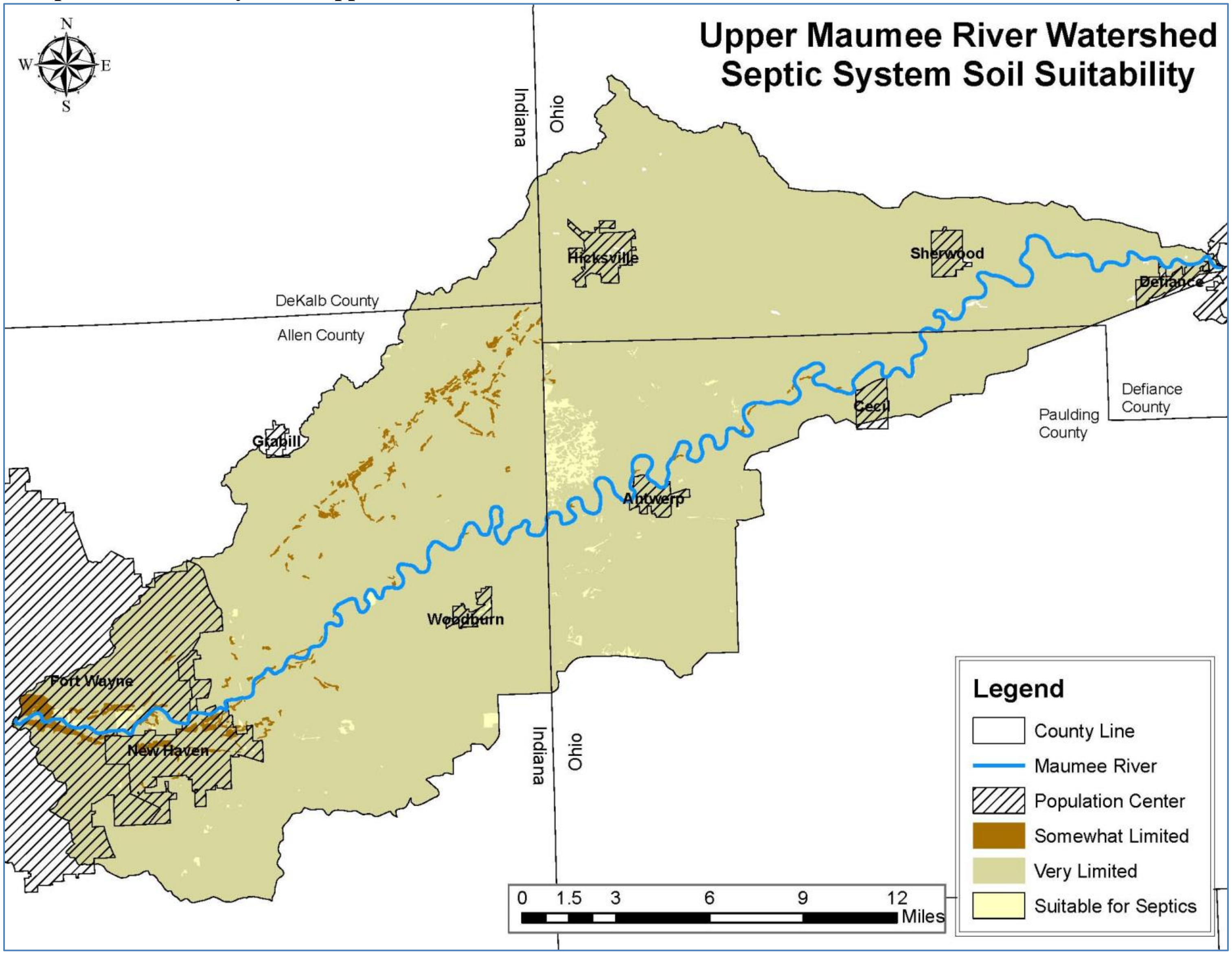
Hydric soils, while posing a significant problem when farmed, also are quite beneficial as they are prime locations to create or restore wetlands, which is a concern for the UMRW steering committee and stakeholders. The Upper Maumee watershed is located where the historic Great Black Swamp was located until it was drained and converted to prime farmland in the late 19^{th} century which may account for the presence of hydric soils as over 59% of the soil in the watershed is classified as hydric and over 21% of the soils are classified as partially hydric. Wetlands are great resources as they supply many ecological benefits and could help prevent polluted runoff from reaching open water.

Figure 2.5 Upper Maumee Hydric Soils



Soil type is important to consider when installing a septic tank as traditional septic tanks utilize the soil to absorb effluent discharged from the tank into absorption fields. Septic tank absorption fields are subsurface systems of French drains that distribute septic liquid waste evenly throughout the designated area and into the natural soil. Soil properties and landscape features that affect the ability of the soil to properly absorb and filter the effluent should be considered when designing a septic system. Most of the rural population within the UMRW project area uses septic systems to process their wastewater. All incorporated population centers utilize a centralized sewer system to handle household effluent. The UMRW steering committee expressed concern regarding failing on-site waste disposal systems and since the majority of the watershed is rural and using on-site waste disposal, it is important to note that nearly all (96.4%) soils located within the project area are rated as "very limited" for septic usage according to the NRCS. Only 1% of the soils located throughout the project area are classified as "somewhat limited" for the installation of an on-site sewage processing. Somewhat limited means that modifications can be made to either the site of septic installation or to the system itself to overcome any potential problems. A designation of "Very limited" means that modifications to the septic system site, or septic system itself, are either impractical or impossible. However, since less than 3% of the project area can safely handle a septic system (Figure 2.6), the ideal situation would be to not install any septic systems and revert to an above ground mound system or hook up to a centralized sewer system.

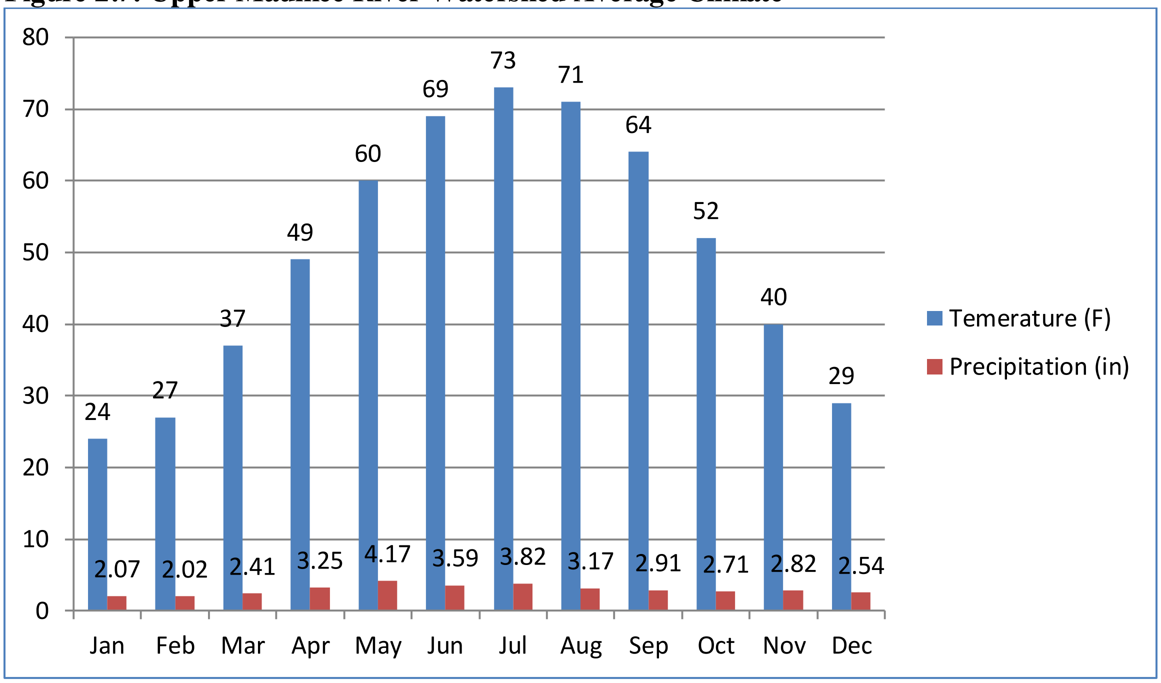
Figure 2.6: Septic Soil Suitability in the Upper Maumee River Watershed



2.3 Climate

The climate in the project area is considered temperate with warm summers and cold winters. According to the National Weather Service, the average high in July is 84°F and the average low in January is 16°F. There is an average of 35.5 inches of precipitation each year. Figure 2.7 graphically illustrates the average temperature range and precipitation per month within the project area.

Figure 2.7: Upper Maumee River Watershed Average Climate



2.4 Hydrology

There are 712.8 miles of streams, rivers, ditches, and canals located within the Upper Maumee River Watershed (UMRW) with the Maumee River itself measuring 71.062 miles between the confluence of the St. Marys and St. Joseph Rivers in Fort Wayne to Defiance, OH where the Tiffin River outlets to the Maumee River. Table 2.2 and Figure 2.8 represent the various types of flowing water in the UMRW according to the National Hydrography Dataset compiled by the USGS which defines each type of waterway as:

- Stream/River – A body of flowing water
- Artificial Path – A feature that represents flow through a two-dimensional feature, such as a lake of double-banked stream
- Connector Path – Established a known, but non-specific connection between two non-adjacent network segments that each has flow

- Canal/Ditch – An artificial open waterway constructed to transport water, to irrigate or drain land, to connect two or more bodies of water, or to serve as a waterway for a watercraft

Table 2.2: Stream Miles in the Upper Maumee River Watershed

Stream/River	Artificial Path	Connector path	Canal/Ditch	Unit
585.83	75.18	0.04	51.75	Miles
			Total 712.8	

There are few lakes or ponds located in the watershed, and none of significant size. It is estimated that there are only 169.51 acres of lakes or ponds in the watershed with no lake being greater than 15.57 acres in size.