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

This project has been funded wholly or in part by the United State Environmental Protection Agency under assistance agreement (C9975482-11) to the Indiana Department of Environmental Management. The contents of this document do not necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

This report has been funded wholly or in part by the ODNR Division of Soil and Water Resources through the Defiance Soil and Water Conservation District under award NA12NOS4190115 from the National Oceanic and Atmospheric Administration, U.S. Department of Commerce through the Ohio Department of Natural Resources, Office of Coastal Management. The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the views of the National Oceanic and Atmospheric Administration, Department of Commerce, Ohio Department of Natural Resources, or the Office of Coastal Management.

Acknowledgements

This project would not have been a success had it not been for many key people and organizations who provided the Upper Maumee River Watershed Steering Committee continued support.

The Upper Maumee River Watershed Project became a collaboration between the Allen County Soil and Water Conservation District and Defiance County Soil and Water Conservation District when both organizations received Federal funding to compile a comprehensive management plan for the Upper Maumee River Watershed. Supervisors of the two projects determined that efforts would be better spent working together as a team. This team effort was aided by the dedication and help of the Defiance County SWCD, and the Upper Maumee Watershed Coordinator. The Watershed Coordinator worked with the Allen County consultant to contribute to documentation, mapping, and planning. A sincere thank you is owed to the Defiance County SWCD for their dedication to this project and improving water quality throughout the Upper Maumee River Watershed. This WMP would not be the comprehensive document it is without their help.

Additional thank yous are necessary for the Allen County Soil and Water Conservation District staff who also supplied continued support to the consultant, and worked to coordinate and facilitate steering committee meetings, and provide background data on the watershed.

In addition to the Steering Committee, many others provided this project with much support. A sincere thank you goes out to all of them. Without their help this document would not be possible.

Greg Lake	District Director	Allen County SWCD
Sharon Partridge-Domer	Watershed Project Manager	Allen County SWCD
Jill Krause	Watershed Project Manager	Allen County SWCD
Matt Jones	Water Resource Ed. Specialist	ACPWQ
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

Table of Contents

Table of Figures

Table of Tables

List of Acronyms

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

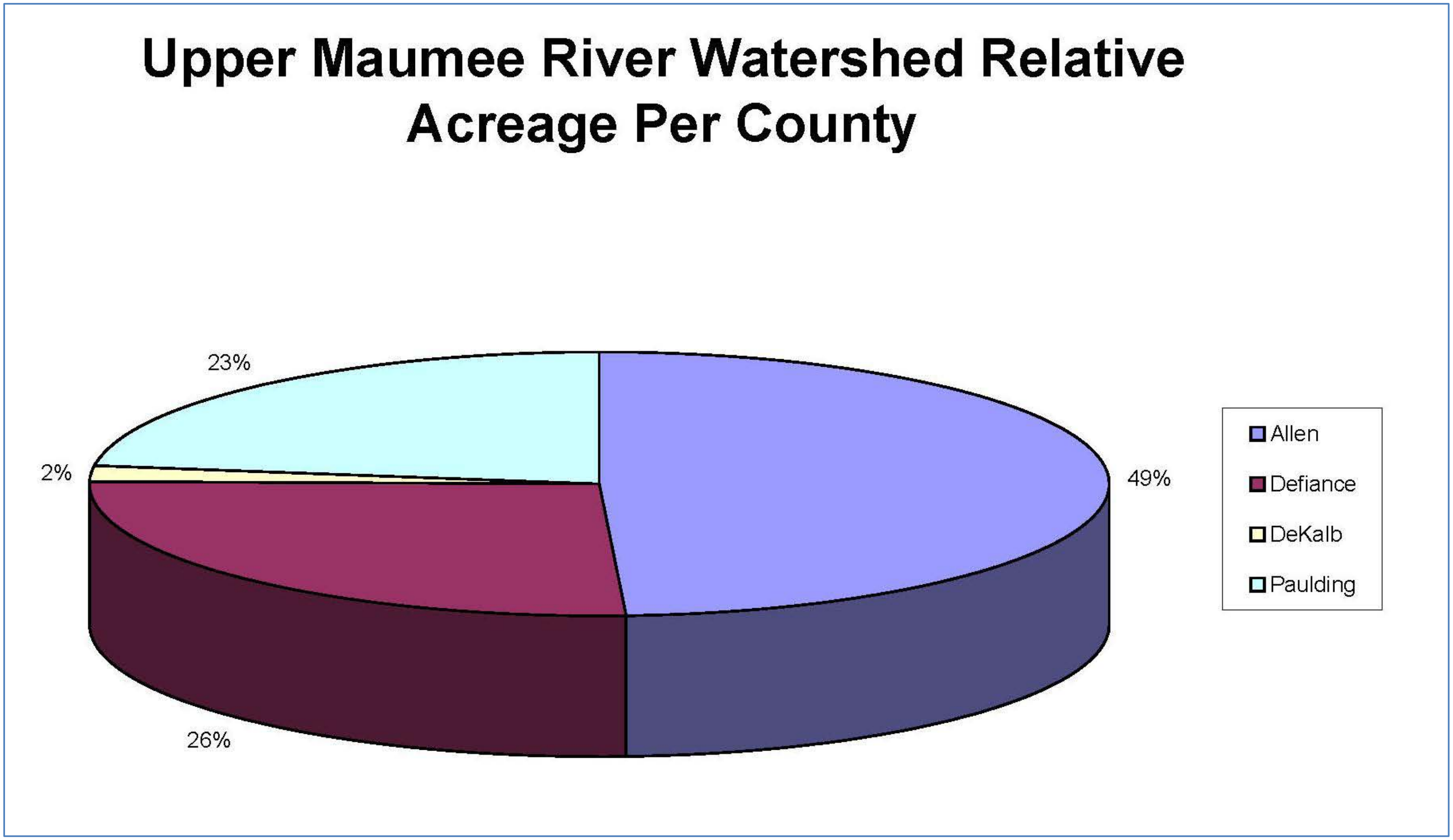
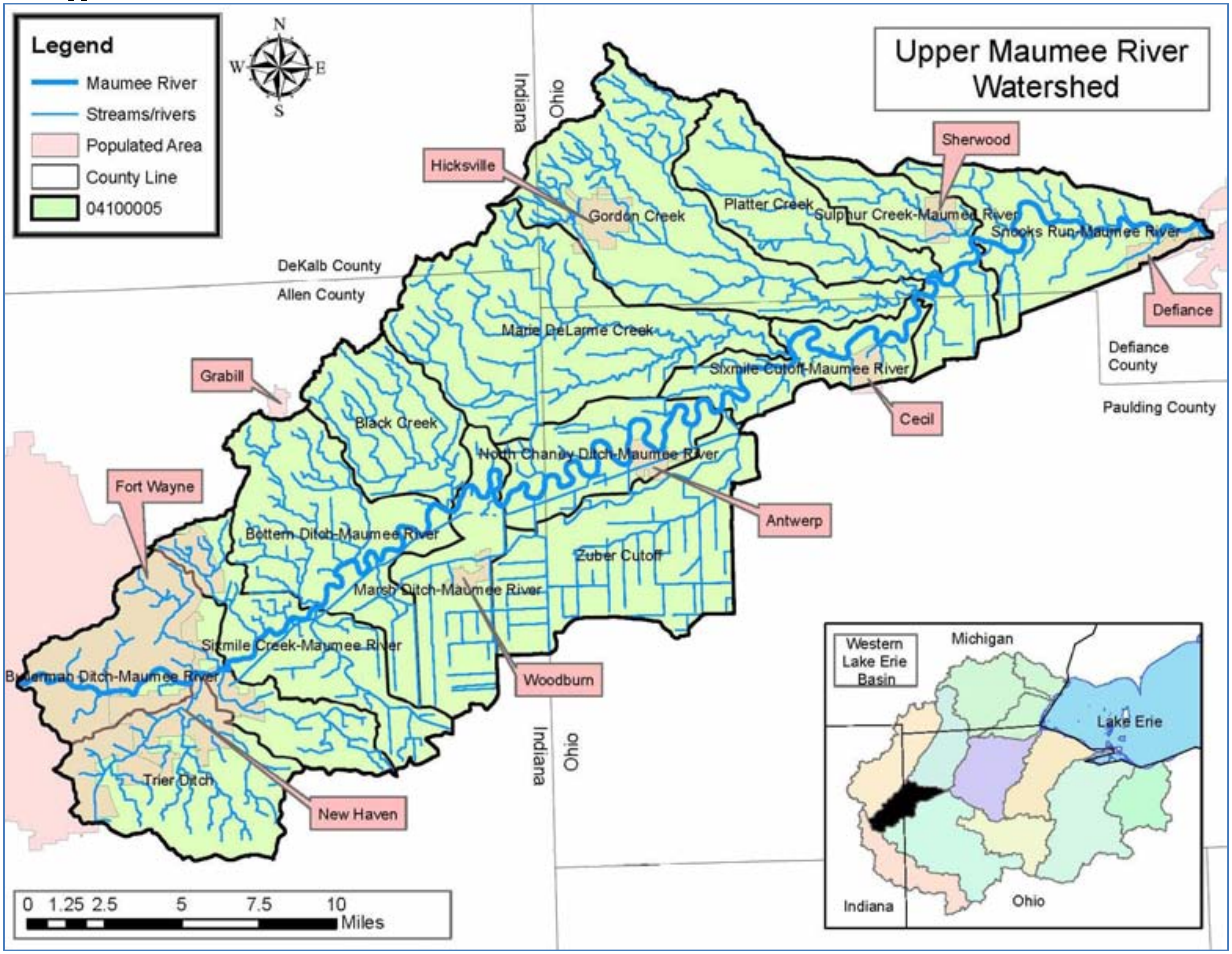


Figure 2.2: Upper Maumee River Watershed Boundaries



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

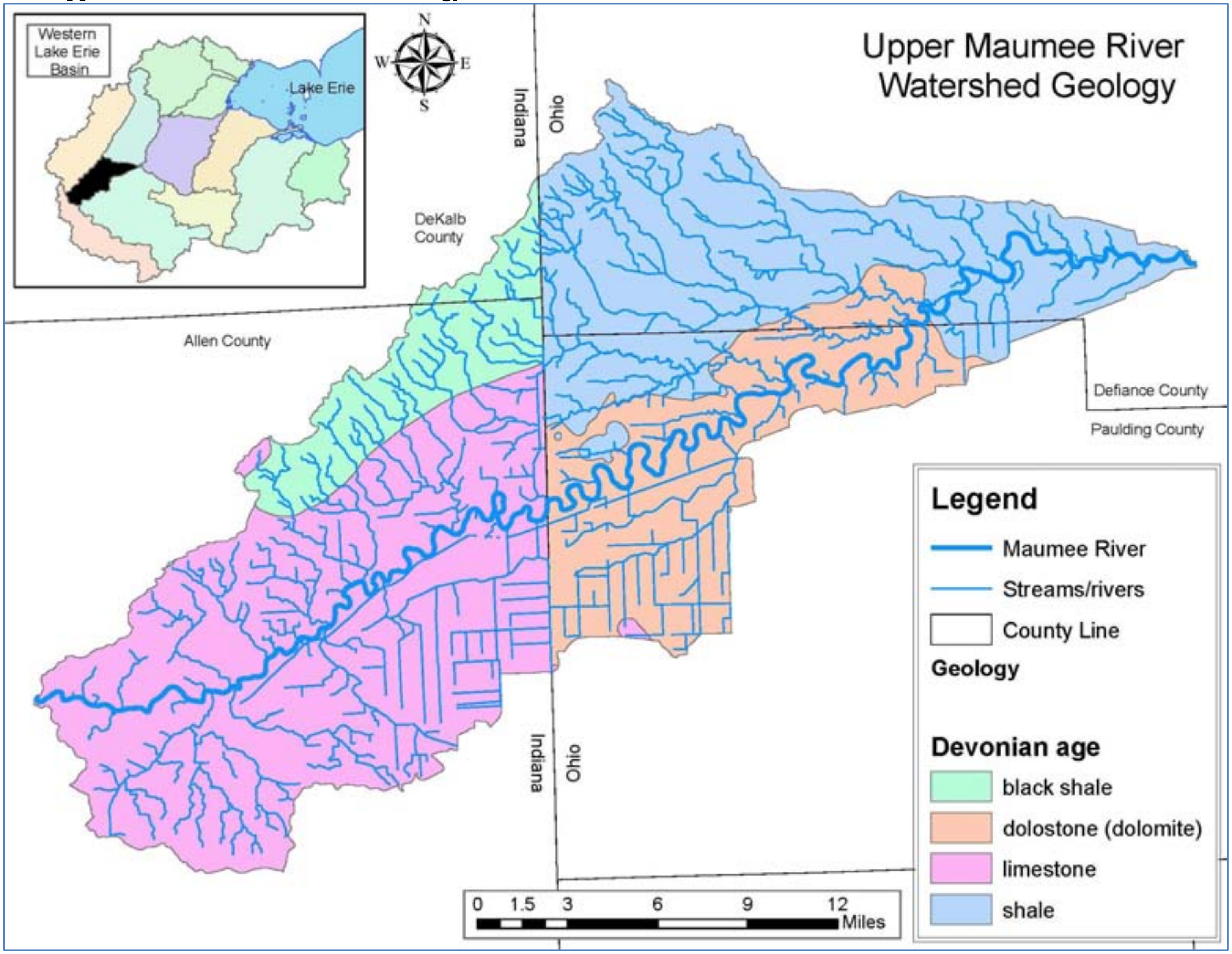


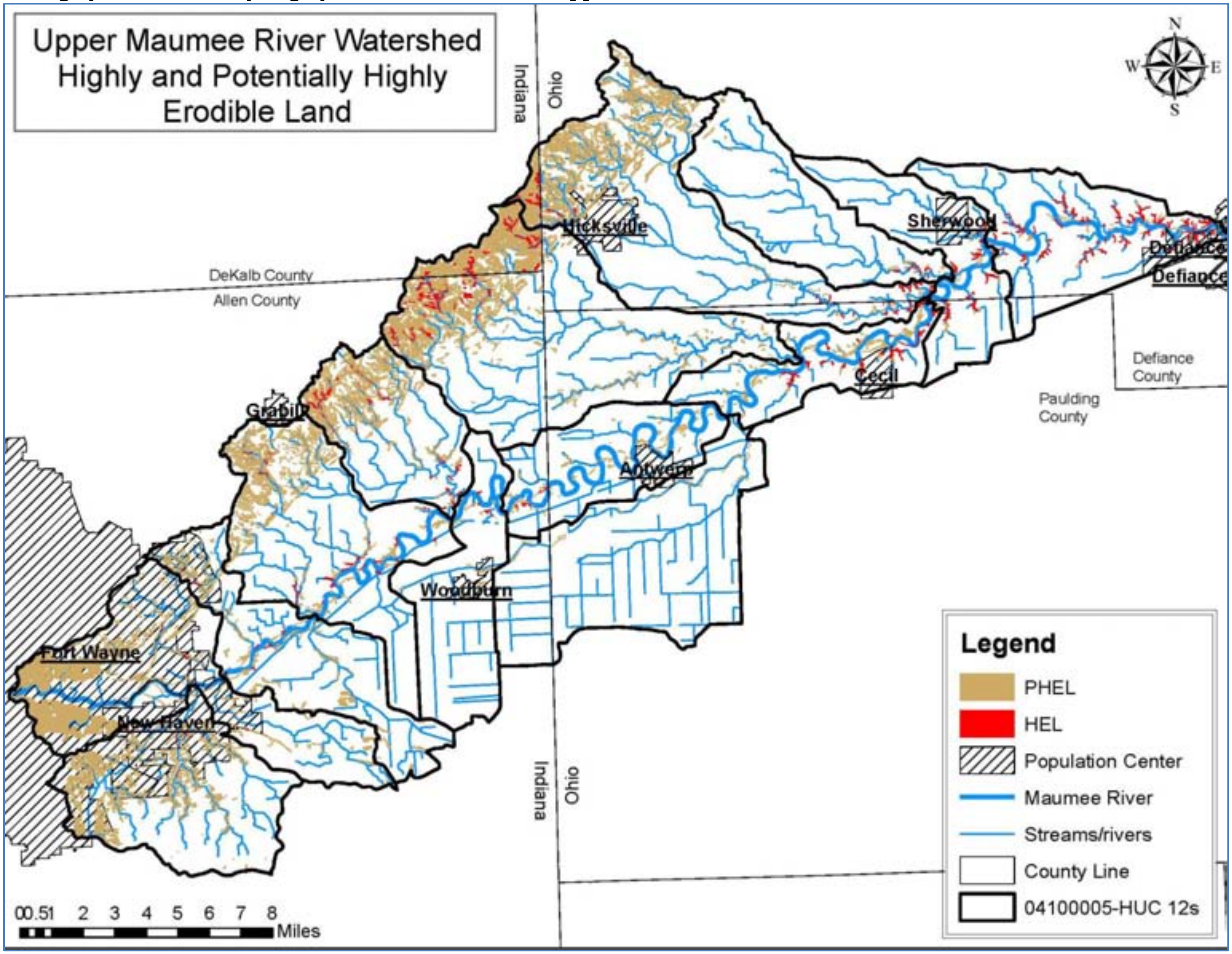
Table 2.1 Soil Associations

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

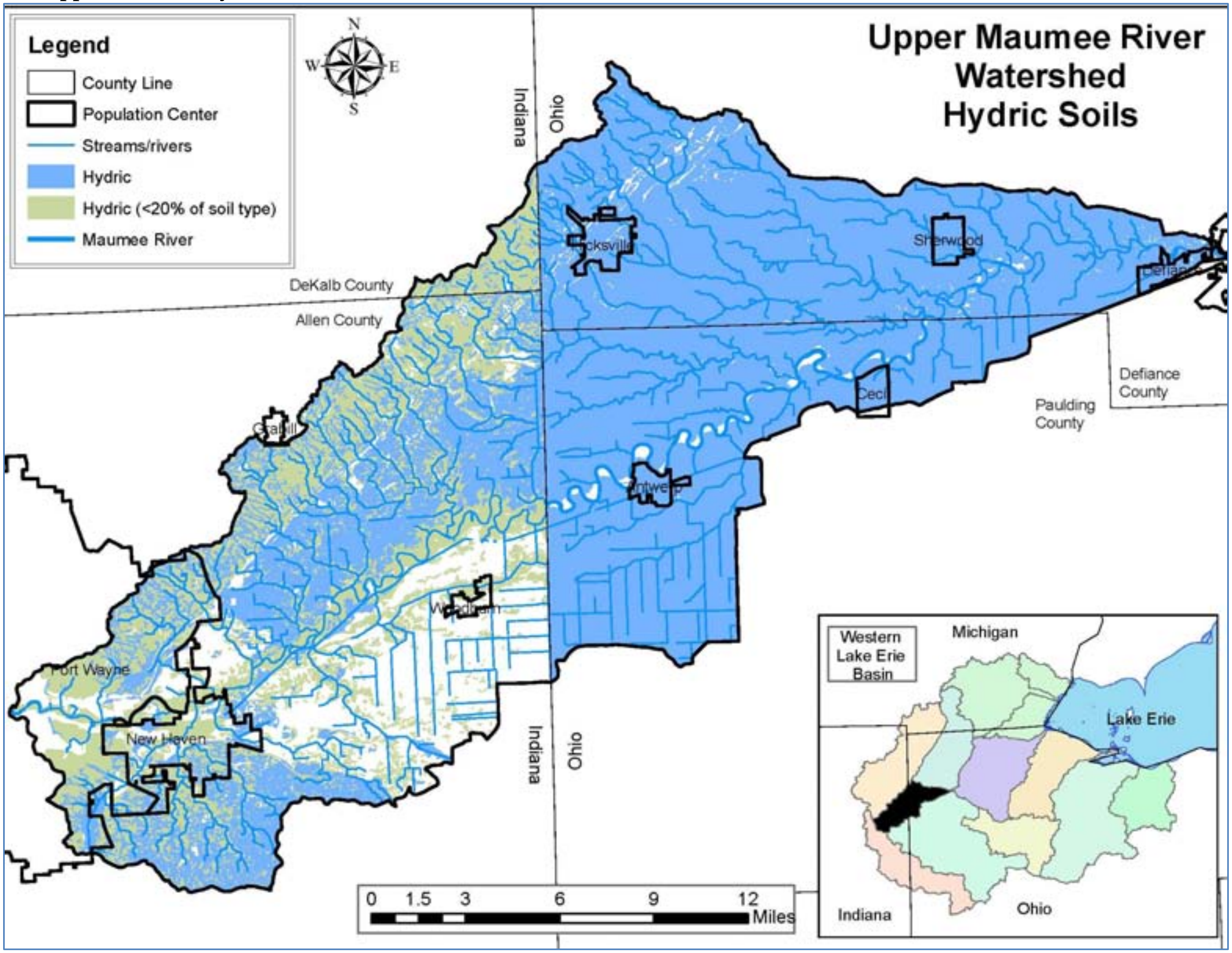


Hydric soils are present where wetlands are, or were. Several soils present within the project area are classified by the local Natural Resource Conservation Service (NRCS) as hydric as can be seen in the following Figure 2.5. Each state classifies the soils present within their jurisdiction differently, 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.

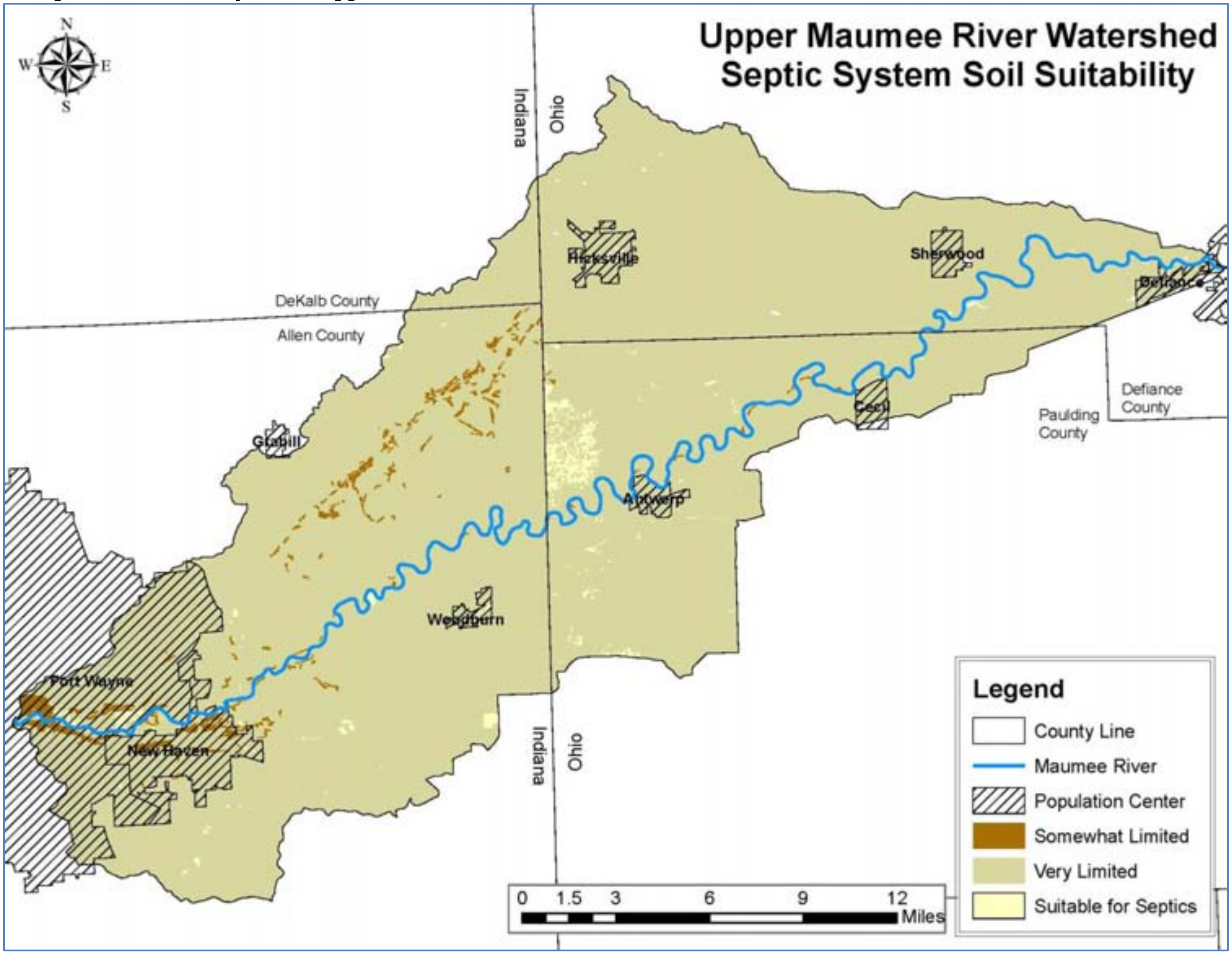
Hydric soils, while posing a significant problem when farmed, also are quite beneficial as they are prime locations to create or restore wetlands, which is a concern for the UMRW steering committee and stakeholders. The Upper Maumee watershed is located where the historic Great Black Swamp was located 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.

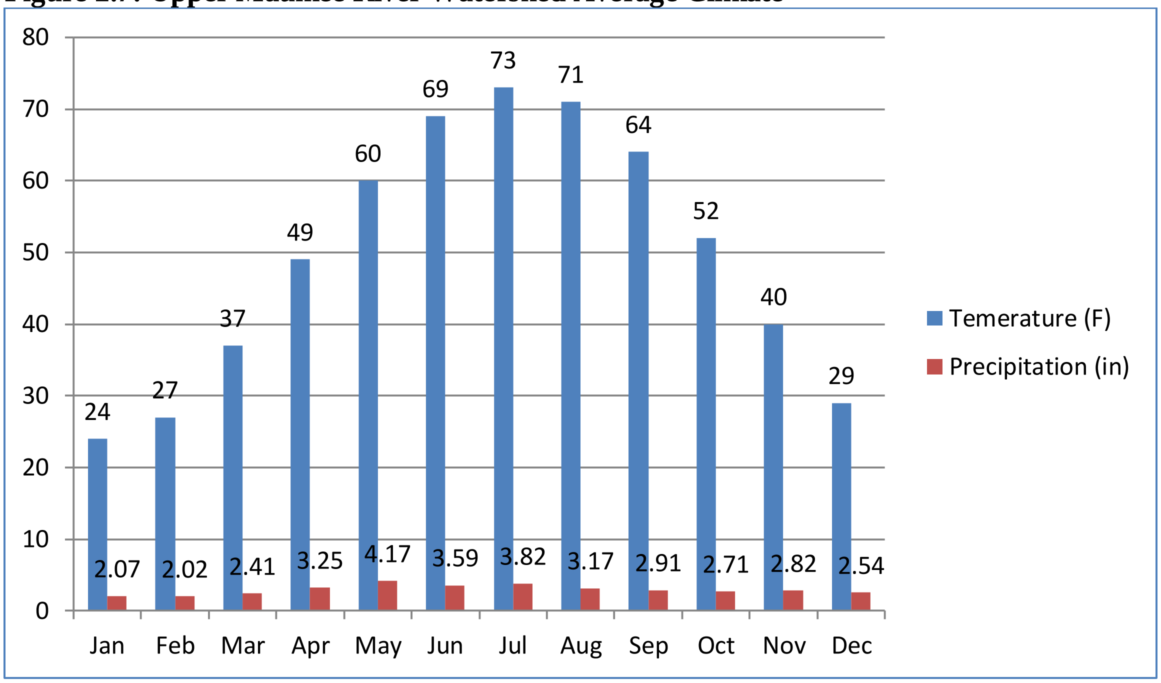
Figure 2.6: Septic Soil Suitability in the Upper Maumee River Watershed



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

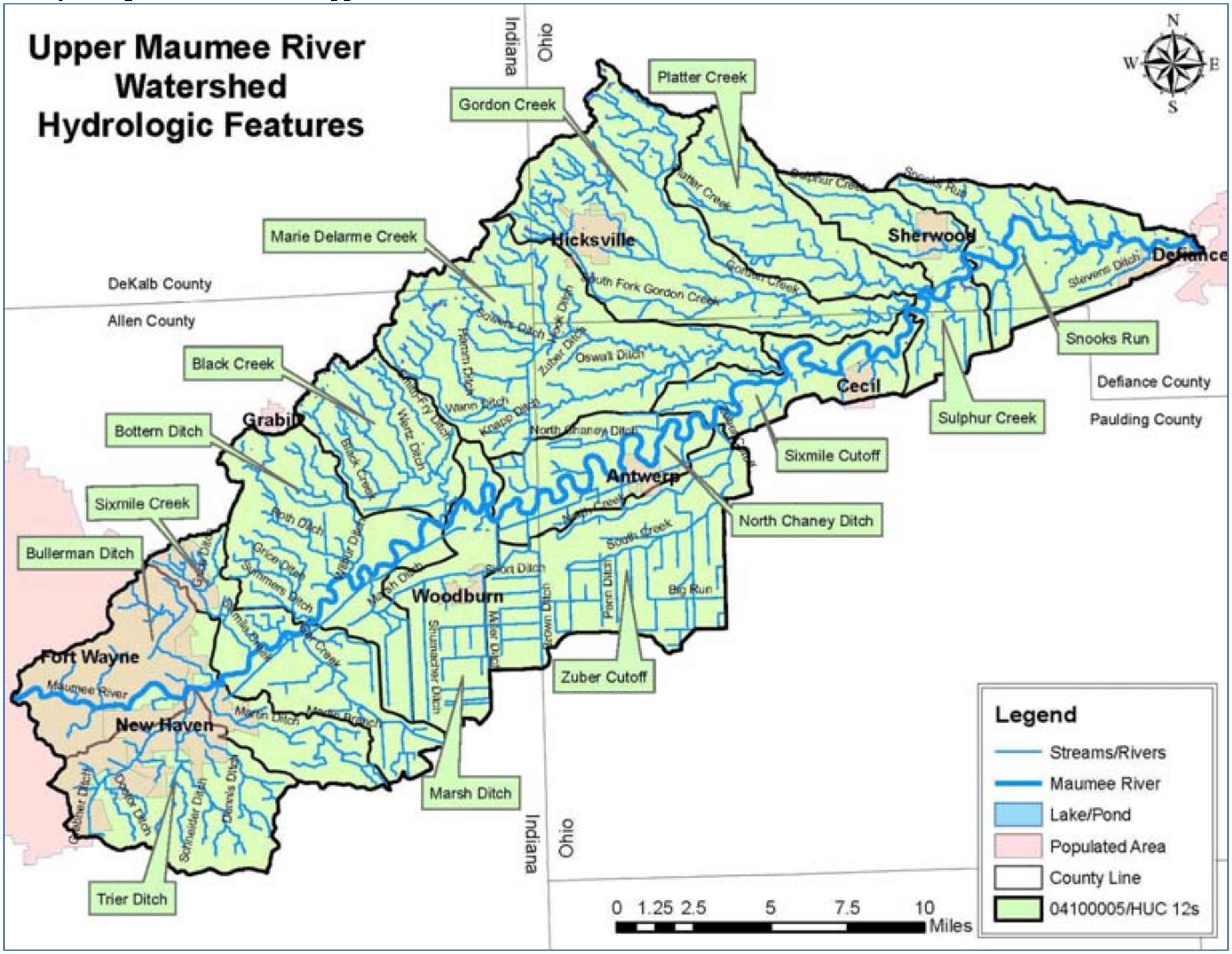
- Canal/Ditch – An artificial open waterway constructed to transport water, to irrigate or drain land, to connect two or more bodies of water, or to serve as a waterway for a watercraft

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.

Figure 2.8: Hydrologic Features in the Upper Maumee



The Maumee River is a warm water river which has limited recreational opportunities due to the fact that the Upper Maumee watershed is dominated by privately owned agricultural land. There are few desirable fish present in the watershed due to the draining of the Black Swamp in the late 19th century however anglers may enjoy catching catfish, walleye, and bass. The IN DNR and ODNR maintain active lists of all boat launch sites in each state, respectively. According to the IN DNR there is one site located in New Haven off N River Rd at Kreager Park and the ODNR lists two boat launch sites; one southeast of Sherwood off of CR424 and the other at Riverside Park in Antwerp.

2.4.1 Scenic and Wild Rivers

The ODNR passed the very first "scenic rivers act" in the U.S. with the intent to preserve Ohio's remaining streams and rivers that are relatively unaltered and have many of their natural characteristics intact. The Maumee River is designated by the Ohio DNR, Division of Watercraft as a State Scenic River. The river was so designated in 1974 from the Indiana-Ohio state line to the U.S. 24 Bridge west of Defiance because of its meandering floodplains and relatively healthy forested corridor along the river. There are no other National or State scenic or wild designations for waters in the Upper Maumee River Watershed.

2.4.2 Legal Drains

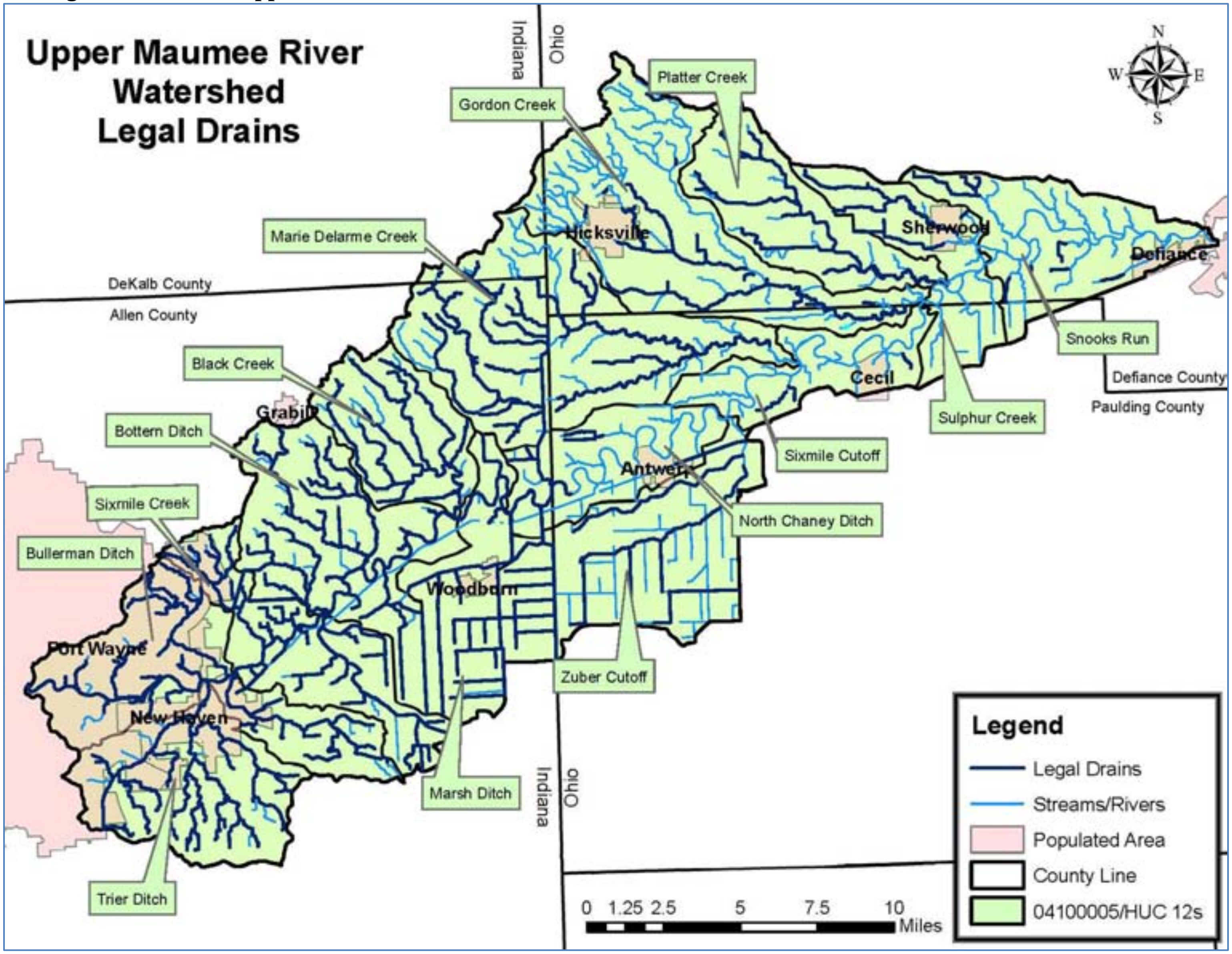
The natural streams, as well as legal drains, within the project area are used as a means to carry excess water from the land so that it may be used for agriculture, commerce, industry, and many other uses. However, due to flooding issues, which was noted as a concern by the watershed's stakeholders, many of the tributaries have been channelized to increase the velocity of water flowing downstream and decrease the risk of ponding and flooding. As can be seen in Figure 2.8, many streams in the sub-watersheds Sixmile Creek, Marsh Ditch, and Zuber Cutoff have been channelized and straightened to aid in the draining of those heavily farmed areas.

Local drainage boards, SWCDs, and County Engineering Departments are charged with maintaining many of the streams and ditches so that they may continue to function properly for their designated use. These maintained waterways are often referred to as legal drains. There are 534.35 miles of legal drains maintained by the county government within the UMRW. Table 2.3 provides a breakdown of legal drain miles within the project area for each county and Figure 2.9 shows the location of the legal drains. It should be noted that Paulding County only has a plat map with the location of the legal drains drawn on it. Therefore, the legal drains represented in Figure 2.9 for Paulding County are approximations only.

Table 2.3: Legal Drains in the Upper Maumee River Watershed

County	Allen	DeKalb	Defiance	Paulding
Miles	405.76	1.42	78.92	48.25
				Total = 534.35

Figure 2.9: Legal Drains in the Upper Maumee River Watershed

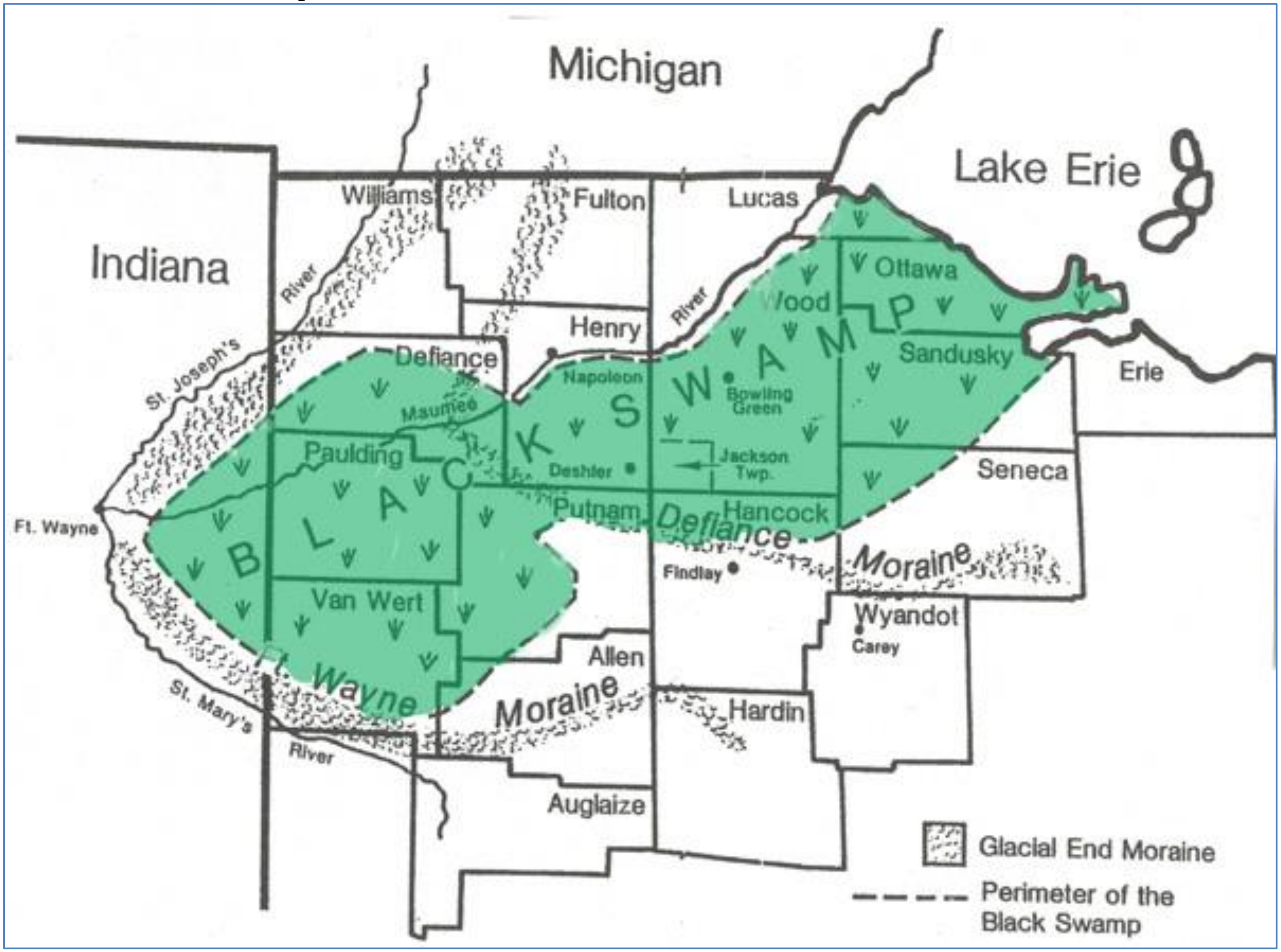


2.4.3 Wetlands

The UMRW is located in the heart of the historic Great Black Swamp, which was drained and converted to prime Midwestern farmland in the late 19th century. As can be seen in Figure 2.10 on page 29, the Black Swamp was located in all four counties of the Upper Maumee River Watershed project. The proximity of the project area to this historic swamp accounts for the presence of hydric soil.

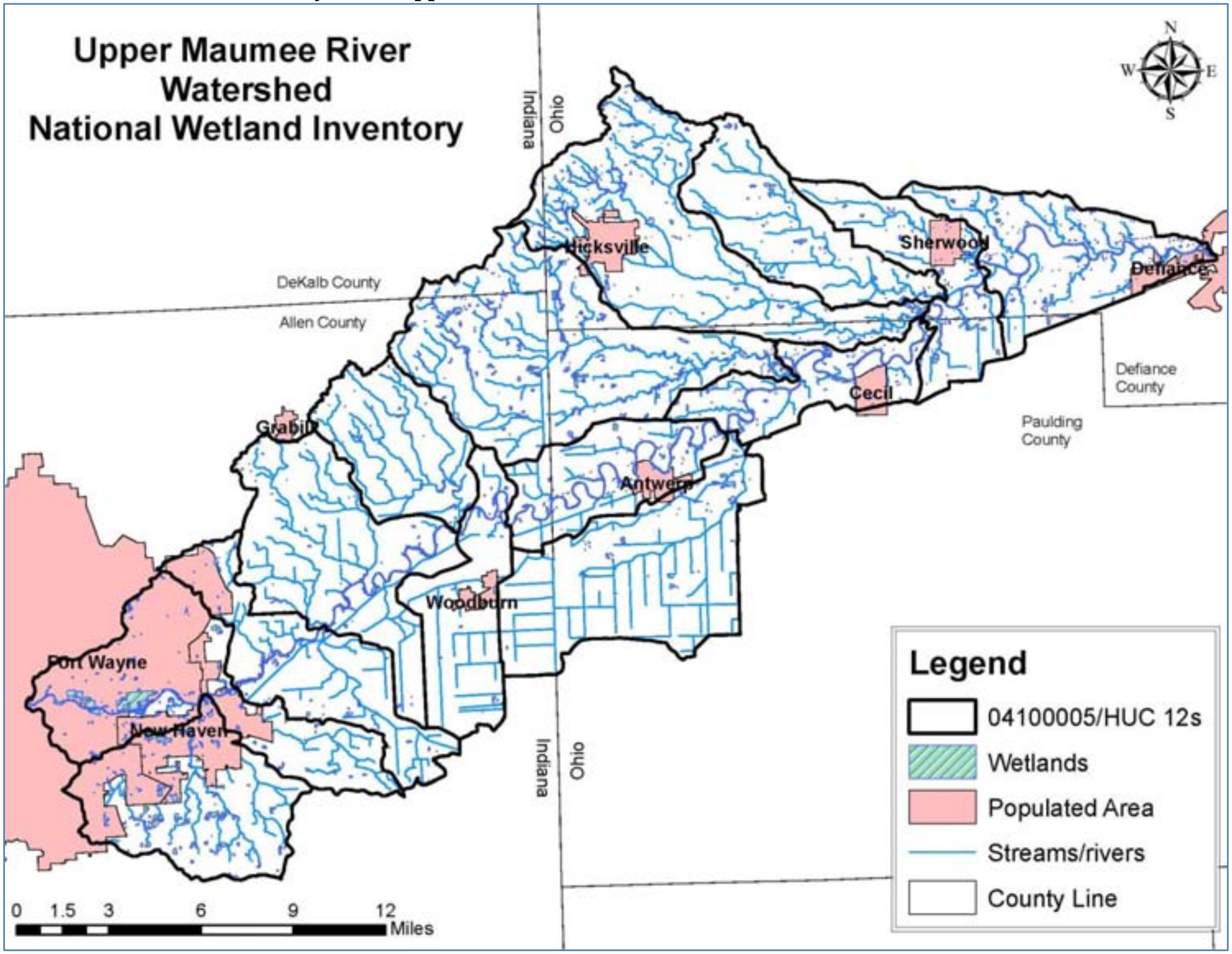
Wetlands play an integral role in our lives as recreation areas for wildlife and bird watching, and fishing, as well as many other recreational past-times. Wetlands also help to lessen the impact of flooding and act as pollution sinks. However, there are few wetlands still present in the UMRW. Ohio DNR estimates that Ohio has lost nearly 90% of all the historic wetlands in the state when early settlers realized the crop production potential on the fertile soils of the wetlands. There are currently only 7,385.08 acres of wetlands still present in the UMRW, which accounts for less than 3% of the watershed area. The loss of wetlands has increased flooding and drought damage, as well as initiated the major decline in fish, bird, and wildlife species and numbers in the watershed. Figure 2.11 shows where the wetlands within the UMRW have been delineated by the USFW National Wetland Inventory (NWI). The wetlands delineated in Figure 2.11 were not verified by a ground survey so should not be considered definite wetland boundaries but rather estimations only.

Figure 2.10: The Great Black Swamp Delineation



(Map taken from the website *http://www.nwoet.org/swamp/black_swamp_map.htm*)

Figure 2.11: National Wetland Inventory in the Upper Maumee River Watershed



2.4.4 Flooding and Levees

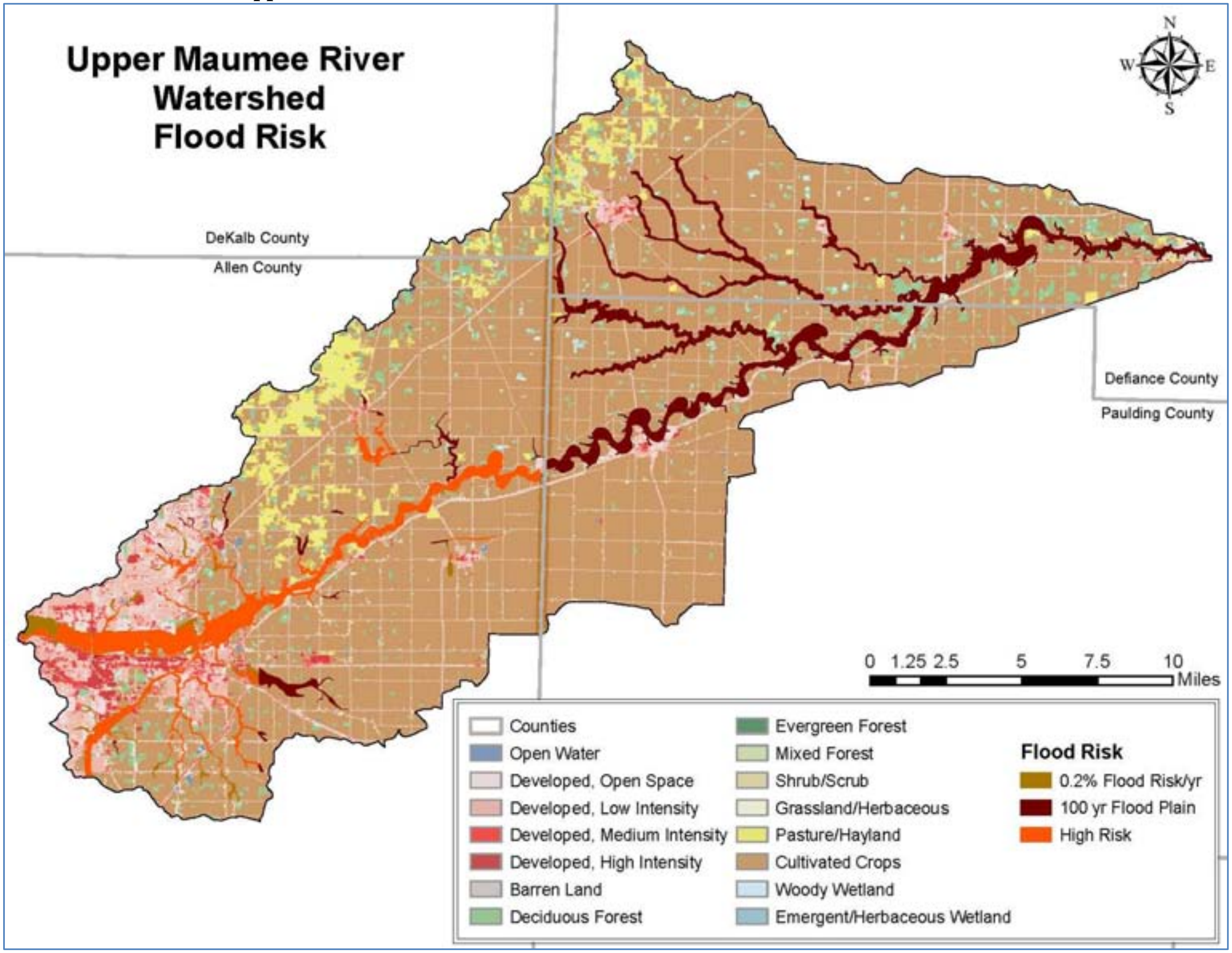
Stakeholders in the UMRW expressed concern over flooding issues within the watershed which can be linked to economic hardship, water impairment, and destruction of key wildlife habitat. Since 2003, the UMRW has experienced several small scale floods, as well as larger, “100 year flood events” in 2003, 2006, and 2009, all of which damaged property and infrastructure. Indiana State Law formed the Maumee River Basin Commission (MRBC) in the 1990’s to help communities within the Maumee River Basin reduce flood loss and implement sustainable watershed management by offering cost-share incentives to buyout structures within the floodplain, convert agricultural land to natural areas and wetlands, and help property owners flood proof their structure. The MRBC also provides flood education to the public, as well as facilitates the removal of obstructions within local waterways.

As can be seen in Figure 2.12, the Maumee River poses a high risk of flooding in Indiana, likely due to the amount of imperviousness surrounding the city of Fort Wayne and New Haven which adds to the amount of water within the river, as well as the velocity and erosive power of the river. Ohio state agencies have deemed the Maumee River and many of its tributaries to be in a 100 year flood plain which means there is a 1% annual chance of the area becoming flooded. Figure 2.12 also shows the significant amount of developed land that is located within the floodplain of the Maumee River.

Due to the potential of flood damage to residences and businesses located within the floodplain, Fort Wayne was federally authorized to install levees as an urban flood protection measure. The Fort Wayne East Flood Protection Project, as authorized by the Water Resources Development Act of 1990, and the construction of the levees were completed by 2000. The levee system in Fort Wayne consists of 26,000 linear feet (4.9 miles) of earthen levees, concrete floodwalls, stoplog closures, and an interior drainage system which includes a pumping station. The U.S. Army Corp of Engineers (US ACE) conducts periodic inspections of federally authorized levees. The last reported inspection conducted by the US ACE was dated April 13, 2011. The inspection report states that the levee system is deficient and therefore, the flood protection offered by the levees may not be adequate in the event of a major rain event.

It is important to mention that after the catastrophic events following hurricane Katrina, the US ACE adopted new rules to insure the integrity of levees. One such rule is the annual spraying of levees with a pesticide to kill off any vegetation living on the levee system. While this practice can reduce the risk of vegetation causing harm and lessening the integrity of levees, it also poses a threat to water quality due to the excess runoff of the pesticide. Pesticides in the river can harm aquatic life which is vital to a healthy aquatic ecosystem so seeking alternatives to this practice may be beneficial to the health of the rivers.

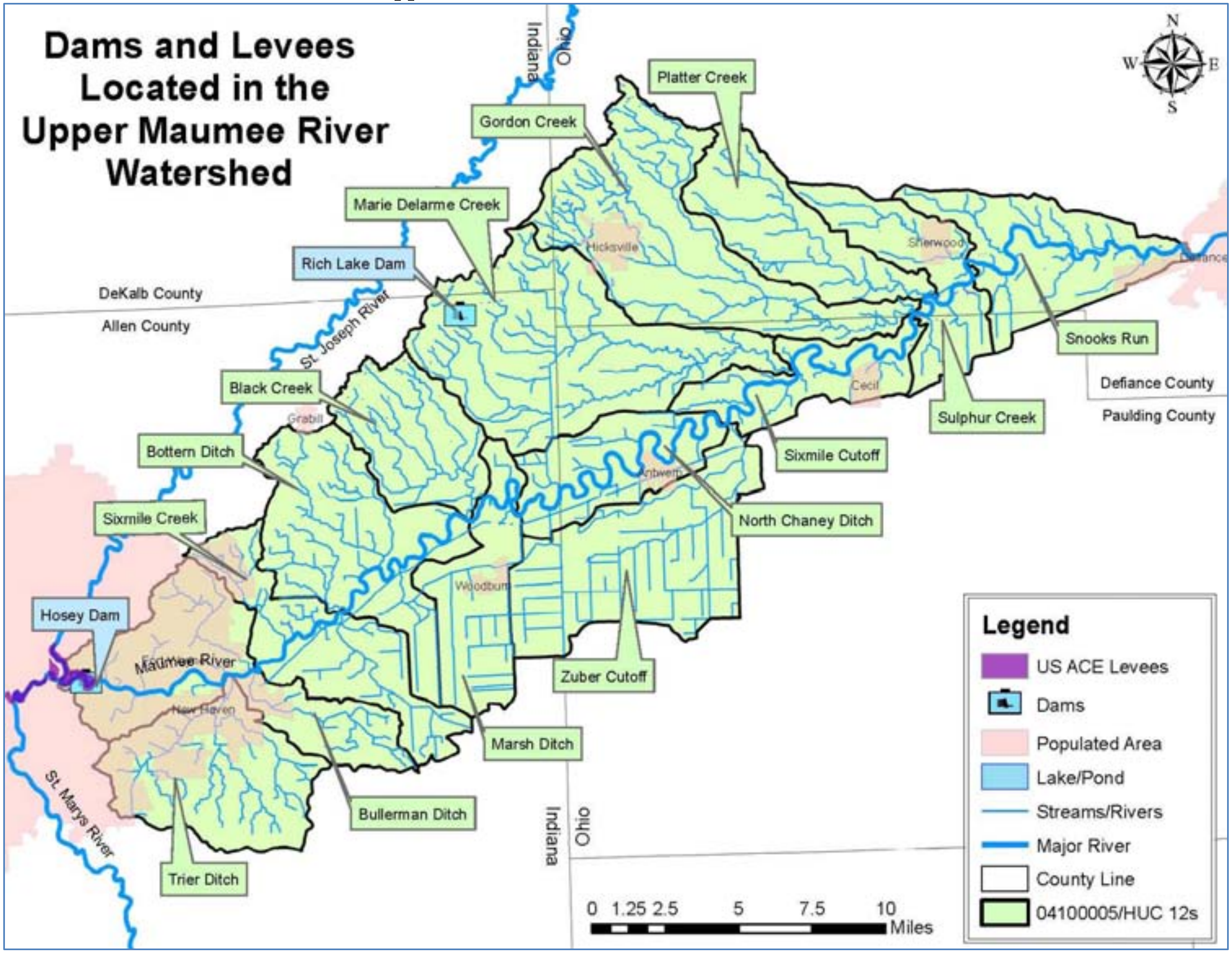
Figure 2.12: Flood Risks in the Upper Maumee River Watershed



2.4.5 Dams

There are two dams located within the Upper Maumee River Watershed; Hosey Dam in Fort Wayne which was installed in 1925 as a flood control measure, and the Rich Lake Dam west of Hicksville, OH which was completed in 1970 on an unnamed tributary of the Hamm Interceptor Ditch to form a 15.5 acre residential lake. While dams can be beneficial to communities to supply recreational opportunities, drinking water reservoirs, hydroelectric power, and help control flood waters, they can also be detrimental to the natural hydrology and aquatic ecosystem. Some of the dangers of dams include blocking fish migration, slowing the natural flow of a river, altering the water temperature, decreasing oxygen levels, and causing silt, debris, and nutrients to collect in the waters behind the dam. Also, dams have an expected life span of about 50 years at which point their intended purpose may become compromised. The Hosey Dam is well beyond its expected life span and the Rich Lake Dam is quickly approaching the end of its expected life span. A map of the dams and levees located within the project area can be seen in Figure 2.13.

Figure 2.13: Dams and Levees Located in the Upper Maumee River Watershed



2.4.6 Groundwater Resources

The UMRW is partially located within the Michindoh aquifer boundary (Figure 2.14), which is a glacial, sand and gravel aquifer. The aquifer is at a depth of just below ground surface to 200 feet deep. In 2007 the City of Bryan, OH petitioned the US EPA to designate the Michindoh aquifer as a Sole Source Aquifer as it provides water to more than 385,000 people who withdraw 72 million gallons of water a day. According to the EPA Region 5 webpage, last updated in December, 2011, the US EPA is continuing to do additional research before it will make a final determination.

Many residents in the watershed acquire their drinking water from groundwater through wells including Woodburn and Grabill, IN, and Antwerp, Hicksville, Cecil, and Sherwood, OH. Fort Wayne and New Haven, IN get their drinking water from the St. Joseph River but it is important to note that Defiance, OH acquires their drinking water from the Maumee River at a rate of 3.6 million gallons per day (MGD) (though the treatment plant is capable of taking in 8 MGD). All rural residents acquire their drinking water from water wells. The county health departments are responsible for the safety of the groundwater for private water wells and test the water before a new well can be installed. The health departments report very few areas where the water has proven to be inadequate over the past six years. The wells are deemed inadequate for drinking if they test positive for the presence of fecal coliforms.

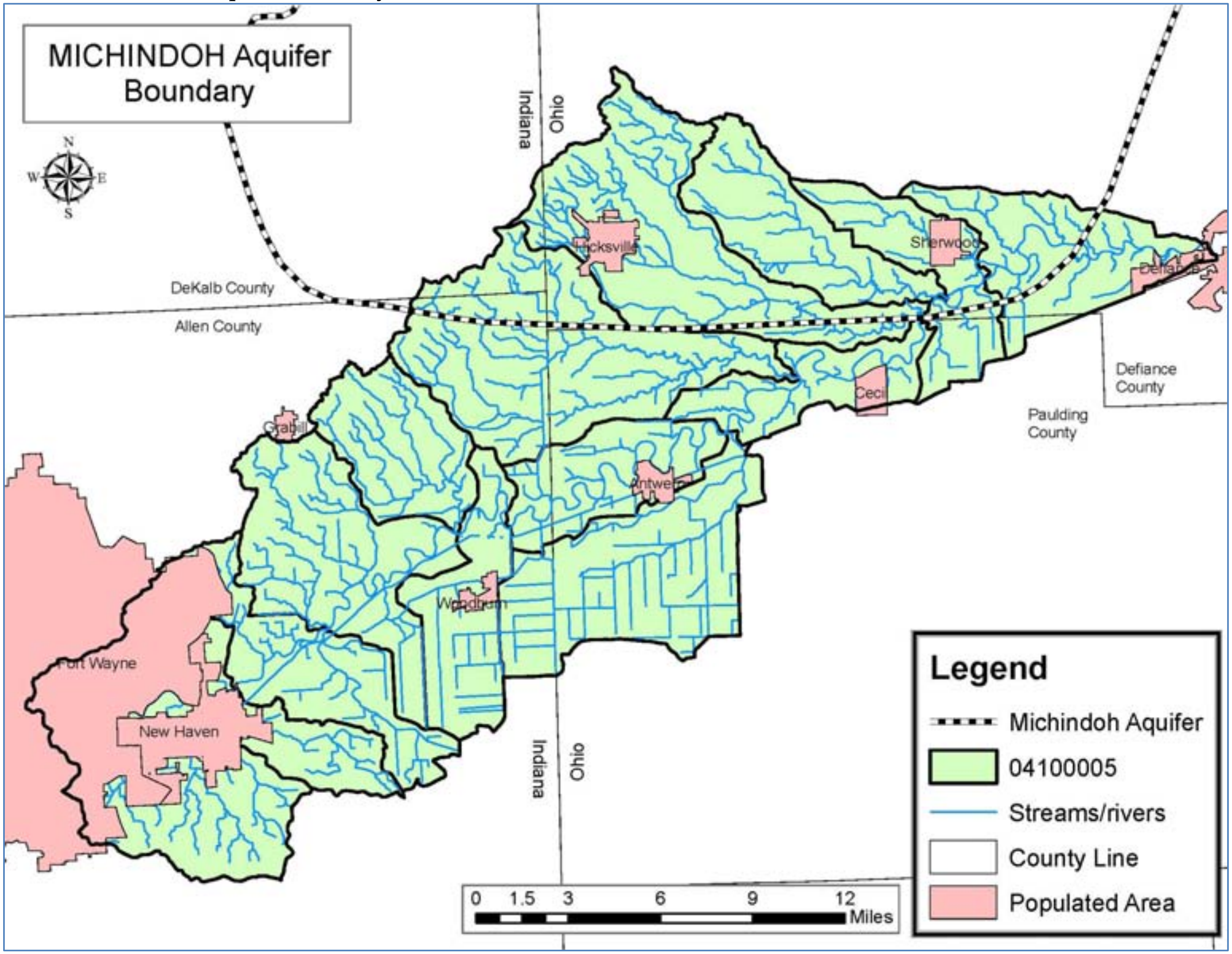
A survey of water withdrawals done by the USGS in 2005 showed that Indiana and Ohio withdraw 844 million gallons of water per day from ground water resources. Table 2.4 shows the total water withdrawals for Indiana and Ohio.

Table 2.4: Water Withdrawals in Indiana and Ohio

State	% of Population	Ground-water (Mgal/day)	Surface water (Mgal/day)	Total (Mgal/day)
Indiana	74	356	320	676
Ohio	83	488	647	1430
Total Mgal/day		844	967	2106

According to the Western Lake Erie Basin Study; Upper Maumee Watershed Assessment conducted by the US Army Corp of Engineers, 7.77 million gallons of water is withdrawn from the UMRW daily with 6.06 MGD used from surface water and 1.71 MGD used from ground water. 64.5% of that is for public usage, 22% for industry, 1.7% for agriculture, 9.4% for mining, and 2.4% for golf courses.

Figure 2.14: MICHINDOH Aquifer Boundary



2.5 Land use

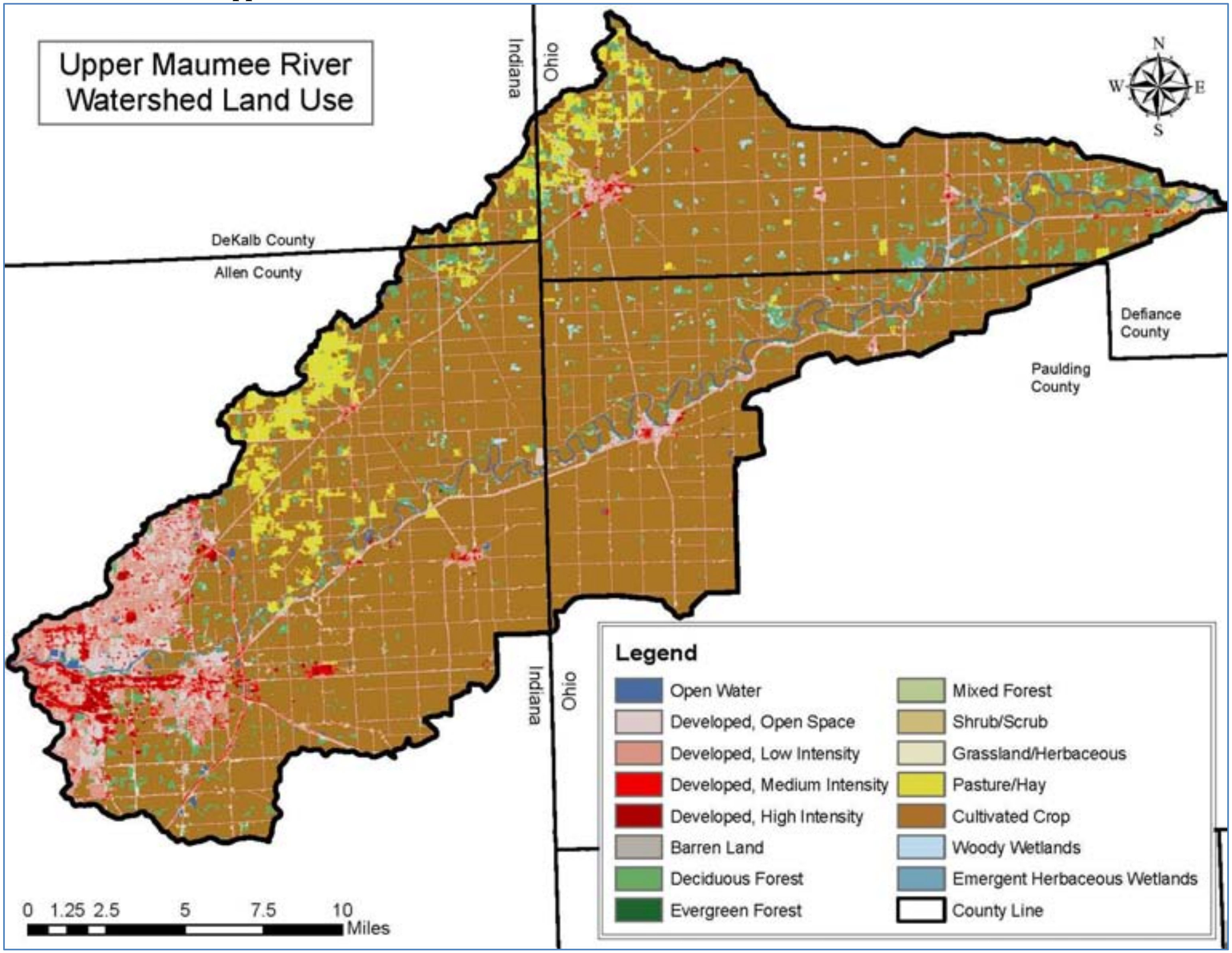
Land use in the project area greatly influences the quality of the water resources. Land in agricultural production has the potential to erode, especially if over worked or if it is conventionally tilled annually. Thus soil particles carrying high levels of nutrients and pesticides have the potential to reach open water sources and affect aquatic plants and animals and cause the water to become non-potable. Livestock operations often can lead to high levels of bacteria in open water from manure storage areas that are not properly maintained or from livestock having direct access to open water sources. These two activities can also lead to high levels of sedimentation and nutrients in surface water. Industrial areas and urban centers can pose a threat to water quality due to the increased imperviousness of the landscape and industrial waste outfalls. For the reasons listed above, it is very important to investigate land use activities in the project area so as to determine the best method of remediating the pollution coming from the various land uses in the project area. Below is a general description of land uses in the project area. Section 3 of this WMP will provide a more in depth look at the land use in the watershed by breaking it down to HUC 12 sub-watersheds.

The predominant land use in the watershed is agriculture as can be seen in Figure 2.15. There are few urban settings including Antwerp (Pop.=1,736), Cecil (Pop.=188), Hicksville (Pop.=3,581), Sherwood (Pop.=827) and a small portion of Defiance (Pop.=16,494) in Ohio and Woodburn (Pop.=1,520), New Haven (Pop.=14,794), and a portion of Fort Wayne (Pop.=253,691) in Indiana. Table 2.5 below shows the number of acres of land in each type of land use per state.

Table 2.5: Land use in the Upper Maumee River Watershed

Land use	Ohio	Indiana	Total	% of Watershed
Open Water	1,631.49	1,273.21	2,904.7	1.15
Developed, Open Space	6,925.82	11,883.89	18,809.71	7.47
Developed, Low Intensity	2,086.29	10,482.14	12,568.43	4.99
Developed, Medium Intensity	352.94	2,911.59	3,264.53	1.30
Developed, High Intensity	148.11	1,654.4	1,802.51	0.72
Barren Land	33.36	36.92	70.28	0.03
Deciduous Forest	6,827.74	5,536.96	12,364.7	4.91
Evergreen Forest	8.9	21.57	30.47	0.01
Mixed Forest	6.23	4.23	10.46	0.00
Shrub/Scrub	3.11	227.51	230.62	0.09
Herbaceous/Grassland	447.68	959.63	1,407.31	0.56
Pasture/Hay	3,306.12	7,262.97	10,569.09	4.19
Cultivated Crop	100,234.02	84,877.21	185,111.23	73.47
Woody Wetlands	1,565.88	564.22	2130.1	0.85
Emergent Wetlands	515.51	157.46	672.97	0.27
Total	124,093.2	127,853.91	251,947.11	100

Figure 2.15: Land Use in the Upper Maumee River Watershed



2.5.1: Tillage Transect

Since the counties located within the project area are predominately agriculture based, each tillage transect is performed in each county typically every other year to gage the adoption of various conservation tillage practices and to get an accurate count of crop acreage. The Western Lake Erie Basin (WLEB) specialist of the ODNR disseminated a power point presentation to interested parties in 2012 which shows the adoption of conservation tillage practices since 2006 in each of the HUC 8 watersheds within the WLEB (excluding Michigan). Data from the 2006 and 2012 tillage transects for the Upper Maumee River Watershed are displayed in Table 2.6. As can be seen in the below Table, the adoption rate of conservation tillage practice has been on the rise since 2006 and that greater than 50% of fields located in the UMRW are currently using some form of conservation tillage practice.

Table 2.6: Tillage Transect in 2006 and 2012 in the Upper Maumee River Watershed

Crop	Corn		Beans		
Year	2006	2012	2006	2012	Unit
No-Till	36.5	47.7	78.5	73.7	Percent
Mulch-Till/Strip-Till	13.5	15.9	4.7	10.2	Percent
Total	50	63.6	83.2	83.9	Percent

2.5.2: Septic System Usage

There are 11 areas where the population is served by a centralized sewer system including the incorporated areas of Fort Wayne, New Haven, Woodburn, Hicksville, Antwerp, Cecil, Sherwood and Defiance, and smaller neighborhoods in Cecil, Hicksville, and Sherwood. However, all rural areas located within the UMRW rely on on-site sewage disposal. It should also be noted that there is a large Amish population in the watershed, located mostly in Northeast Allen County and the western edge of Defiance County, all of which utilize on-site sewage disposal.

Allen, Defiance, and Paulding County Health Departments were contacted to obtain statistics on the number of septic systems in use within each county and the number of those that are currently failing and discharging untreated waste to either ground or surface water. The Allen County Health Department estimates 15,376 systems are in use in the county with nearly 9,000 of those posing a significant risk to human health. The Allen County Health Department also acknowledges that there is a possibility of some of the systems being a “straight-pipe” discharger to open water sources; meaning the waste does not go through any treatment prior to being discharged. Estimates of failing septic systems in Defiance and Paulding Counties could not be obtained from the local Health Departments. However, as reported on the Tetra Tech website (http://it.tetratech-ffx.com/steplweb/Faq.htm#Q13), a study conducted by the National Environmental Service Center in 1992 and 1998 estimates that approximately 25% – 30% of on-site sewage treatment systems in the state of Ohio are failing due to back-ups or surfacing of effluent. These failures would be due to the system being placed in an area unsuitable for it or due to a lack of, or improper maintenance of the system. Septic system leachate may increase nutrient levels, as well as, fecal coliform, including the harmful *E. coli* bacteria, in both surface water and ground water.

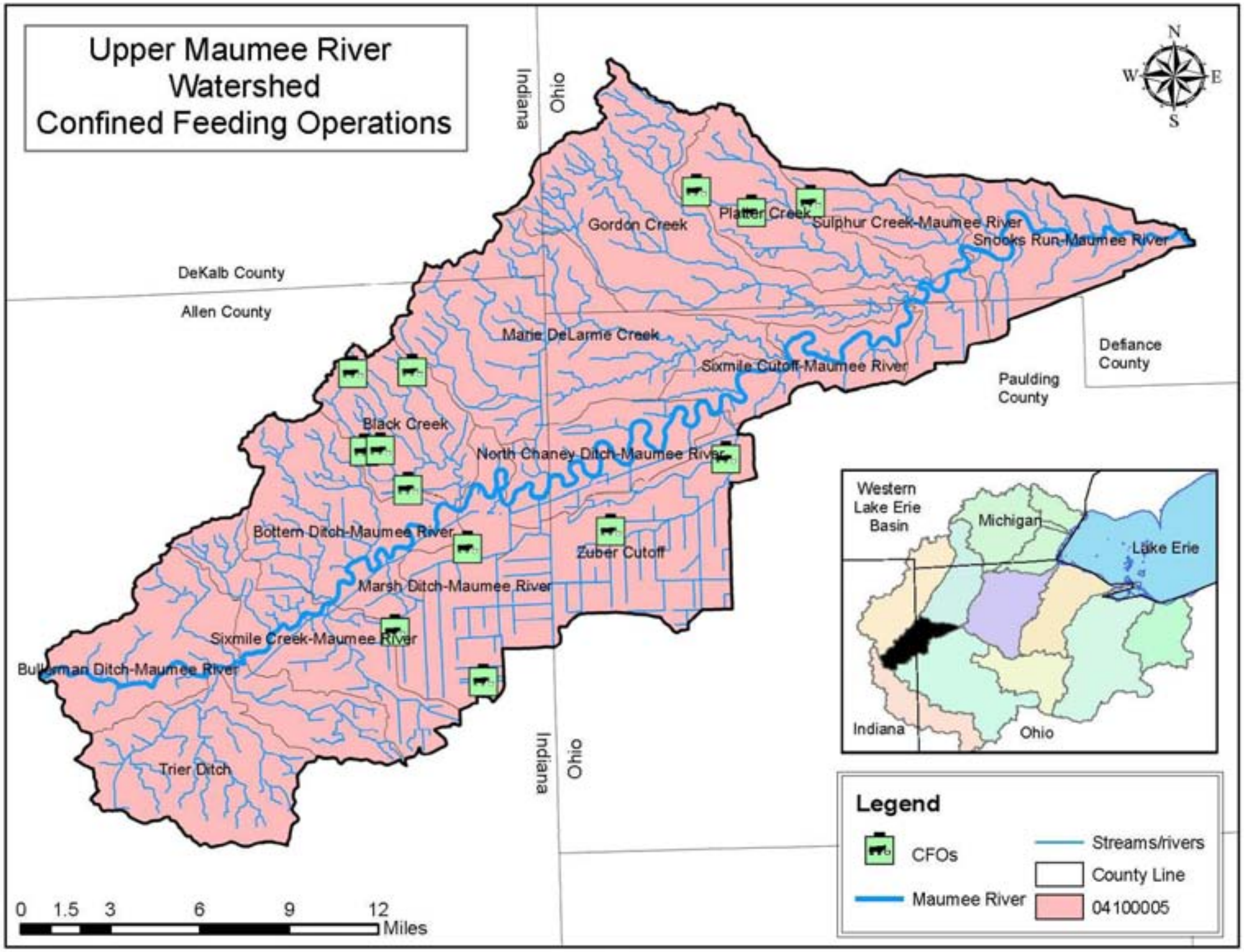
2.5.4: Confined Feeding Operations

Animal feeding operations (AFOs) located within the project area can present a significant pollution problem if animal waste is not properly confined. There are thirteen permitted confined feeding operations (CFOs) located within the project area totaling over 90,000 animals; five in Ohio and eight in Indiana and outlined in Table 2.7, below. A confined feeding operation is so designated if there are 300 cattle, 500 horses, 600 swine or sheep, or 30,000 fowl present on the property and confined for at least 45 days during the year where there is no ground cover or vegetation present over at least half of the animals' confinement area. What are called CFOs in Indiana are referred to as Confined Animal Feeding Facilities (CAFFs) by Ohio which are overseen by the Ohio Department of Agriculture (ODA). If the size of the operation is very large, or there have been compliance issues with an operation in the past, the CFO may be designated as a Concentrated Animal Feeding Operation (CAFO), and will be required to obtain a National Pollution Discharge Elimination System (NPDES) permit. Figure 2.16 shows the location of each of the CFOs located within the UMRW.

Table 2.7: Confined Feeding Operations in the Upper Maumee River Watershed

Operation	Sub-watershed	Designation	Animal Type	Animal #
5 C Farms	Platter Creek	CAFF	Beef	3,350
Pheasant Run Farms	Platter Creek	CAFF	Swine	7,100
Vissers Dairy, LLC	Platter Creek	CAFO	Dairy	1,600
Zylstra Dairy	Zuber Cutoff	CAFO	Dairy	1,400
Flatland Dairy, LLC	Zuber Cutoff	CAFO	Dairy	2,400
W R Farms	Sixmile Creek	CFO	Finishers/Sows	160 / 1335
Richard and David Hartman	Marsh Ditch	CFO	Nursery Pigs/Finishers	1800 / 720
James and Rosa Lengacher	Black Creek	CFO	Broilers	53,000
Brenneke Dairy	Marsh Ditch	CFO	Dairy	505
Mark S Rekeweg	Black Creek	CAFO	Finishers/Nursery Pigs	7,000/1,000
Impressive Pork Production Inc	Black Creek	CAFO	Finishers	4,800
Schlatter Farms LLC	Black Creek	CAFO	Finishers	4,000
Mark S Rekeweg	Black Creek	CAFO	Grow-Finisher	2,000

Figure 2.16: Confined Feeding Operations in the Upper Maumee River Watershed



2.5.5: Windshield Survey

A windshield survey was conducted throughout the watershed to identify areas where nonpoint source pollution (NPS) may be an issue. The survey was conducted from May through September 2012, with two people per vehicle, driving each road within each sub-watershed, and making note of any areas of significant soil loss, lack of riparian buffer, livestock access to open water, or other potential pollution sources. The notes taken during the windshield survey were then verified via a “desktop survey” of the watershed using 2011 aerial photography. The survey revealed several areas of erosion, areas where livestock had direct access to open water, barnyard and pasture runoff issues, among other problems. The windshield survey will be discussed in further detail, at the sub-watershed level, in Section three of this WMP.

2.5.6: National Pollution Discharge Elimination System

Facilities that discharge directly into a waterbody are required to obtain an NPDES permit from the overseeing state agency (IDEM and OH EPA). The permit regulates the amount of contaminants a facility can discharge into surface water and requires the facility to conduct regular water quality monitoring. While these facilities are regulated by the State, there is the potential that they may have accidental discharges above permit limits, or in some cases, the facilities may release a substance that they are not required to report to the State which may pose a threat to water quality; phosphorus is a common parameter not required to be reported. There are 18 NPDES permitted facilities located within the project area which are outlined in Table 2.8. Figure 2.17 is a map showing the location of each of the permitted facilities. The NPDES permitted facilities will also be mapped in their respective sub-watershed in Section three of this WMP.

It should be noted that the Cecil Waste Water Treatment Plant (WWTP), and Fort Wayne WWTP had several exceedances beyond their permit limits and had formal actions taken against them by the regulating state agency.

2.5.7 Brownfields

Brownfields are defined by the USEPA as “real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant”. Examining these sites in closer detail to determine potential future uses for the sites by cleaning up any environmental hazards present, will help to protect the environment, can improve the local economy, and reduces pressure on currently undeveloped lands for future development. The EPA, States, and local municipalities often offer assistance in the form of grants and low interest rate loans for the cleanup and redevelopment of identified and potential brownfield sites.

There are six identified brownfield sites located in the UMRW, all located within the Bullerman Ditch and Trier Ditch sub-watersheds. The City of Fort Wayne was granted funds for a community wide project to investigate potential brownfield sites that may be present within the city limits. Figure 2.17 is a map delineating each specific brownfield site. The specific brownfield sites will be discussed in further detail in Section 3 of this WMP.

2.5.8 Superfund Sites

A Superfund site is a place where there is either an uncontrollable release of a hazardous material, or an abandoned site where hazardous waste is located. These sites pose a potential risk to the ecosystem and/or people. Sites are categorized by the severity of the risk to the surrounding environment and are then placed on the National Priorities List. There is one Superfund site located in the UMRW, in Fort Wayne, IN as can be seen in Figure 2.17. This site will be discussed in further detail in Section 3 of this WMP.

2.5.9 Combined Sewer Overflows

A combined sewer overflow (CSO) is a piped outfall that is part of a combined sewer system which carries both sanitary waste and storm water runoff through the same pipe to the waste water treatment plant (WWTP). However, during rain events, the system is designed to discharge flows in excess of the WWTPs system capacity to receiving waters. Each population center that contains CSOs is required to comply with the Clean Water Act and manage the discharges of combined sewer. Many CSO communities enter into a consent decree or an agreed order/administrative agreement, which is a federally or state administered enforcement mechanism that compels the community to implement a plan to improve water quality. The consent decree or agreed order may include a Long Term Control Plan for construction of sewer system improvements as well as documented plans for the operation, maintenance and rehabilitation of the sewer system to minimize or eliminate CSO discharges to receiving waters. The cities of Fort Wayne, New Haven, and Hicksville all have LTCPs.

The City of Fort Wayne has a total of 43 CSO outfalls which discharge into the St. Marys, St. Joseph, or Maumee River; thirteen (13) of the 43 CSOs discharge directly into the Upper Maumee River Watershed. The City of New Haven has three (3) CSO outfalls and Hicksville has Five (5) CSO outfalls. There are no other CSOs that discharge within the UMRW beyond those mentioned above. All CSOs are delineated in Figure 2.17. CSOs will be discussed in further detail in Section 3 of this WMP.

2.5.10 Underground Storage Tanks

An underground storage tank (UST) is a container placed under ground to store chemicals necessary to run a business or provide a service. Most USTs store gasoline, diesel, kerosene, or dry cleaner chemicals, though USTs are not limited to those chemicals alone. USTs pose a risk to the surrounding environment as they have the potential to leak (LUSTs) their contents into the soil which can leach into groundwater, or surface water, and contaminate them.

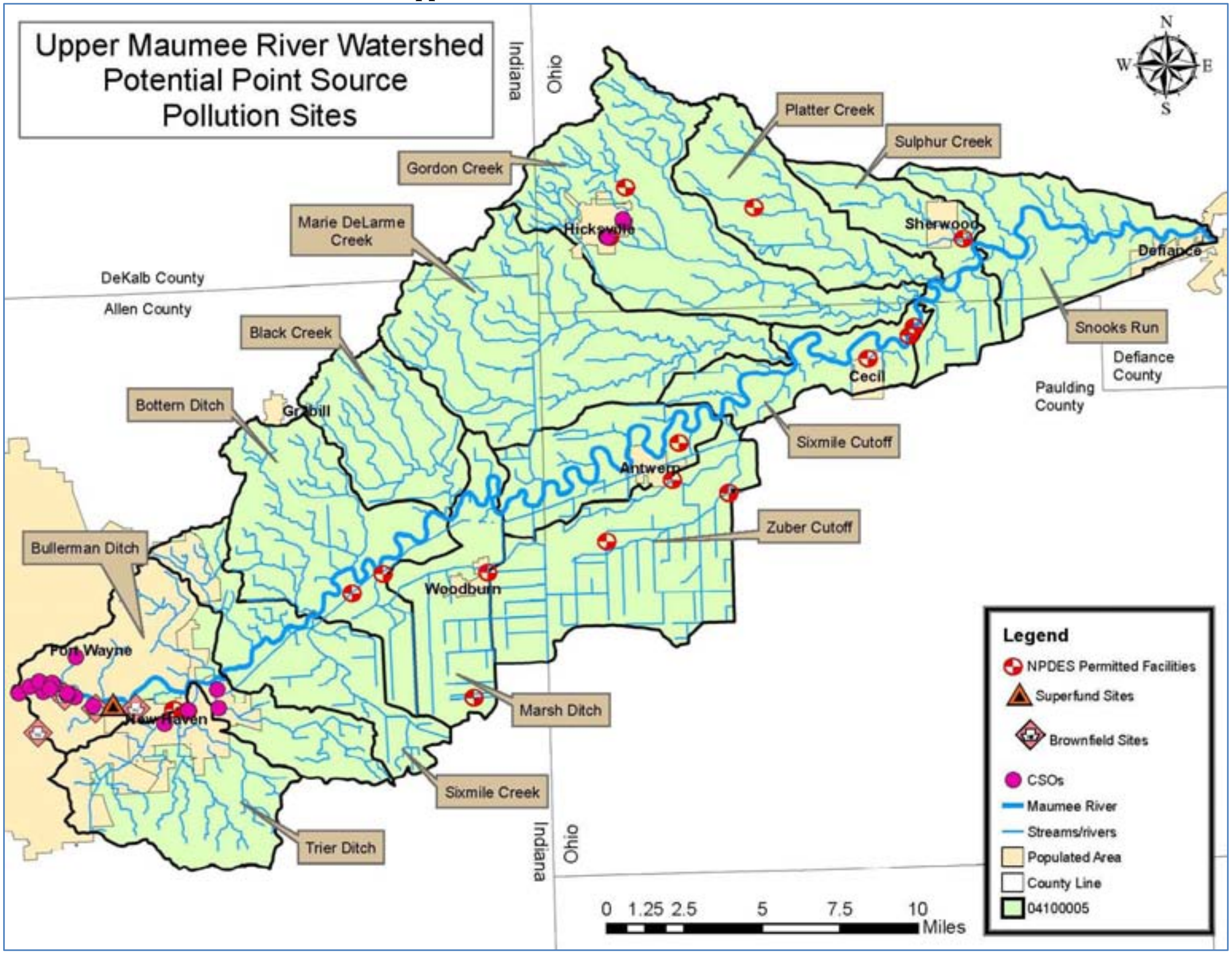
USTs are managed by the IDEM Office of Land Quality's Underground Storage Tank program and the OH Commerce Division of Fire Marshal, Bureau of Underground Storage Tank Regulations. However, the state of OH has not been granted state program approval by the US EPA to manage the UST program unsupervised. The states are charged with insuring all USTs meet state and federal regulations so as to not contaminate surrounding land and/or water resources. The states are also responsible for making sure those tanks that do not meet requirements are properly closed or upgraded. There are currently 131 LUSTs located in the project area. LUSTs will be discussed in Section 3 under the respective sub-watershed where they will also be mapped.

Table 2.8: National Pollution Discharge Elimination System Permits

Permit Name	Permit #	County Name	Street Address	City	State Code	State Water Body Name	Effluent Exceedances (3 yrs)	Enforcement Actions (I=informal; F=formal) (5 yrs)
Antwerp WWTP	OH0022195	Defiance	CR 43 and 176	Antwerp	OH	North Creek	11	0
BF Goodrich Tire Manufacturing	IN0000507	Allen	18906 US 24 E	Woodburn	IN	Maumee River	2	0
Boston Weatherhead Div. DANA Co.	OH0002713	Paulding	5278 US 24E	Antwerp	OH	Maumee Cemetery Ditch	12	0
Brentwood MHP	OH0130061	Paulding	North of US 24, 1mile	Cecil	OH	Maumee River	8	1 (I)
Cecil WWTP	OH0029238	Paulding	17228 CR 105	Cecil	OH	Maumee River	60	4 (I) 1(F)
The Country Oasis	ING080256	Allen	16817 East US 24	Woodburn	IN	Grover Ditch	0	0
Middle Gordon Creek subdiv WWTP	OH0053465	Defiance	W side of SR 49	Hicksville	OH	Gordon Creek	incomplete DMR (Discharge Monitoring Report)	
Flat Land Dairy	OH0130559	Paulding	6787 CR 144	Antwerp	OH	South Creek	incomplete DMR	
Fort Wayne WWTP	IN0032191	Allen	2601 Dwenger Ave	Fort Wayne	IN	Maumee River	4	2(I) 2(F)
Hanson Aggregates Midwest Inc.	ING490049	Allen	22821 Dawkins Rd	Woodburn	IN	Edgerton Carson Ditch-Maumee River	0	0
Hicksville WWTP	OH0025771	Defiance	500 S Bryan	Hicksville	OH	Mill Creek	9	2 (I)
New Haven CSS	INM020346	Allen	815 Lincoln Hwy E	New Haven	IN	Martin Drain and Trier Ditch to Maumee	0	0
Norfolk Southern Railway	IN0000485	Allen	7315 Nelson Rd	Fort Wayne	IN	Trier Ditch to Maumee River	2	0
Vagabond Village (WWTP)	OH0132462	Paulding	13173 US 24	Cecil	OH	Maumee River	109	4 (I)

Permit Name	Permit #	County Name	Street Address	City	State Code	State Water Body Name	Effluent Exceedances (3 yrs)	Enforcement Actions (I=informal; F=formal) (5 yrs)
Village of Sherwood (WWTP)	OH0020281	Defiance	Coy Rd south of the B&O	Sherwood	OH	Sulphur Creek	62	5(I)
Vissers Dairy	OH0137979	Defiance	09711 Breininger Rd	Mark Center	OH	Platter Creek	incomplete DMR	
Woodburn WWTP	IN0021407	Allen	23304 Tile Mill Rd	Woodburn	IN	Maumee River	39	4(I)
Zylstra Dairy LTD	OH0132799	Paulding	11753 Rd 21	Antwerp	OH	UT South Creek	incomplete DMR	

Figure 2.17: Potential Point Source Sites in the Upper Maumee River Watershed



2.5.11: Parks

Thirty-eight parks and preserves are located within the project area totaling over 695 acres of land. Many of the parks are small municipal parks which are predominantly used by local residents and are supplied with playground equipment and picnic tables for the public to enjoy. However, there are a few larger trails, parks and nature preserves of note including the 172.6 acre Kreager Park managed by the Fort Wayne Parks and Recreation and Indiana DNR, the 36.2 acre Mengerson Nature Preserve managed by Acres Land Trust, the 292 acre Forest Woods Nature Preserve managed by the Black Swamp Conservancy and home to over 30 rare, threatened, or endangered species, and a portion of the 24 mile River Greenway, a walking trail along the Maumee River which is managed by various local governments including Fort Wayne, New Haven and Allen County. Table 2.9 lists all parks located within the project area, how many acres or miles they encompass and who manages them.

Table 2.9: Parks Located in the Upper Maumee River Watershed

Name	Area	Ownership	Facilities/Activities
Sherwood Memorial Park	3.25 Acres	Village of Sherwood	Gazebo, walking path, flower gardens, stocked fishing pond
Sherwood Moats Park	10 Acres	Village of Sherwood	2 shelter houses, 3 ball diamonds, volleyball, basketball, and tennis courts, batting cages, playground, picnic tables, and grills
Little Reservation Station	2.5 Acres	Village of Sherwood	2 shelter houses, large playground
Shelter House	Unknown	Woodburn	Shelter house
Woodburn Park on Overmeyer	Unknown	Woodburn	3 baseball diamonds, basketball court, slides, swings, playground
Canal Landing	1/3 Acre	New Haven	Pavilion, park benches
Havenhurst	29 Acres	New Haven	Walking trail, basketball court, ball diamond, pavilion, soccer field, playground, 2 tennis courts
Heatherwood Park	Unknown	New Haven	Walking path through woods, playground
Jury Park	Unknown	New Haven	4 tennis courts, pavilion, playground equipment, 2 pools, rain garden
Klotz Park	Unknown	New Haven	Soccer field, pavilion, baseball diamond, large green space
Moser Park	Unknown	New Haven	Nature trail, trail head for the Rivergreenway, nature center, pond, disc golf course, basketball court, ball diamond, pavilion

Name	Area	Ownership	Facilities/Activities
River Greenway	24 Miles	New Haven/ Allen County/ Fort Wayne	Recreational paved path along the Maumee River (Each entity responsible for a portion of the walking path)
Schnelker Park	Unknown	New Haven	Gazebo, pavilion, playground
Werling	7 Acres	New Haven	Green space, and 1/2 mile walking loop
North River Road Nature Area	Unknown	New Haven	Wetland area, canoe launch
Deetz Nature Preserve	72 Acres	New Haven	Nature trails
Daryl C Cobin Memorial Park	6.2 Acres	Fort Wayne	Baseball diamond (Carrington Field)
Casselwood Park	1.5 Acres	Fort Wayne	Baseball diamond, basketball court, picnic tables, playground, swing set
East Central Playlot	1 Acre	Fort Wayne	Playground, swing set
Lakeside Park	23.8 Acres	Fort Wayne	Pavilions, basketball and tennis courts, playgrounds, rose gardens, walking path, fishing pond
Memorial Park	42 Acres	Fort Wayne	Ball diamonds, pavilions, playgrounds, swimming pool, picnic tables, basketball courts
Rea Park	5.5 Acres	Fort Wayne	5 acres of natural green space, soccer field, 1/2 mile walking path
Sieling Block Park	0.60 Acre	Fort Wayne	Open green space
Turpie Playlot	0.62 Acre	Fort Wayne	Playground
Jehl Park	3.7 Acres	Fort Wayne	Tennis and basketball courts, playground, picnic areas, playground
Kreager Park	172.6 Acres	Fort Wayne and Indiana DNR	Softball fields, playground, soccer, green space, tennis courts, river greenway access (Fort Wayne), boat access (DNR)
Antwerp Community Park	Unknown	Antwerp	3 Baseball diamonds
Riverside Park	Unknown	Antwerp	Green space, shelter house, picnic tables, playground, hiking trails, fishing, small boat access
Rotary Park	Unknown	Hicksville	Green space, Pavilion
Hicksville Community Park	Unknown	Hicksville	Pool, baseball diamond, playground, soccer field, tennis court, track
Defiance County Fairgrounds	Unknown	Hicksville	Grandstand, track, picnic area, stables
Maumee River Overlook	0.9 Acre	Acres Land Trust	River Overlook
Mengerson Nature Preserve	36.2 Acres	Acres Land Trust	Successional Forest, Preserve

Name	Area	Ownership	Facilities/Activities
Maumee Roadside Park	Unknown	IN DNR	Wildlife Reserve
Forest Woods Nature Preserve	292 Acres	Black Swamp Conservancy	Nature Preserve (Open to public with permit only)
McMillan Park	168.2 Acres	Fort Wayne	Ball Diamonds, Pavilions, playground, soccer, tennis courts, picnic tables, basketball courts, golf course, Lifetime Sports Academy, Swimming Pools, several commemorative statues, Hiking
McCormick Park	9.0 Acres	Fort Wayne	Green space, playground, pavilion, Splash Pad/Sprayground, benches, basketball Courts
Klug Park	2.0 Acres	Fort Wayne	Green space, playground, picnic tables, basketball Courts
Sherwood Forest Park	21.5 Acres	Village of Sherwood	Green space, picnic tables, Crystal Fountain Auditorium

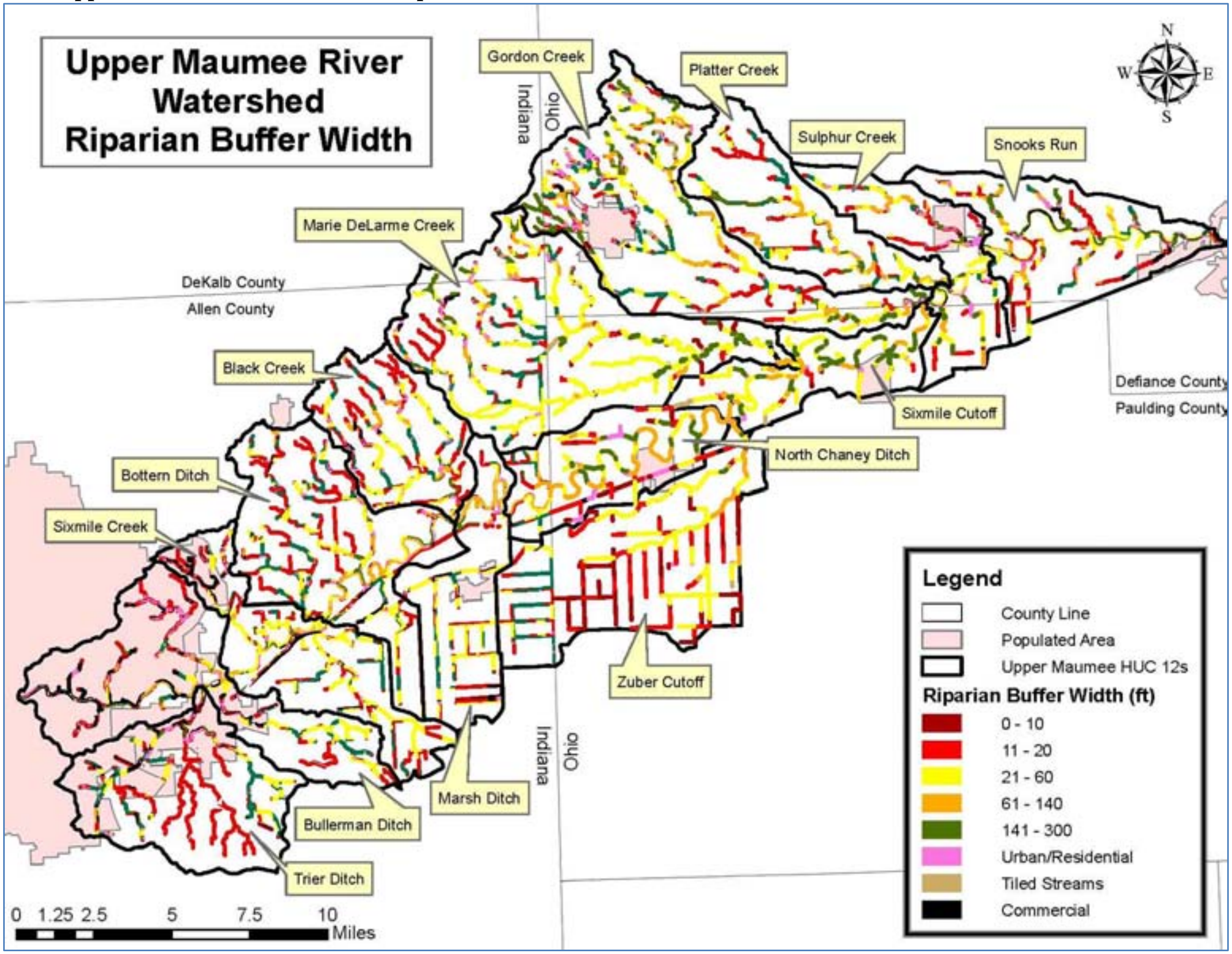
2.5.12 Riparian Buffer Inventory

Since over 77% of the watershed is used for agriculture, it is not surprising that many ditches and streams have been moved, straightened, and/or deepened to aid in the quick removal of water from agricultural fields. Furthermore, many landowners, especially with the rising prices being paid for agricultural commodities, are planting row crops as close to the stream bank as possible. This practice can increase sedimentation and nutrient levels in ditches and streams. Therefore, the UMRW project contracted the Allen County Partnership for Water Quality to perform a stream buffer analysis within the Upper Maumee River Watershed. Parcel GIS layers were gathered from the Allen, and DeKalb surveyors and the Defiance County engineer, and orthophotography was also gathered from each respective county, though the origin of all orthophotography was from the USDA. Paulding County did not have their parcel data digitized, so parcels were visualized, and estimated from aerial photography, the total number of parcels represented in the Table and Figure below may not be an accurate count of parcels in Paulding County. Table 2.10 below is a breakdown of the percentages of parcels that have anywhere from 0 to 300 foot buffers or are located within an urban or industrial area, or where the stream has been tiled and no longer exists on the surface as shown from the National Hydrological Data GIS layer. It should be noted, that a differentiation between grassed and woody vegetated buffers could not be easily determined from the desktop survey. Figure 2.18 is a map that shows the location each buffer.

Table 2.10: Riparian Buffer Inventory

	Buffer Width	# of Parcels	Percent of Parcels
	0 - 10	6148	57%
	11 - 20	524	5%
	21 - 60	978	9%
	61 - 140	387	4%
	141 - 300	409	4%
	Urban/Residential	1790	17%
	Industrial/Commercial	522	5%
	Water Diverted or Tiled	32	0.30%

Figure 2.18: Upper Maumee River Watershed Riparian Buffers



2.6 Previous Watershed Planning Efforts

The Maumee River plays an important role for residents living within the Western Lake Erie Basin as the Maumee River is the largest contributor to Lake Erie. The Maumee River also supplies drinking water to over 50,000 people in Defiance, as well as those living downstream who acquire their drinking water from Lake Erie. For these reasons, the Upper Maumee River and its tributaries are important to understand and protect. There have been few studies of the river system and the surrounding land uses conducted, as well as, few city and county master plans that have been written to outline problems and threats to our natural resources, and propose ways of protecting those resources in the watershed. This section provides a description of each of the previous studies and watershed planning efforts that have been conducted since 2000, or are still in effect in the UMRW. Figure 2.19 delineates the jurisdiction of each of the studies or plans that have taken place in the Upper Maumee River Watershed.

2.6.1 City and County Master/Comprehensive Plans

Plan-It Allen

Plan-It Allen is a Comprehensive Plan that was developed under the guidance of the planning commission of Fort Wayne and Allen County and encompasses all of Allen County, Fort Wayne, and the surrounding smaller communities. There are two chapters in the Plan that are of particular interest to this project; Chapter 1: Land Use and Chapter 5: Environmental Stewardship. Each chapter outlines particular goals and objectives to meet to minimize the impact of development on our natural areas and to protect the natural resources we currently have available. Below is a list of the goals outlined in the Plan.

Chapter 1:

1) Encourage the adoption of the Conceptual Development Map (page 25 of Plan-It Allen) to utilize existing infrastructure for new development.
2) Encourage revitalization, remodels, and new development along existing infrastructure.
3) Discourage development in growth not currently served by a sanitary sewer.
4) Encourage a ‘fix-it” first approach to existing facilities prior to new development within Fort Wayne.
5) Encourage sustainable growth and coordinated development with mixed land uses.
6) Encourage development proposals that are sensitive to preserve or reserve areas.
7) Encourage Sustainable growth by conserving natural features and environmentally sensitive land with significant value.
8) Identify and implement additional floodplain and watershed management tools.
9) Inform and educate the public and appropriate community stakeholders about sustainable development alternatives that conserve natural features and preserve environmentally sensitive land.
10) Collaborate with NGOs to acquire and/or protect significant and environmentally sensitive land.
11) Continue to coordinate with existing adopted river-oriented plans and strategies.
12) Enhance the use and presence of the three rivers.

Chapter 5:

1) Ensure the conservation of significant land resources, including but not limited to agricultural land, woodlands, and wetlands.
2) Pursue wetland restoration initiatives.
3) Protect wildlife habitats and limit invasive species.
4) Preserve and improve the quality of groundwater and surface water resources.
5) Support and collaborate in the establishment of watershed management plans that recommend actions to major sources of surface water contamination.
6) Encourage the expansion of riparian buffers and enhance public access to waterfronts.
7) Protect the natural and built environment through comprehensive floodplain management initiatives.
8) Encourage utilization of green building technologies to promote sustainable development.
9) Encourage brownfield redevelopment.

City of Defiance Strategic Plan - 2030

In 2005 the City of Defiance Strategic Planning Committee began working to update the Downtown Redevelopment Plan originally developed in 2003. The Defiance City Council approved the revised Plan in 2007.

The main focus of the Strategic Plan is development in commercial and industrial areas including the expansion and improvement of infrastructure to support direct growth, repair railways so they are ready for redevelopment purposes, and promote the industrial expansion along 24 west of the city center.

The last portion of the Strategic Plan focuses on balancing future city development with the protection of unique environmental attributes. There are three objectives outlined in the Plan to help accomplish the goal of protecting environmental attributes which are listed below:

1) Pursue technical and financial assistance to facilitate conservation efforts.
2) Implement conservation easements where necessary to ensure conservation of open spaces.
3) Prepare a protected corridor plan for the Maumee, Tiffin, and Auglaize Rivers to address shoreline protection, erosion control, and public access and to maintain public ownership of key environmentally sensitive areas along them.

Defiance County Comprehensive Plan – 2000

The Defiance County Commissioners contracted Brea Birch Institute to develop a comprehensive plan for the county, which was approved in 2000. The Plan outlines the physical and cultural environment of Defiance County, the county's land use control strategy and infrastructure. The Plan discusses the peak stream flow of the Maumee River and its contribution to flooding, as well as the various soils present in the county, explaining the need for fertilizer use on agricultural land in the county that was developed on poorly suited soil.

The Plan is predominately an overview of the county in general and provides a few recommendations to limit the impact of human activities on water resources. Those recommendations in the Plan are listed below;

1) Plant wind breaks around agricultural fields to prevent erosion.
2) Avoid development in floodplains.
3) Construction of levees, floodwalls, and dikes should not take place prior to an extensive study of their overall environmental, economical, and social implications.
4) Stream channelization should not take place without serious study of the possible negative consequences.
5) Leave and actively plant vegetation along stream banks to prevent erosion and sedimentation, and enhance wildlife habitat.
6) Retention ponds should be constructed for new commercial and residential development.
7) Wetland revitalization and construction should be encouraged.
8) Periodic monitoring of surface water to help safeguard public health.
9) Encouragement to avoid residential development on poorly drained soils if on-site septic systems are to be used.
10) Soil analysis is encouraged on agricultural and residential land to determine the correct amount of fertilizer to use to help the growth of the respective crop.
11) Preserve and conserve natural areas, especially large forest stands, for wildlife use.
12) Encourage the use of conservation easements.

Woodburn Strategic Plan

The City of Woodburn contracted the Sturtz Public Management Group to write a strategic plan which is still only available in draft form. The vision outlined in the Plan is to "…enhance the city's quality of life by promoting sustainable growth and development while retaining the community's rural character. The Plan focuses on industrial and residential growth without affecting the integrity of the agricultural landscape. There are few objectives outlined in the Plan that focus on environmental stewardship, however those that are outlined in the Plan are listed below;

1) Minimize adverse environmental influences of industrial operations to the greatest extent possible.
2) Discourage new development where there is need for septic systems.
3) Encourage "mixed-use" development to lower the impact of having to expand existing infrastructure.

DeKalb County Comprehensive Plan of 2004

In June, 2004 the Commissioners of DeKalb County adopted the DeKalb County Comprehensive Plan. This Plan is intended to be relevant for the county for the next five to ten years, at which point, the Plan will be updated. There are two chapters in the Plan that are relevant to the UMRW project; Chapter 5 – Protect Environmental Assets and Chapter 7 – Provide High Quality

Public Services. Chapter 5 has four objectives including protecting the quality and quantity of water resources, protect and enhance the natural environment, allow for sustainable growth, and reduce risks of flooding. This chapter encourages the development and protection of wetlands and swales for stormwater control, reducing point source discharges, enforcing wellhead protection plans, reserving open space, conserving tree stands, discouraging development of sensitive areas, the adoption of best management practices, allowing development within the 100 year flood plain on a minimal basis, and preserving regulated drains in the county. Chapter 7 also has four objectives including develop plans for community services to meet county growth, enhance public services, improve communication between city and county governments and agencies, and develop a county parks board and parks and recreation master plan, which has not yet been completed. These objectives will be met by protecting future park and recreational areas, encouraging the donation of land to the County to be used as a public park, and establishing public parks that provide passive recreation.

The DeKalb County comprehensive Plan, if implemented successfully, can address the UMRW Steering Committee's concerns regarding an increase in impervious surfaces, lack of riparian buffers and segmented forested areas, wildlife corridors, and urban contamination sites.

DeKalb County Unified Development Ordinance (UDO)

The UDO was adopted by DeKalb County in January, 2009. The UDO is a plan to allow for development while not decreasing the quality of the land and its resources. Only a small portion of DeKalb County is located within the UMRW boundary, and that land is mostly rural. However, more private residences are being built in rural settings. The UDO designates environmental setbacks and easements for natural areas which must be followed during development. The UDO also states that no trees can be removed during construction unless they are dead or diseased, or replaced with comparable vegetation. Finally, the UDO outlined specific standards in wellhead protection areas, such as banning dry cleaners and laundromats, scrap yards, bulk chemical storage, CFOs, and put a maximum of 1000 gallons of above ground storage of liquid chemicals. There are no wellhead protection areas located within the UMRW in DeKalb County, however this is important as these regulations will protect the St. Joseph River, which is a major tributary to the Maumee River.

Western Lake Erie Basin Partnership Strategic Plan

The Western Lake Erie Basin Partnership was formed in 2006 after the US Army Corps of Engineers and US NRCS brought together 14 federal, state, and regional partners to create a comprehensive watershed management partnership comprised of key stakeholders located within the WLEB. In 2007, the WLEB Partnership adopted a strategic plan to improve water quality throughout the WLEB. The Plan includes goals for the following topics;

- Invasive Aquatic Species Control
- Habitat Conservation and Species Management
- Stream and Coastal Health/Water Quality
- Areas of Concern/Contaminants

- Nonpoint Source Pollution
- Toxics
- Sustainable and Balanced Growth
- Hydrologic Management/Flooding Attenuation
- Forest Resource Protection
- Native Plant Community
- Public Information/Education

Many of the goals are in-line with concerns expressed by the UMRW steering committee such as industrial discharge and runoff, structures located within the floodplain, septic systems, and nonpoint source pollution from CSOs, AFOs, and other animal operations.

2.6.2 Watershed Management Studies

Western Lake Erie Basin Study – Upper Maumee Watershed Assessment

The US Army Corp of Engineers completed a study of the Upper Maumee River Watershed in 2009 to provide watershed, city, and county planners with a tool to help restore, protect, and promote sustainable uses of water resources and the surrounding land within the Western Lake Erie Basin (WLEB).

The WLEB-UMRW study outlined flood risks within the watershed and stated that Allen County has declared numerous disasters due to flooding and that river, flash, and urban flooding are all common types of floods in the county. The WLEB-UMRW study also noted there are 158 structures which can expect some type of damage in a 100 year storm event. The study indicated that there are 4000 residents in Defiance County that are at risk from flood damage and that Paulding County only has one property that has had repeated flood damage though, there are many roads which are subject to frequent floods. There are several issues and concerns that were outlined in the study which are listed below.

1) Increase in impervious surfaces in Fort Wayne is contributing to flooding issues.
2) Sedimentation and stream bank erosion are prevalent in the study area.

The study also outlines several strategies to address the concerns presented above. Those strategies are listed below.

1) Encourage soft engineering to combat increasing impervious surfaces rather than constructing levees.
2) Restore wetlands to reduce peak discharges of stormwater.
3) Increase the use of tile drainage management to slow runoff from tiled agricultural fields.
4) Develop an inventory of stream bank erosion problem sites.
5) Implement sediment control devices.
6) Clear log jams and debris from streams and ditches.
7) Enhance data and mapping of flood prone areas outside of the designated floodplain.
8) Incorporate stream restoration and protection into drainage projects.

There are several other recommendations listed in Table 3-15 in the WLEB-UMRW study with an estimated cost totaling over $16.5 million. All of the recommendations made in the study were estimated to be completed by 2014 which is now recognized as an unrealistic timeframe. However, the study provided this project with historic information and with a baseline of actions that are needed to improve the overall water quality of the WLEB-UMRW.

2.6.3 Wellhead Protection Plans

Fort Wayne, New Haven (St. Joseph River), and Defiance (Maumee River) are the only communities within the UMRW that acquire their drinking water from surface water. The majority of the rural community and smaller incorporated areas and villages acquire their drinking water from groundwater wells. Those communities are commonly known as community public water supply systems (CPWSS). A CPWSS is designated as such if it has 15 service connections or supplies drinking water to at least 25 people, according to the federal Safe Drinking Water Act. The entity controlling the system is required to develop a Wellhead Protection Plan (WHPP). A WHPP must contain five elements according to the IDEM; 1) Establishment of a local planning team, 2) Wellhead Protection Area Delineation of where ground water is being drawn from, 3) Inventory of existing and potential sources of contamination to identify known and potential areas of contamination within the wellhead protection area, 4) Wellhead Protection Area Management to provide ways to reduce the risks found in step three, and 5) Contingency Plan in case of a water supply emergency. It is also important to identify areas for new wells to meet existing and future water supply needs.

There are two phases of wellhead protection. Phase I is the development of the WHPP which involves delineating the protection area and determining sources of potential contamination. Phase II is the implementation of the WHPP. All communities located within the project area have completed Phase I of the requirement and are slated to be working on Phase II. Table 2.11 identifies those CPWSSs located within the project area and which phase they are currently in. A map of well head protection areas in Indiana is not available since the delineation of such areas is not made public. However, Ohio has made available the delineation of wellhead protection plans which are shown in Figure 2.19.

Table 2.11: Wellhead Protection Plans

System Name	Population Served	Phase	Watershed
Woodburn Waterworks	1581	Phase I	0410000501
Woodburn Waterworks	-	Phase I	0410000502
Hicksville Village Water	3581	Phase I	0410000502
Sherwood Village Water	827	Phase I	0410000502

2.6.4 Source Water Protection Plans

Source water protection plans (SWPPs) serve the same purpose as wellhead protection plans though the Plans are in much less detail than a WHPP. There are several different types of SWPPs including *Community Water Systems*, which are public water systems that supply water to the same population year round, *Non-transient Non-Community Water Systems*, which are water systems that supply water regularly to at least 25 people for at least six months out of the year, and *Transient Non-Community Water Systems*, which are public water systems that provide water in places like restaurants and gas stations where different populations pass through. There are no SWPPs for any communities located in the Indiana portion of the UMRW, however there are several present in Ohio portion of the watershed. The SWPPs in Ohio are outlined in Table 2.12.

Table 2.12: Source Water Protection Plans in the Upper Maumee River Watershed

System Name	Population Served	Water Source	Type	Pump Rate	Watershed
City of Defiance	16,986	Surface Water	Community	Unknown	041000050208
Antwerp Village Water	1741	Ground Water	Community	299,200 GPD	041000050202/ 041000050201
Kingdom Hall of Jehovah Witness	100	Ground Water	Transient Non-Community	4165 GPD	041000050202
Hickory Hills Golf Club	107	Ground Water	Transient Non-Community	4165 GPD	041000050204
Hicksville Christian Fellowship Church	55	Ground Water	Transient Non-Community	830 GPD	041000050204
Brentwood Community MHP LLC	90	Ground Water	Community	10,120 GPD	041000050205
Vagabond Village	230	Ground Water	Transient Non-Community	5000 GPD	041000050205
Shepherd Pasture Campground PWS	150	Ground Water	Transient Non-Community	Unknown	041000050208
Harvest Life Fellowship Inc.	120	Ground Water	Transient Non-Community	1320 GPD	041000050208

2.6.4 Storm Water Quality Management Plans

The federal Clean Water Act (CWA) requires storm water discharges from larger urbanized areas to be permitted under the National Pollutant Discharge Elimination System (NPDES) program. These communities are referred to as Municipal Separate Storm Sewer System (MS4) Communities and are required to develop a Storm Water Quality Management Plan (SWQMP).

There are several areas in the watershed designated as an MS4 community including the cities of Fort Wayne and New Haven, Indiana, and Defiance, as well as Allen County. Hicksville, Ohio is not an MS4 community; however the Village proactively developed a SWQMP to lessen the impact of polluted stormwater to receiving waters. The City of Fort Wayne is co-permitted with Indiana University-Purdue University; Fort Wayne, Ivy Tech State College-Northeast, Indiana Institute of Technology, and the University of Saint Francis. However, only Indiana Institute of Technology is located within the Upper Maumee River Watershed. IDEM describes a MS4 as "a conveyance or system of conveyances owned by a state, city, town, or other public entity that discharges to waters of the United States and is designed or used for collecting or conveying storm water." The reason that MS4s are required is that urban storm water runoff has one of highest potentials for carrying pollutants to our waterways and as such, the Federal Clean Water Act requires that certain storm water dischargers acquire a National Pollutant Discharge Elimination System (NPDES) permit. As being a MS4 community, the governments listed above were required to develop a Storm Water Quality Management Plan (SWQMP). The SWQMP must include six management techniques, referred to as "minimum control measures" (MCMs) including; 1) Public education and outreach; 2) Public participation and involvement; 3) Illicit discharge, detection and elimination; 4) Construction site runoff control; 5) Post-construction site runoff control; and 6) Pollution prevention and good housekeeping. Essentially, the MCMs list several management practices to limit the amount of storm water entering the sewers on a regular basis. Table 2.13 lists the entities required to have a SWQMP and their population.

Table 2.13: Municipal Separate Storm Sewer System Communities

Community	Year Plan Developed	Population
Indiana		
Fort Wayne	2005	253,691
New Haven	2006	14,794
Allen County	2005	358,327
Ohio		
Defiance	2007	16,494

2.6.5 Total Maximum Daily Load Documents

The OH EPA is currently working to develop a Total Maximum Daily Load (TMDL) for the Maumee River Basin, including the Upper and Lower Maumee watersheds located in Ohio, and the Auglaize and Tiffin watersheds located in Ohio. Water samples were gathered from the project area in 2012 and 2013. The OH EPA has contracted the compilation of the TMDL out to an EPA subcontractor and it is slated to be completed in 2014.

The IDEM released a TMDL for *E. coli* in the Maumee River on June 9, 2006. The TMDL addresses 29.49 miles of the Maumee River which is impaired for recreational (April 1st – October 31st) use due to high *E. coli* levels. *E. coli* data collected by IDEM for the development of the TMDL violated the geometric mean standard of 125 CFU/100 ml from five equally spaced samples taken over a 30 day period, 86% of the time. It should be noted that the TMDL does not include the major tributaries of Bullerman Ditch, Bottern Ditch, Black Creek, Gar Creek, Trier Ditch, or Ham Interceptor Ditch as there was not enough information available at the time the TMDL was written to determine if they were in fact impaired. Through desktop surveys and reviews of previous studies through 2006, the IDEM determined that possible contributors to the *E. coli* impairment in the Maumee River are:

1) Failing septic systems
2) Wildlife
3) Fort Wayne Waste Water Treatment Plant and the Woodburn Sewage Treatment Lagoons
    a. All NPDES permits with a sanitary component are in compliance
4) Municipal separate storm sewer systems (MS4) communities (Fort Wayne and New Haven)
    a. IDEM does not consider MS4 communities a significant source *E. coli*
5) Combined Sewer Overflow (CSO) communities (Fort Wayne and New Haven)
6) Confined Feeding and Concentrated Animal Feeding Operations (CFOs and CAFOs, respectively)
    a. Though all facilities are in compliance
7) Small Animal Operations

Through load duration curves it was concluded that NPS was the major source of *E. coli* contamination in the Maumee River which include small animal operations, wildlife, leaking and failing septic systems, as well as the point source of CSO discharge points. The TMDL makes several recommendations to bring *E. coli* levels into compliance including:

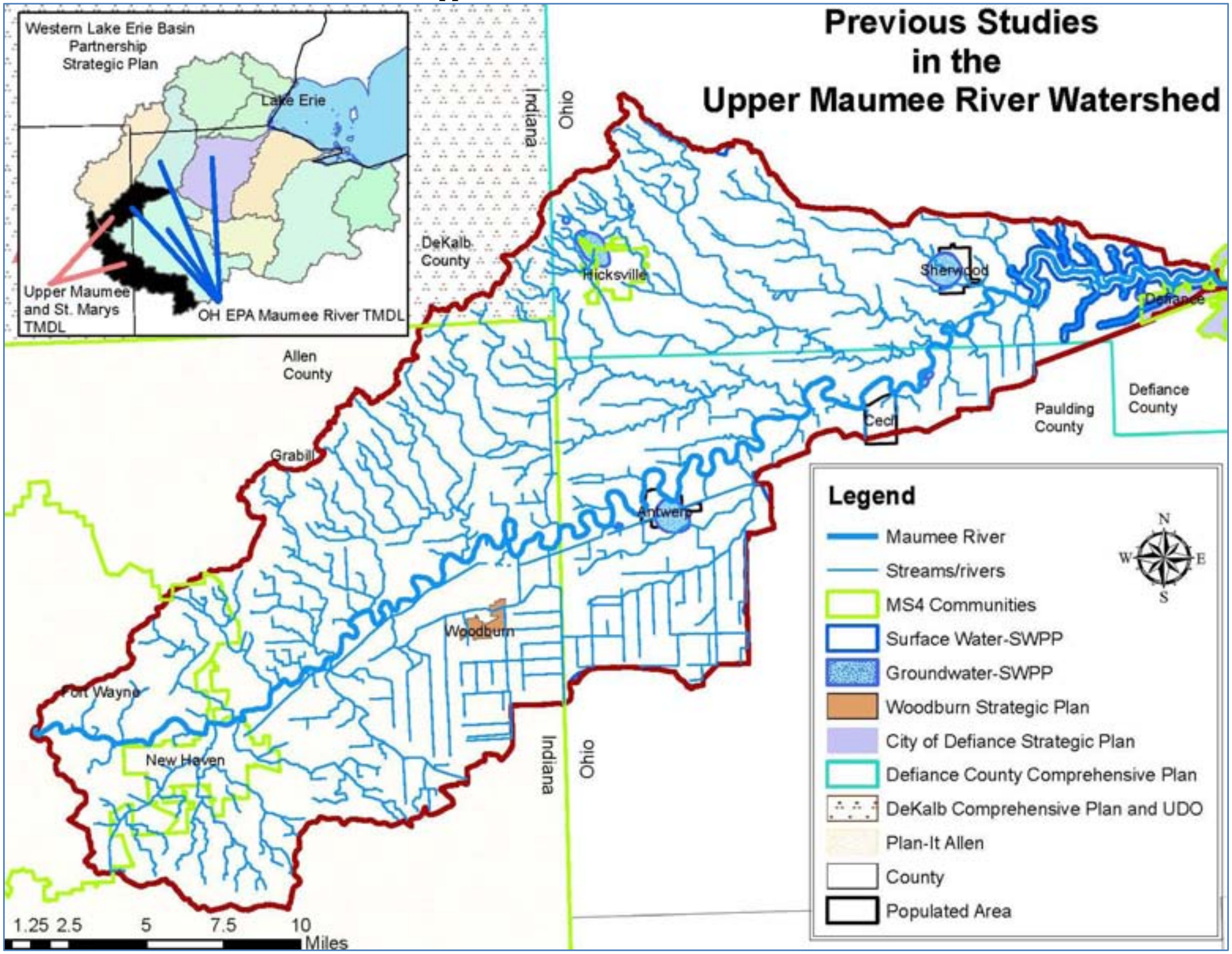
1) Monitor *E. coli* by lagoon discharges to insure *E. coli* levels meet state standards
2) CFOs and CAFOs be in compliance of their permits at all times
3) Implementation of BMPs to control *E. coli* runoff
4) MS4 permits being issued to Fort Wayne and New Haven (completed)
5) Long Term Control Plans being written and approved for Fort Wayne and New Haven (complete)
6) Replacement of inadequate and failing septic systems

2.6.6 Water Quality Related Social Behavior Studies

The Ohio State University College of Food, Agriculture and Environmental Sciences performed a study that was released in mid-2013 on farmer's motivation to adopt, or not adopt certain BMPs to reduce Dissolved Reactive Phosphorus loading into the local waterways, and ultimately Lake Erie. The study focused on row crop farmers living within the Maumee watershed in northwest Ohio. The key findings of the study include the following.

1. Most surveyed farmers believe agriculture practices contribute to water quality issues, but they believe the current practices on their farm are adequate.
2. While most farmers are concerned about nutrient loss and its impact on water quality, they believe the seriousness of the impact on water quality is only moderate.
3. Most surveyed farmers feel they have limited control over the runoff from their land, though most are also willing to adopt at least one new practice to help control NPS.
4. Nearly half of the surveyed farmers feel pressure from the farming community to adopt BMPs (though more for filter strips than cover crops, for example). However, most do not feel the need to farm in the same way as other farmers in their community.
5. The surveyed farmers are more aware of the algae issues in the Grand Lake St. Marys watershed than they are in Lake Erie.
6. A minority of farmers currently participates in conservation programs, but the study revealed there is the potential to increase the adoption of several BMPs. A minority of farmers currently implement such practices as grid sampling, comprehensive nutrient management planning, and cover crops. The study revealed that it is possible to increase the percentage of farmers who avoid manure application on frozen ground and in the fall. It was also found that a majority of farmers use a broadcast application in a limited tillage system which leads to the potential to increase fertilizer incorporation or subsurface application.

Figure 2.19: Previous Studies and/or Plans in the Upper Maumee River Watershed



2.7 History of the Upper Maumee River Watershed

The Upper Maumee watershed has a very rich cultural history. Because of the vast natural resources and travel provided by the Maumee River, the Maumee Valley has been a hub for human settlement. Throughout history, the area has been inhabited by many different groups and continues to be developed with the Maumee River as a central feature.

The area has been inhabited by humans for 12,000 years. Many Native American Tribes have called the area home including the Miami, Wyandot, Delaware, Shawnee, Ottawa, Potawatomi, Kickapoo, and Chippewa Tribes. In the 1770's, Kiihkayonki (Kekionga), located at the headwaters of the Maumee River in what is now Fort Wayne, was one of North Americas largest Native American villages.

As European traders began to enter the area around 1680, the rich lands surrounding the river were repeatedly contested. For the next 150 years, France, Britain, colonial militias, Native American tribes, and eventually the United States army fought for control of this area. The two major cities within the Upper Maumee watershed, Fort Wayne and Defiance, were both once strategic military outposts on the Maumee River. The land fell under control by the United States after the Indian Confederacy was defeated by General Anthony Wayne at the Battle of Fallen Timbers in 1794. Then again in the War of 1812, the British, and allied Native Americans led by Tecumseh, battled the American forces of William Henry Harrison. Ultimately, the land fell to the United States which opened up the Northwest Territory for permanent settlement.

As the area was more widely settled by early Americans and European immigrants, the Great Black Swamp was largely drained and converted to productive agricultural lands. The Maumee River served as key means of transportation to the interior lands and enabled the construction of the second largest canal in the world in the 1840s; the Erie Canal. The Erie Canal aided in the growth of the region making goods more readily available and brought thousands of workers to the valley. There was a short lived oil and gas boom in the early 19th century which created major industries such as glass and auto manufacturing. Today, the major industries with the Upper Maumee watershed remain largely agriculture with some auto related industries and glass production. The small villages within the watershed were typically developed around the need for a local grain elevator which grew small agricultural communities.

As settlement of the United States grew west, the railroad became the major means of transportation of people and goods from the East to the West. The rail system in the Upper Maumee River Watershed began in the late 1800's and even continues today. Many of the historical sites of importance listed on the National Register of Historic Places are in connection with the railroad system.

Currently, the Upper Maumee watershed sits within the Maumee Valley Heritage Corridor, which is a designated heritage area including the entire Maumee River watershed. Heritage areas must have distinctive features unified by a significant large resource or feature. The Maumee River is the centerpiece of this designation. The Maumee Valley Heritage Corridor, an organization based out of Ft. Wayne, IN seeks to create partnerships to improve the quality of life while advocating for the preservation of cultural and natural resources of the area.

There are several places of significance that are located in the UMRW that are designated as a historic site either by the U.S. Parks Department, IN DNR Historic Preservation and Archeology Division, or the Ohio Historical Society. The states run their historic preservation program differently; those listed by Ohio are eligible for, and will apply for designation as a historic site on the National Registry, those listed in Indiana have several levels of historical significance. After discussions with the IN DNR, it was decided that those sites listed as "outstanding" are likely the most similar to the sites listed by Ohio as being eligible for federal designation. Table 2.14 lists the sites that are designated as historical on the National Registry, Table 2.15 are the sites listed by Ohio that are eligible for historical designation, and Table 2.16 are the sites listed by Indiana as "outstanding". Figure 2.20 is a map showing the location of each of the historic sites listed on the National Registry.

Table 2.14: National Registry of Historic Sites

Resource Name	Address	State	County	City/Town	Watershed
St. Paul's Episcopal Church	High St.	OH	Defiance	Hicksville	Gordon Creek
Antwerp Norfolk and Western Depot	W. Water St.	OH	Paulding	Antwerp	North Chaney Ditch
Forest Park Boulevard Historic District	Roughly bounded by Dodge Ave., the alley bet. Forest Park Blvd. and Anthony Blvd, Lake Ave. and the alley	IN	Allen	Fort Wayne	Bullerman Ditch
Fort Wayne Park and Boulevard System Historic District	Roughly the following parks and adjacent right-of-way: Franke, McCormick, McCulloch, McMillen, Memorial	IN	Allen	Fort Wayne	Bullerman Ditch
Craigville Depot	Ryan and Edgerton Rds.	IN	Allen	New Haven	Sixmile Creek
New York Chicago and St. Louis Railroad Steam Locomotive No. 765	15808 Edgerton Rd.	IN	Allen	New Haven	Sixmile Creek
St. Louis, Besancon, Historic District	15529--15535 E. Lincoln Hmy.	IN	Allen	New Haven	Bullerman Ditch
Wabash Railroad Depot	530 State St.	IN	Allen	New Haven	Trier Ditch

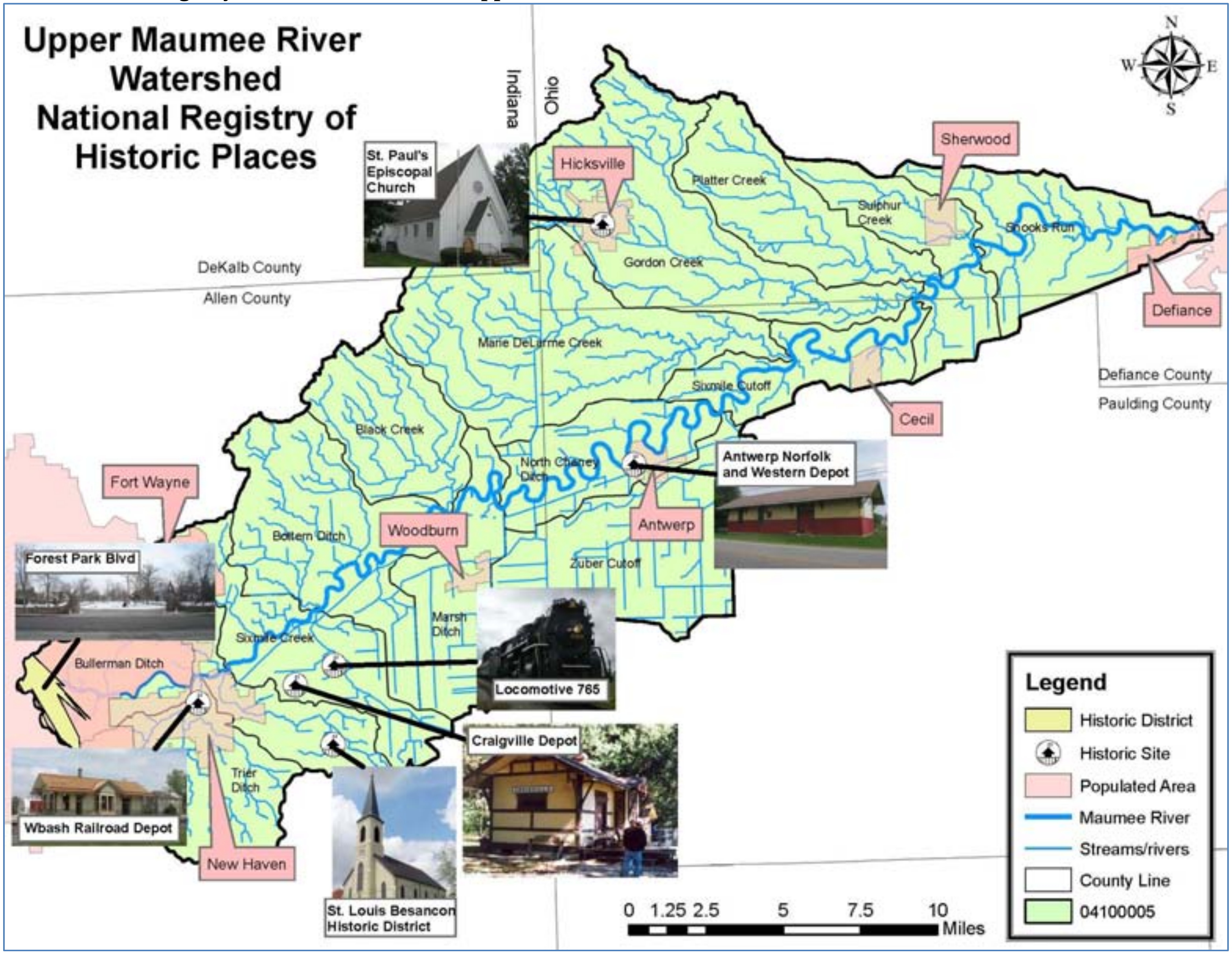
Table 2.15: State of Ohio Listed Historic Sites

Project Name	Address	State	County	City/Town	Watershed
BRIDGE #2031264	The Bend Rd, Over Maumee River	OH	Defiance	Delaware Twp.	Snooks Run
Crystal Fountain	100 Spiritualist Dr	OH	Defiance	Sherwood	Sulphur Creek
PAU - New Rochester Roadside Rest Area	CR 424	OH	Paulding	Cecil	Sixmile Cutoff
Historic Downtown Building	210 S Main	OH	Paulding	Antwerp	North Chaney Ditch
Historic Downtown Building	208 S Main	OH	Paulding	Antwerp	North Chaney Ditch
Historic Downtown Building	204 S Main	OH	Paulding	Antwerp	North Chaney Ditch
Historic Downtown Building	205 S Main	OH	Paulding	Antwerp	North Chaney Ditch

Table 2.16: State of Indiana Historic Sites Rated as "Outstanding"

Name	Address	State	County	City/Town	Watershed
Farm	11231 Linden	IN	Allen	New Haven	Bullerman Ditch
Milan Center School	Doty Rd @ Milan Center	IN	Allen	Milan Center	Sixmile Creek
George W. Warner Farm	23502 Hurshtown Road	IN	Allen	Scipio Twp	Marie DeLarme Creek
Thomas Hood House	17314 State Rd 37	IN	Allen	Harlan	Black Creek
Bridge	River Rd	IN	Allen	Maumee Twp.	North Chaney Ditch
G.A. Reeder House/Home Hotel	11928 Water St.	IN	Allen	Harlan	Black Creek
Scipio Township District Number 2 Schoolhouse	Corner of 14900 North Allen Rd and 24800 Spring	IN	Allen	Harlan	Marie DeLarme Creek
Maumee Township School Number 1	2588 River Rd	IN	Allen	Woodburn	North Chaney Ditch
Bridge	River Rd W of IN/OH line over Hamm Inceptor Ditch	IN	Allen	Maumee Twp.	North Chaney Ditch

Figure 2.20: National Registry of Historic Sites in the Upper Maumee River Watershed



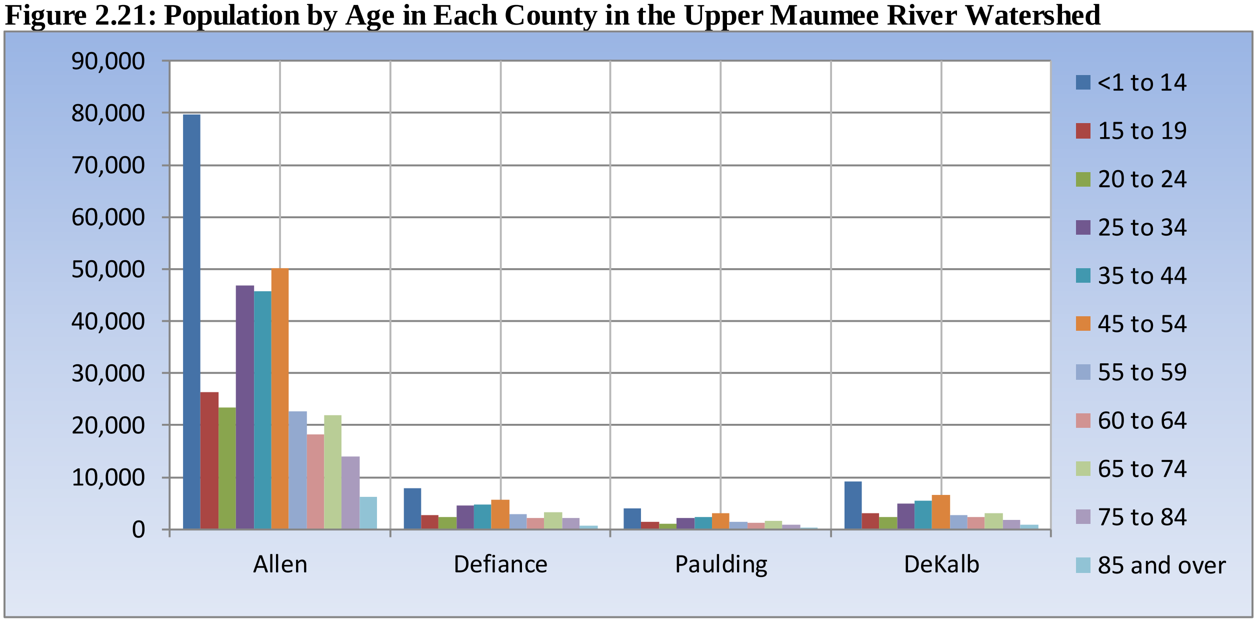
2.8 Demographics

Understanding the demographics of the project area will help to focus the implementation efforts of the WMP to the areas where the suggested management measures will be accepted both scientifically and financially. Below is a description of the demographics of the UMRW and the growth patterns observed in the past decade. All demographic information was obtained from the 2010 Census unless otherwise noted.

2.8.1 Population Trends

The population in Allen and DeKalb County, IN has increased by 29,260 between 2000 and 2010, which is a 7% growth rate in a decade. The population of Defiance and Paulding County, OH on the other hand has decreased by 1142, which is a 1% decrease in population between 2000 and 2010. According to the US Census Bureau, these trends are estimated to continue with the population to continue to increase in Allen and DeKalb County and decrease in Defiance and Paulding County. These trends may be due to the fact that the population in the bigger cities in Allen County (Fort Wayne) and DeKalb County (Auburn; not in the project area) continues to rise as more opportunities for jobs become available in these areas and Defiance and Paulding Counties are mostly rural. Figure 2.21 below shows the population by age in 2010.

Figure 2.21: Population by Age in Each County in the Upper Maumee River Watershed



2.8.2 Education and Income Level

The increase in population in Indiana Counties may be because there are more opportunities for individuals with a higher level of education to acquire a higher paying job. 23% of the population in Allen County has a bachelors, graduate or professional degree, where only 11% of the population in Defiance County, 5% of the population in Paulding County and 12% of the population in DeKalb County have degrees at the bachelor level or beyond. The graphs below illustrate the education level and household income for the counties located within the UMRW.

Figure 2.22: Education Level in Each County in the Upper Maumee River Watershed

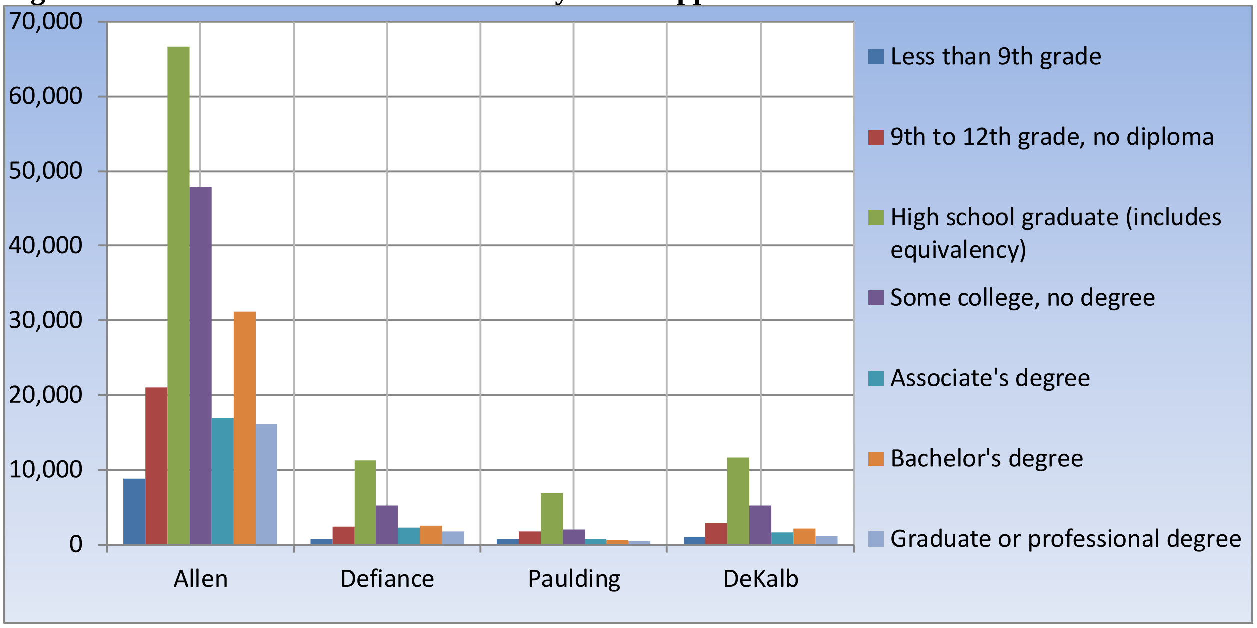
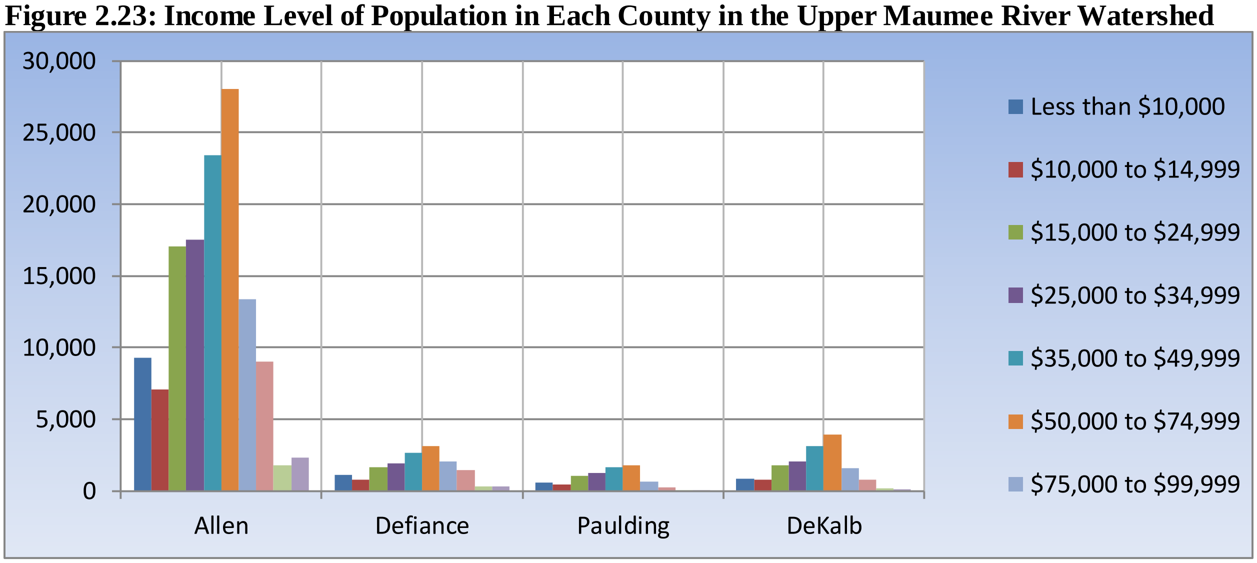


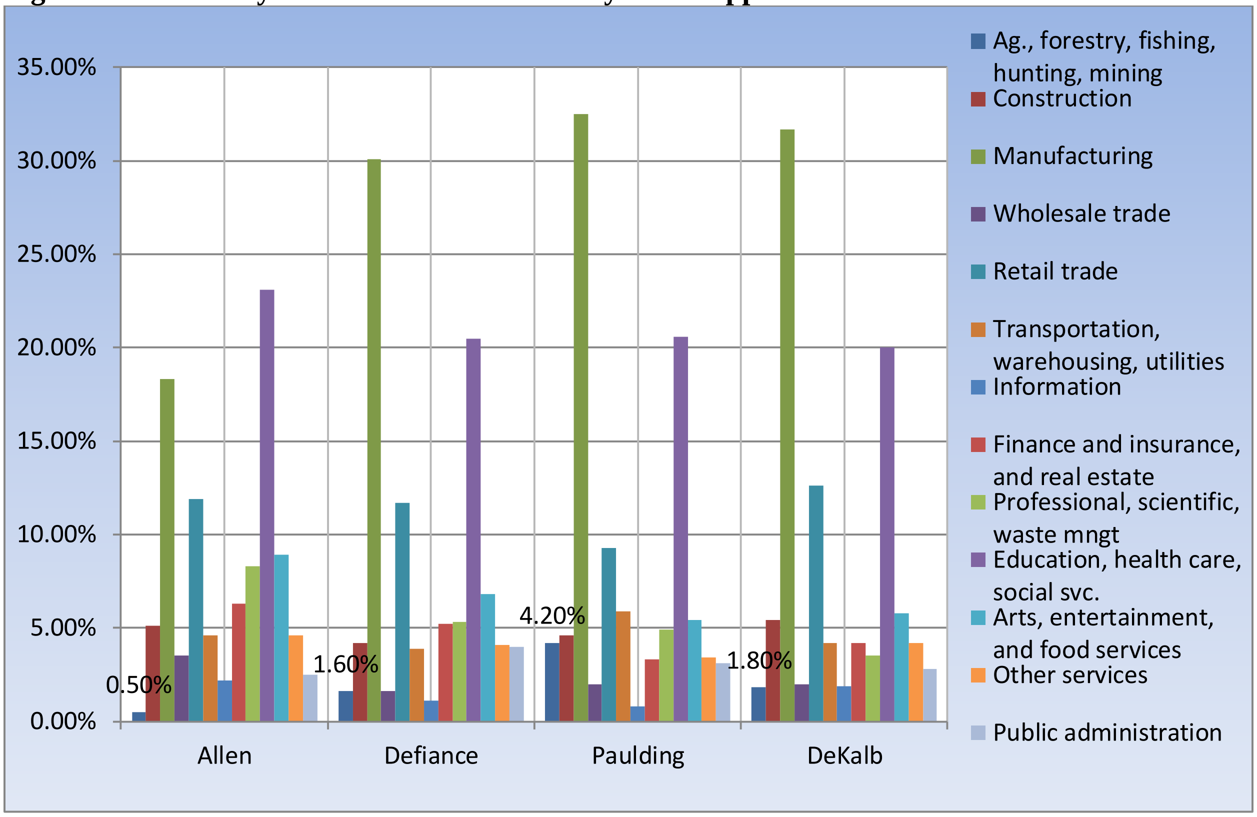
Figure 2.23: Income Level of Population in Each County in the Upper Maumee River Watershed



2.8.3 Workforce

Developed areas comprise 14% of the watershed and management measures will need to be implemented in those urbanized areas to decrease NPS pollution. However, the majority of the land use within the UMRW is agriculture, therefore producers will likely be the largest demographic targeted for the implementation of management measures in the watershed. According to Community Facts of the US Census Bureau, over 7% of the population within the four counties located in the UMRW work in agriculture, forestry, fishing, hunting and mining. The graph below illustrates the percentage of the population that works in each type of industry in each county. The percentages for agriculture, forestry, fishing, hunting, and mining are labeled on the graph.

Figure 2.24: Industry Workforce in Each County in the Upper Maumee River Watershed



2.8.4 Development

The increase in population may indicate that more construction of residential property and businesses is occurring. However due to the economic depression that began in 2008, development is on the decline. However, in the past year, development has picked up again in Fort Wayne particularly for business and commercial complexes and road construction to accommodate for the increased traffic to those areas, as well as residential homes. The Allen, Defiance, and Paulding County planning departments were contacted to learn the number of permits that were acquired for various construction projects in 2000 and 2012. DeKalb County was not contacted due to the small area of the county in the watershed which is mostly rural farmland. Table 2.17 shows the number of permits, and what type of permit, was acquired in 2000 and 2012 in each county. Note that the level of detail that was able to be acquired from each county is different and reflected in the following table.

Table 2.17: County Building Permits in the Upper Maumee River Watershed (2000-2012)

Type of Permit	Allen		Defiance		Paulding	
	2000	2012	2000	2012	2000	2012
Single Family Buildings	N/A	N/A	134	29	78	6
Two Family Buildings	N/A	N/A	4	3	2	0
3-4 Famiyl Buildings	N/A	N/A	0	0	1	0
5+ Family Buildings	N/A	N/A	0	0	7	0
Commercial	28	11	1	11	0	5
Residential	1649	612	N/A	N/A	N/A	N/A

2.9 Urban Areas

Urban landuses pose a unique, yet very prevalent threat to water quality. The balance between living, working, and recreating in an urban setting without adversely affecting the natural environment is a tenuous one. Urban areas typically have the highest concentration of point sources of pollution, as well as the most likelihood of having a direct effect on the surrounding water's quality through NPDES permit holder discharges to open water, road runoff carrying sediment, salt, oil and gas, and heavy metals, turf grass fertilizer runoff (residential, commercial and golf courses), Canada Geese, pet waste, and excess amounts of stormwater due to the high percentage of land cover that is impervious. The threat of these pollutants is exacerbated by CSO discharges which carry not only over land runoff to storm sewers, but also human waste and household chemicals and cleaners during heavy rain events. According to the National Land Cover database, administered by the USGS, over 14% of the UMRW is considered to be urban including the nine incorporated cities, towns, and villages that lie wholly, or partly, within the UMRW.

The City of Fort Wayne, IN is located at the headwaters of the Maumee River with nearly 90% of its 70,164 acres lying within the Western Lake Erie Basin, the remaining portion of the city drains to the Wabash River, however all combined sewers drain to the WLEB. The portion of Fort Wayne that drains to Lake Erie is located in the UMRW, Lower St. Joseph River Watershed (LSJRW), or the St. Marys River Watershed (SMRW). Watershed Management Plans were completed and approved by IDEM, for the LSJRW and SMRW in 2008 and 2009, respectively. The land within the city limits is predominately used for housing developments, and commercial and industrial uses. Table 2.18 is a breakdown of landuse within Fort Wayne's boundaries according to the 2006 National Land Use Database. Below the table is a definition of each of the "developed" land uses.

Table 2.18: Land Uses within Fort Wayne City Limits

Open Water	Dev. Open Space	Dev. Low Intensity	Dev. Medium Intensity	Dev. High Intensity	Cultivated Crops	Wetland	Forest/ Scrub	Total	Unit
948.2	20,984.3	26,919	7,942.7	4,245.3	4,059.7	708.9	4,233.2	70041.3	Acres
1.35%	29.96%	38.43%	11.34%	6.06%	5.80%	1.01%	6.04%	100.00%	%

- Developed; Open Space – < 20% impervious. Large lot single-family housing units, parks, golf courses.
- Developed; Low Intensity – 20% – 49% impervious. Mostly single-family housing units.
- Developed; Medium Intensity – 50% - 79% impervious. Mostly single-family housing units.
- Developed; High Intensity – 80% - 100% impervious. Apartment complexes, row houses, and commercial and industrial complexes.

Fort Wayne has several potential point sources of pollution located within its boundaries including 662 USTs, 302 of which are considered to be leaking (LUSTs), one superfund site (located wholly in the UMRW), 24 Brownfield locations, and 7 NPDES permitted facilities with 84 pipe outlets to the WLEB (43 of which are CSO discharge points). Fort Wayne is also growing with new construction of roads, and commercial and residential properties, mostly along the north side of the city. Fort Wayne also has over 80 parks and 19 golf courses located within its boundaries, both of which have regular lawn maintenance performed to keep the properties well-manicured, including the use of pesticides and fertilizer, and they are regularly irrigated.

Many other common urban practices are observed throughout Fort Wayne as well, including the lack of vegetated riparian buffers along ditches and streams, and homes and businesses with their gutter downspouts connected directly to the sewer system which may contribute to the amount of water needing processed by the WWTP during rain events in CSO areas and thus, can increase the number of CSO events. Due to the increase in imperviousness, more properties get flooded from smaller ditches and streams during moderate rain events. Therefore, the county surveyor's office has begun to dredge the waterways to straighten and deepen them to move water downstream faster. However, that practice involves removing vegetation from the riparian area, thus decreasing the amount of water that will be absorbed prior to entering the ditches, destabilizing the stream banks, and destroying wildlife habitat.

The LSJRW and SMRW WMPs were written and approved at a time when urban issues were not a focus of nonpoint source pollution remediation, and urban pollution was largely overlooked. Each of the WMPs, now outdated, mentioned very little about the urban landscape contributing to water quality issues in the WLEB. Below is a list of critical areas, according to the LSJRW and SMRW Management Plans, to focus implementation and remediation efforts within the boundaries of Fort Wayne.

Lower St. Joseph River Watershed Management Plan

- Northside Neighborhood for CSOs, pet waste, residential lawn fertilizer, construction and road runoff.
- North Anthony Corridor for Road runoff, high % of imperviousness, sediment
- Indiana University-Purdue University Campus for high traffic and % imperviousness, nuisance geese, lawn fertilizer, construction

- I69 at Beckett's Run for highway construction on bridge, bank erosion and increased runoff velocity
- Commercial construction at Dupont and Lima Roads for construction, increased traffic, increased solid waste and % imperviousness
- Dupont Rd and Union Chapel Rd for increased traffic and construction
- Parks and Green space for nuisance geese
- Ely Run and Martin Ditch for bank erosion

St. Mary River Watershed Management Plan

- Regulatory flood hazard area
- Industry under Rule 6 permitting requirements (none located within the City boundaries)

As can be seen in the above list, very little was identified as a critical area within the city limits in either of the WMPs. However, that is not because urban pollutants were not an issue at the time, it is due to the fact that urban best management practices were an emerging idea, but not readily viewed as obtainable. However, as technology expands, and new ideas emerge regarding ways to lessen the impact of urban pollutants and increase stormwater infiltration rates, urban best management practices are becoming more attainable and even sought after by developers and individuals. Figure 2.25, below, identifies the potential sources of pollution to the UMRW from the City of Fort Wayne and Figure 2.26 shows the landuse and impervious cover within the City of Fort Wayne.

Figure 2.25: Potential Point Sources of Pollution in Fort Wayne

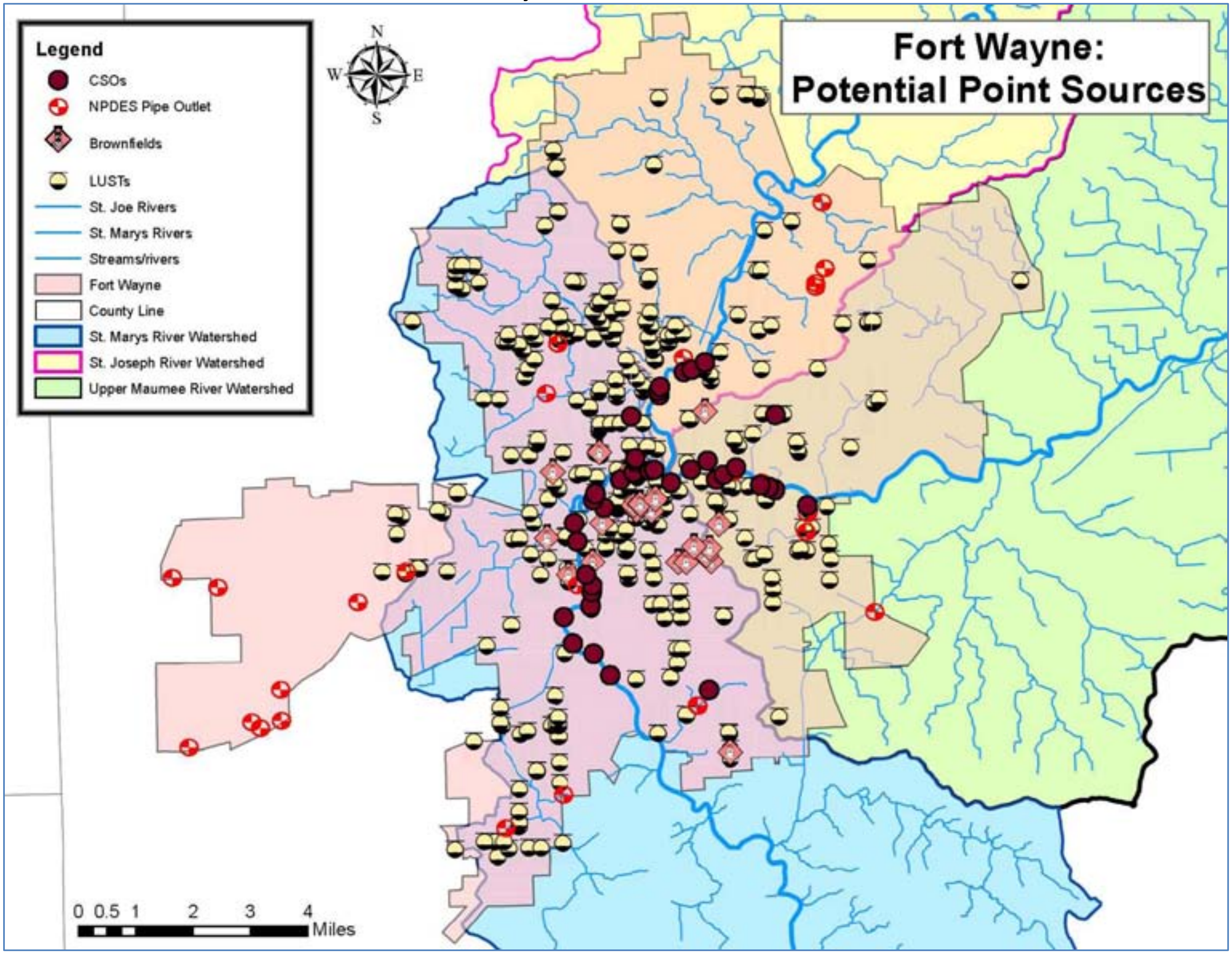
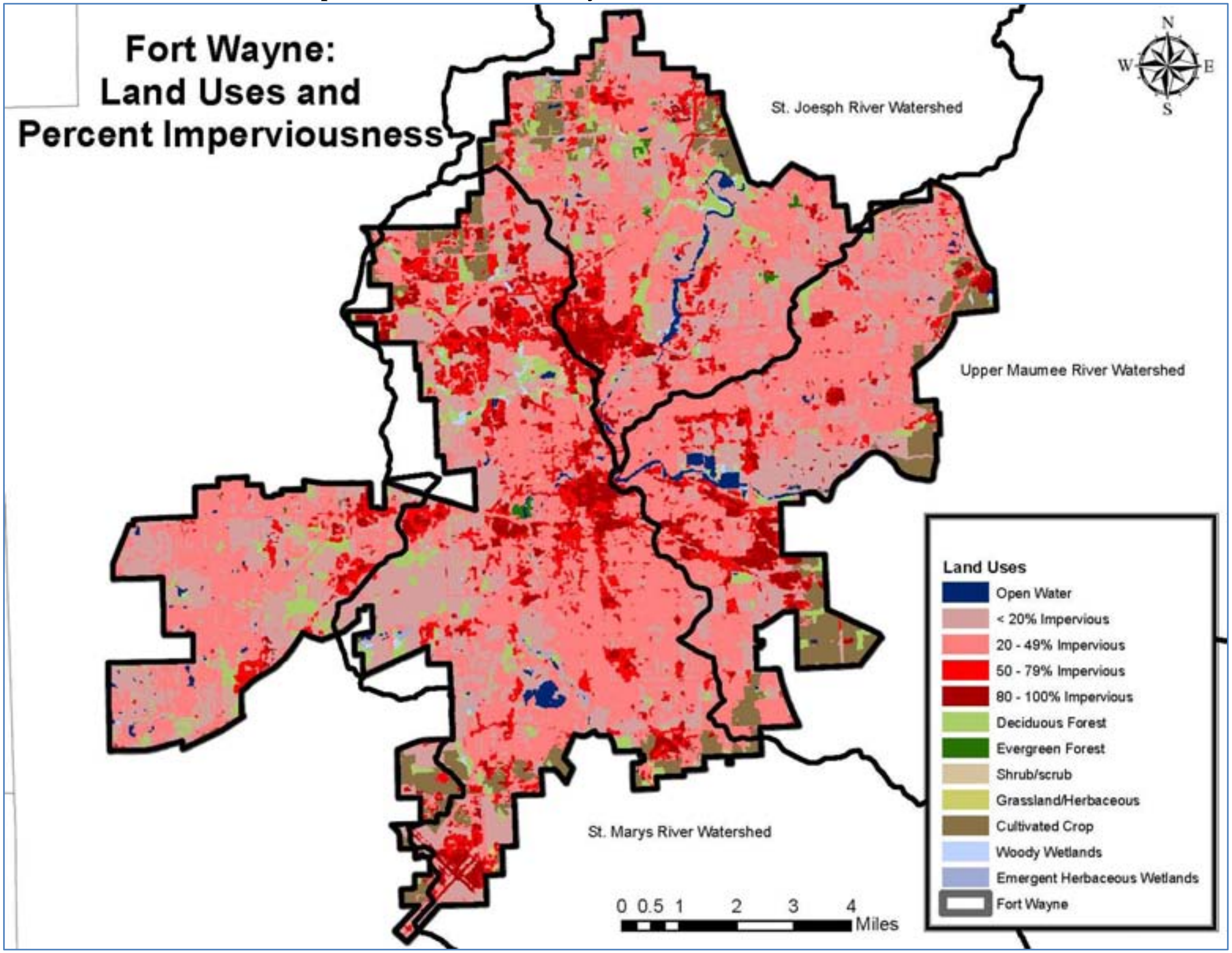


Figure 2.26: Land Uses and Percent Impervious Cover in Fort Wayne



2.10 Endangered Species

The UMRW is home to many federally and state listed endangered and threatened species. The US Fish and Wildlife Service (USFWS) maintains a database of those species that are either endangered or candidates to become endangered on the federal level which can be seen in Table 2.19. There are several species of significance located within the UMRW which rely on streams, wetlands, or upland forested areas for habitat, including the White Cat's Paw Pearly Mussel which currently can only be found in Fish Creek in the St. Joseph River watershed and the Indiana Bat.

According to the USFWS, the Indiana Bat population has decreased by over half since it was originally listed as endangered in 1967. This decrease in population can be attributed to human activities disturbing the Indiana Bat's habitat. Indiana Bats are very vulnerable to disturbances in their hibernation grounds as they hibernate in mass numbers (20,000 to 50,000) in caves in southern Indiana. The reason the bats population has declined in northern Indiana is mainly due to their breeding and feeding grounds, riparian and upland forests, being cleared for agricultural land and expanding urban areas. The Eastern Massasauga Rattlesnake lives in wetland areas, many of which have been drained to be used for agriculture. The ancestral Black Swamp which has all, but the northeast corner of the swamp near Toledo, been drained and converted to farm land is one such wetland area in which the Eastern Massasauga would use as prime habitat. With much of the Eastern Massasauga's habitat being converted for other uses, the snakes numbers have declined dramatically. Finally, the last known population of White Cat's Paw Pearly Mussel is located in the St. Joseph River though the mussel is still considered to be endangered in the Upper Maumee River watershed as it used to be home to the mussel. These mussels live in streams that have a coarse sand or gravel bottom. With the increase in intensive agriculture throughout the Upper Maumee River watershed, the amount of sediment entering surface water has also increased, thus smothering the mussels in the streambed. According to the United States Fish and Wildlife Service (USFWS), pesticides and fertilizers that runoff agricultural fields have also contributed to the demise of the White Cat's Paw Pearly Mussel, as well as other mussels as they are filter feeders and take in contaminated water each time they eat. The protection of the habitat in which all the species listed in Table 2.19 live is essential to their survival.

Table 2.19: Federally Listed Endangered Species

COUNTY	SPECIES	COMMON NAME	STATUS	HABITAT
MAMMALS				
Defiance and Paulding (OH) Allen and DeKalb (IN)	*Myotis sodalis*	Indiana Bat	Endangered	Hard wood forest and hardwood pine forest
MUSSELS				
Defiance (OH) Allen and DeKalb (IN)	*Pleurobema clava*	Clubshell	Endangered	Fresh water
Defiance (OH) Allen and DeKalb (IN)	*Epioblasma torulosa rangiana*	Northern Riffleshell	Endangered	Well graveled river beds with swift flow
Defiance and Paulding (OH) Allen and DeKalb (IN)	*Epioblasma obliquata peroblique*	White Cat's Paw Pearly Mussel	Endangered	Fresh water
Defiance and Paulding (OH)	*Villosa fabalis*	Rayed Bean	Endangered	Fresh water
Allen and DeKalb (IN)	*Villosa fabalis*	Rayed Bean	Candidate	Fresh water
Allen and DeKalb (IN)	*Quadrula cylindrica cylindrica*	Rabbitsfoot	Candidate	Fresh water
REPTILES				
Defiance (OH)	*Nerodia erythogaster neglecta*	Copperbelly Water Snake	Threatened	Lowland Swamps
Allen (IN)	*Sistrurus catenatus catenatus*	Eastern Massasauga	Candidate	Wooded and permanently wet areas such as oxbows, sloughs, brushy ditches and floodplain woods
BIRDS				
Defiance and Paulding (OH) Allen (IN)	*Haliaeetus Leucocephalus*	Bald Eagle	Species of Concern	Near Rivers with old trees

2.11 Invasive Species

Invasive species are those organisms that do not naturally occur in a specific area and when introduced will cause deleterious effects on the ecology of the area. Invasive species pose a significant threat to the natural areas within the UMRW. Due to the fact that the newly introduced organism does not have natural predators, the organism can spread through an area quickly and can outcompete native organisms that make an ecosystem thrive. Table 2.20 is a list of invasive species that are located within one or more of the four counties that are located in the UMRW.

Table 2.20: Invasive Species in the Upper Maumee River Watershed

COUNTY	SPECIES	COMMON NAME	HABITAT
Vegetation			
DeKalb and Allen (IN)	*Robinia pseudoacacia*	Black Locust	Openland
	Sicyos angulatus	Burcucumber	Openland
	Cirsium arvense	Canada Thistle	Openland
	Sorghum almum	Columbus Grass	Openland
	Lysimachia nummularia	Creeping Jenny	Forest, Wetland
	Securigera varia	Crown Vetch	Openland
	Potamogeton crispus	Curly-Leaf Pondweed	Lake
	Hesperis matronalis	Dame's Rocket	Forest, Openland
	Myriophyllum spicatum	Eurasian Watermilfoil	Lake
	Sorghum halepense	Johnsongrass	Openland
	Acer platanoides	Norway Maple	Forest
	Littorina littorea	Periwinkle	Forest
	Ligustrum obtusifolium	Privet	Forest
	Euonymus fortunei	Purple Winter Creeper	Forest
	Sorghum bicolor	Shattercane	Openland
	Ulmus pumila	Siberian Elm	Forest
	Bromus inermis	Smooth Brome	Forest, Openland
	Melilotus officinalis	Sweet Clover	Openland
	Festuca arundinacea	Tall Fescue	Openland
	Ailanthus altissima	Tree of Heaven	Forest
	Morus alba	White Mulberry	Openland
Defiance and Paulding (OH)	*Senecio glabellus*	Cressleaf Groundsel	Openland
	Vitis L.	Grapevines	Forest
	Ploygonum perforliatum	Mile-a-Minute Weed	Openland
	Carduus nutans	Musk Thistle	Openland
	Chrysanthemum leucanthemum	Ox-Eye Daisy	Openland
	Conium maculatum	Poison Hemlock	Wetland
	Salsola kali	Russian Thistle	Openland
	Daucus carota	Wild Carrot	Openland
	Brassica kaber	Wild Mustard	Openland

COUNTY	SPECIES	COMMON NAME	HABITAT
	Pastinaca sativa	Wild Parship	Openland
DeKalb and Allen (IN) and Defiance and Paulding (OH)	*Elaeagnus umbellata*	Autumn Olive	Openland
	Rhamnus cathartica	Buckthorn, Common	Wetland, Openland
	Rhamnus frangula	Buckthorn, Glossy	Wetland, Openland
	Phargmites australis	Common Reed Grass	Wetland
	Alliaria petiolata	Garlic Mustard	Forest
	Lonicera japonica	Japanese Honeysuckle	Forest
	Polygonum cuspidatum	Japanese Knotweed	Forest
	rosa multiflora	Multiflora Rose	Forest, Openland
	Lythrum salicaria	Purple Loosestrife	Wetland
	Phalaris arundinacea	Reed Canary Grass	Wetland
Fish			
Paulding (OH)	*Sander canadensis x vitreus*	Saugeye	Lake
Allen (IN)	*Micropterus*	Black Bass	Lake
	Dorosoma cepedianum	Gizzard Shad	Lake
	Cyprinus carpio	Common Carp	Lake
Mussels			
Allen & Defiance	*Dreissena polymorpha*	Zebra Mussel	Lake, River

Of specific interest to the Maumee River and Lake Erie is the Asian Carp (Common Carp is one species of Asian Carp). There is currently no evidence supporting the fact that Asian Carp are in the Maumee River, however there is potential for the Carp to infiltrate the Maumee River Watershed from Eagle Marsh, a 705 acre nature preserve in south west Fort Wayne which is susceptible to flood waters from the Wabash River Watershed, in which Asian Carp currently inhabit. Several plans have been drawn up to prevent Asian Carp from reaching the Maumee River watershed via the Eagle Marsh, but no final decisions have been made at the time of this document being written. More information on the plan to prevent Asian Carp from invading the Great Lakes Region can be found at http://glmris.anl.gov/.

2.12 Summary of Watershed Inventory

All of the elements described above, when combined, can provide a larger picture of how the watershed functions and what activities may pose a greater threat to our water resources. This section will summarize the characteristics of the project area and describe how they relate to each other. This will be examined more closely in subsequent sections.

The predominant land use in the UMRW is agriculture due to the fertile soils, much of which used to be wetlands as can be seen by the amount of hydric soil present within the watershed (Figure 2.5, page 21). Hydric soils are not ideal for agricultural use due to the frequency of ponding and/or flooding. When soils are over saturated, excess nutrients and animal waste often wash off the field and may discharge directly into surface waters. Many landowners install field tiles or petition to convert open water to legal drains to be maintained by the county surveyor or engineer to prevent crop land from becoming over saturated. As can be seen in Figure 2.9 on page 27 many streams and ditches have been converted to be on regular maintenance by the County. However, this practice provides a direct means for nutrients, sediment, and bacteria to enter surface water, or depending on the depth to the water table, to groundwater resources used for irrigation or drinking water. For these reasons best management practices should be implemented on agricultural land with hydric soils, especially those using field tiles to drain the crop land.

Although only a little more than 14% of the watershed is considered developed, it is important to focus water quality improvement efforts in the urban areas. The city of Fort Wayne, population 255,824 (2010), is located at the headwaters of the Maumee River at the confluence of St. Marys and St. Joseph Rivers. Due to the high amount of impervious surfaces in Fort Wayne (refer to pages 70 and 74) and the neighboring city of New Haven, stormwater flow, carrying many urban and suburban pollutants, is on the rise and causing a problem for local water quality. The high amount of imperviousness is also the cause of the many CSO events in the watershed; 43 total outfalls into the St. Marys and St. Joseph, which flow into the Maumee River, or the Maumee River directly from Fort Wayne, three outfalls in New Haven and five outfalls in Hicksville. The City of Fort Wayne has an urban stormwater outreach program in place, along with partners including the Allen County Partnership for Water Quality and the Allen County SWCD. The City of Fort Wayne also offers Rain Garden installation classes and has a gutter-downspout disconnect program. However, more education and outreach events that reach further than the City of Fort Wayne and New Haven are essential for preventing polluted stormwater runoff from urban areas. There are also a multitude of urban best management practices that can be installed that will help to prevent urban pollution from running off the land in excessive stormwater flow and Low Impact Design should have a greater focus in the urban areas with intense development to help prevent an increase in stormwater from reaching combined sewers and decrease the number of CSO events.

There are few soils in the UMRW that are considered HEL or PHEL, as can be seen in Figure 2.4 on page 19. Even though less than 10% of the soils in the watershed are considered to be erodible, special precautions should be taken by those producers working HEL and PHEL land to limit the amount of soil erosion. As soil erodes, it can increase stream and lake sedimentation. The eroding soil particles often carry nutrients that bind to the particles to open water sources as well. This may cause an increase in phosphorus and nitrogen levels within the water system, leading to unsuitable water quality.

Since the majority of the land use in the UMRW is agriculture, specifically row crops (greater than 73% of the watershed), sedimentation can have a major effect on water quality and biota. Tillage data collected by each county in the watershed indicates a relatively fair adoption of conservation tillage practices. It is also clear from Table 2.6 on page 39 that the number of acres that qualify as no-till has declined 5% for beans, though has increased 11% for corn between 2006 and 2012. It appears that many of those fields have been switched to mulch or strip till, which is still a form of conservation tillage. Conservation tillage requires a minimum of

30% residue cover on the land. This decreases the potential for soil erosion, decreases soil compaction, and can save the producer time and money by minimizing the number of passes made on each field while preparing for the next planting season.

There are seven populated areas that are wholly within the UMRW, as well as the eastern half of the City of Fort Wayne and the most western edge of Defiance, OH. All of the above mentioned towns are served by a centralized sewer system, as well as some smaller populated areas such as neighborhoods and trailer parks. However, much of the watershed, approximately 85% is rural and therefore, many homes utilize on-site sewage treatment for their household effluent. While accurate estimates of the number of failing or failed septic systems could not be obtained for much of the project area, the estimates that were provided clearly identifies failing septic systems are a true issue in the watershed. The USDA soil survey for Allen, DeKalb, Defiance and Paulding counties lists less than 3% of the soil in the project area as being suitable for on-site sewage treatment as can be seen in Figure 2.6 on page 22. These two facts may lead one to believe that bacteria contamination, and excessive nutrients found within the water samples may be partly due to improperly sited septic systems and/or failing systems.

The majority of the major population centers obtain their drinking water from surface waters; Fort Wayne and New Haven from the St. Joseph River, and Antwerp, Cecil and Defiance from the Maumee River. However, Woodburn, Hicksville, and Sherwood obtain their drinking water from wells. Hicksville and Sherwood obtain their drinking water from the MICHINDOH aquifer which lies under the portion of the UMRW in DeKalb and Defiance Counties, and a small portion of Allen County, as can be seen in Figure 2.14 on page 36. Field tiles and improperly placed or faulty septic systems can seriously affect the integrity of the aquifer to be used for drinking water as the contaminated effluent may not be entirely filtered as it percolates through the soil. Leaking underground storage tanks can also pollute groundwater contaminating drinking water with various harmful chemicals. For this reason, special precautions must be taken to ensure that the watershed's drinking water source is not polluted.

As stated earlier, the majority of the land within the project area is used for agriculture and many of the wetlands that were once present have been drained for pasture land or row crops such as the Great Black Swamp as can be seen in Figure 2.10 on page 28. Wetlands play an important role in our ecosystem, not only as flood water traps and pollution sinks, but also as prime habitat for many of the species listed as endangered or threatened. For instance, the Indiana Bat, Copperbelly Water Snake, and Massasauga Rattlesnake all prefer the habitat provided by wetlands. Forest land, much of which has been cleared for agriculture, is also a vital habitat for endangered species, such as the Indiana Bat. Leaving some agricultural land fallow and replanting the fields with native vegetation to allow the landscape to return to forest or wetland will provide more vital habitat for those endangered and threatened species. Many of the strategic and comprehensive planning efforts by local governments and interest groups have made goals for conserving and protecting natural areas including *Plan-It Allen, City of Defiance Strategic Plan, Defiance Comprehensive Plan, and the WLEB Partnership Strategic Plan*.

Table 2.21, below, links those concerns that stakeholders from the public meetings had regarding the project area and water resources, to evidence found during the initial project area inventory. More evidence will be provided in subsequent sections at the 12 digit HUC level.

Table 2.21: Stakeholder Concerns and Evidence found for Concerns

Concerns	Evidence	Potential Problems
Flooding	All riparian areas of the Maumee River are considered to be high risk for flooding in IN and are considered to be located within the 100 year floodplain in OH. All incorporated areas within the watershed are located partially within a floodplain. Several log jams, which often contribute to flooding were observed during the windshield survey. Three major floods have taken place within the watershed over the past decade.	Sedimentation, impaired biotic community, heavy metals and other toxic chemicals, and nutrients
Log Jams	Six log jams were observed during the windshield survey.	Sedimentation and flooding
Stream Bank Erosion	Many population centers including Fort Wayne, New Haven, Antwerp, Cecil, and Defiance are located along the banks of the Maumee which can contribute to streambank erosion due to the increase in stormflow resulting from the high amount of impervious surfaces in those areas. Nearly 10% of the watershed, specifically farm land in the northern portion of the watershed is considered PHEL or HEL which when conventionally farmed can increase streambank erosion.	Sedimentation, turbidity, and impaired biotic community
Lack of Riparian Buffer	Nearly 535 miles of stream/ditches are under regular maintenance by the county surveyors. These legal drains are typically cleared of woody vegetation to allow easy access for heavy equipment to the ditch. The Indiana Bat, Copperbelly Watersnake, Eastern Massasauga, and Bald Eagle, all listed on the endangered species list; rely on habitat often associated with riparian areas, indicating a possible loss of habitat.	Sedimentation, turbidity, temperature, and impaired biotic community
Recreational Opportunities and Safety	There are only three boat launches managed by the DNR located within the Upper Maumee River Watershed. There is one canoe launch at Moser Park managed by New Haven. There are a total of six parks in the watershed that are located near the river, however there is limited access for fishing, boating and general recreating on the river.	Lack of action to conserve and preserve the river.

Concerns	Evidence	Potential Problems
Segmented/Lack of Forested Areas	Only 4.92% of the watershed is classified as forested. The land use map on page 38 shows how segmented the forested areas are. There are three species on the endangered species list for the four counties of the UMRW that rely on forested areas for their habitat and the continued segmentation of their habitat may have contributed to them being listed.	Impaired Biotic Community, and decreased wildlife habitat, including endangered and threatened species
Lack of Water Education/Outreach	There was not an organization focused solely on the Upper Maumee River Watershed until the Upper Maumee Watershed Partnership was formed in 2009. As per State law each CSO community must develop a plan to educate the public on water quality and stormwater management. Those communities include Fort Wayne, New Haven, Hicksville, and Defiance. The Allen County Partnership for Water Quality provides education and outreach on water quality issues throughout Allen County. It is not clear how much of the water quality education reaches the public.	Increase in nonpoint source pollution
Rural legal drains	There are 534.35 miles of ditches managed by the county regulating agency. Several streams and ditches have been dredged and straightened.	Nutrients, pesticides, sediment, turbidity, impaired biotic community
Combined Sewer Overflows	Fort Wayne has 43 CSOs discharging to the St. Joesph, St. Marys, and Maumee Rivers, all of which eventually flow to the Maumee River. 13 of those 43 CSOs discharge into the Maumee River. New Haven has three CSOs and Hicksville has five CSOs.	Sedimentation, *E. coli*, impaired biotic community, turbidity, nutrients
Need for Wetland Protection / Restoration	59% of the soils in the watershed are classified as hydric by the NRCS which is likely due to a large portion of the Great Black Swamp that was located within the Ohio portion of the watershed. The Ohio DNR estimates that 90% of the wetlands in Ohio have been drained and converted to farm land as currently only 3% of the watershed is classified as wetland.	Sedimentation, impaired biotic community, turbidity, nutrients, flooding

Concerns	Evidence	Potential Problems
Increase in Impervious Surfaces	Plan-It Allen, City of Defiance Strategic Plan, Defiance County Comprehensive Plan, Woodburn Strategic Plan, DeKalb County UDO and Comprehensive Plan all have increasing business and industry as a goal, as well as increasing navigability of the towns and counties. Due to the depressed economy, construction has been on the decline over the past decade, however current housing and building trends indicate construction may be on the rise again soon which will increase impervious surfaces.	Oil and grease, sediment, nutrients, increase in combined sewer overflows
Urban Contamination Sites	There are 19 NPDES permitted facilities, six brownfields, one superfund site, and 131 leaking underground storage tanks located within the UMRW.	Oil and grease, heavy metals, and other toxic chemicals, impaired biotic community
Need for More Water Quality Studies/Planning Efforts	There was only one previously written watershed plan which included the Upper Maumee River Watershed, however none have been written specific to the Upper Maumee Watershed alone. The US Army Corp of Engineers wrote a management plan to provide watershed, city, and county planners with a tool to help restore, protect, and promote sustainable uses of water resources and the surrounding land within the Western Lake Erie Basin.	Lack of action to conserve and preserve the river.
Increasing Hypoxic Zone in WLEB	Federal interest in the Great Lakes has begun to move toward Lake Erie due to the growing algal bloom along the Western Lake Erie coast.	DRP, sedimentation, impaired biotic community, blue green algal blooms
Increase in Dissolved Reactive Phosphorus	DRP from the Maumee River is known to be a contributing factor to the increasing hypoxic zone in the WLEB.	Increase in WLEB hypoxic zone and algal blooms, and impaired biotic community

Concerns	Evidence	Potential Problems
Fish and Wildlife Habitat	There are nine species of fish, wildlife, and birds on the federal endangered species list. There are 46 invasive species of fish, mussels, and vegetation found within the four counties of the UMRW which can use up resources and take over prime habitat that indigenous species rely on.	Lack of vegetative stream buffers and riparian corridors, fragmented landscape, and an increase in pollution entering the water
Soil Erosion and Sedimentation	Nearly 10% of the project area has soil considered to be PHEL or HEL and most of it is located on the northern portion of the watershed which is predominantly farm land. There are six species of mussel listed on the endangered species list. It is common for sediment to cover the stream floor thus suffocating mussel habitat.	Sedimentation, turbidity, and impaired biotic community
Unbuffered Tile Inlets	A specific inventory of tile inlets was not conducted.	Sediment, nutrients, pesticides
Structures within Floodplain	The entire UMRW is at some risk of flooding, though the area directly adjacent to the Maumee River in Indiana is considered to be at high risk of flooding which includes Fort Wayne and New Haven. Woodburn is surrounded by streams that are at a high risk of flooding. The land directly adjacent to the Maumee River, and many of its tributaries in Ohio are considered to be within the 100 year flood plain. Antwerp, Hicksville, Sherwood, and Defiance are all located within the 100 year floodplain.	*E. coli*, heavy metals, other toxic chemicals, sediment

Concerns	Evidence	Potential Problems
Failing or Straight pipe Septic Systems	The Allen County Health Department estimates that nearly 9,000 (50%) of the septic systems in Allen County are, or are at risk of failing. It is estimated that 25%-30% of the septic systems in Ohio are failing. 96% of the watershed soils are considered to be very limited, and 1% of the soils are considered somewhat limited for the placement of septic systems, leaving less than 3% of the watershed suitable for the placement of on-site waste disposal.	*E. coli*, nutrients, sediment, turbidity
Storm Water Control	There have been three major floods in the Maumee River Watershed within the past decade. There are Long Term Control Plans (LTCPs) in place in Fort Wayne, New Haven, Hicksville, and Defiance to separate sewers and to educate the public on storm water control methods. The number of CSO events have not decreased within the CSO communities since the development of the LTCPs	Sediment, turbidity, nutrients, *E. coli*, flooding
Decrease in Desirable Fish Species	There are no fish on the Federal endangered species list within the UMRW (Table 2.19), though there are 21 species of fish listed on the Indiana and/or Ohio State Endangered Species list. There are four species of invasive fish that can be found within the four counties of the UMRW.	Impaired Biotic Community
Rivers / Streams / Watershed Listed as "impaired" by Regulating State Agency	The list of waters deemed impaired by OEPA and IDEM are outlined in Tables 3.2 and 3.3.	*E. coli,* nutrients, sediment, impaired biotic community
Barnyard Runoff into Surface Water	There are 13 CFOs (CAFFs) with the potential to produce barnyard runoff. Nearly 4.2% of the watershed land use is considered to be pasture/hayland which would indicate the presence of livestock in those areas which could potentially result in barnyard runoff into surface waters.	*E. coli*, nutrients, sediment
Livestock Access to Open Water	Nearly 4.2% of the watershed land use is considered to be pasture/hayland which would indicate the presence of livestock in those areas which could potentially result in manure runoff into surface waters.	*E. coli,* nutrients, sedimentation, turbidity, impaired biotic community

3.0 Watershed Inventory by Sub-watershed

3.1 Water Quality Data

An important aspect of the watershed planning process is to examine current water quality data, as well as historic data to understand the issues present in the watershed. The historic data, some of which has been collected for decades, though only data collected since 2003 will be presented in this WMP, will provide a baseline in which to compare the data collected by the UMRW project in 2012. The historical data of consequence (collected since 2003) was combined with the watershed assessment that was done as part of this project to characterize water quality problems and their sources and tie them to stakeholder concerns. The following sections will provide a detailed description of all water quality data that has been collected in the watershed to date.

3.1.1 Water Quality Parameters

Many organizations, including IDEM, the City of Fort Wayne, Defiance College, Ohio EPA, Heidelberg University, and the USGS, have collected water quality information in the UMRW over the past decade for a myriad of different parameters including heavy metals, herbicides, nutrients, and bacteria. The UMRW project is most interested in sediment, herbicides, nutrients, and bacteria as those parameters are often released into the water system via non-point sources. The effects of various parameters on water quality are presented below.

Ammonia - Ammonia is common in the water system as it is released in the waste of living mammals. It is also released into the water system via farmland runoff as ammonium hydroxide is used as a fertilizer for row crops. Ammonia is important to measure for two reasons: the free form of ammonia, NH3, is toxic to fish and can lower reproduction and growth of aquatic organism, or even result in death, and the nitrification of ammonia removes dissolved oxygen from the water. Measuring the amount of ammonia in the water is also a good indicator for other pollutants that may be reaching the water as well. Due to the toxic nature of too much ammonia in the water, the state of Indiana has set a standard of between 0 and 0.21 mg/L, dependent on temperature.

Atrazine - Atrazine is one of the world's most used pesticides by row crop producers to control weeds. Atrazine is a highly soluble chemical that is not easily broken down in water. It has been shown that high levels of atrazine can cause some aquatic animals to become sterile, hermaphroditic, or even convert males to females. There is still debate in the scientific world as to whether or not atrazine can cause cancer in humans. But people who consume water containing high levels of atrazine over an extended period of time have been noted as presenting with cardio vascular problems. For these reasons the US EPA has set the Maximum Contaminant Level (MCL) for atrazine at 3 parts per billion (ppb).

Alachlor - Alachlor is an herbicide used predominantly on corn, sorghum, and soybeans to control annual grasses and broadleaf weeds. Alachlor is used regularly by producers within the Upper Maumee River watershed. It has been shown that people drinking water containing excessive amount of alachlor may present with eye, liver, kidney, or spleen problems. They may also experience anemia and an increased risk of getting cancer. For these reasons the US EPA has set the MCL for alachlor to be 2 ppb.

Metolachlor - Metolachlor is a pre-emergent grass weed herbicide that is effective on corn, soybeans, sorghum, peanuts, and cotton fields. While the product is very effective, its use is on the decline due to the deleterious effects it may have on organisms. Metolachlor has been shown to be a cytotoxin (toxic to cells) and a genotoxin (a toxic substance that damages DNA). The US EPA gave metolachlor a category C rating meaning that there is limited evidence showing it to be a carcinogen. However, the US EPA has given metolachlor a health advisory level of 52.5 ppb in drinking water. The UMRW steering committee decided to use the target of 50 ppb which is the Canadian drinking water standard for Metolachlor.

Dissolved Oxygen - Dissolved oxygen (DO) is the measure of oxygen in the water available for uptake by aquatic life. Typically, streams with a DO level greater than 8 mg/L are considered very healthy and streams with DO levels less than 2 mg/L are very unhealthy as there is not enough oxygen to sustain aquatic life. DO is affected by many factors including; temperature - the warmer the water the harder it is for oxygen to dissolve, flow –more oxygen can enter a stream where the water is moving faster and turning more, and aquatic plants – an influx of plant growth will use more oxygen than normal which does not leave enough available DO for other aquatic life, however photosynthesis will add oxygen to the water during the day. Thus, DO levels may change frequently when there is excessive aquatic plant growth. Excessive amounts of suspended or dissolved solids will decrease the amount of DO in the water. The state of Indiana has set a standard of at least an average of 5 mg/L per calendar day, but not less than 4 mg/L of DO for warm water streams. The US EPA recommends that DO not exceed 9 mg/L so as to avoid super-saturation of DO in the water system.

Temperature - As mentioned above, temperature can affect many aspects of the health of the water system. Water temperature is a controlling factor for aquatic organisms. If there are too many swings in water temperature, metabolic activities of aquatic organisms may slow, speed up, or even stop. Many things can affect water temperature including stream canopy, dams, and industrial discharges. The state of Indiana has set a standard for water temperature (which may be found in 327 IAC 2-1-6) depending on if the waterbody is a cold or warm water system.

Escherichia coli - *E. coli* is a bacteria found in all animal and human waste. *E. coli* testing is used as an indicator of fecal contamination in the water. While not all *E. coli* is harmful, there are certain strains that can cause serious illness in humans. *E. coli* may be present in the water system due to faulty septic systems, CSO overflows, wildlife; particularly geese, and from contaminated stormwater runoff from animal feeding operations. Due to the serious health risks from certain forms of *E. coli*, and other bacteria that may be present in water, the state of Indiana has developed the full body contact standard of less than 235 CFU/100 ml of *E. coli* in any one water sample and less than 125 CFU/100 ml for the geometric mean of five equally spaced samples over a 30 day period.

Total Kjeldahl Nitrogen - TKN is the sum of organic nitrogen, ammonia, and ammonium. High levels of TKN found in water is typically indicative of manure runoff from farmland or sludge discharging to the water from failing or inadequate septic systems. The level of TKN in the water is a good indicator of other pollutants that may be reaching the water. The US EPA recommends a target level not to exceed 0.076 mg/L.

Turbidity -Turbidity is the measure of the cloudiness of the water which may be caused by sediment or an overgrowth of aquatic plants or animals. High levels of turbidity can block out essential sunlight for submerged plants and animals and may raise water temperatures, which then can decrease DO. Sediment in the water causing it to be turbid can clog fish gills and smother nests when it settles, thus affecting the overall health of the aquatic biota. Turbid water may be caused from farm field erosion, feedlot or urban stormwater runoff, eroding stream banks, and excessive aquatic plant growth. The US EPA recommends that the turbidity in the water measure less than 10.4 NTUs.

pH - pH is the measure of a substance's acidity or alkalinity and is an important factor in the health of a water system because if a stream is too acidic or basic it will affect the aquatic organisms' biological functions. A healthy stream typically has a pH between 6 and 9, depending on soil type and substances that come from dissolved bedrock. pH can also change the water's chemistry. For example, a higher pH means that a smaller amount of ammonia in the water may make it harmful to aquatic organisms and a lower pH may increase the amount of metal present in the water as it will not dissolve as easily. For these reasons, the state of Indiana has set a standard for pH of between 6 and 9.

Total Suspended Solids - Total suspended solids (TSS) is a measure of particulate matter in a water sample. TSS is measured by passing a water sample through a series of sieves of differing sizes, drying the particulate, and weighing the dried matter. The amount of Total Suspended Solids (TSS) in the water system will have the same type of deleterious effect on water quality as mentioned above under turbidity including, debilitating aquatic habitat and life, and carrying other pollutants to the water such as fertilizers and pathogens. The Michigan state code has set a standard for TSS to be equal to or lesser than 20 mg/L, and the Indiana state code standard for TSS is equal to or lesser than 30 mg/L. Based on this knowledge and other available studies on TSS concentrations, a target of 25 mg/L has been set for this project.

Total Dissolved Solids - Total dissolved solids are all dissolved organic or inorganic molecules that are found in the water. The difference between TDS and TSS is that TSS cannot pass through a sieve of 2 micrometers or smaller. So, the lower the TDS measurement in the water sample the purer the water is. TDS is a measurement of any pollutant in the water including salt, metal, and other minerals. The IN state code has a standard of <750 mg/L to maintain a healthy aquatic ecosystem.

Phosphorus - Phosphorus is an essential nutrient for aquatic plants however, too much phosphorus can create an over growth of plants which can lower the DO in a water system and decrease the amount of light that penetrates the surface thus killing other aquatic life that depends on these for survival. Some types of aquatic plants that thrive when phosphorus levels are high, such as blue-green algae, are toxic when consumed by humans and wildlife. Excessive amounts of phosphorus have also been found in ground water thus increasing the bacteria growth in underground water systems. Phosphorus can reach surface and ground water through contaminated runoff from row crop fields, and urban lawns where fertilizer has been applied, animal feeding operations, faulty septic tanks, and the disposal of cleaning supplies containing phosphorus in landfills or down the drain. The state of Indiana has set a target of 0.3 mg/L of total phosphorus (under certain conditions) in a water sample to list a waterbody as impaired on the state's impaired water list as required by the CWA § 303(d), often referred to as the 303(d) list. Though, the OEPA has set a standard of 0.08 mg/L in warm water headwater streams and a standard of 0.3 mg/L for large rivers. The UMRW steering committee decided to use OEPA's target of 0.08 mg/L for all tributaries and 0.3 mg/L for samples taken from the mainstem.

Dissolved Reactive Phosphorus (DRP)/Ortho-Phosphate – DRP is another form of phosphorus that is readily available for plant uptake once it reaches open water as it does not bind to soil particles. It is often considered the limiting factor to algae growth, which is a major concern throughout the natural resources world for the Upper Maumee River Watershed and the Western Lake Erie Basin. There has been an increase in algal blooms in Lake Erie, as well as an increase in DRP found throughout the WLEB. DRP can come from a variety of sources including point source dischargers and non-point sources. The North Carolina State University recommends concentrations of DRP be less than 0.05 mg/L in water samples to maintain a viable aquatic ecosystem.

Nitrite - Nitrites are highly toxic to aquatic life and also toxic to humans, especially babies, if consumed in excessive amounts. Nitrites can cause shortness of breath and blue baby syndrome, which can lead to death in babies which is of great concern to those individuals who acquire their drinking water from wells. Nitrites are commonly found in the water system in trace amounts because nitrite is quickly oxidized to nitrate. However nitrites can be introduced in excessive amounts from sewage treatment plants if the oxidation process is interrupted, from farm field runoff, animal feeding lot runoff, and faulty septic systems. For the harmful health effects mentioned above, the state of Indiana adopted the US EPA MCL standard of less than 1 mg/L of nitrite in drinking water which can be found in 327 IAC 2-1-6.

Nitrate - Nitrates can have the same effect on the water system as phosphorus, only to a much lesser degree. Nitrates can be found at levels up to 30mg/L in some waters before detrimental effects on aquatic life occur. However, due to the fact that infants who consume water with nitrate levels exceeding the US EPA MCL of 10 mg/L can become ill, nitrates in drinking water should be of particular concern to people who use wells as their drinking water source. The most common sources of nitrates are from fertilizer runoff from row crop fields, faulty septic systems, and sewage. The UMRW steering committee has decided to use the US EPA reference level for nitrates in the water system, which is set at 1.6 mg/L.

Macroinvertebrate Index of Biotic Integrity - The Macroinvertebrate Index of Biotic Integrity (mIBI) is used as an indicator of water quality. Macroinvertebrates are collected from the water system and classified down to the genus level. The number and type of macroinverbrates found show the overall health of the water as some macroinvertebrates can only survive when little to no contaminants are present. The UMRW steering committee set a target of the index ranking to be greater than 23 based on the Hoosier Riverwatch method of collecting and ranking samples. Hoosier Riverwatch ranks macroinvertebrates as follows; >23 = excellent, 17-22 = good, 11-16 = fair, <10 = poor.

Citizens Qualitative Habitat Evaluation Index - The Qualitative Habitat Evaluation Index is another method used to determine the quality of a waterway. Various aspects of aquatic habitat are evaluated including in-stream habitat and the surrounding land use, to determine the waterways ability to support aquatic life such as fish and macroinvertebrates. A score greater than 61 is considered to be a stream that fully supports aquatic life, and a score between 51 and 61 is considered a stream that partially supports aquatic life.

3.1.2 Water Quality Targets

When the above parameters are combined a greater picture of the overall quality of the waterway can be gleaned. For the purpose of interpreting inventory data and defining problems, target values were identified for water quality parameters of concern by the UMRW steering committee (Table 3.1). It is important to note that the same parameters were not analyzed by each entity that collected water quality samples.

Table 3.1: Water Quality Targets

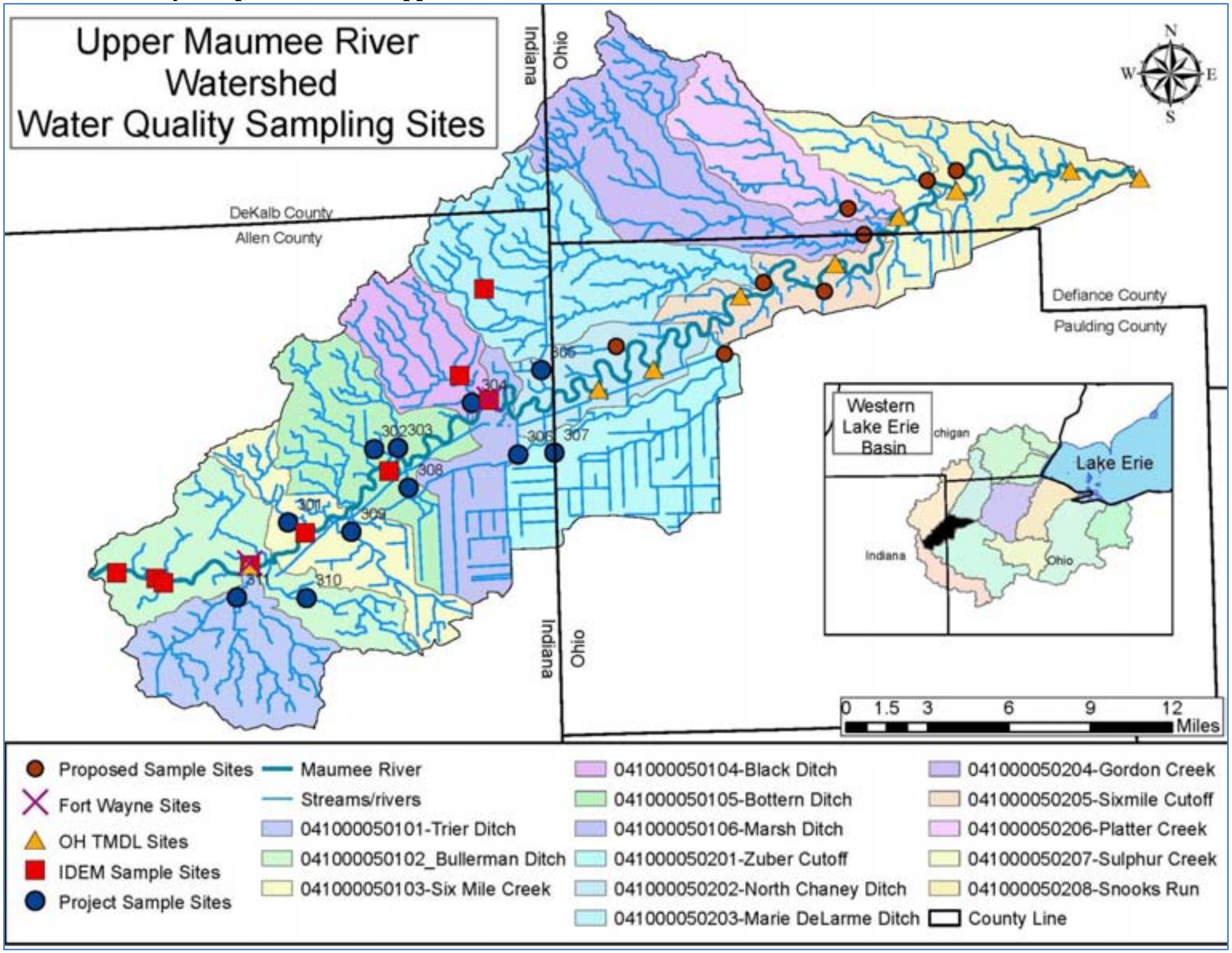
Parameter	Target	Source
Atrazine	< 3.0 ppb	US EPA drinking water MCL
Alachlor	< 2 ppb	US EPA drinking water MCL
Metolachlor	< 50 ppb	Canadian drinking water std
Dissolved Oxygen	>5mg/L but not < 4 mg/L and not > 9 mg/L (EPA recommendation)	327 IAC 2-1-6
Temperature	4.44 - 29.44 degrees C	327 IAC 2-1-6
Escherichia Coli	235 CFU/100 ml (single sample) or 125 CFU/100 ml (geo mean-5 equally spaced samples over a 30 day period)	327 IAC 2-1.5-8
Turbidity	< 10.4 NTU	US EPA recommendation (2000)
pH	> 6 and < 9	327 IAC 2-1-6
Total Suspended Solids	< 25 mg/L	Based on Rule 50 of MI water quality standards and 327 IAC 2-1-6
Total Dissolved Solids	< 750 mg/L	327 IAC 2-1-6
Total Phosphorus	< 0.08 mg/L – Tributaries < 0.30 mg/L - Mainstem	Ohio State Standard 327 IAC 2-1.5-8
Dissolved Reactive Phosphorus	< 0.05 mg/L	North Carolina State University Recommendation
Total Ammonia	< 0.21 mg/L depending on temperature	327 IAC 2-1-6
Nitrite	< 1 mg/L	327 IAC 2-1-6
Nitrate + Nitrite	< 1.6 mg/L	US EPA reference level (2000)
Total Kjeldahl Nitrogen (TKN)	< 0.591 mg/L	US EPA recommendation (2000)
Macroinvertebrate index of biotic Integrity	>23 points = Excellent 17-22 points = Good 11-16 points = Fair <10 points = Poor	Hoosier Riverwatch (2011)
Citizen's Qualitative Habitat Evaluation index	100-114 points = Exceptional > 60 points = Adequate	Hoosier Riverwatch (2011)

3.2 Water Quality Sampling Efforts

A variety of water quality assessment projects have been completed within the UMRW. These include the Indiana and Ohio Integrated Report monitoring, the IDEM Watershed Assessment and Planning Branch studies, the OEPA Total Maximum Daily Load (TMDL) project, the City of Fort Wayne monitoring program, and the Allen County SWCD's assessment performed as a part of this project. A summary of each study's methodology and general results are discussed below. Subsequent sections detail specific study information as it relates to each sub-watershed. Figure 3.1 displays all the historic sampling locations in the project area, the project sampling locations and the proposed sites that the Defiance County SWCD has selected as ideal locations to do water quality testing once funding is made available. Note that the sample sites with numbers associated with them are sample locations of the Allen County SWCD's and the only sites that have assigned labels.

The OEPA TMDL study sample sites are along the main stem of the Maumee River only. Therefore, we will extrapolate data from those sites to better understand the impact of NPS from a group of sub-watersheds rather than presenting each sub-watershed on its own. This process will be described in more detail in Section 3.3.

Figure 3.1: Water Quality Sample Sites in the Upper Maumee River Watershed



3.2.1 IDEM and OH EPA Integrated Reports

Each state is required to perform water quality analysis of its surface waters and report their findings to EPA in a report called the "Integrated Report" (IR) on a biannual basis, as mandated by the CWA§305(b). Prior to compiling the IR, a list of water bodies that do not meet state standards is developed as mandated by the Clean Water Act section 303(d). This has become commonly known as the 303(d) list. Many stream segments located within the UMRW are listed on the 2012 IDEM 303(d) list of impaired waters for *E. coli,* impaired biotic community, and PCBs in fish tissue. IDEM's 2012 IR can be found at http://www.in.gov/idem/nps/2639.htm. Ohio's 2012 IR has also been approved by the US EPA and shows that the entire portion of the UMRW project area located within Ohio is impaired for Aquatic Life use. The OEPA's Integrated Report can be found at http://www.epa.ohio.gov/dsw/tmdl/ohiointegratedreport.aspx. A full list of those waters impaired within the UMRW, as designated by each State, can be found in Table 3.2 and Table 3.3, and a map of those listed waters can be seen in Figure 3.2.

As part of the IDEM monitoring process, water samples are analyzed for numerous substances. Those relative to this WMP include: nitrogen as ammonia, nitrate+nitrite, total phosphorus, TKN, pH, TDS, TSS, DO, turbidity, temperature, and *E. coli*. Data collected by IDEM since 2003 was analyzed and sorted for the purpose of this project.

Ohio EPA has not collected water quality data for the 303(d) list of impaired waters within the Upper Maumee Watershed since 1993. However, the OEPA has begun the process of developing a TMDL for the Western Lake Erie Basin in Ohio including the Upper and Lower Maumee River Watersheds, the Auglaize River Watershed, and the Tiffin River Watershed. The OEPA collected water quality samples in the Ohio portion of these watersheds, as well as the New Haven, IN Landin Rd. City of Fort Wayne sample site, during the spring of 2012. The parameters analyzed in the Upper Maumee River watershed that are relevant to this WMP include: TDS, TSS, nitrogen as ammonia, nitrate+nitrite, nitrite, TKN, total phosphorus, temperature, DO, pH, and *E. coli*.

The list of waters deemed impaired by OEPA and IDEM are outlined in the following Tables 3.2 and 3.3, respectively.

Table 3.2: OEPA 303(d) List for the Upper Maumee River Watershed

Assessment Unit	Assessment Unit Name	Assessment Unit Size (Sq. Mi.)	Aquatic Life	Aquatic Life Uses	Recreation	Drinking Water Supply	Human Health/ Fish Tissue	Next Field Monitoring	Projected TMDL
41000050201	Zuber Cutoff	36.9	5hx	WWH/MWH-C	3	N/A	3	2016	2019
41000050202	North Chaney Ditch	18.4	5hx	WWH/MWH-C	3	N/A	3i	2016	2019
41000050203	Marie DeLarme Creek	49	5hx	WWH/MWH-C	3	N/A	3	2016	2019
41000050204	Gordon Creek	44.2	5hx	WWH/MWH-C	3	N/A	3	2016	2019
2008 Data Merritt Ditch at Hicksville - Industrial Park, River Mile 2.3, Non-attainment for Warm Water Habitat									
2008 Data Merritt Ditch at Hicksville - near Hospital, River Mile 1.9, Non-attainment for Warm Water Habitat									
41000050205	Sixmile Cutoff	15.7	5hx	WWH/MWH-C	3	N/A	3	2016	2019
41000050206	Platter Creek	21.7	5hx	WWH/MWH-C	3	N/A	3	2016	2019
41000050207	Sulphur Creek	18.2	5hx	WWH/MWH-C	3	N/A	3	2016	2019
41000050208	Snooks Run	25	5hx	WWH/MWH-C	3	N/A	3i	2016	2019

Category Description		Sub-Category	
Category 0	No waters currently utilized for water supply		
Category 1	Use attaining	h	Historical data
		x	Retained from 2010 IR
Category 2	Not applicable in new (2010) Ohio system		
Category3	Use attainment unknown	h	Historical data
		i	Insufficient data
		x	Retained from 2010 IR
Category 4	Impaired; TMDL not needed	A	TMDL complete
		B	Other required control measures will result in attainment of use
		C	Not a pollutant
		h	Historical data
		n	Natural causes and sources
		t	Category 4A may not tell the "whole story"
		x	Retained from 2010 IR
Category 5	Impaired; TMDL needed	M	Mercury
		h	Historical data
		x	Retained from 2010 IR

WWH = Warm water Habitat; MWH-C=Modified Warm water Habitat-Channelized

Table 3.3: IDEM Consolidated List of Impaired Waters for the Upper Maumee River Watershed

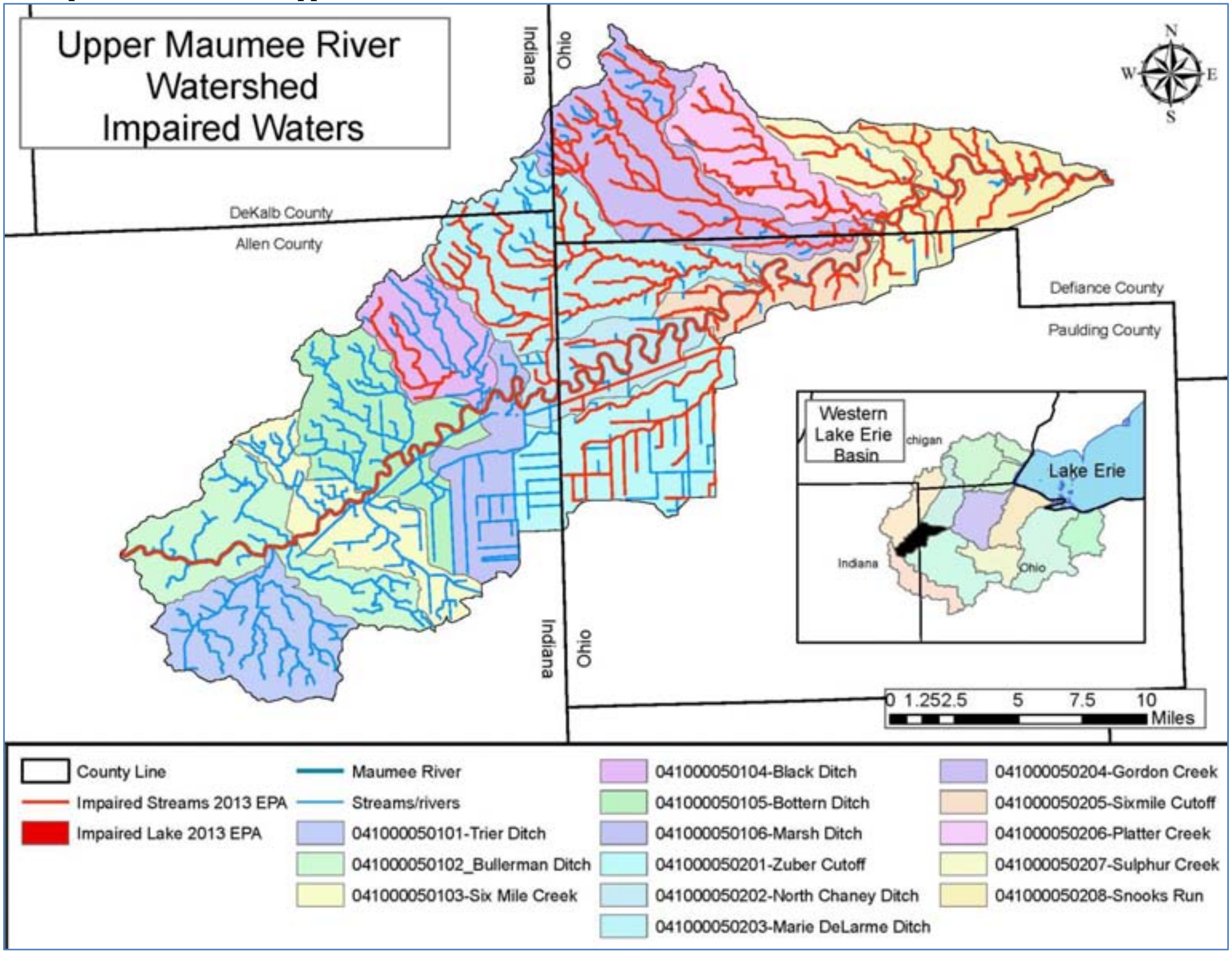
Assessment Unit	Assessment HUC	Assessment Unit Name	Aquatic Life	Recreation	Drinking Water Supply	Human Health /Fish Tissue	E. coli	Fish Tissue (PCBs)	Algae	IBC	Nutrients
INA0512_00	41000050101	SCHMIDT DITCH-COCHOIT DITCH	3	3		3					
INA0513_00	41000050101	TRIER DITCH	3	3		3					
INA0511_00	41000050102	RIVER HAVEN AND OTHER TRIBUTARYS	3	3		3					
INA0511_M 1007	41000050102	MAUMEE RIVER	5A	4A		5B	4A	5B			
INA0514_00	41000050102	BULLERMAN DITCH AND OTHER TRIBUTARIES	2	3		3					
INA0514_M 1006	41000050102	MAUMEE RIVER	5A	4A		5B	4A	5B			
INA0515_00	41000050102	MARTIN DITCH	3	3		3					
INA0516_00	41000050103	SIXMILE CREEK AND OTHER TRIBUTARYS	3	3		3					
INA0516_M 1005	41000050103	MAUMEE RIVER	2	4A		5B	4A	5B			
INA0517_00	41000050103	GAR DITCH	3	3		3					
INA051B_01	41000050104	BLACK CREEK (HARLAN, IN)	5A	5A	5A	3	5A		5A	5A	5A
INA051B_02	41000050104	BLACK CREEK	2	3		3					
INA051B_T1 001	41000050104	OBERHALTZER DITCH	3	5A		3	5A				
INA051B_T1 002	41000050104	REICHELDERFER DITCH	3	5A		3	5A				
INA051B_T1 003	41000050104	WARD LAKE DITCH	3	5A		3	5A				

Assessment Unit	Assessment HUC	Assessment Unit Name	Aquatic Life	Recreation	Drinking Water Supply	Human Health /Fish Tissue	E. coli	Fish Tissue (PCBs)	Algae	IBC	Nutrients
INA051B_T1 004	41000050104	BLACK CREEK - UNNAMED TRIBUTARIES	3	3		3					
INA051B_T1 005	41000050104	WERTZ DITCH	3	3		3					
INA051B_T1 006	41000050104	SMITH-FRY DITCH	3	3		3					
INA051B_T1 007	41000050104	KILLEN DITCH	3	3		3					
INA051B_T1 008	41000050104	BLACK CREEK - UNNAMED TRIBUTARY	3	3		3					
INA0518_00	41000050105	SPINDLER DITCH AND OTHER TRIBUTARYS	3	3		3					
INA0518_M 1004	41000050105	MAUMEE RIVER	2	4A		5B	4A	5B			
INA0519_00	41000050105	WILBUR DITCH AND TRIBUTARIES	3	3		3					
INA0519_T1 008	41000050105	BOTERN DITCH AND TRIBUTARIES	2	3		3					
INA051A_00	41000050105	GROVER DITCH AND OTHER TRIBUTARYS	3	3		3					
INA051A_M 1003	41000050105	MAUMEE RIVER	2	4A		5B	4A	5B			
INA051C_00	41000050106	MARSH DITCH AND OTHER TRIBS	3	3		3					
INA051C_M 1002	41000050106	MAUMEE RIVER	5A	4A		5B	4A	5B			5A

Assessment Unit	Assessment HUC	Assessment Unit Name	Aquatic Life	Recreation	Drinking Water Supply	Human Health /Fish Tissue	E. coli	Fish Tissue (PCBs)	Algae	IBC	Nutrients
INA051D_00	41000050201	VILAND DITCH AND OTHER TRIBS	3	3		3					
INA051D_M1001	41000050202	MAUMEE RIVER	5A	4A		5B	4A	5B			5A
INA051E_00	41000050203	HAM INTERCEPTOR DITCH	5A	3		3				5A	5A
INA0524_00	41000050203	MARIE DELARME CREEK-TUSTISON CREEK	3	3		3					
INA05P1008_00	41000050203	RICH LAKE	3	3		3					

	Category Description	Sub-Category
Category 1	Water Quality attainment for all designated uses and no use is threatened.	
Category 2	Water Quality attainment for some designated uses and no use is threatened; and insufficient data and information is available to determine if the remaining uses are attained or threatened.	
Category 3	Insufficient data and information are available to determine if any designated use is attained.	
Category 4	Waterway is impaired or threatened for one or more designated uses but does not require the development of a TMDL.	
	A TMDL has been completed that will result in the attainment of all applicable water quality standards.	A
	Other pollution control requirements are reasonably expected to result in the attainment of the water quality standard.	B
	Impairment is not caused by a pollutant for which a TMDL can be calculated.	C
Category 5	The Water quality standard in not attained. Waters may be listed in both 5A and 5B depending on the parameters causing the impairment.	
	The waters are impaired or threatened for one or more designated uses by a pollutant(s) and require a TMDL(s).	A
	The waterbody Assessment Unit are impaired due to the presence of mercury or PCBs, or both in the edible tissue of fish collected from them at levels exceeding Indiana's human health criteria for these contaminants. The state believes that a conventional TMDL is not the appropriate approach to address these pollutants.	B

Figure 3.2: Impaired Waters in the Upper Maumee River Watershed



3.2.2 Fish Consumption Advisory (FCA)

The Indiana Department of Environmental Management, the Indiana Department of Natural Resources and the Indiana Department of Health have worked together since 1972 on a collaborative effort to compile the Indiana Fish consumption advisory. The Ohio Department of Health works in cooperation with Ohio EPA and the Ohio Department of Natural Resources to issue sport fish consumption advisories annually. It is important to note that a fish advisory on a body of water does not necessarily mean that the water is unsafe for other recreational activities.

Carp greater than 20 inches and Walleye greater than 26 inches are on the Do Not Consume list for all counties and water bodies located within Indiana. There are FCAs for several species of fish that can be found in the UMRW. The main stem of the Maumee River has a FCA advising sensitive populations to avoid eating any fish from the river and the general population should not eat fish from the river more than once every other month. Go to the Indiana State Department of Health's website for more information on Indiana's FCA. (http://www.in.gov/isdh/23650.htm). The Ohio Fish Consumption Advisory for the UMRW has the Maumee River in Defiance and Paulding counties listed for several different species of fish as well. Go to http://www.epa.state.oh.us/dsw/fishadvisory/index.aspx, for more information. Table 3.4 lists all species of fish that are on the Indiana and Ohio's FCA for the Maumee River.

Table 3.4: Fish Consumption Advisory for the Maumee River

State	Fish Species	Size Limit	Frequency for Safe Consumption	Contaminant
Ohio	Freshwater Drum	-	1X Month	PCBs
	Smallmouth Bass	-	1X Month	PCBs
	Smallmouth Buffalo	-	1X Month	Mercury and PCBs
	Common Carp	-	1X Month	Mercury
	Flathead Catfish	-	1X Month	Mercury
Indiana	All Fish in Maumee*	-	1X Month	PCBS
	All Fish in Maumee**	-	0	PCBs
	Common Carp	>20"	1X / 2 Months	PCBs
	River Redhorse	> 14"	1X / 2 Months	PCBs
	Rock Bass	>8"	1X / 2 Months	PCBs
	Shorthead Redhorse	>16"	1X / 2 Months	PCBs
	Walleye	≤21"	1X / 2 Months	PCBs
	Walleye	>21"	0	PCBs

* Advisory for the General Population unless more restrictive advisory is listed.

**Sensitive Population which includes pregnant or nursing women, women that will become pregnant, and children under 6 years old.

3.2.3 IDEM TMDL Report Monitoring

Many waters within the Upper Maumee River Watershed have been listed as impaired by IDEM for over a decade. In 2006, IDEM wrote, and was granted approval by the US EPA, a TMDL for E. coli in the Upper Maumee River Watershed. IDEM sampled two sites in the Upper Maumee Watershed at Anthony Blvd. and Landin Rd. monthly during the recreational season between the years of 2001 and 2003 and wrote the TMDL based off of the data that was gathered during that time frame. That data was excluded from this report as there is ample data available that has been collected over the past decade which will provide a better picture of what the condition of the watershed is today.

3.2.4: City of Fort Wayne Monitoring Sites

The City of Fort Wayne measures water quality at two sites within the Upper Maumee River Watershed because the City holds an NPDES permit which permits the discharge of effluent from combined sewers to the river during wet weather events. Thirteen of Fort Wayne's CSOs are upstream of the Landin Rd. sampling site in New Haven. While New Haven does not do any water testing of their own, their CSO outfalls are upstream of the City of Fort Wayne's St. Rd. 101 sampling site. Samples are collected and analyzed once monthly by the City of Fort Wayne Utilities staff at the city's laboratory. The city provided this project with results of their water quality analysis from January 2002 through December 2012. Samples are analyzed for the following parameters which are of interest to this project; *E. coli*, dissolved oxygen, ammonia, pH, total phosphorus, total dissolved solids, total suspended solids, and temperature.

3.2.5: Allen County SWCD Sampling

The IDEM CWA§319 grant provided to the Allen County SWCD has funds in it that are specifically allocated to sampling water within the UMRW. Specifically, the SWCD was to collect samples at 11 sites located in the UMRW, all of which are located in Indiana only, weekly during the recreational season in 2012 and 2013. Due to time constraints of the UMRW project, only 2012 data has been analyzed for this project. Indiana University-Purdue University, Fort Wayne (IPFW) was contracted to collect water samples for analysis of nitrate+nitrite, phosphorus, TDS, turbidity, DO, *E. coli*, temperature, pH, alachlor, atrazine, and metolachlor. IPFW performed the analysis for *E. coli* and pesticide samples in their lab located on the IPFW campus, and used the Hydrolab MS5 to collect data for D.O., temperature, turbidity, and pH. Nitrate+nitrite was analyzed by Sherry Labs in Fort Wayne, IN and the City of Fort Wayne's water treatment facility performed the analysis for total phosphorus. SNRT, Inc. was contracted by the SWCD to collect flow rates twice during high flow, and twice during low flow, as well as to analyze macroinvertebrates and perform an aquatic habitat assessment using the volunteer monitoring protocol designated by the IN DNR Hoosier Riverwatch program once during the first year of the grant.

3.2.6 Heidelberg University Sampling

Heidelburg University in Tiffin, Ohio has been studying the transport of nutrients from Northwest Ohio cropland to Lake Erie for the past several years. Heidelberg has a set of water sampling sites they test on a regular basis within the WLEB, with one site located within the UMRW at a site known as "The Bend". This is the same site used by the OH TMDL staff; site 76. However, only data collected during the recreational season in 2010 was available at the time of writing this document. Parameters analyzed by Heidelburg at Site 76 include Chlorophyll-a, ammonia, nitrite, nitrate, DRP, and total phosphorus.

3.3 Water Quality Data per Sub-watershed

This Section discusses historic and current water quality data that has been collected within each HUC 12 sub-watershed in the Upper Maumee River Watershed to help provide a picture of the overall health of each of the sub-watersheds.

3.3.1 Trier Ditch Sub-watershed Water Quality Analysis

Water quality in the Trier Ditch sub-watershed was only analyzed by the Allen County SWCD as part of this project, so water quality data is limited within this sub-watershed. Samples were collected at one site on Trier Ditch in New Haven, IN during 2012 during the recreational season. The location of the sample site is shown in Figure 3.3. As can be seen in Table 3.5, *E. coli* exceeded the state standard of 235CFU/100ml in 59% of the samples analyzed and had an average measurement of 446 CFU/100ml. However, the geometric mean was well below the standard at 86 CFU/100ml. The geomean excludes any outliers giving a more accurate representation of the *E. coli* counts that will typically be found in the waterway. Phosphorus exceeded the target of 0.08mg/L in 46% of the samples and D.O. exceeded the target level of 9mg/L in 13% of the samples. Of significant note is that turbidity levels exceeded the target level of 10.4 NTU in 75% of the samples with an average reading twice that of the target level.

Figure 3.3: Trier Ditch Sub-watershed Water Quality Sample Sites

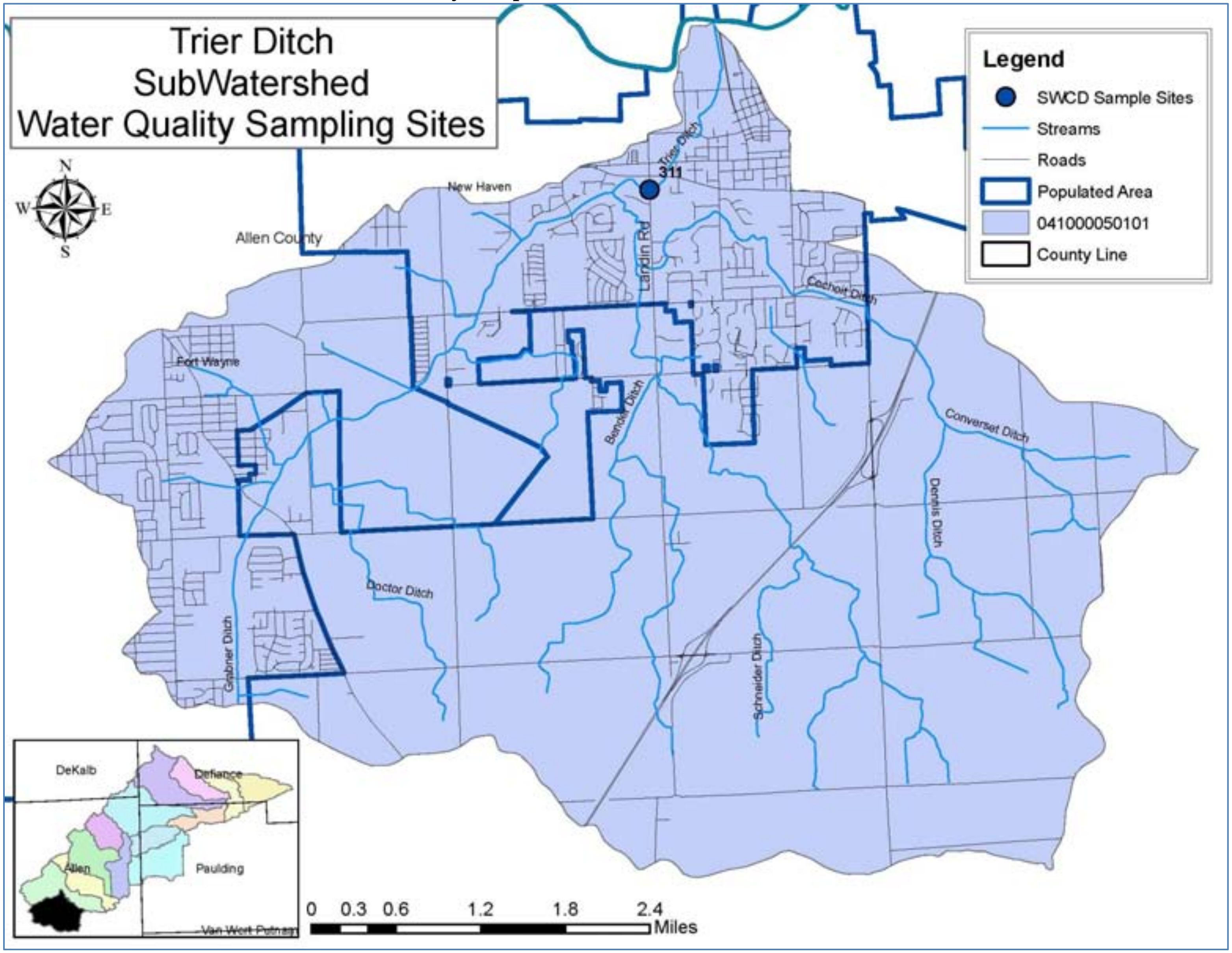


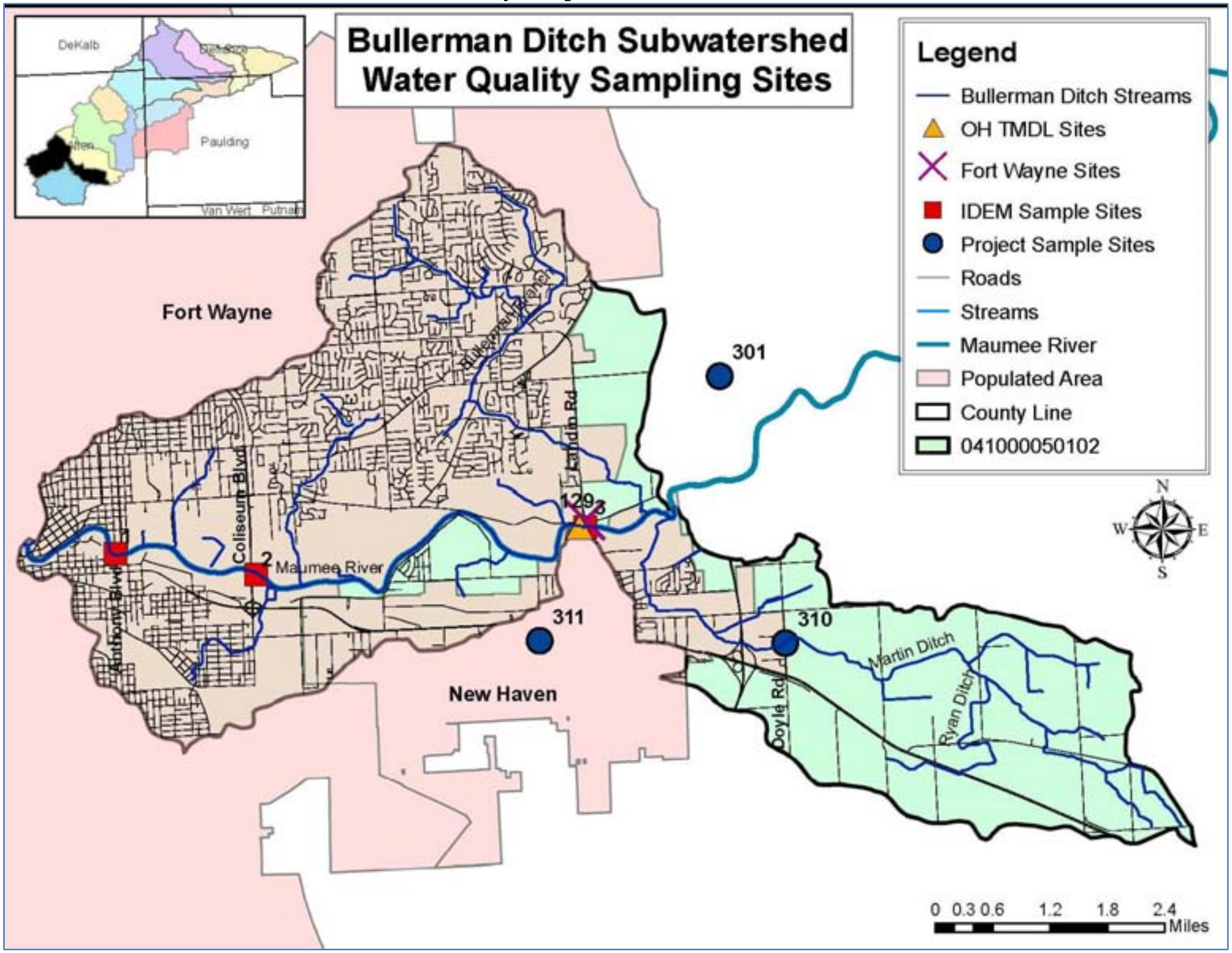
Table 3.5: 2012-Allen County SWCD Water Quality Analysis-Trier Ditch (311)

Trier Ditch (Allen County SWCD - Site 311)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
D.O.	7.18	mg/L	3/24 > 9mg/L	13%
E. coli	446 (Mean) 86 (Geomean)	CFU/100 ml	13/22 (235 CFU/100ml)	59%
Nitrate+Nitrite	0.149	mg/L	0/24	0%
pH	8.052	SU	0/24	0%
Phosphorus	0.088	mg/L	11/24	46%
Temperature	20.767	Celsius	1/24 > 29.44 ºC	4%
TDS	453.792	mg/L	0/24	0%
Turbidity	23.225	NTU	18/24	75%
Alachlor	0.061	ppb	0/23	0%
Atrazine	0.24	ppb	0/23	0%
Metolachlor	0.125	ppb	0/23	0%
Macroinvertebrates	22	points	Good	
Habitat	81	points	Good	

3.3.2: Bullerman Ditch Sub-watershed Water Quality Analysis

Bullerman Ditch sub-watershed has been sampled by IDEM, OH EPA, the City of Fort Wayne, and the Allen County SWCD. There is a sample site in Bullerman Ditch located on Landin Road which is a fixed sample site managed by IDEM which has over 100 samples and the City of Fort Wayne has over 300 samples taken from that location over the past decade. Therefore, there is ample historical data available in the Bullerman Ditch sub-watershed. Figure 3.3 shows the location of each of the sample sites from each of the entities within the Bullerman Ditch sub-watershed. Tables 3.6 through 3.11 shows the analysis of the water quality samples from each of the sites.

Figure 3.4: Bullerman Ditch Sub-watershed Water Quality Sample Sites



IDEM sampled water from the Maumee River at the Anthony Blvd bridge in Fort Wayne, IN randomly from 2003 through 2010. The results of that sampling show that D.O., nitrate+nitrites, TKN, TSS, and turbidity are all issues that can be found from the urban setting surrounding this water sample site. Table 3.6 shows the results of the analysis for IDEM sample site 1.

Table 3.6 IDEM, Site 1 Water Quality Analysis-Bullerman Ditch sub-watershed

Bullerman Ditch (IDEM-1; Lat. 41.078402, Long. -85.086747)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
Ammonia	0.202	mg/L	2/85	2%
D.O.	10.39	mg/L	57/90 >9mg/L	63%
E. coli				
Nitrate+Nitrite	2.85	mg/L	54/85	64%
TKN	1.37	mg/L	85/85	100%
pH	7.48	SU	1/90 <6 SU	1%
Phosphorus	0.20	mg/L	15/85	18%
Temperature	12.16	Celsius	27/90	30%
TDS	394	mg/L	0/85	0%
TSS	22.33	mg/L	61/85	72%
Turbidity	71.69	NTU	78/90	87%

IDEM sampled water from the Maumee River at the Coliseum Blvd bridge in Fort Wayne, IN randomly from 2003 through 2010. The results of that sampling showed that ammonia, nitrate+nitrite, E.coli, TKN, Phosphorus, TSS and turbidity are all issues in the Maumee River at that location. Table 3.7 shows the results of the analysis for the IDEM sample site 2.

Table 3.7: IDEM, Site 2 Water Quality Analysis-Bullerman Ditch sub-watershed

Bullerman Ditch (IDEM-2; Lat. 41.0761973, Long. -85.08176649)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
Ammonia	0.3	mg/L	2/3	67%
D.O.	7.63	mg/L	0/10	0%
E. coli	2890.96 (mean) 478.62 (geomean)	CFU/100ml	3/5 (235 CFU/100ml)	60%
Nitrate+Nitrite	3.37	mg/L	3/3	100%
TKN	1.85	mg/L	2/3	67%
pH	7.38	SU	0/10	0%
Phosphorus	0.31	mg/L	1/3	33%
Temperature	20.556	Celcius	0/10	0%
TDS	490	mg/L	0/3	0%
TSS	22.33	mg/L	1/3	33%
Turbidity	27.49	NTU	10/10	100%

IDEM collected water quality samples at the fixed station on the Maumee River at the Landin Rd bridge on an almost monthly basis between 2003 and 2010. As can be seen in Table 3.8, parameters of concern at this sample site are D.O. nitrate+nitrite, TKN, Phosphorus, TSS and turbidity, as all of those parameters exceeded their target levels in over 60% of the samples. Temperature exceeded the target level in 29% of the samples analyzed. Nearly all D.O. samples that exceeded 9mg/L were taken between October and March of each year.

Table 3.8: IDEM, Site 3 Water Quality Analysis-Bullerman Ditch Sub-watershed

Bullerman Ditch (IDEM Lat. 41.0819444, Long. -85.11472222)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
Ammonia	0.03	mg/L	3/121	2%
D.O.	10.23	mg/L	77/122 >9 mg/L	63%
Nitrate+Nitrite	2.69	mg/L	78/120	65%
Total Kjeldahl Nitrogen (TKN)	1.32	mg/L	119/120	99%
pH	7.78	SU	0/234	0%
Phosphorus	0.2	mg/L	83/120	69%
Temperature	12.4	Celsius	35/122 < 4.44 ºC	29%
TDS	394.79	mg/L	0/121	0%
TSS	50.34	mg/L	82/120	68%
Turbidity	77.81	NTU	111/121	93%

In preparation to write the TMDL for the Western Lake Erie Basin watersheds, the OH EPA collected samples throughout the UMRW and included the Landin Rd fixed station site to help form a baseline, since there was over a decade of other samples taken from that site. The OH EPA sampled water from the Landin Rd sample location six times between June and September 2012. As can be seen in Table 3.9, OH EPA found similar results as IDEM in that nitrate+nitrite, and TKN all exceeded target levels significantly. TSS, Phosphorus, and D.O. also exceeded target levels but to a lesser degree than the other parameters. D. O. fell below 4 mg/L once during the sample cycle, and TSS exceeded the target level of 25 mg/L in one sample.

Table 3.9: OH EPA Water Quality Analysis-Bullerman Ditch Sub-watershed

Bullerman Ditch (OH EPA - Maumee River @ New Haven IN Gage)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
Dissolved Oxygen	5.235	mg/L	1/6 under 4 mg/L	17%
Ammonia	0.145	mg/L	0/6	0%
pH	7.64	SU	0/6	0%
Phosphorus	0.193	mg/L	1/6	17%
TDS	467.667	mg/L	0/6	0%
Temperature	24.258	Celsius	0/6	0%
TSS	19.8	mg/L	1/6	17%
Nitrate + nitrite	3.72	mg/L	5/6	83%
Nitrite	0.067	mg/L	0/6	0%
TKN	1.68	mg/L	6/6	100%

The City of Fort Wayne has been collecting water quality data from the Landin Rd sample site for over a decade. They collect samples once a month during the winter, and weekly from April through October. Data the city has collected since 2002 through 2012 was analyzed for the purposes of this project. As can be seen in Table 3.10, E. coli exceeded the state standard in nearly 48% of the samples, with the geometric mean exceeding the state standard as well. Ammonia exceeded the target in 11% of the samples, temperature in 9%, phosphorus in 18%, and TSS in 68% of the samples. D.O. fell below the state standard 7/389 times and exceeded the target of 9mg/L in 156 samples, making it not meet the target level in nearly 42% of the samples. The City of Fort Wayne provided dates in which CSO events occurred for 2012. Two of the highest *E. coli* readings for the Landin Road sample site, 1553 CFU and 2420 CFU, occurred on days that there was a CSO event. There were six other dates in 2012 where E. coli levels at this sample site exceeded state standards for a single sample, and CSO events occurred within the week prior to the reading taking place during all but one sampling event, indicating that the CSOs may have a significant impact on *E. coli* levels at this sample site.

Table 3.10: City of Fort Wayne Water Quality Analysis-Bullerman Ditch Sub-watershed

Bullerman Ditch (City of Fort Wayne - Landin Rd)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
Dissolved Oxygen	8.6	mg/L	7/389 < 4 and 156/389 > 9	41.90%
E. coli	792.8 (mean) 246.4 (geomean)	CFU/100ml	187/390 (235 CFU/100ml)	47.90%
Ammonia	0.15	mg/L	46/393	11.70%
pH	7.7	SU	1/390 < 6 and 2/390 > 9	0.80%
Phosphorus	0.33	mg/L	71/392	18%
TDS	415.3	mg/L	0/393	0
Temperature	17	Celsius	18/205 < 4.4 and 1/205 > 29.44	9.3
TSS	55.1	mg/L	270/393	68.70%

The Allen County SWCD has one sample site located in the Bullerman Ditch sub-watershed on the A. Martin Drain on Doyle Rd. As can be seen in Table 3.11, phosphorus, nitrate+nitrite, turbidity, D.O. and *E. coli* are all issues at this sample site, which is predominately surrounded by agriculture, where the other sample sites within Bullerman Ditch sub-watershed are located within heavily populated areas. It should be noted that the geometric mean for *E. coli* does fall below the state standard and the macroinvertebrate score is on the low end of the "good" scale.

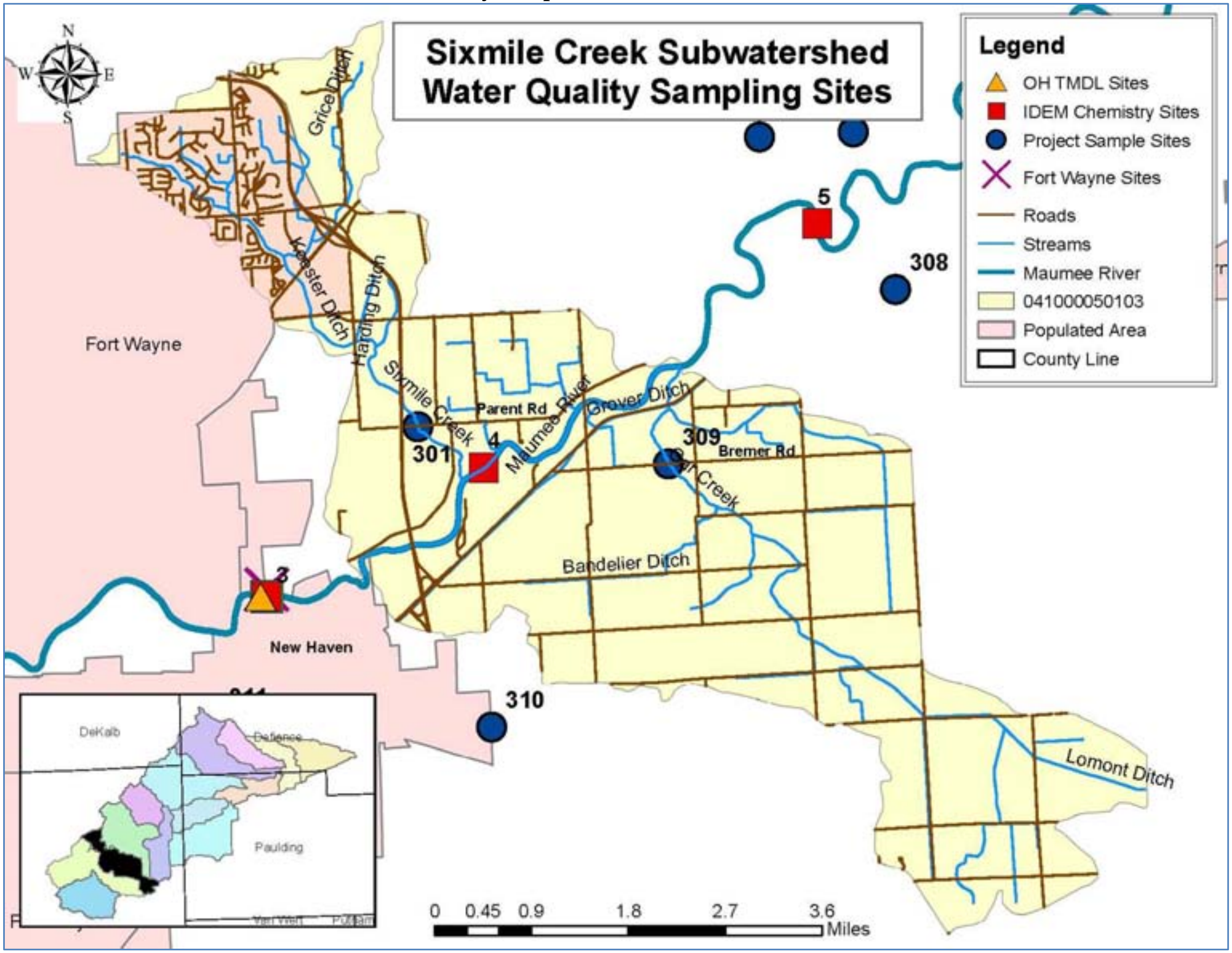
Table 3.11: 2012-Allen County SWCD Water Quality Analysis-Bullerman Ditch (310)

Bullerman Ditch (Allen County SWCD - Site 310)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
D.O.	6.923	mg/L	1/18 < 4mg/L and 3/18 > 9mg/L	22%
E. coli	313.559 (Mean) 31 (Geomean)	CFU/100 ml	7/17 (235 CFU/100ml)	41%
Nitrate+Nitrite	1.523	mg/L	4/18	22%
pH	7.813	SU	0/18	0%
Phosphorus	0.125	mg/L	11/18	61%
Temperature	18.987	Celsius	0/18	0%
TDS	488.261	mg/L	0/18	0%
Turbidity	36.106	NTU	15/18	83%
Alachlor	0.165	ppb	0/18	0%
Atrazine	0.278	ppb	0/18	0%
Metolachlor	0.347	ppb	0/18	0%
Macroinvertebrates	17	Points	Good	
Habitat	77	Points	Good	

3.3.3 Sixmile Creek Sub-watershed Water Quality Analysis

Water quality samples were taken in the Sixmile Creek sub-watershed by IDEM in 2010 at one site and by the Allen County SWCD in 2012 at two sites. It should be noted that due to the 2012 drought, samples were not able to be taken at both sites weekly due to low water levels. Due to the fact that historic samples were only taken three times during 2010, there is not a significant amount of historical data to note specific changes in water quality over the past several years. Figure 3.4 shows the location of each of the sample sites and Tables 3.12 through 3.14 show the water quality analysis of each sample site.

Figure 3.5: Sixmile Creek Sub-watershed Water Quality Sample Sites



IDEM sampled water quality at one site on the Maumee River in 2010 three times for chemistry, 10 times using the hydrolab, and five equally spaced samples were taken over a 30 day period for *E. coli*. As can be seen in Table 3.12 Phosphorus, TSS, and Turbidity exceeded the target levels in 100% of the samples. Nitrate+Nitrite and TKN readings exceeded target levels in 67% of the samples and D.O. exceeded the target level in 30% of the samples. E. coli, which was measured to determine if it met the geometric mean state standard of 125 CFU/100ml did not meet the standard and exceeded the state standard of a single sample (235 CFU/100ml) in 60% of the samples.

Table 3.12: IDEM – Site 4 Water Quality Analysis-Sixmile Creek Sub-watershed

Sixmile Creek (IDEM-4; Lat. 41.1010727, Long. -84.98127925)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
Ammonia	0.13	mg/L	0/3	0%
D.O.	7.79	mg/L	3/10 > 9 mg/L	30%
E. coli	219.54 (Mean) 175.15 (Geomean)	CFU/100 ml	3/5 (235 CFU/100ml)	60%
Nitrate+Nitrite	2.4	mg/L	2/3	67%
Total Kjeldahl Nitrogen (TKN)	0.73	mg/L	2/3	67%
pH	7.98	SU	0/10	0%
Phosphorus	0.54	mg/L	3/3	100%
Temperature	20.44	Celsius	0/10	0%
TDS	400	mg/L	0/3	0%
TSS	78.67	mg/L	3/3	100%
Turbidity	67.12	NTU	10/10	100%

The Allen County SWCD sampled water quality from the Sixmile Creek located on Parent Rd at Site 301 weekly throughout the recreational season during 2012. As can be seen in Table 3.13, D.O. did not meet the target level in 43% of the samples, with 7 samples falling below the 4 mg/L target and 2 samples falling above the 9 mg/L target. Phosphorus and turbidity exceeded target levels in more than 50% of the samples analyzed and E. coli exceeded the state standard in 30% of the samples analyzed, however the geometric mean fell well below the state standard. The macroinvertebrate score of 17 is on the low end of the “good” range.

Table 3.13: Allen County SWCD Water Quality Analysis-Sixmile Creek (301)

Sixmile Creek (Allen County SWCD - Site 301)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
D.O.	5.836	mg/L	7/21 < 4 mg/L 2/21 > 9 mg/L	43%
E. coli	149.04 (Mean) 10.133 (Geomean)	CFU/100 ml	6/20 (235 CFU/100ml)	30%
Nitrate+Nitrite	0.141	mg/L	0/21	0%
pH	7.92	SU	0/21	0%
Phosphorus	0.092	mg/L	11/21	52%
Temperature	18.83	Celsius	0/21	0%
TDS	570.35	mg/L	1/21	5%
Turbidity	26.457	NTU	16/21	67%
Alachlor	0.03	ppb	0/20	0%
Atrazine	0.109	ppb	0/20	0%
Metolachlor	0.042	ppb	0/20	0%
Macroinvertebrates	17	Points	Good	
Habitat	75	Points	Good	

The Allen County SWCD also sampled water quality weekly through the recreational season from Gar Creek at Bremer Rd at Site 309. It should be noted that due to the severe drought of 2012, only six samples were taken during the recreational season. As can be seen in Table 3.14, nitrate+nitrite and phosphorus samples exceeded the target levels 50% of the time. Turbidity exceeded the target levels in one sample and E. coli exceeded the state standard of 235 CFU/100ml in 60% of the samples (the five samples taken were not equally spaced over a 30 day period so the 235 CFU/100ml standard still holds). Finally, of significant note is that atrazine exceeded the target level in 33% of the samples. Atrazine levels measured 4.603 ppb on May 25 and 3.125 ppb on June 4, 2012.

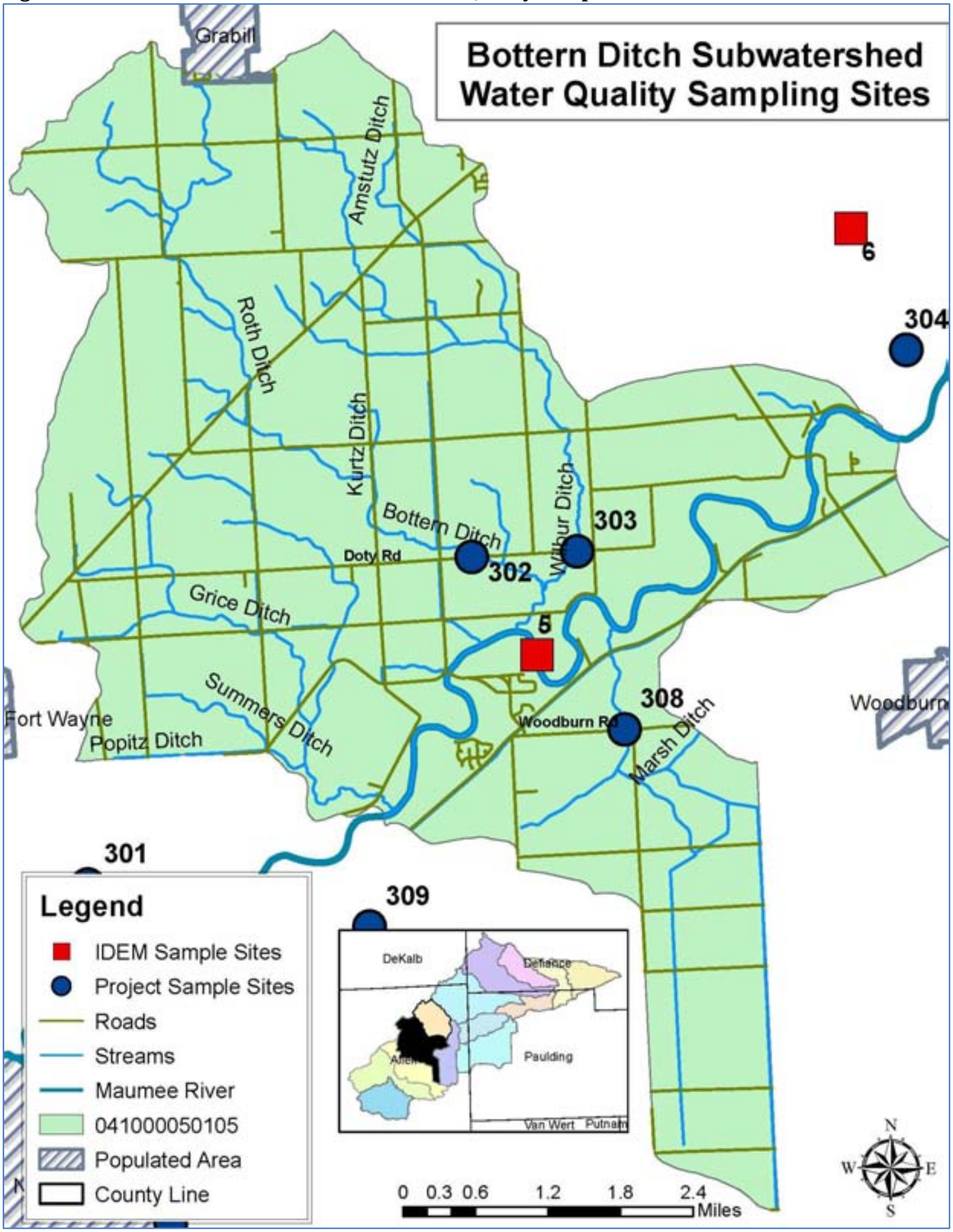
Table 3.14: Allen County SWCD Water Quality Analysis-Sixmile Creek (309)

Sixmile Creek (Allen County SWCD - Site 309)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
D.O.	6.767	mg/L	0/6	0%
E. coli	906.02(Mean)	CFU/100 ml	3/5 (235 CFU/100ml)	60%
Nitrate+Nitrite	4.173	mg/L	3/6	50%
pH	7.938	SU	0/6	0%
Phosphorus	0.174	mg/L	3/6	50%
Temperature	19.648	Celsius	0/6	0%
TDS	410.2	mg/L	0/6	0%
Turbidity	8.017	NTU	1/6	17%
Alachlor	0.11	ppb	0/6	0%
Atrazine	1.619	ppb	2/6	33%
Metolachlor	0.285	ppb	0/6	0%
Macroinvertebrates	36	Points	Excellent	
Habitat	92	Points	Good	

3.3.4 Bottern Ditch Sub-watershed Water Quality Analysis

Water quality samples were collected in the Bottern Ditch sub-watershed at one IDEM site in 2010 and at three sites by the Allen County SWCD in 2012. It should be noted that due to the drought samples were not able to be taken at both sites weekly due to low water levels. Due to the fact that historic samples were only taken three times during 2010, there is not a significant amount of historical data to note specific changes in water quality over the past several years. Figure 3.5 shows the location of each of the sample sites and Tables 3.15 through 3.18 show the water quality analysis of each sample site in the Bottern Ditch sub-watershed.

Figure 3.6: Bottern Ditch Sub-watershed Water Quality Sample Sites



IDEM sampled water quality at one site on the Maumee River in 2010 three times for chemistry, 10 times using the hydrolab, and five equally spaced samples were taken over a 30 day period for *E. coli*. As can be seen in Table 3.15 turbidity exceeded the target levels in 100% of the samples analyzed, phosphorus, TKN and TSS exceeded the target levels in two of the samples analyzed, and nitrate+nitrite exceeded the target level in one of the samples analyzed. E. coli, which was measured to determine if it met the geometric mean state standard of 125 CFU/100ml did not meet the standard and exceeded the state standard of a single sample (235 CFU/100ml) in 40% of the samples.

Table 3.15: IDEM-Site 5 Water Quality Analysis –Bottern Ditch Sub-watershed

Maumee River (IDEM-5; Lat. 41.13298835, Long. -84.92092362)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
Ammonia	0	mg/L	0/3	0%
D.O.	7.654	mg/L	4/10 > 9 mg/L	40%
E. coli	234.84 (Mean) 170.538 (Geomean)	CFU/100 ml	2/5 (235 CFU/100 ml)	40%
Nitrate+Nitrite	2.367	mg/L	1/3	33%
Total Kjeldahl Nitrogen (TKN)	0.8	mg/L	2/3	67%
pH	8.07	SU	0/10	0%
Phosphorus	0.487	mg/L	2/3	67%
Temperature	20.132	Celsius	0/10	0%
TDS	390	mg/L	0/3	0%
TSS	49.667	mg/L	2/3	67%
Turbidity	37.03	NTU	10/10	100%

The Allen County SWCD attempted to sample water quality weekly through the recreational season from Bottern Ditch at Doty Rd at Site 302. It should be noted that due to the severe drought of 2012, only four samples were taken during the recreational season. As can be seen in Table 3.16, phosphorus exceeded the target level in three of the samples analyzed and turbidity exceeded the target level in one of the samples analyzed. E. coli exceeded the state standard of 235 CFU/100ml in two samples. It should be noted that macroinvertebrates and habitat were assessed in October, 2012 and that an excellent variety of macroinvertbrates were found; representing a relatively healthy ecosystem.

Table 3.16: Allen County SWCD Water Quality Analysis – Bottern Ditch Sub-watershed – Site 302

Bottern Ditch (Allen County SWCD - Site 302)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
D.O.	5.268	mg/L	0/4	0%
E. coli	437.10 (Mean)	CFU/100 ml	2/4 (235 CFU/100ml)	50%
Nitrate+Nitrite	0.44	mg/L	0/4	0%
pH	7.92	SU	0/4	0%
Phosphorus	0.18	mg/L	3/4	75%
Temperature	20.53	Celsius	0/4	0%
TDS	532.6	mg/L	0/4	0%
Turbidity	14.65	NTU	1/4	25%
Alachlor	0.053	ppb	0/4	0%
Atrazine	0.361	ppb	0/4	0%
Metolachlor	0.149	ppb	0/4	0%
Macroinvertebrates	24	Points	Excellent	
Habitat	83	Points	Good	

The Allen County SWCD also sampled water quality in the Bottern Ditch sub-watershed from Wilbur Ditch at Doty Rd, Site 303. The Wilbur Ditch did not dry up as did Bottern Ditch so water samples were able to be collected 24 times during the recreational season of 2012. As can be seen in Table 3.17, phosphorus exceeded the target level in 96% of the samples analyzed, turbidity exceeded the target level in 79% of the samples, and D.O. did not meet the target level in 42% of the samples analyzed with 10 samples falling below the 4mg/L limit. *E. coli* exceeded the state standard of 235 CFU/100ml in 64% of the samples analyzed with the average sample measuring over 2720 CFU/100ml. Of significance is that atrazine exceeded the target level once during a drought period. However, it is also important to note that macroinvertebrate populations, as measured in October 2012, were in excellent condition and the aquatic habitat is in good condition.

Table 3.17: Allen Co. SWCD Water Quality Analysis –Bottern Ditch Sub-watershed – Site 303

Wilbur Ditch (Allen County SWCD - Site 303)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
D.O.	4.454	mg/L	10/24 < 4 mg/L	42%
E. coli	2720.059 (Mean) 226 (Geomean)	CFU/100 ml	14/22 (235 CFU/100ml)	64%
Nitrate+Nitrite	0.392	mg/L	1/24	4%
pH	7.88	SU	0/24	0%
Phosphorus	0.399	mg/L	23/24	96%
Temperature	18.768	Celsius	0/24	0%
TDS	542.29	mg/L	1/24	4%
Turbidity	29.813	NTU	19/24	79%
Alachlor	0.102	ppb	0/24	0%
Atrazine	0.54	ppb	1/24	4%
Metolachlor	0.154	ppb	0/24	0%
Macroinvertebrates	25	Points	Excellent	
Habitat	83	Points	Good	

The Allen County SWCD also sampled water quality in the Bottern Ditch sub-watershed from Grover Ditch at Woodburn Rd, Site 308. The Grover Ditch also did not dry up as did Bottern Ditch so water samples were able to be collected 24 times during the recreational season of 2012. As can be seen in Table 3.18, phosphorus exceeded the target level in 58% of the samples analyzed, turbidity exceeded the target level in 88% of the samples, and D.O. did not meet the target level in 29% of the samples analyzed with four samples falling below the 4mg/L limit and three measuring above the 9mg/L limit. E. coli exceeded the state standard of 235 CFU/100ml in 83% of the samples analyzed with the average sample measuring at 2379 CFU/100 ml. Of significance is that atrazine exceeded the target level three times during a drought period. On July 23 and 30th, and August 6 atrazine measured above the target level at 3.385 ppb, 3.086 ppb, and 3.235 ppb, respectively.

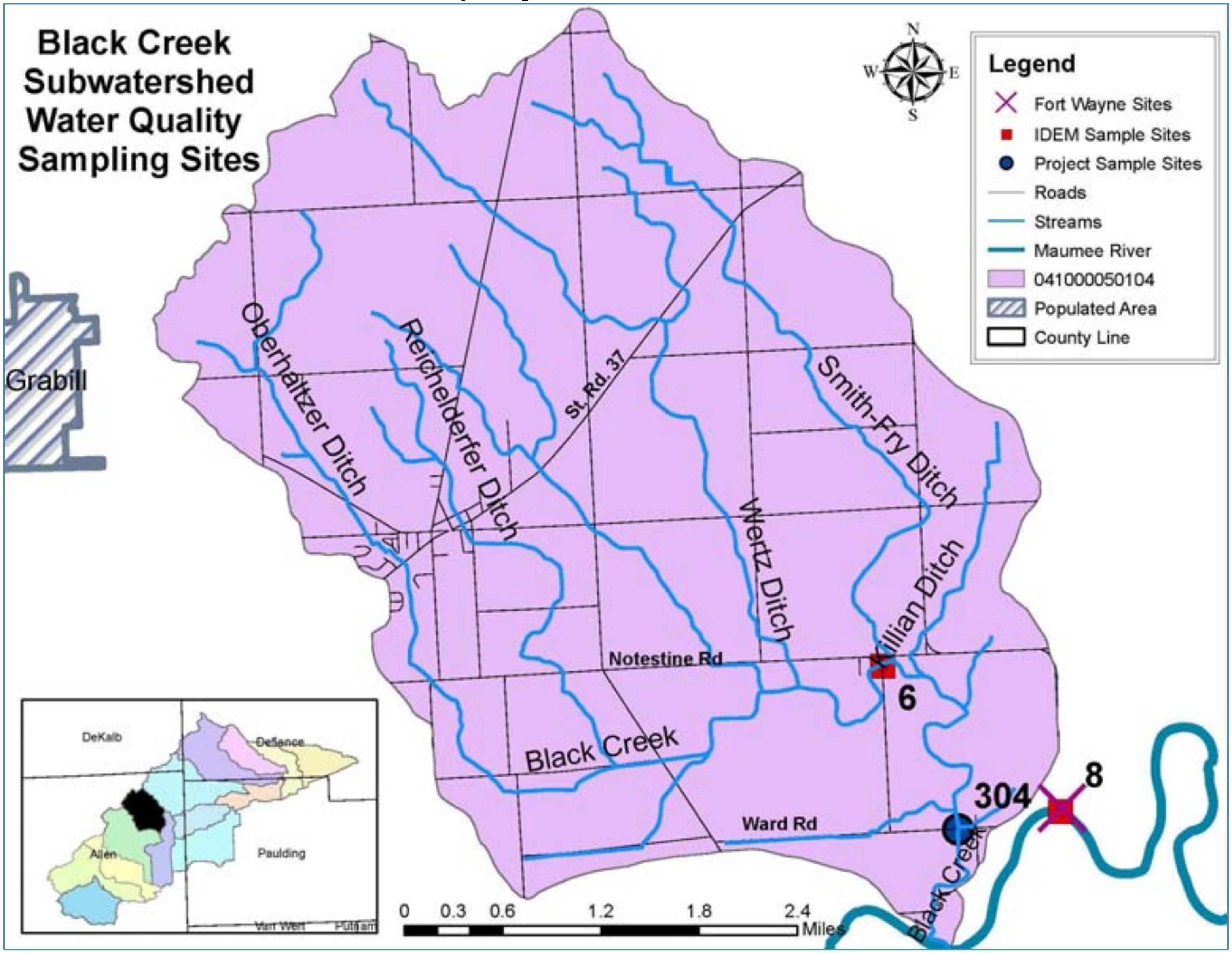
Table 3.18: Allen County SWCD Water Quality Analysis – Bottern Ditch Sub-watershed –Site 308

Grover Ditch B (Allen County SWCD - Site 308)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
D.O.	6.021	mg/L	4/24 < 4mg/L and 3/24 > 9mg/L	29%
E. coli	2379 (Mean) 514 (Geomean)	CFU/100 ml	19/23 (235 CFU/100ml)	83%
Nitrate+Nitrite	2.289	mg/L	8/24	33%
pH	7.907	SU	0/24	0%
Phosphorus	0.299	mg/L	14/24	58%
Temperature	19.078	Celsius	0/24	0%
TDS	670.654	mg/L	5/24	21%
Turbidity	28.296	NTU	21/24	88%
Alachlor	0.175	ppb	0/23	0%
Atrazine	0.91	ppb	3/23	13%
Metolachlor	0.372	ppb	0/23	0%
Macroinvertebrates	21	Points	Good	
Habitat	81	Points	Good	

3.3.5 Black Creek Sub-watershed Water Quality Analysis

Water quality samples were collected in the Black Creek sub-watershed at one site by IDEM in 2010 and at one site by the Allen County SWCD in 2012. Due to the fact that historic samples were only taken three times during 2010, there is not a significant amount of historical data to note specific changes in water quality over the past several years. Figure 3.6 shows the location of each of the sample sites and Tables 3.19 and 3.20 show the water quality analysis of each sample site in the Black Creek sub-watershed.

Figure 3.7: Black Creek Sub-watershed Water Quality Sample Sites



IDEM sampled water quality at one site on Black Creek in 2010 three times for chemistry, 10 times using the hydrolab, and five equally spaced samples were taken over a 30 day period for *E. coli*. As can be seen in Table 3.19 phosphorus exceeded the target level in one of the samples analyzed, TKN exceeded the target level in 50% of the samples, Nitrate+nitrite exceeded the target level in 67% of the samples analyzed, Ammonia exceeded the target level in one of the samples, TSS exceeded the target level in one of the samples analyzed, and turbidity exceeded the target level in 40% of the samples analyzed. *E. coli*, which was measured to determine if it met the geometric mean state standard of 125 CFU/100ml did not meet the standard as the geomean was well above the standard at 349 CFU/100ml and it exceeded the state standard of a single sample (235 CFU/100ml) in 40% of the samples.

Table 3.19 IDEM-Site 6, Water Quality Analysis -Black Creek Sub-watershed

Black Creek (IDEM Lat. 41.183025, Long. -84.869582)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
Ammonia	0.08	mg/L	1/3	33%
D.O.	5.84	mg/L	0/10	0%
E. coli	749.98 (mean) 349.62 (geomean)	CFU/100ml	2/5 (235 CFU/100ml)	40%
Nitrate+nitrite	2.7	mg/L	2/3	67%
Total Kjeldahl Nitrogen (TKN)	0.35	mg/L	1/2	50%
pH	7.82	SU	0/10	0%
Phosphorus	0.36	mg/L	1/3	33%
Temperature	19.53	Celsius	0/10	0%
TDS	405	mg/L	0/3	0%
TSS	18.33	mg/L	1/3	33%
Turbidity	27.3	NTU	4/10	40%

The Allen County SWCD sampled water quality weekly through the recreational season from Black Creek at Ward Rd at Site 304. As can be seen in Table 3.20, phosphorus exceeded the target level in 79% of the samples analyzed and turbidity exceeded the target level in 63% of the samples analyzed. D.O. did not meet the target levels in 38% of the samples analyzed with eight samples falling below the 4mg/L threshold and one sample measuring greater than the 9mg/L target. *E. coli* exceeded the state standard of 235 CFU/100ml in 74% of samples with an average measurement of 1380 CFU/100ml and the geometric mean measured at 285 CFU/100ml. It should be noted that macroinvertebrates and habitat were assessed in October, 2012 and that an excellent variety of macroinvertbrates were found, as well as a high habitat score; representing a relatively healthy ecosystem.

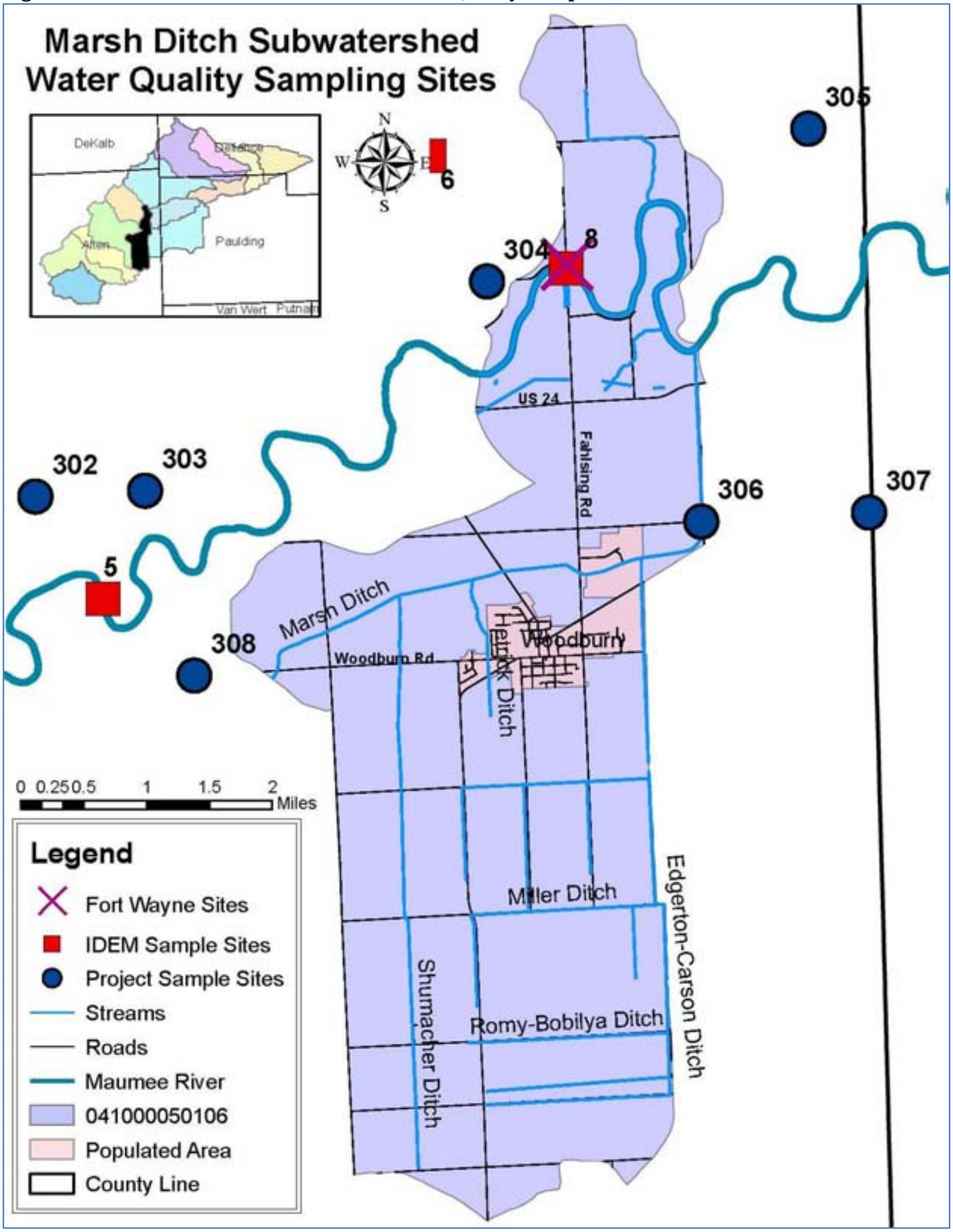
Table 3.20: Allen County SWCD Water Quality Analysis – Black Creek Sub-watershed - Site 304

Black Creek (Allen County SWCD - Site 304)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
D.O.	5.204	mg/L	8/24 < 4mg/L and 1/24 > 9mg/L	38%
E. coli	1380 (Mean) 285(Geomean)	CFU/100 ml	17/23 (235 CFU/100ml)	74%
Nitrate+Nitrite	0.419	mg/L	1/24	4%
pH	8.015	SU	0/24	0%
Phosphorus	0.24	mg/L	19/24	79%
Temperature	18.313	Celsius	0/24	0%
TDS	445.229	mg/L	0/24	0%
Turbidity	37.913	NTU	15/24	63%
Alachlor	0.152	ppb	0/24	0%
Atrazine	0.816	ppb	0/24	0%
Metolachlor	0.334	ppb	0/24	0%
Macroinvertebrates	31	Points	Excellent	
Habitat	91	Points	Good	

3.3.6 Marsh Ditch Sub-watershed Water Quality Analysis

Water quality samples were collected in the Marsh Ditch sub-watershed at one site by IDEM from 2003 through 2010, the City of Fort Wayne samples water quality at that same site and has provided to this project water quality data that has been collected from 2002 through 2012, and the Allen County SWCD collected water samples at one site in Marsh Ditch in 2012. Figure 3.7 shows the location of each of the sample sites and Tables 3.21 through 3.23 show the water quality analysis of each sample site in Marsh Ditch sub-watershed.

Figure 3.8: Marsh Ditch Sub-watershed Water Quality Sample Sites



IDEM sampled water quality at one site on the Maumee River at S.R. 101 and has supplied this project with data from 2003 through 2010. As can be seen in Table 3.21 phosphorus exceeded the target level in 18% of the samples analyzed, TKN exceeded the target level in 100% of the samples, Nitrate+nitrite exceeded the target level in 81% of the samples analyzed, TSS exceeded the target level in 64% of the samples analyzed, turbidity exceeded the target level in 91% of the samples analyzed and temperature did not meet the target level in 27% of the samples analyzed with 29 samples falling below the 4.44 degrees C threshold and 1 sample measuring above the 29.44 degrees C target. D.O. did not meet the target level in 70% of the samples analyzed with 1 sample falling below the 4 mg/L target and 77 measuring above the 9 mg/L target. It should be noted that 44% of the samples that measured above the 9mg/L target did so during the recreational season. This indicates that the majority of the exceedances were a result of the natural tendencies of D.O. in water when the temperature of the water drops. *E. coli* was not measured at this fixed station.

Table 3.21: IDEM-Site 8, Water Quality Analysis-Marsh Creek Sub-watershed

Maumee River (IDEM-8; Lat. 41.16972222, Long. -84.84916667)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
Ammonia	0.029	mg/L	3/111	3%
D.O.	10.54	mg/L	1/112 < 4 mg/l and 77/112 > 9 mg/l	70%
Nitrate+Nitrite	3.41	mg/L	89/110	81%
Total Kjeldahl Nitrogen (TKN)	1.4	mg/L	110/110	100%
pH	7.89	SU	0/216	0%
Phosphorus	0.24	mg/L	20/110	18%
Temperature	12.94	Celcius	29/112 < 4.44 ºC and 1/112 > 29.44 ºC	27%
TDS	398.6	mg/L	0/112	0%
TSS	52.13	mg/L	71/111	64%
Turbidity	102.01	NTU	99/109	91%

The City of Fort Wayne has been collecting water quality from the S.R. 101 sample site for over a decade. They collect samples once a month during the winter, and weekly from April through October. Data the city has collected since 2002 through 2012 was analyzed for the purposes of this project. As can be seen in Table 3.22, *E. coli* exceeded the state standard in nearly 40% of the samples, with the geometric mean exceeding the state standard as well. Phosphorus exceeded the target in 17% of the samples, temperature in 25%, and TSS in nearly 60% of the samples. D.O. fell below the state standard 1/120 times and exceeded the target level of 9mg/L in 80 samples, making it not meet the target in nearly 67.5% of the samples. It should be noted that of those samples that exceeded the target of 9 mg/L, 41% of the samples exceeded the target during the recreational season, indicating that the majority of the samples that exceeded did so due to the natural progression of D.O. during the colder winter months.

Table 3.22: City of Fort Wayne Water Quality Analysis-Marsh Ditch S.R. 101

Maumee River (City of Fort Wayne - State Rd 101)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
Dissolved Oxygen	10.5	mg/L	1/120 < 4 and 80/120 > 9	67.5%
E. coli	843.9 (mean) 191.5 (geomean)	CFU/100ml	47/120 (235 CFU/100ml)	39.2%
Ammonia	0.14	mg/L	3/120	2.5%
pH	7.9	SU	1/119 < 6 and 2/119 > 9	2.5%
Phosphorus	0.22	mg/L	20/120	17%
TDS	403.19	mg/L	0/121	0%
Temperature	13	Celsius	16/64 < 4.4 and 0/64 > 29.44	25%
TSS	54.1	mg/L	72/121	59.5%

The Allen County SWCD sampled water quality weekly through the recreational season from Marsh Ditch at Maumee Center Rd at Site 306. As can be seen in Table 3.23, phosphorus exceeded the target level in 67% of the samples analyzed, nitrate+nitrite exceeded the target level in 25% of the samples analyzed, and turbidity exceeded the target level in 92% of the samples analyzed. D.O. exceeded the target level of 9mg/L in 13% of the samples analyzed. *E. coli* exceeded the state standard of 235 CFU/100ml in 74% of samples with the average measurement at 580 CFU/100ml and the geometric mean measured at 346 CFU/100ml. Atrazine measured greater than the target level twice, both in May, 2012 measuring at 11.97 ppb and 25.85 ppb, respectively. It should be noted that macroinvertebrates and habitat were assessed in October, 2012 and that an excellent variety of macroinvertbrates were found, as well as a high habitat score; representing a relatively healthy ecosystem.

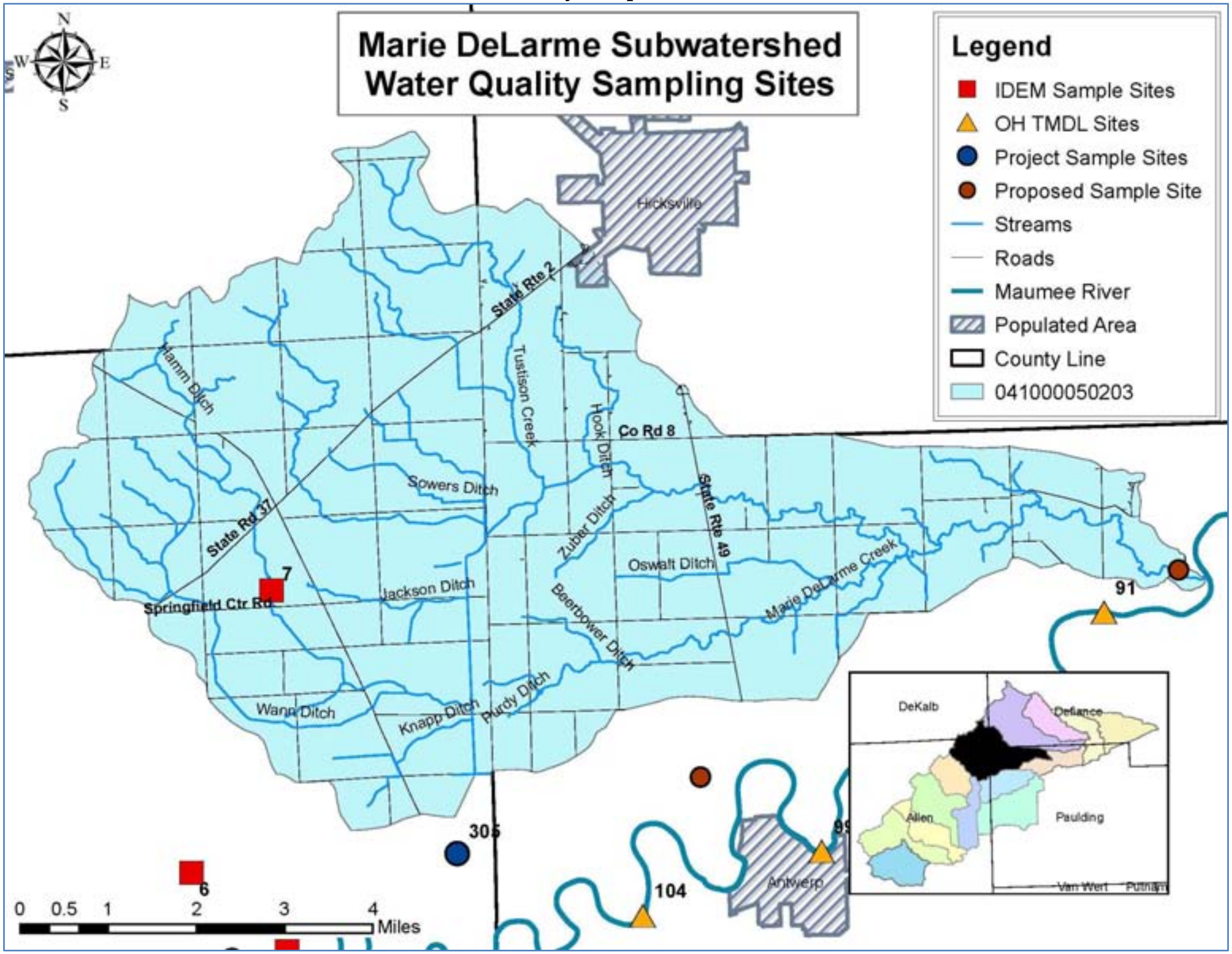
Table 3.23: Allen County SWCD Water Quality Analysis-Marsh Ditch Sub-watershed - Site 306

Marsh Ditch (Allen County SWCD - Site 306)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
D.O.	6.494	mg/L	3/24 > 9mg/L	13%
E. coli	580 (Mean) 346 (Geomean)	CFU/100 ml	17/23 (235 CFU/100ml)	74%
Nitrate+Nitrite	1.91	mg/L	6/24	25%
pH	7.948	SU	0/24	0%
Phosphorus	0.31	mg/L	16/24	67%
Temperature	19.106	Celsius	0/24	0%
TDS	614.442	mg/L	0/24	0%
Turbidity	29.704	NTU	22/24	92%
Alachlor	0.096	ppb	0/23	0%
Atrazine	2.053	ppb	2/23	9%
Metolachlor	0.307	ppb	0/23	0%
Macroinvertebrates	28	Points	Excellent	
Habitat	88	Points	Good	

3.3.7 Marie DeLarme Creek Sub-watershed Water Quality Analysis

Water quality in the Marie DeLarme Creek sub-watershed has only been analyzed by IDEM at one site in 2010. Therefore, there is limited data available to determine current water quality conditions, and later, pollutant loadings. The Defiance County SWCD is currently in the process of acquiring funding to implement a water quality testing program which will aid in determining current conditions of the water in the Marie DeLarme Creek sub-watershed. Figure 3.8 shows the location of IDEM's sample site, as well as Defiance County SWCD's proposed sample site and Table 3.24 shows the results of IDEM's sampling efforts.

Figure 3.9: Marie DeLarme Creek Sub-watershed Water Quality Sample Sites



IDEM sampled water quality at one site on the Hamm Ditch in 2010 three times for chemistry, 10 times using the hydrolab, and five equally spaced samples were taken over a 30 day period for *E. coli*. As can be seen in Table 3.24 phosphorus exceeded the target level in 67% of the samples analyzed, nitrate+nitrite exceeded the target level in one sample, and turbidity exceeded the target level in 70% of the samples analyzed. D.O. exceeded the target level of 9 mg/L in 30% of the samples analyzed and *E. coli*, which was measured to determine if it met the geometric mean state standard of 125 CFU/100ml did not meet the standard as the geomean was well above the standard at 616 CFU/100ml and it exceeded the state standard of a single sample (235 CFU/100ml) in 100% of the samples.

Table 3.24: IDEM-Site 7, Water Quality Analysis-Marie DeLarme Creek Sub-watershed

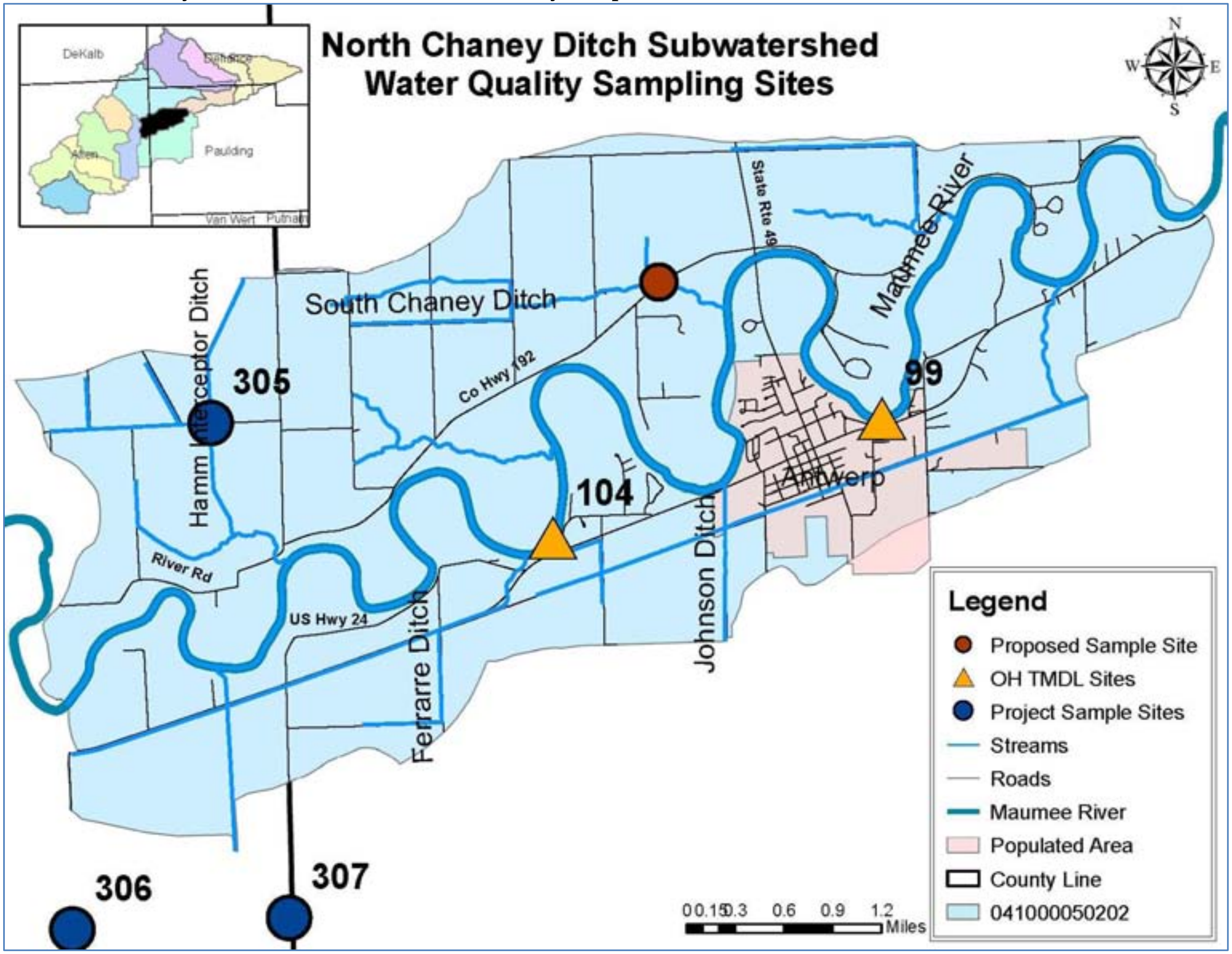
Hamm Ditch (IDEM - 7; Lat. 41.22916608, Long. -84.85066921)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
Ammonia	0	mg/L	0/3	0%
D.O.	8.031	mg/L	3/10 > 9 mg/L	30%
E. coli	853.1 (Mean) 616.17 (Geomean)	CFU/100 ml	5/5 (235 CFU/100ml)	100%
Nitrate+Nitrite	0.767	mg/L	1/3	33%
Total Kjeldahl Nitrogen (TKN)	0	mg/L	0/3	0%
pH	8.083	SU	0/10	0%
Phosphorus	0.087	mg/L	2/3	67%
Temperature	17.653	Celsius	0/10	0%
TDS	593.33	mg/L	0/3	0%
TSS	9	mg/L	0/3	0%
Turbidity	15.52	NTU	7/10	70%

The IDEM sample site only accounts for the input from a small portion of the land use in the sub-watershed. Most of the Marie DeLarme watershed that drains into Sixmile Cutoff sub-watershed will be accounted for at the OEPA TMDL sample site 85. The results at Site 85 are discussed below in Section 3.3.11.

3.3.8 North Chaney Ditch Sub-watershed Water Quality Analysis

Water quality samples were collected in the North Chaney Ditch sub-watershed at two sites by the OEPA in 2012 as part of the TMDL development process. The Allen County SWCD collected samples at one site in the North Chaney Ditch sub-watershed in 2012 as part of this project. Due to the fact that the only available data in North Chaney Ditch is from 2012, during an extreme drought period, there is limited historical data to give an entirely accurate picture of water quality in the watershed. The Defiance County SWCD has one site they propose to conduct water quality sampling efforts located in the North Chaney Ditch sub-watershed. The Defiance SWCD is in the process of acquiring funds to conduct that sampling. Figure 3.9 shows the location of each of the sample sites and Tables 3.25 through 3.27 show the water quality analysis of each sample site in the North Chaney Ditch sub-watershed.

Figure 3.10: North Chaney Ditch Sub-watershed Water Quality Sample Sites



The OEPA conducted water quality monitoring in the Upper Maumee Watershed as part of their Western Lake Erie Basin, TMDL process. They had two sample sites located on the Maumee River in the North Chaney Ditch sub-watershed that were sampled bi-weekly between June and September in 2012; Site 104 west of Antwerp and Site 99 on the east side of Antwerp. Table 3.25 shows the results of the analysis of samples taken at Site 104. As can be seen in the table TKN exceeded target levels in 100% of the samples analyzed, nitrate+nitrite exceeded the target level in 67% of the samples analyzed and TSS exceeded target levels in one of the six samples analyzed.

Table 3.25: OEPA-Site 104 Water Quality Analysis-North Chaney Ditch Sub-watershed

Maumee River (OH EPA - 104; Maumee River 1.0 Mi. W. of Antwerp @Road C-250a)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
D.O.	6.34	mg/L	0/6	0%
E. coli	104.8 (Mean)	CFU/100ml	0/5 (235 CFU/100ml)	0%
Ammonia	0.059	mg/L	0/6	0%
pH	7.963	SU	0/6	0%
Phosphorus	0.173	mg/L	0/6	0%
TDS	485	mg/L	0/6	0%
Temperature	24.087	Celsius	0/6	0%
TSS	19.667	mg/L	1/6	17%
Nitrate+Nitrite	2.392	mg/L	4/6	67%
Nitrite	0.033	mg/L	0/6	0%
TKN	1.105	mg/L	6/6	100%

Table 3.26 shows the water quality analysis from the OEPA efforts taken at Site 99. As can be seen in the Table TKN exceeded the target level in 100% of the samples, nitrate+nitrite exceeded the target level in 70% of the samples, TSS exceeded the target level in 30% of the samples, and ammonia exceeded the target level in one sample. D.O. measured greater than the target level in 25% of the samples. *E. coli* did not exceed the state standard in any of the samples taken averaging only 120 CFU/100ml, however this can be expected as the samples are taken with the larger Maumee River where the *E. coli* count can be diluted by the volume of water running through the sample site.

Table 3.26: OEPA-Site 99 Water Quality Analysis-North Chaney Ditch Sub-watershed

Maumee River (OH EPA - 99; Maumee River @ Antwerp City Park)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
D.O.	8.411	mg/L	2/8 > 9 mg/l	25%
E. coli	120.6 (Mean)	CFU/100ml	0/5 (235 CFU/100ml)	0%
Ammonia	0.149	mg/L	1/10	10%
pH	8.046	SU	0/8	0%
Phosphorus	0.14	mg/L	0/10	0%
TDS	445.8	mg/L	0/10	0%
Temperature	22.221	Celsius	0/8	0%
TSS	27.1	mg/L	3/10	30%
Nitrate+Nitrite	2.601	mg/L	7/10	70%
Nitrite	0.046	mg/L	0/10	0%
TKN	1.012	mg/L	10/10	100%

The Allen County SWCD sampled one site (Site 305) in the North Chaney Ditch sub-watershed from the Hamm Interceptor Ditch at Notestine Rd in 2012. Samples were taken weekly during the recreational season. As can be seen in Table 3.27 phosphorus exceeded the target level in 39% of the samples, turbidity exceeded target levels in 61% of the samples, and D.O. fell below the state standard of 4 mg/L in four samples. *E. coli* exceeded the state standard of 235 CFU/100ml in 21% of the samples, however the geometric mean was only 17 CFU/100ml and the average measurement of *E. coli* was 177 CFU/100ml. It should be noted that macroinvertebrate sampling showed an excellent variety of pollution sensitive species, indicating a good ecosystem.

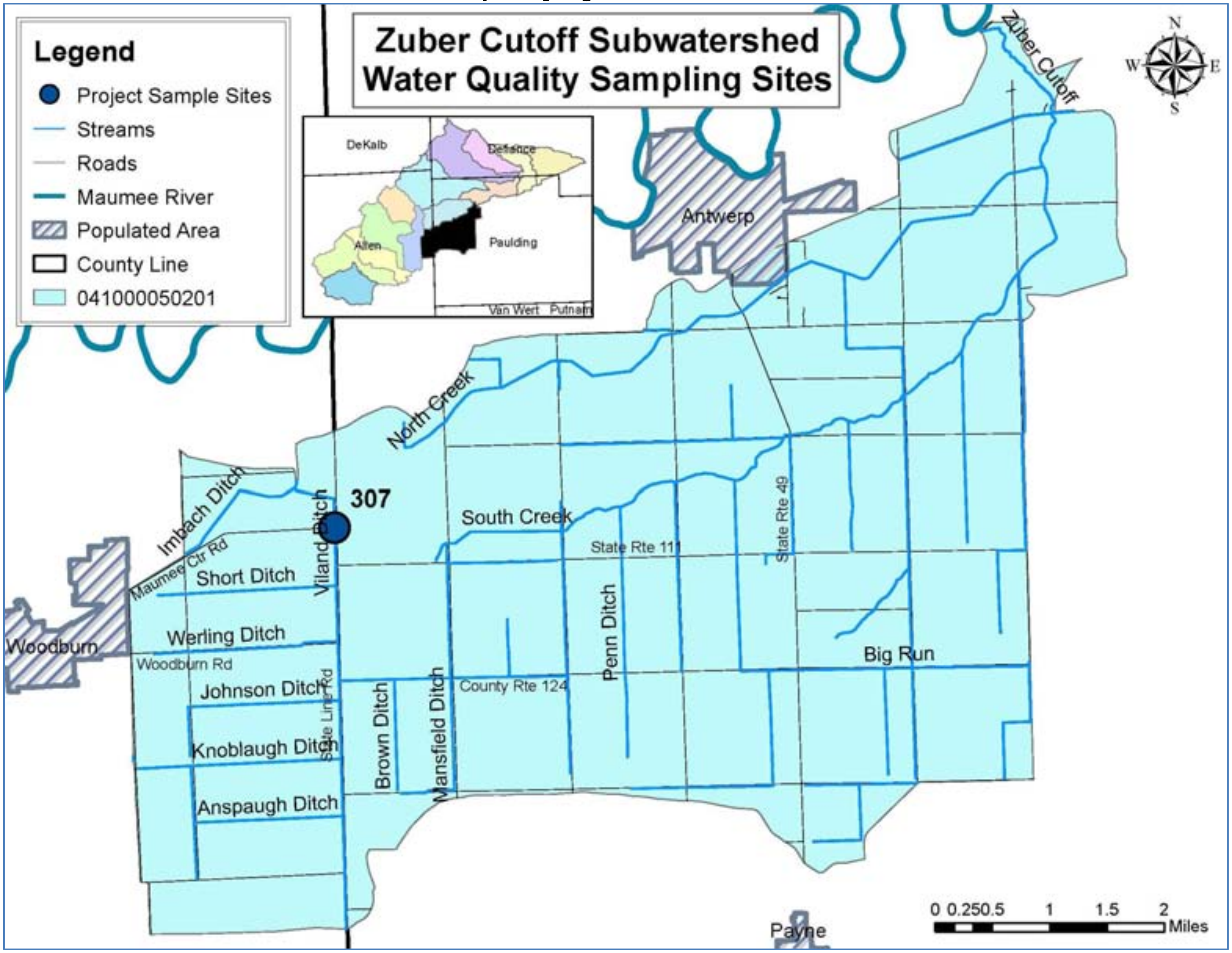
Table 3.27: Allen County SWCD Water Quality Analysis-North Chaney Ditch - Site 305

North Chaney Ditch (Allen County SWCD - Site 305)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
D.O.	5.156	mg/L	4/23 < 4mg/L	17%
E. coli	177.176(Mean) 17(Geomean)	CFU/100 ml	5/24 (235 CFU/100ml)	21%
Nitrate+Nitrite	0.33	mg/L	1/23	4%
pH	7.953	SU	0/23	0%
Phosphorus	0.092	mg/L	9/23	39%
Temperature	19.004	Celsius	0/23	0%
TDS	411.996	mg/L	0/23	0%
Turbidity	36.409	NTU	14/23	61%
Alachlor	0.068	ppb	0/22	0%
Atrazine	0.224	ppb	0/22	0%
Metolachlor	0.088	ppb	0/22	0%
Macroinvertebrates	25	Points	Excellent	
Habitat	85	Points	Good	

3.3.9 Zuber Cutoff Sub-watershed Water Quality Analysis

Water quality in the Zuber Cutoff sub-watershed was analyzed by the Allen County SWCD at one site in 2012. Due to extreme drought conditions samples were not able to be collected weekly throughout the recreational season and only seven samples total were taken. Since the only available water quality data available for the Zuber Cutoff sub-watershed was taken during drought conditions, there is little information available to determine pollution problems and accurate pollution loads to the watershed. Figure 3.10 shows the location of the water sample site in Zuber Cutoff sub-watershed.

Figure 3.11: Zuber Cutoff Sub-watershed Water Quality Sampling Sites



As mentioned earlier, there is little available water quality data in the Zuber Cutoff sub-watershed. However, the Allen SWCD did get some samples pulled from Viland Ditch at State Line Rd seven times throughout the recreational season in 2012. As can be seen in Table 3.28 turbidity exceeded target levels in 100% of the samples, phosphorus exceeded the target level in 43% of the samples, and nitrate+nitrite exceeded the target level in 29% of the samples. D.O. measured greater than 9mg/L in one sample and *E. coli* measured greater than the 235 CFU/100ml state standard in five of the six samples taken, this could be due to low water levels and a higher concentration of pollutants due to the low water levels. It is important to note that atrazine exceeded the target level once in August 2012 where it measured 4.295 ppb. Also of significance is that a low representation of pollution intolerant macroinvertebrates was found during the October 2012 inventory, indicating a less than optimal aquatic habitat. This corresponds with the habitat score within the "acceptable" range, where it would be preferred to have a habitat score in the "good" to "excellent" range.

Table 3.28: Allen County SWCD Water Quality Analysis-Zuber Cutoff Sub-watershed (Site 307)

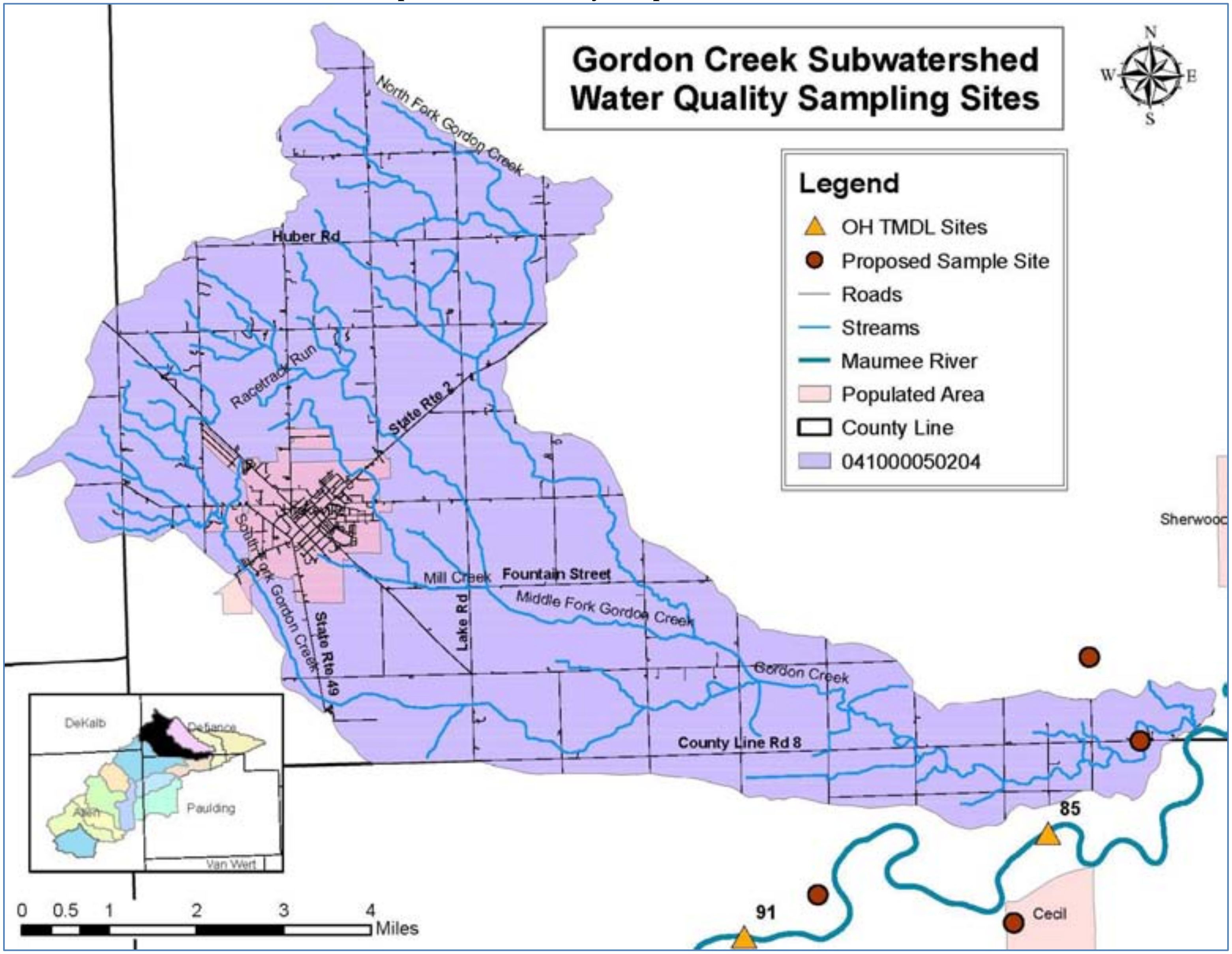
Viland Ditch (Allen County SWCD - Site 307)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
D.O.	7.337	mg/L	1/7 > 9mg/L	14%
E. coli	815 (Mean) 564.17 (Geomean)	CFU/100 ml	5/6 (235 CFU/100ml)	83%
Nitrate+Nitrite	2.807	mg/L	2/7	29%
pH	7.997	SU	0/7	0%
Phosphorus	0.089	mg/L	3/7	43%
Temperature	17.237	Celsius	0/7	0%
TDS	329.357	mg/L	0/7	0%
Turbidity	29.971	NTU	7/7	100%
Alachlor	0.357	ppb	0/7	0%
Atrazine	1.318	ppb	1/7	14%
Metolachlor	0.804	ppb	0/7	0%
Macroinvertebrates	15	Points	Fair	
Habitat	72	Points	Acceptable	

The project sample site only accounts for the input from the Indiana side of the sub-watershed. The rest of the Zuber Cutoff watershed drains into Sixmile Cutoff sub-watershed. Therefore, polluted runoff from the majority of Zuber will be accounted for at the OEPA TMDL sample site 91. The results at Site 91 are discussed below in Section 3.3.11.

3.3.10 Gordon Creek Sub-watershed Water Quality Analysis

There are no current or historic sampling efforts in the Gordon Creek sub-watershed. The Defiance County SWCD has a proposed site they would like to sample once funding is acquired. If sampling is able to be conducted in Gordon Creek it will help to identify pollutant loads into the Gordon Creek sub-watershed and validate findings of this watershed management plan. Figure 3.11 is a map showing the proposed location of the Defiance County SWCD sample site.

Figure 3.12: Gordon Creek Sub-watershed Proposed Water Quality Sample Site



While Gordon Creek does not have any sample sites located within its boundaries, sample site 79, located within Sulphur Creek sub-watershed can help provide information regarding what type of polluted runoff may be coming from Gordon Creek. Sample site 79 will be discussed in Section 3.3.13.

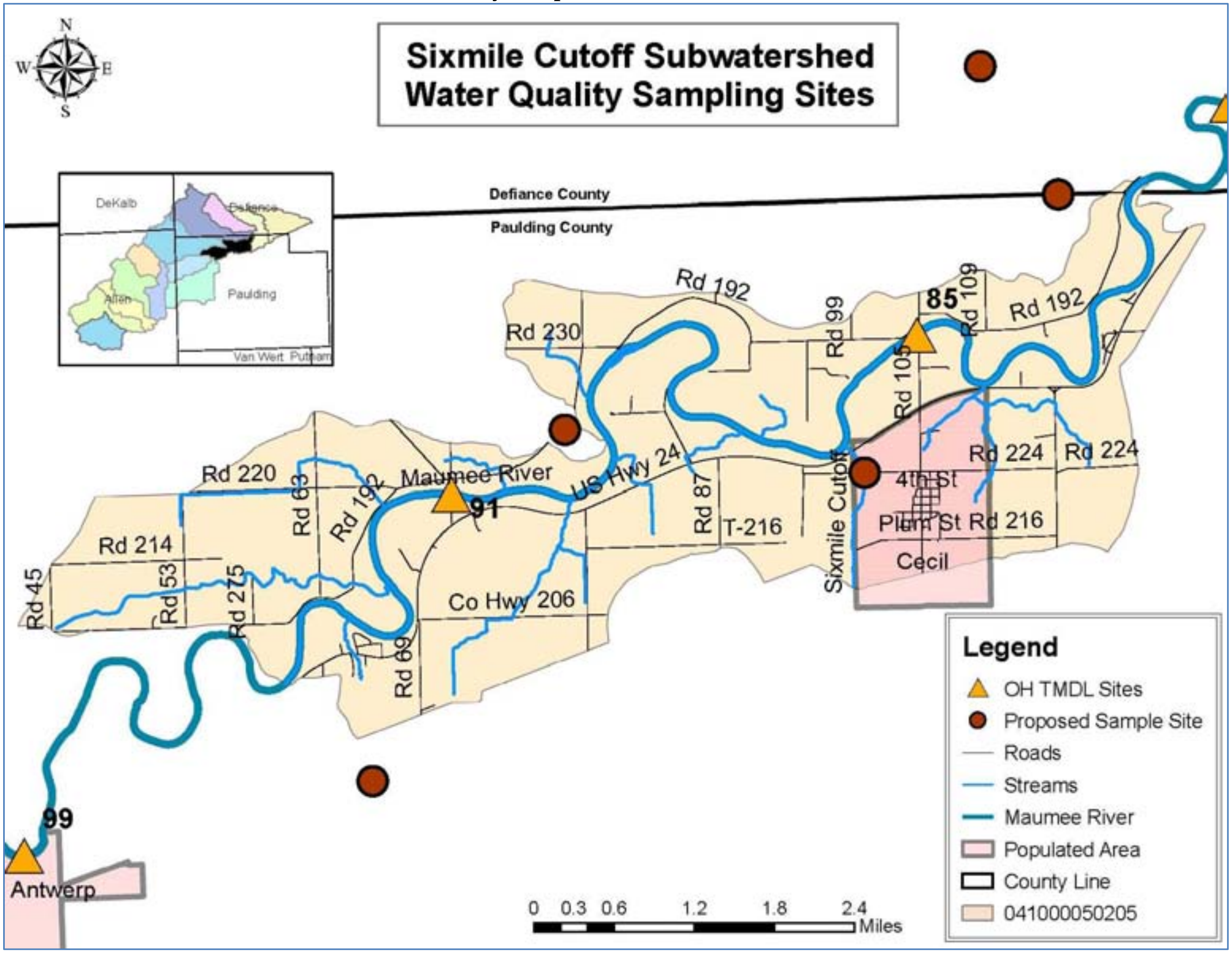
3.3.11 Sixmile Cutoff Sub-watershed Water Quality Analysis

Water quality was analyzed in 2012 by the OEPA in their efforts to acquire information for a TMDL for the WLEB at two sites; site 91 and site 85, both on the Maumee River mainstem. The Defiance County SWCD has one site chosen to conduct water quality sampling should they acquire funds to do so. Due to the lack of historic water quality data, and samples being taken during an extreme drought season, a representative sample of water quality in the Sixmile Cutoff sub-watershed cannot be presented. However, an analysis of available data was performed and will be used as a baseline of water quality in the sub-watershed at this time. Figure 3.12 shows the location of the sample sites in the Sixmile Cutoff sub-watershed and Tables 3.29 and 3.30 show the analysis of the OEPA water quality data.

The OEPA site 91 is located approximately one river mile downstream from the confluence of Zuber Cutoff and the Maumee River in Sixmile Cutoff. Site 91 will provide information to help us extrapolate the amount and type of polluted runoff that is entering the Maumee River from Zuber Cutoff sub-watershed, as well as the east portion of Gordon Creek sub-watershed.

The OEPA site 85 is located approximately three river miles downstream from the confluence of Marie DeLarme and the Maumee River in Sixmile Cutoff sub-watershed. Site 85 will provide information to help us extrapolate the amount and type of polluted runoff that is entering the Maumee River from Marie DeLarme sub-watershed.

Figure 3.13: Sixmile Cutoff Sub-watershed Water Quality Sample Sites



The OEPA conducted water quality monitoring in the Upper Maumee Watershed as part of their WLEB TMDL process. They had two sample sites located on the Maumee River in the Sixmile Cutoff sub-watershed that were sampled bi-weekly between June and September in 2012; Site 91 west of Cecil and Site 85 directly north of Cecil. Table 3.29 shows the results of the analysis of samples taken at Site 91. As can be seen in the table TKN exceeded target levels in 100% of the samples analyzed, and nitrate+nitrite exceeded the target level in 67% of the samples analyzed.

Table 3.29: OEPA-Site 91 Water Quality Analysis Sixmile Cutoff Sub-watershed

Sixmile Cutoff (OH EPA - 91; Maumee River @ Eater Rd. / County Road 73)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
Dissolved Oxygen	6.648	mg/L	0/6	0%
E. coli	89.4 (Mean)	CFU/100ml	0/5	0%
Ammonia	0.097	mg/L	0/6	0%
pH	8.065	SU	0/6	0%
Phosphorus	0.153	mg/L	06	0%
TDS	458.5	mg/L	0/6	0%
Temperature	24.48	Celsius	0/6	0%
TSS	14.667	mg/L	0/6	0%
Nitrate+Nitrite	2.83	mg/L	4/6	67%
Nitrite	0.027	mg/L	0/6	0%
TKN	0.99	mg/L	6/6	100%

The results from samples taken by OEPA from Site 85, north of Cecil are shown in Table 3.30. As can be seen below, TKN exceeded the target levels in 100% of the samples, nitrate+nitrite exceeded the target level in 83% of the samples, and *E. coli* exceeded the state standard of 235 CFU/100ml in 40% of the samples. It should be noted that *E. coli* was measured monthly during the recreational season.

Table 3.30: OEPA-Site 85 Water Quality Analysis Sixmile Cutoff Sub-watershed

Sixmile Cutoff (OH EPA - 85; Maumee River @ County Road 105)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
Dissolved Oxygen	6.108	mg/L	0/6	0%
E. coli	186.6 (Mean)	CFU/100ml	2/5 (235CFU/100ml)	40%
Ammonia	0.129	mg/L	0/6	0%
pH	8.022	SU	0/6	0%
Phosphorus	0.137	mg/L	0/6	0%
TDS	467	mg/L	0/6	0%
Temperature	24.428	Celsius	0/6	0%
TSS	12.667	mg/L	0/6	0%
Nitrate+Nitrite	2.992	mg/L	5/6	83%
Nitrite	0.031	mg/L	0/6	0%
TKN	1.078	mg/L	6/6	100%

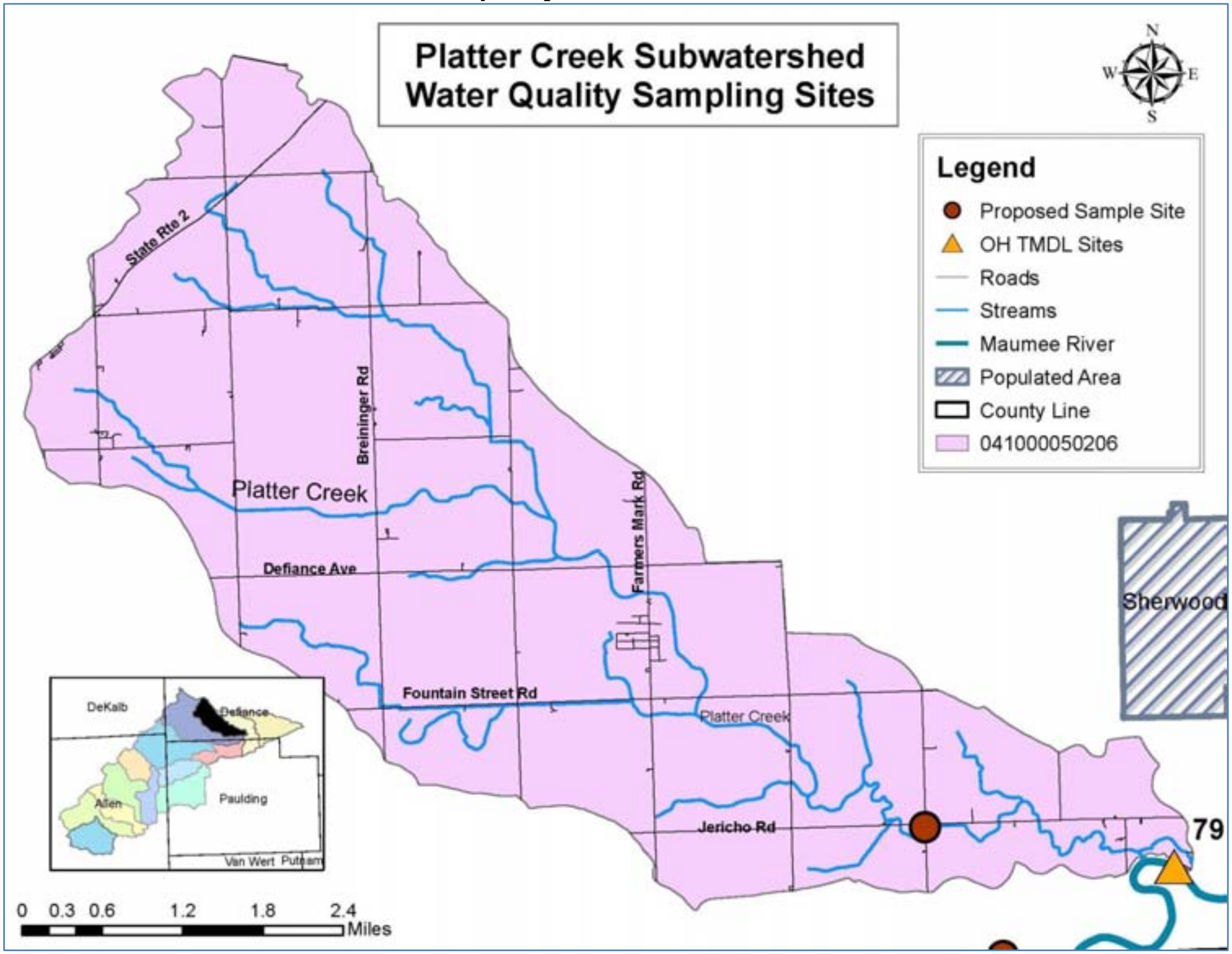
3.3.12 Platter Creek Sub-watershed Water Quality Analysis

There are no current or historic sampling efforts in the Platter Creek sub-watershed. The Defiance County SWCD has a proposed site they would like to sample once funding is acquired. While there are no sampling efforts that have taken place within Platter Creek to date, OEPA's TMDL sample site 79, located in the Sulphur Creek sub-watershed, is located just downstream from the confluence of Platter Creek and the Maumee River. Therefore, site 79 provides a more representative sample for Platter Creek than for Sulphur Creek.

If the Defiance SWCD's sampling is able to be conducted in Gordon Creek it will help to identify pollutant loads into the Gordon Creek sub-watershed and further validate findings of this watershed management plan. Figure 3.11 is a map showing the proposed location of the Defiance County SWCD sample site.

While Platter Creek does not have any sample sites located within its boundaries, sample site 79, located within Sulphur Creek sub-watershed can help provide information regarding what type of polluted runoff may be coming from Platter Creek. It should be noted that Sample site 79 will provide a measurement of polluted runoff from the east side of North Chaney Ditch, Gordon Creek and Platter Creek. Sample site 79 will be discussed in Section 3.3.13.

Figure 3.14: Platter Creek Sub-watershed Water Quality Sample Sites

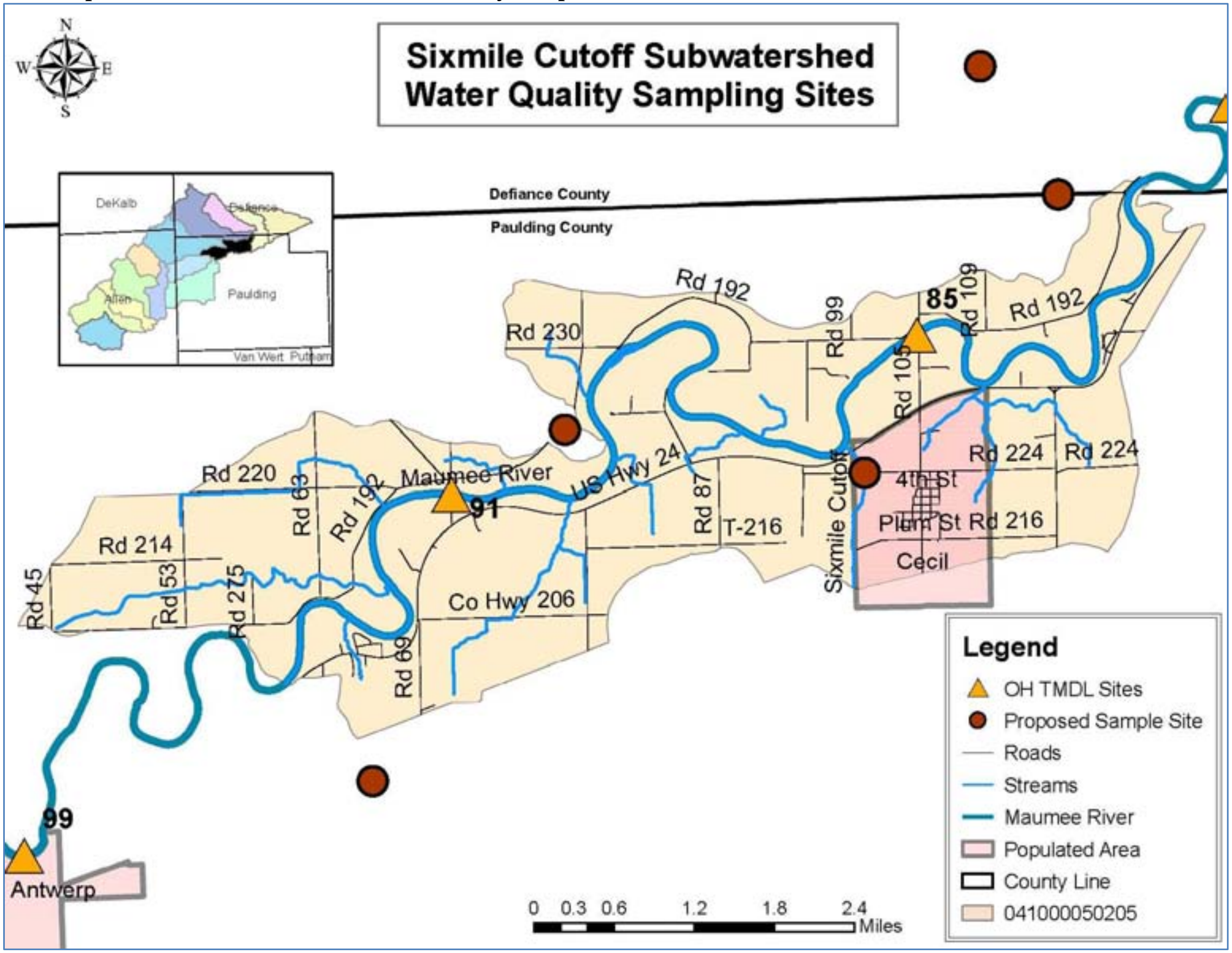


3.3.13 Sulphur Creek Sub-watershed Water Quality Analysis

Water quality was analyzed in 2012 by the OEPA in their efforts to acquire information for a TMDL for the WLEB at one site; site 79, on the Maumee River mainstem, located in the Sulphur Creek Sub-watershed. However, as described in Section 3.3.12, that sample site provides a more representative sample of the pollutant load from Gordon and Platter Creek Sub-watersheds. It should be noted that sample site 76 is located approximately one river mile downstream from the confluence of the Sulphur Creek sub-watershed to Snooks Run. Therefore, the data from site 76, located in Snooks Run sub-watershed is more representative of what the land uses from Sulphur Creek are contributing to the river. Site 76 will be discussed in the following Section.

The Defiance County SWCD has one site chosen to conduct water quality sampling should they acquire funds to do so. Due to the lack of historic water quality data, and samples being taken during an extreme drought season, a representative sample of water quality in the Sulphur Creek sub-watershed cannot be presented from the OEPA sample site 79. However, an analysis of available data was performed and will be used as a baseline of water quality from land uses in Gordon Creek and Platter Creek sub-watersheds at this time. Figure 3.14 shows the location of the sample sites in the Sulphur Creek sub-watershed and Table 3.31 shows the analysis of the OEPA water quality data.

Figure 3.15: Sulphur Creek Sub-watershed Water Quality Sample Sites



The OEPA collected water quality samples in the Sulphur Creek Sub-watershed just below the confluence of Gordon and Platter Creeks in the Maumee River biweekly (except for *E. coli* samples which were collected monthly between Jun. and Sept. 2012). Table 3.31 shows that *E. coli* exceeded the state standard of 235 CFU/100ml once, however the average fell well below the standard, TKN exceeded the target level in 100% of the samples analyzed, nitrate+nitrites exceeded the target level in 83%, and TSS exceeded the target in 33% of the samples analyzed.

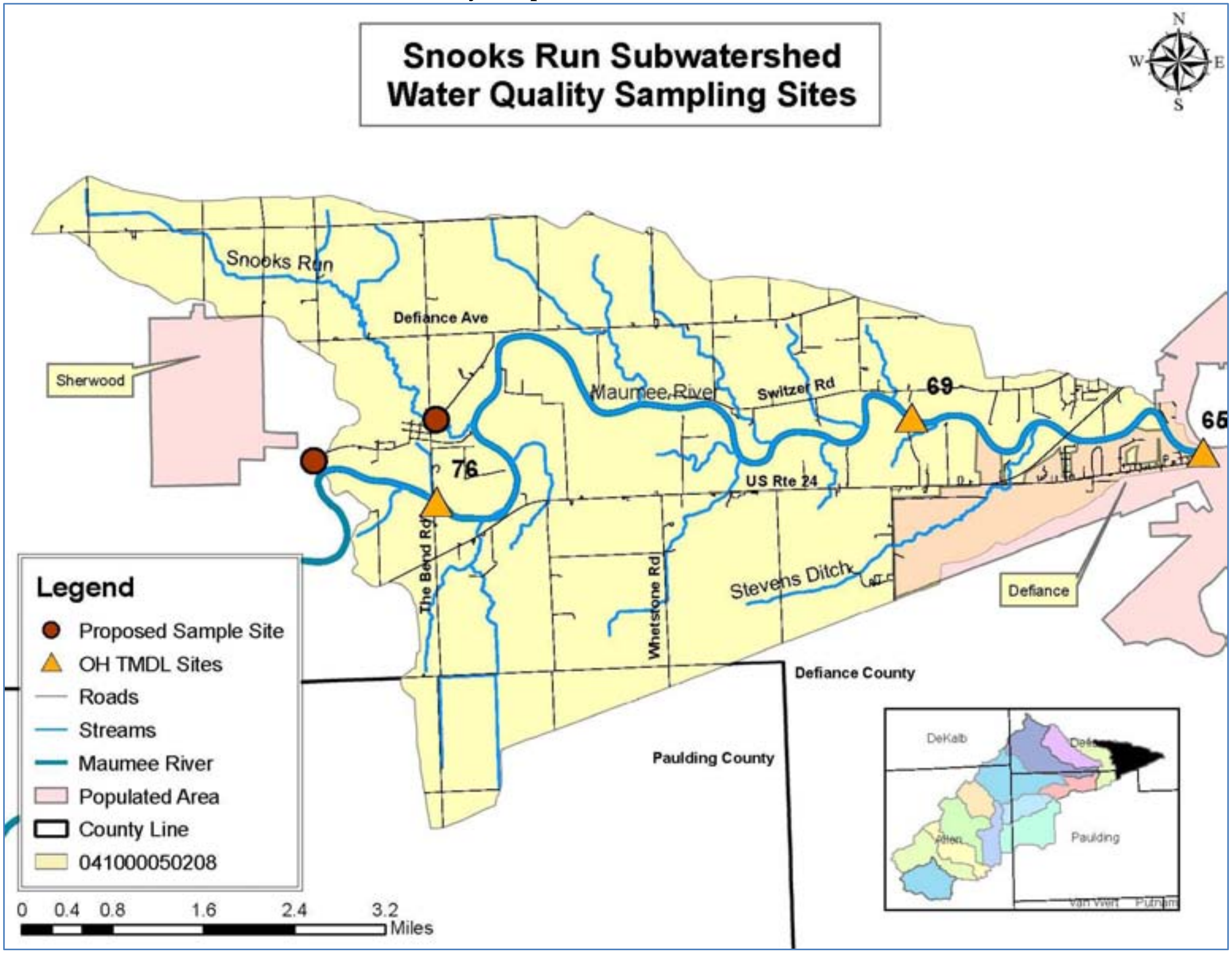
Table 3.31: OEPA-Site 79 Water Quality Analysis Gordon, Platter, Sulphur Creek Sub-watersheds

Maumee River (OH EPA Maumee River @ State Route 127)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
D.O.	7.508	mg/L	0/6	0%
E. coli	106 (Mean)	CFU/100ml	1/5 (235 CFU/100 ml)	20%
Ammonia	0.074	mg/L	0/6	0%
pH	8.257	SU	0/6	0%
Phosphorus	0.135	mg/L	0/6	0%
TDS	467	mg/L	0/6	0%
Temperature	25.115	Celsius	0/6	0%
TSS	23.167	mg/L	2/6	33%
Nitrate+Nitrite	3.176	mg/L	5/6	83%
Nitrite	0.031	mg/L	0/6	0%
TKN	1.075	mg/L	6/6	100%

3.3.14 Snooks Run Sub-watershed Water Quality Analysis

Snooks Run Sub-watershed is the farthest downstream sub-watershed located in the Upper Maumee River Watershed. About 15-20% of the city of Defiance is located within the sub-watershed and the Defiance Water Treatment Plant intake is located within the sub-watershed. The OEPA conducted water quality analysis at three sites in the Snooks Run Sub-watershed; Sites 76, 69, and 65 which is at the Defiance Water Treatment Plant, during the summer of 2012. The Defiance County SWCD has identified a site that they propose to be a water quality sample site and are in the process of acquiring funds to begin the sampling efforts. Due to the lack of historic water quality data, and samples being taken during an extreme drought season, a representative sample of water quality in the Snooks Run sub-watershed cannot be presented. However, an analysis of available data was performed and will be used as a baseline of water quality in the sub-watershed at this time. Figure 3.15 shows the location of the sample sites in the Snooks Run sub-watershed and Tables 3.32 and 3.33 show the analysis of the OEPA water quality data.

Figure 3.16: Snooks Run Sub-watershed Water Quality Sample Sites



The OEPA conducted water quality analysis at Site 76 monthly between March and June, and September and November, and biweekly between June and September, except for *E. coli* which was sampled monthly between June and September. As can be seen in Table 3.32 D.O. exceeded the target level in one of eight samples analyzed, Nitrate+Nitrite exceeded the target level in 50%, TKN exceeded the target levels in 100% of samples analyzed, and TSS exceeded the target level in 90% of the samples analyzed. *E. coli* did not meet the state standard of 235 CFU/100ml in two of the five samples analyzed with the average measuring at 208 CFU/100ml.

Table 3.32: OEPA – Site 76 Water Quality Analysis for Sulphur Creek/Snooks Run Sub-watersheds

Snooks Run (OH EPA - 76; Maumee River @ The Bend Rd.)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
D.O.	8.123	mg/L	1/8 > 9 mg/l	13%
E. coli	208.4 (Mean)	CFU/100ml	2/5 (235 CFU/100ml)	40%
Ammonia	<.05	mg/L	0/10	0%
pH	8.255	SU	0/8	0%
Phosphorus	0.117	mg/L	0/10	0%
TDS	442.4	mg/L	0/10	0%
Temperature	22.883	Celsius	0/8	0%
TSS	37.6	mg/L	9/10	90%
Nitrate+Nitrite	2.723	mg/L	5/10	50%
Nitrite	0.04	mg/L	0/10	0%
TKN	1.018	mg/L	10/10	100%

Heidelberg University conducted water quality analysis in Snooks Run at the Site known as "The Bend" (OH EPA Site 76) monthly in 2010 from March through November. As can be seen in Table 3.33 all parameters fell within target levels, however, chlorophyll–a, which is used as an indicator to determine the amount of nutrients in the water effecting algal growth, measured high on three instances; one in July, August, and September.

Table 3.33 – "The Bend" – Heidelberg University Water Quality Analysis

Snooks Run (Heidelberg University; Maumee River @ The Bend Rd.)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
Chl - a	19.04	µg/L	3/8 > 10 µg/L	38%
DRP	< 0.01	µg/L	0/9	0%
Nitrate	1.85	mg/L	0/9	0%
Nitrite	0.009	mg/L	0/9	0%

The OEPA sampled water quality from site 69 biweekly between June and September, except for *E. coli* measurements which were taken monthly between June and September. As can be seen in Table 3.34 D.O. exceeded the target level in 33% of the samples analyzed, nitrate+nitrites exceeded the target level in 67% and TKN exceeded the target level in 100% of the samples analyzed. TSS exceeded the target level in 50% of the samples analyzed and *E. coli* never exceeded the state standard with the average measurement being less than 100 CFU/100ml.

Table 3.34: OEPA – Site 69 Water Quality Analysis Snooks Run Sub-watershed

Snooks Run (OH EPA - 69; Maumee River @ Intersection of Switzer Rd. and Dowe Rd)				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
D.O.	7.78	mg/L	2/6 > 9 mg/l	33%
E. coli	98.8 (Mean)	CFU/100ml	0/5 (235 CFU/100 ml)	0%
Ammonia	0.08	mg/L	0/6	0%
pH	8.32	SU	0/6	0%
Phosphorus	0.12	mg/L	0/6	0%
TDS	461	mg/L	0/6	0%
Temperature	25.66	Celsius	0/6	0%
TSS	35.33	mg/L	3/6	50%
Nitrate+Nitrite	3.4	mg/L	4/6	67%
Nitrite	0.05	mg/L	0/6	0%
TKN	0.99	mg/L	6/6	100%

The final sample site located within the Upper Maumee River Watershed is located at the Defiance WTP. The OEPA measured only the key parameters of concern for drinking water at the WTP intake site 65, with the exception of *E. coli* which was not measured. As can be seen in Table 3.35, ammonia exceeded the target level in 20% of five samples, and nitrate+nitrite exceeded the target level in 67% samples analyzed.

Table 3.35: OEPA – Site 65 Water Quality Analysis Snooks Run Sub-watershed

Site Location: OH EPA - 65; Maumee River @ Defiance WTP				
Parameter	**Mean**	**Unit**	**# of Times Does Not Meet Target**	**% Does not Meet Target**
Ammonia	0.61	mg/L	1/5	20%
Nitrate+Nitrite	4.94	mg/L	3/5	67%
Phosphorus	0.11	mg/L	0/5	0%

3.3.15 Summary of Water Quality Data

As can be gleaned from the sections above and Table 3.35 below, the major water quality problems observed throughout the watershed are from nitrogen, phosphorus, *E. coli* and sediment and/or turbidity. All of these pollutants can discharge from faulty septic systems, barnyard or animal feeding operation runoff, improper application of manure on crop land, conventional tillage on HEL and PHEL farmland, as well as from urban runoff from lawn fertilizer, excess stormwater and CSO events. However, high nutrient, and turbidity levels can also come directly from row crop fields either through surface runoff or tile discharge. High nutrient and turbidity levels may also be the cause of inadequate dissolved oxygen levels found throughout the project area at various times throughout the year. Atrazine also had very few exceedences of the EPA recommended MCLs after spring application, however atrazine is a minimal problem in comparison to *E. coli*, nutrients, and turbidity. Though, it should be noted that many best management practices that should be implemented to minimize the impact on water quality from nutrients and turbidity will also minimize the impact from herbicides and pesticides. Also of particular note are the low mIBI scores in Trier Ditch, Bullerman Ditch, and Zuber Cutoff sub-watersheds. Sources of pollutants will be easier to identify after combining the water quality analysis results with land use data.

Table 3.36 shows the average of all water quality data collected since 2003 per parameter per drainage area. Those values that are highlighted in pink exceed the target levels set by this project for that parameter.

Table 3.36: Summary of Water Quality Data (analysis and percent exceedance) per Parameter per Drainage Area

Para-meter	Trier Ditch	Buller-man Ditch	Six-mile Creek	Bottern Ditch	Black Creek	Marsh Ditch	Marie De-Larme Creek	Marie DeLarme and East Sixmile Cutoff Site 85	North Chaney Ditch	West Zuber Cutoff	Zuber Cutoff and West Sixmile Cutoff Site 91	Gordon Creek and Platter Creek Site 79	Sulphur Creek and West Snooks Run (site 76)	Snooks Run (Site 69)
Alachlor (ppb)	0.061 0%	0.165 0%	0.07 0%	0.11 0%	0.152 0%	0.096 0%	*	*	0.068 0%	0.357 0%	*	*	*	*
Atrazine (ppb)	0.24 0%	0.278 0%	0.864 8%	0.604 4%	0.816 0%	2.053 9%	*	*	0.224 0%	1.32 14%	*	*	*	*
Metol-achlor (ppb)	0.125 0%	0.347 0%	0.164 0%	0.225 0%	0.334 0%	0.307 0%	*	*	0.088 0%	0.804 0%	*	*	*	*
D.O. (mg/L)	7.18 13%	7.6 44%	6.798 32%	5.849 37%	5.522 26%	9.178 56%	8.031 30%	6.108 0%	6.636 16%	7.34 0%	6.648 0%	7.508 0%	8.123 13%	7.78 33%
E. coli (CFU/ 100ml)	446 59%	1012 47%	424.9 40%	1442.88 58%	1065 68%	712 45%	853.1 100%	186.6 40%	134.19 15%	815 83%	89.4 0%	106 20%	208.4 40%	98.8 0%
Nitrogen, Ammonia (mg/L)	*	0.14 10%	0.13 0%	0	0.08 33%	0.085 3%	0	0.129 0%	0.104 6%	*	0.097 0%	0.074 0%	<0.05 0%	0.08 0%
Nitrate+ Nitrite (mg/L)	0.149 0%	2.78 62%	2.238 17%	1.372 6%	1.56 11%	2.66 71%	0.767 33%	2.992 83%	1.774 31%	2.807 29%	2.836 67%	3.176 83%	2.723 50%	3.4 67%
Nitrite (mg/L)	*	0.07 0%	*	*	*	*	*	0.031 0%	0.04 0%	*	0.027 0%	0.031 0%	0.04 0%	0.05 0%

Para-meter	Trier Ditch	Buller-man Ditch	Six-mile Creek	Bottern Ditch	Black Creek	Marsh Ditch	Marie De-Larme Creek	Marie DeLarme and East Sixmile Cutoff Site 85	North Chaney Ditch	West Zuber Cutoff	Zuber Cutoff and West Sixmile Cutoff Site 91	Gordon Creek and Platter Creek Site 79	Sulphur Creek and West Snooks Run (site 76)	Snooks Run (Site 69)
TKN (mg/L)	*	1.39 86%	0.73 67%	0.8 67%	0.35 50%	1.4 100%	0	1.078 100%	1.059 100%	*	0.99 100%	1.075 83%	1.018 100%	0.99 100%
pH (SU)	8.052 0%	7.7 0%	7.946 0%	7.944 0%	7.918 0%	7.913 0%	8.083 0%	8.022 0%	7.987 0%	7.997 0%	8.065 0%	8.257 0%	8.255 0%	8.32 0%
TDS (mg/L)	453.8 0%	442.1 0%	460.2 3%	533.89 3%	425.1 0%	472.1 0%	593.3 0%	467 0%	447.6 0%	329.4 0%	458.5 0%	467 0%	442.4 0%	461 0%
TSS (mg/L)	*	39.65 68%	78.67 100%	49.667 67%	18.33 33%	53.12 62%	9 0%	12.667 0%	23.384 25%	*	14.667 0%	23.167 17%	37.6 90%	35.33 50%
Temp ^{o}C	20.77 0%	18.81 15%	19.64 0%	19.627 0%	18.92 0%	15.02 23%	17.65 0%	24.428 0%	21.77 0%	17.24 0%	24.48 0%	25.115 0%	22.883 0%	25.66 0%
Turbidity (NTU)	23.23 75%	46.27 92%	33.87 73%	27.447 79%	32.61 56%	65.86 91%	15.52 70%	*	36.41 61%	29.97 100%	*	*	*	*
Total P (mg/L)	0.088 46%	0.27 31%	0.269 57%	0.341 94%	0.3 67%	0.25 22%	0.08 67%	0.137 0%	0.135 27%	0.089 43%	0.153 0%	0.135 0%	0.117 0%	0.12 0%
CQHEI	81	77	83.5	82.33	91	88	*	*	85	72	*	*	*	*
mIBI	22	17	26.5	23.33	31	28	*	*	25	15	*	*	*	*

3.4 Land Use per Sub-watershed

This section will provide information that was obtained through windshield and desktop surveys of each sub-watershed, as well as information that has been gathered via government agencies (i.e. IDEM and OH EPA) and historic data found through research at the sub-watershed level. However it is important to note that there are particular trends that have been found watershed wide as described below.

The predominant land use in the project area is agriculture, as can be seen in Table 2.5, and Figure 2.13 in Section 2.5, encompassing nearly 78% of the total land use in the project area. Landowners using modern farming practices are scattered throughout the project area. The stream bank buffer inventory conducted as part of this project in 2013 revealed that 71% of the parcels within the UMRW have a riparian buffer less than 60 feet, with 57% of those parcels having a stream buffer equal to 0 – 10 feet in total width. The windshield survey conducted as part of this project, which took place between April and June, 2012, consisted of two people driving each road within the UMRW and looking for potential issues of land use, farming techniques, or urban issues. The car was stopped at each bridge and observations were recorded about the surrounding land use, and any potential water quality problems. The windshield survey revealed that streambank and surface runoff erosion is a major issue contributing to NPS in surface waters, as is livestock with access to open water. Leaky septic systems may be a significant contributor to surface and ground water pollution, as well as most of the rural community utilizes on-site sewage treatment. In most cases, erosion control, buffering ditch banks, septic system education, and livestock management will be BMPs that will help to remediate the pollution issues in the UMRW.

Although there are few urban areas in the project area contributing to less than 15% of the land use, it has been found that urban stakeholders do influence the water system in the project area, especially in the larger cities including Fort Wayne and New Haven at the headwaters of the Maumee. Education and outreach activities, as well as cost-share incentives and BMPs regarding septic tanks, proper fertilizer use, and stormwater management will be the most effective way of managing urban NPS in the UMRW. The utilization of small scale urban BMPs such as rain barrels and rain gardens will help with stormwater management in urban settings and provide a great resource for educational outreach. It will also be beneficial to work with the City and County Parks Departments on ways to improve water based recreation such as streambank stabilization projects, log jam removal, and installation of pervious walking paths and/or trails along the rivers. However, the quickest and most dramatic results in reducing nonpoint source pollutants in the UMRW lie in utilizing BMP installation within the agricultural community.

3.4.1 Trier Ditch Sub-watershed Land Use

The primary influence on water quality in the Trier Ditch sub-watershed is agriculture even though nearly half of the City of New Haven and a portion of the City of Fort Wayne is located within Trier Ditch Sub-watershed. Table 3.36 shows the percentage of Trier Ditch Sub-watershed that is in each land use and Figure 3.16 is a map showing the delineation of land use in the sub-watershed. Using National Land Cover Data acquired from the USGS and analyzed in ArcGIS, over 57% of the land use in Trier Ditch sub-watershed is in cultivated crops, and over 32% of the watershed is developed. However, only 5.5% of the developed land is either a medium or high intensity developed area.

There were eight locations identified as potential problems during the windshield survey conducted in 2012 in the Trier Ditch sub-watershed. Two locations totaling approximately 4900 feet of streambank are eroding along tributaries in agricultural area of the Trier Ditch sub-watershed. Five locations totaling approximately 4210 feet of streambank are eroding along tributaries in the urban areas of the Trier Ditch sub-watershed. The urban erosion taking place on Highway 930 is located next to a carwash where the parking lot is directly adjacent to the stream with little to no buffer in place and many of the other locations are denude of vegetation. Streambank stabilization BMPs will need to be installed in these identified areas to prevent future erosion of the banks. There was one location in the Trier Ditch sub-watershed where there is potential for manure to runoff of a horse pasture field. While the animals are fenced out of the stream, there is a manure pile adjacent to the stream ditch. Proper manure management will help to prevent livestock runoff from contaminating surface waters. Table 3.37 shows the observations that were made during the windshield survey and the approximate number of feet or locations that will need to be remediated to improve water quality in the Trier Ditch sub-watershed and Figure 3.17 shows the location of each of the observations.

There are several potential point sources of pollution in the Trier Ditch sub-watershed including one NPDES permitted facility which discharges into the Trier Ditch (Table 3.38), two brownfield sites (Table 3.39) and 35 underground storage tanks (USTs), 16 of which are considered leaking underground storage tanks (LUSTs) (Table 3.40). There is one CSO located within Trier Ditch sub-watershed. Most of the sites are located within the political boundaries of Fort Wayne and New Haven. These sites pose a threat to both ground and surface water. If the contents held in any of the facilities leak it can leach through the soil and reach groundwater contaminating drinking water wells of local residents, or leach into surface waters and decrease water quality and affect aquatic life.

One brownfield site, located at 110 Lincoln Highway E, has restrictions for development due to Volatile Organic Compounds (VOCs) being found in soil and groundwater. Both Brownfield sites were issued Comfort Letters which basically states that the property owners are exempt of liability due to Indiana Law or IDEM policy. Six of the 16 LUSTs located in the Trier Ditch sub-watershed are still active and are leaking their contents and pose a significant risk to ground and/or surface water. The LUSTs located in Trier Ditch are listed in Table 3.40 which tells the location of the LUST, its priority for cleanup and the area that is affected by the leak. Note that some facilities may be listed in the table more than once due to the fact that there may have been multiple instances of the UST leaking. Figure 3.18 shows the location of each of the point sources of pollution.

Table 3.36: Land Use in the Trier Ditch Sub-watershed

Open Water	Developed Open Space	Developed Low Intensity	Developed Medium Intensity	Developed High Intensity	Deciduous Forest	Grassland Herbaceous	Row Crops	Woody Wetland	Emergent Herbaceous Wetlands	Total	Unit
100.54	2129.31	2766.1	670.99	311.65	1303.96	329.71	10410.16	3.33	13.67	18039.42	Acres
0.56%	11.80%	15.33%	3.72%	1.73%	7.23%	1.83%	57.71%	<0.5%	<0.5%	100%	%

Table 3.37: Windshield Survey Observations in the Trier Ditch Sub-watershed

Observation	Bank Erosion (Agriculture)	Bank Erosion (Urban)	Pasture Runoff
Number	4900 ft	4210 ft	1

Table 3.38: NPDES Facilities Located in the Trier Ditch Sub-watershed

Permit Name	Permit #	County Name	Street Address	City	State Code	State Water Body Name	Effluent Exceedances (3 yrs)	Enforcement Actions (I=informal; F=formal) (5 yrs)
New Haven CSS*	INM020346	Allen	815 Lincoln Hwy E	New Haven	IN	Martin Drain and Trier Ditch to Maumee	0	0

*CSS – Combined Sewer System

Table 3.39: Brownfield Sites Located in the Trier Ditch Sub-watershed

BFD Site #	Name	Address	City	County	Financial Assistance	Other Actions	ERC (NR-Not Required)	Land Use Restriction(s), Contaminants of Concern	Remediation Date for ERC and/or Closure Letter
4110304	EFFT Equities	4429 Allen Martin Dr	Fort Wayne	Allen	N/A	Comfort Letter 05/13/2011	NR	N/A	N/A
4120506	Cap 'N Cork	110 Lincoln Hwy E	New Haven	Allen	N/A	Comfort Letter 07/30/2012	Yes	No Water Wells (VOCs in soil and groundwater)	12/4/2013

*ERC – Environmental Restrictive Covenant

Table 3.40: Leaking Underground Storage Tanks in the Trier Ditch Sub-watershed

UST FACILITY ID	NAME	STREET ADDRESS	CITY	STATE	PRIORITY	AFFECTED AREA	STATUS
22543	Merlin Geraroot	7101 E Tillman Rd	FORT WAYNE	IN	Low	Soil	NFA-Unconditional Closure
2033	VERIZON Ft. Wayne SE CO	7033 Hessen Castle Rd	FORT WAYNE	IN	Low	Soil	NFA-Unconditional Closure
825	Allen County Highway	8317 Tillman Rd	FORT WAYNE	IN	Low	Soil	NFA-Unconditional Closure
9482	Crown Enterprises	4221 Adams Center Rd	FORT WAYNE	IN	Low	Soil	NFA-Unconditional Closure
1995	Mcmillen Park	3900 Hessen Cassel Rd	FORT WAYNE	IN	Low	Soil	Discontinued (active)
6124	McMillian Express	3505 Wayne Trace	FORT WAYNE	IN	Medium	Soil, Groundwater	NFA-Unconditional Closure
8211	Roadway Express Inc	3513 Adams Center Rd	FORT WAYNE	IN	Low	Soil	Discontinued (active)
839	Former Smith Sub	6134 Moeller Rd	FORT WAYNE	IN	Low	Soil	NFA-Unconditional Closure
6324	Navistar International	3402 Meyer Rd	FORT WAYNE	IN	Medium	Soil, Groundwater	NFA-Unconditional Closure
15247	Jones Transfer Co	5929 Moeller Rd	FORT WAYNE	IN	Medium	Soil, Groundwater	NFA-Unconditional Closure
10552	Doc Rickers	1316 US 30 E	New Haven	IN	Medium	Soil, MTBE, Groundwater	NFA-Unconditional Closure
15527	Norm's Point Service	445 Lincoln Hwy W	New Haven	IN	Medium	Soil, Groundwater	Active
					Low	Soil	Discontinued (active)
6765	Speedway NO 6150	103 Lincoln Hwy E	New Haven	IN	Low	Soil	Active
					Medium	Soil, Groundwater	NFA-Conditional Closure

UST FACILITY ID	NAME	STREET ADDRESS	CITY	STATE	PRIORITY	AFFECTED AREA	STATUS
11870	Lassus Bros Oil Handy Dandy #28	633 Broadway	New Haven	IN	Low	Soil	Deactivated (no release confirmed)
14201	Virgil C Brockman	201 Main St	New Haven	IN	Low	Soil	NFA-Unconditional Closure
9729	Mcintosh Energy	404 Broadway	New Haven	IN	Medium	Soil	Active
					Medium	MTBE, Groundwater, Free Product	Active

NFA-No Further Action

Figure 3.17: Land Use in the Trier Ditch Sub-watershed

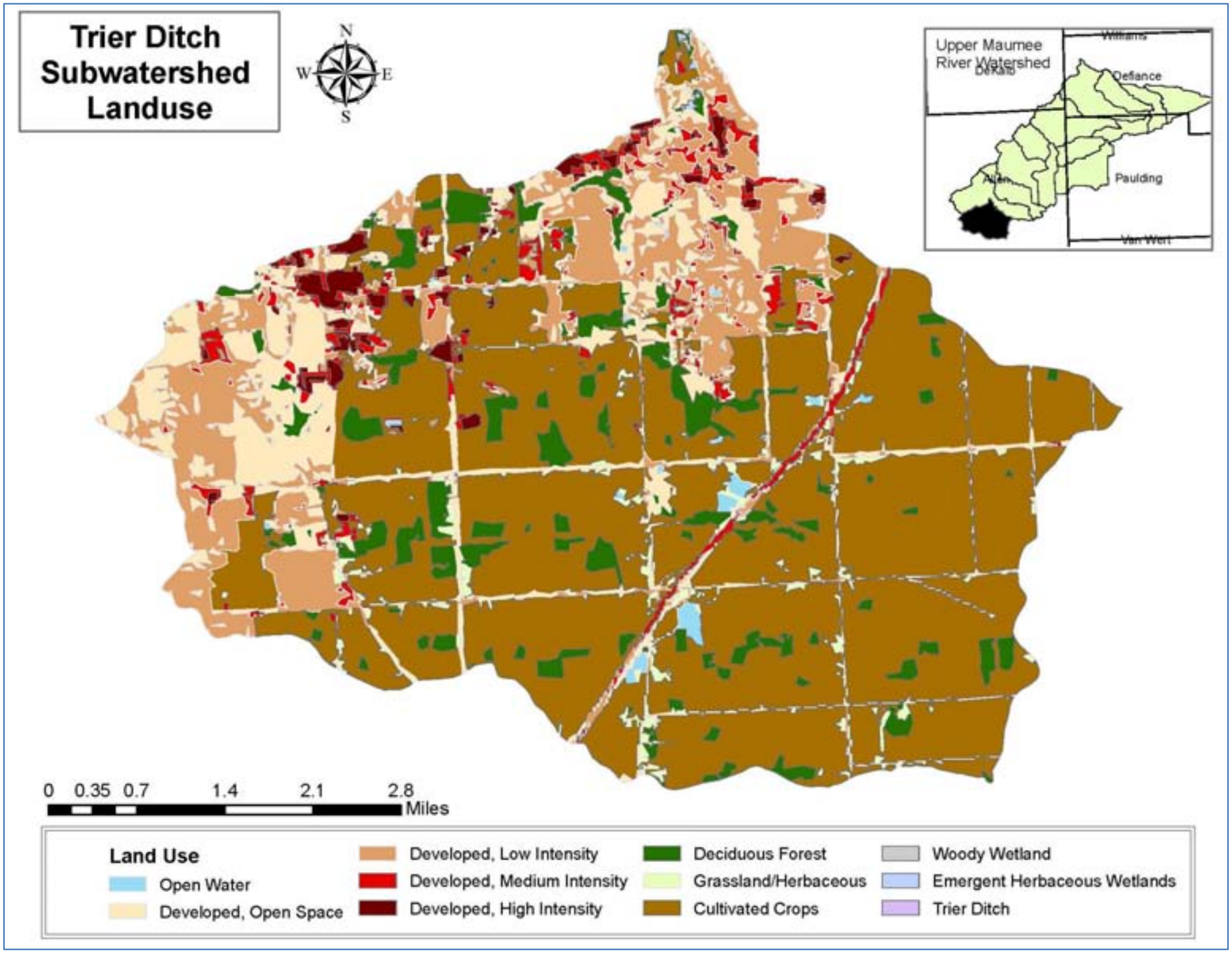


Figure 3.18: Windshield Survey Observations in the Trier Ditch Sub-watershed

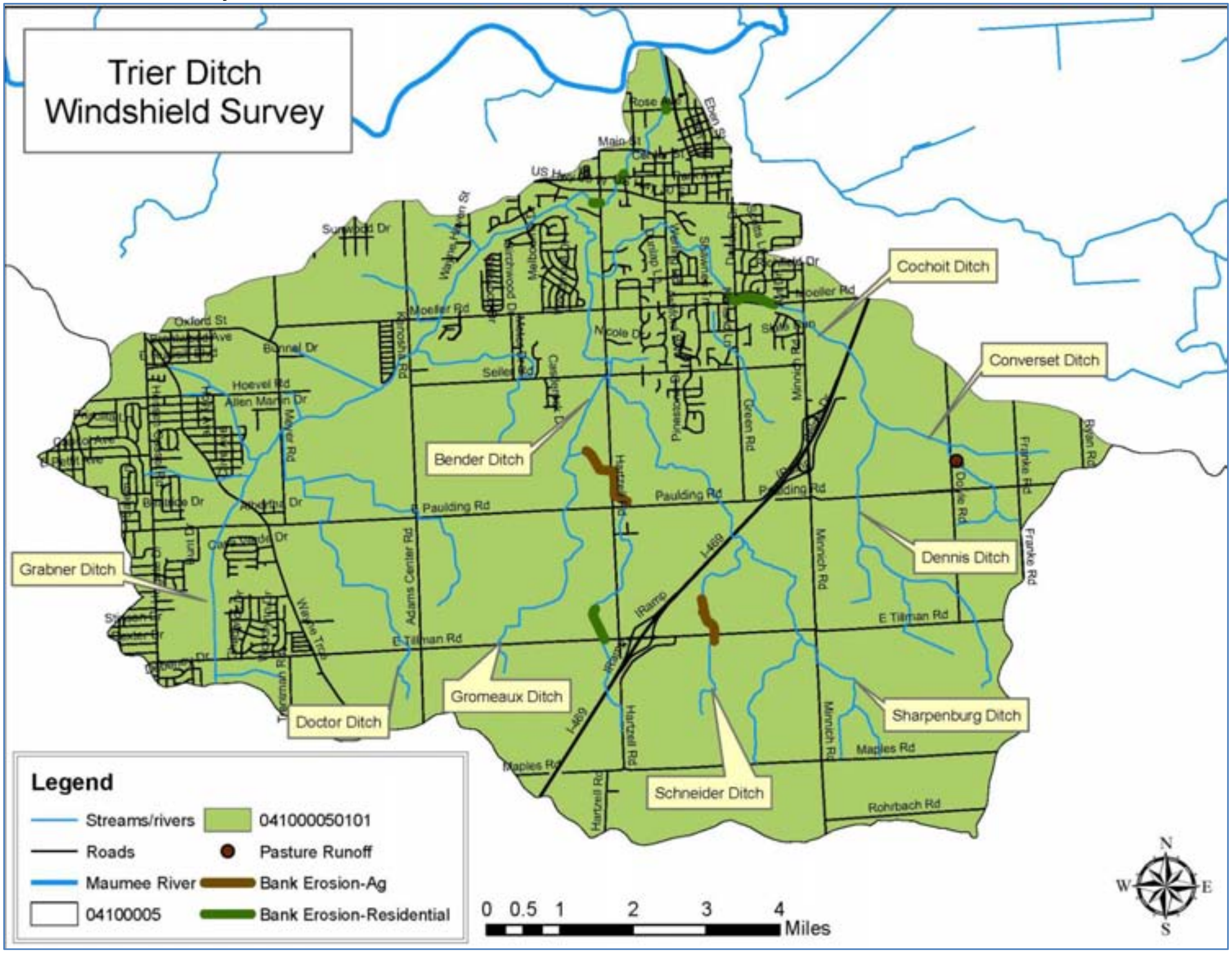
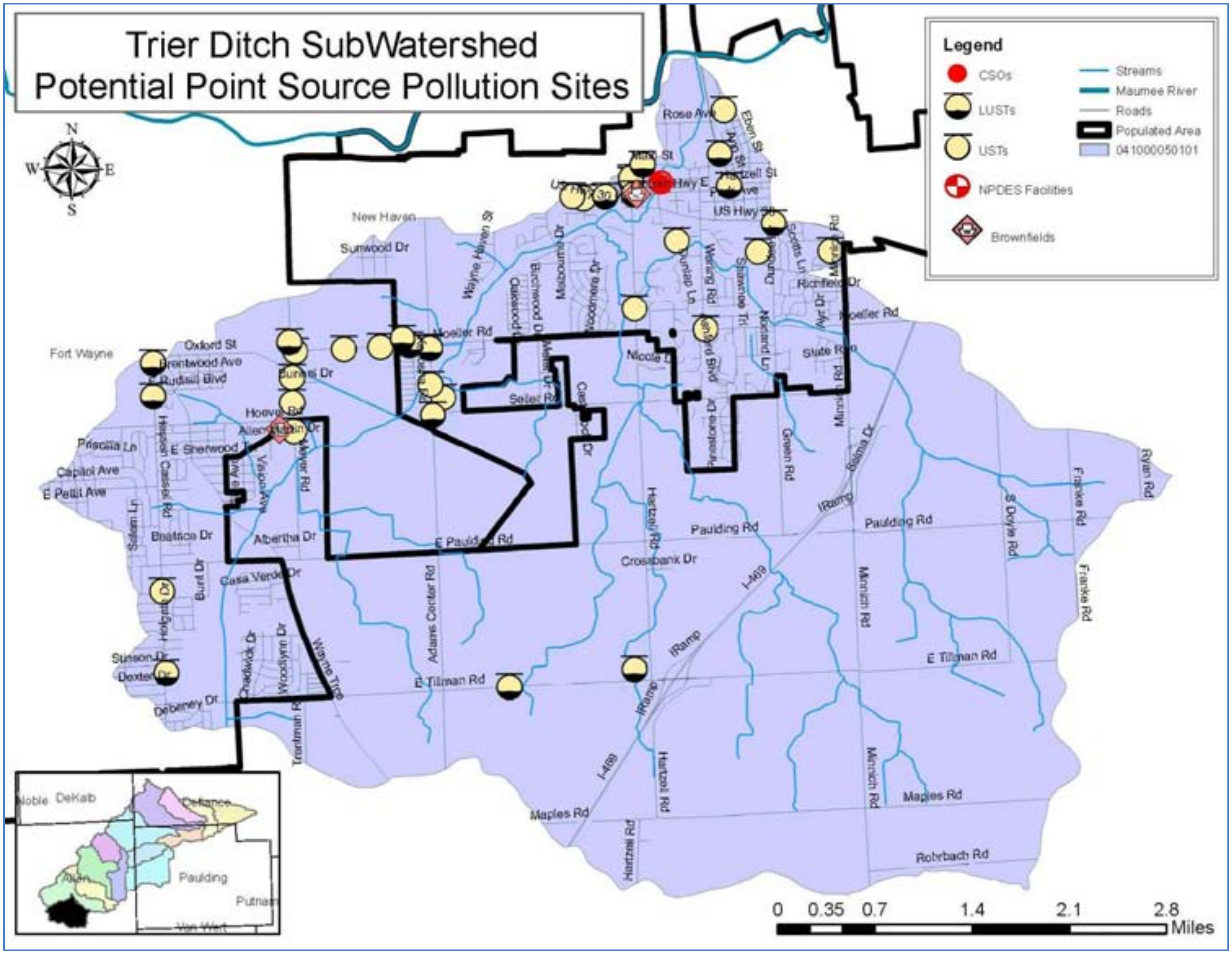


Figure 3.19: Point Sources of Pollution in the Trier Ditch Sub-watershed



Water quality data collected at the one sample site in Trier Ditch, located upstream of the NPDES permitted facility, indicates there is a problem with *E. coli*, phosphorus, and turbidity in the watershed. The high measurements of the above mentioned parameters may also be the reason that the macroinvertebrate community is suffering in Trier Ditch. Referring back to Figure 3.16, it can be seen there is a mixed land use in the surrounding area from high density developed areas to cultivated crop land. All the surrounding land uses may contribute to the excess pollutants in the water. The increase in impervious surfaces of New Haven and Fort Wayne surrounding the water sample site allows for stormwater carrying fertilizer runoff from turf grass, debris from roadways, and pathogens from pets and wildlife to flow directly into surface waters. All the agricultural land in the watershed (nearly 58% of the land use) eventually drains into the sample site as well. Much of the crop land in the UMRW, including those in the Trier Ditch sub-watershed are tiled which is a direct conduit for excess fertilizer and sediment to reach surface waters. There is also the potential for surface flow of the same potential contaminants, however a negligible amount of the soil present in the watershed is considered HEL or PHEL and, and there is a high adoption of conservation tillage practices in the watershed with over 60% of corn and 80% of beans in some kind of conservation tillage. Though, it is important to continue to promote conservation tillage as a sustainable farming practice. Livestock operations may also be contributing to an excess in pollutants in surface water. One livestock operation was identified during the windshield survey that is likely contributing to the high nutrient, pathogen, and turbidity readings in the watershed, though there are likely more facilities in the watershed that could benefit from livestock best management practices to limit polluted runoff.

3.4.2 Bullerman Ditch Sub-watershed Land Use

The primary influence on water quality in the Bullerman Ditch sub-watershed is the urban areas of Fort Wayne and New Haven, Indiana; however a large percentage of the watershed is also in production as prime agricultural land. Table 3.41 shows the percentage of Bullerman Ditch Sub-watershed that is in each land use and Figure 3.19 is a map showing the delineation of land use in the sub-watershed. Using National Land Cover Data acquired from the USGS and analyzed in ArcGIS, over 61% of the land use in Bullerman Ditch sub-watershed is developed, and over 32% of the watershed is agricultural. However, only 13% of the developed land is either a medium or high intensity developed area. Though the percentage of land in medium or high intensity development is low, it is significant as the 2010 Census estimates that there are approximately 2,293.4 persons per square mile in Fort Wayne, which can have a significant impact on the environment, especially with the high amount of impervious surfaces within the city limits.

There were nineteen locations identified as potential problems during the windshield survey conducted in 2012 in the Bullerman Ditch sub-watershed. One location totaling approximately 1032 feet of streambank is eroding along tributaries in the agricultural area of the Bullerman Ditch sub-watershed. Six locations, totaling approximately 2465 feet of streambank are eroding along tributaries in the urban areas of the Bullerman Ditch sub-watershed. The urban erosion taking place on Stellhorn Rd east of Lehmeyer Rd and on State St at Miller's Merry Manor Retirement Community both present with severe bank erosion and are prime locations to install a two-stage ditch to remediate the eroding banks. Most of the urban erosion taking place is due to the increased amount of stormflow from the impervious surfaces running over turf grass adjacent to the ditches that are mowed directly to the streambank with little to no buffer. Streambank stabilization BMPs will need to be installed in these identified areas to prevent future erosion of the banks.

It should be noted that it was observed during the windshield survey that residential land owners typically mow their turf lawns to the stream or ditch bank, leaving no strong buffer to help slow the flow of stormwater. This practice can often lead to streambank erosion, as well as allow for fertilizers and pet waste to enter directly into surface waters.

There were nine locations where either rip rap or a concrete drain was present directing stormwater from turf lawns, parking lots, and in one case a cemetery. This poses a threat to water quality by limiting any infiltration of polluted storm water, thus acting as a direct conduit for urban NPS such as road salt, dirt, fertilizer and pesticides, oil and other automobile waste to reach open water. There were also three locations where the banks of the stream were armored with either rip rap or cement. This poses a threat to water quality by not allowing for slowing and infiltration of stormwater prior to it being deposited into open water. Table 3.42 shows the observations that were made during the windshield survey and the approximate number of feet or locations that will need to be remediated to improve water quality in the Bullerman Ditch sub-watershed and Figure 3.20 shows the location of each of the observations.

There are several potential point sources of pollution in the Bullerman Ditch sub-watershed including two NPDES permitted facilities which discharge into the Bullerman Ditch sub-watershed (Table 3.43) and 138 underground storage tanks (USTs), 61 of which are considered leaking underground storage tanks (LUSTs). All of the sites are located within the political boundaries of Fort Wayne and New Haven. These sites pose a threat to both ground and surface water. If the contents held in any of the facilities leak it can leach through the soil and reach groundwater contaminating drinking water wells of local residents, or leach into surface waters and decrease water quality and affect aquatic life. Eleven of the 61 LUSTs located in the Bullerman Ditch sub-watershed are still active and are leaking their contents and pose a significant risk to ground and/or surface water. The LUSTs located in Bullerman Ditch are listed in Table 3.44 which tells the location of the LUST, its priority for cleanup and the area that is affected by the leak. Note that some facilities may be listed in the table more than once due to the fact that there may have been multiple instances of the UST leaking.

There are four locations where Brownfield funds were spent to investigate the site for contamination and/or develop a plan for remediation in the Bullerman Ditch sub-watershed. The City of Fort Wayne also received Brownfield funds to conduct investigations of contamination sites community wide. Therefore, a specific site cannot be identified as that money was spent at several locations community wide. Through communications with the Brownfield program with the City of Fort Wayne it was learned that specific sites where the community wide Brownfield funds were spent are not known. Table 3.45 lists the areas where

Brownfield funds were used and if any restrictions at that site were put in place due to findings of the site assessment.

Bullerman Ditch sub-watershed has a superfund site located within its boundaries. The Fort Wayne Reduction Dump, owned by Waste Management, is a 35 acre site located within the 100 year flood plain along the Maumee River on the Fort Wayne, New Haven political boundary. It operated as a landfill which accepted hazardous waste, between 1966 and 1974. Hazardous waste was found to be leaking into soil and groundwater during a feasibility study which took place in the 1980s. In April 2011, the third, five-year review of the site took place and was conducted by the US EPA. To date activity that has taken place to clean-up the site includes;

1) Digging up/removing over 27,000 waste-containing drums
2) Collecting and treating groundwater
3) Installation of erosion control mats and planting vegetation
4) Instituting land restrictions and ground water monitoring.

The next step for this Superfund site is to develop a long-term stewardship plan which will include regular inspections to ensure clean-up efforts at the site are still in place and effective. The next scheduled review of the site will be in 2014.

The Fort Wayne Reduction Dump Superfund Site is located within an underserved community, most of which obtains their drinking water from ground wells. Therefore, consistent monitoring of groundwater and the integrity of the pollution barriers put in place at the site are integral to the safety of the people working and residing around the site. For more information on the Fort Wayne Reduction Dump Superfund Site visit www.epa.goc/superfund/sites/.

The City of Fort Wayne and New Haven have CSOs which discharge to the Maumee River or its tributaries, totaling 14 outfalls located within the Bullerman Ditch sub-watershed. The City of New Haven developed a Long Term Control Plan (LTCP) for its CSO to completely eliminate it by pumping its waste water to the Fort Wayne WWTP. The City of Fort Wayne's LTCP, released in December 2007, includes plans to eliminate all CSO events from CSO 48, located at Morton St. on the Maumee River, and to limit all other CSO events into the Maumee River to a maximum of four CSO events annually by improving treatment capacity of waste water during storm event through a variety of different measures. Table 3.46 is a list of the CSOs present in the watershed and the approximate location of each of those outfalls.

Figure 3.21 shows the location of each of the point sources of pollution located within the Bullerman Ditch sub-watershed.

Table 3.41: Land Use in the Bullerman Ditch Sub-watershed

Open Water	Dev. Open Space	Dev. Low Intensity	Dev. Medium Intensity	Dev. High Intensity	Deciduous Forest	Ever-green Forest	Shrub/ Scrub	Grassland/Herbaceous	Row Crops	Woody Wet-land	Emergent Herbaceous Wetlands	Total	Unit
409.1	4380	6031.65	1684.997	1107.34	657.0007	1.136	40.59	120.589	7006	43.88	81.734	21564	Acres
1.90	20.31	27.97	7.81	5.14	3.05	<1	<1	<1	32.49	<1	<1	100%	%

Table 3.42: Windshield Survey Observations in the Bullerman Ditch Sub-watershed

Observation	Bank Erosion (Agriculture)	Bank Erosion (Urban)	Armored Surface Drain	Armored Banks
Number	1032 ft	2465 ft	128 ft	103 ft

Table 3.43: NPDES Permitted Facilities in the Bullerman Ditch Sub-watershed

Permit Name	Permit #	County Name	Street Address	City	State Code	State Water Body Name	Effluent Exceedances past 3 yrs (Substance)	Enforcement Actions (I=informal; F=formal) (5 yrs)
Fort Wayne WWTP	IN0032191	Allen	2601 Dwenger Ave	Fort Wayne	IN	Maumee River	4 (Chlorine, *E. coli*, TSS)	2(I) 2(F)
Norfolk Southern Railway	IN0000485	Allen	7315 Nelson Rd	Fort Wayne	IN	Trier Ditch to Maumee River	2 (Napthalene, TSS)	0

Table 3.44: Leaking Underground Storage Tanks in the Bullerman Ditch Sub-watershed

UST FACILITY ID	NAME	STREET ADDRESS	CITY	STATE	PRIORITY DESCRIPTION	AFFECTED AREA DESCRIPTION	DESCRIPTION
2943	Clark Store #1822	3220 Wayne Trace	FORT WAYNE	IN	Medium	Soil, MTBE, Groundwater	Active
15463	Fire Station #9	2530 E Pontiac St	FORT WAYNE	IN	Low	Soil	NFA-Unconditional Closure
6240	Navistar International Corp	2911 Meyer Rd	FORT WAYNE	IN	Medium	Soil	NFA-Unconditional Closure
1943	Fruehauf Transportation Div	2612 E Pontiac St	FORT WAYNE	IN	Low	Soil	Discontinued (active)
19364	Ray's Self Service Carwash	2510 Pioneer	FORT WAYNE	IN	Low	Soil	NFA-Unconditional Closure
7440	Karl Schmidt Unisia Inc	2425 South Coliseum Road	FORT WAYNE	IN	Low	Soil	NFA-Unconditional Closure
6177	Kipfers Stop & Go	2510 S Coliseum Blvd	FORT WAYNE	IN	Low	Soil	NFA-Unconditional Closure
11311	Cf Motorfreight Fort Wayne	2532 Bremer Rd	FORT WAYNE	IN	Low	Soil	NFA-Unconditional Closure
					Medium	Soil, Groundwater	NFA-Unconditional Closure
7869	Preston Trucking Company Inc	2424 Bremer Drive	FORT WAYNE	IN	Low	Soil	NFA-Unconditional Closure

UST FACILITY ID	NAME	STREET ADDRESS	CITY	STATE	PRIORITY DESCRIPTION	AFFECTED AREA DESCRIPTION	DESCRIPTION
22747	Facility Closed	2401 Meyer Rd	FORT WAYNE	IN	Medium	Soil	Active
4063	Waste Mgt Inc Of Ft Wayne In	2220 Bremer Rd	FORT WAYNE	IN	Low	Soil	Discontinued (active)
					Medium	Soil, Groundwater	NFA-Conditional Closure
7759	Professional Maintenance	2501 Wayne Trace	FORT WAYNE	IN	Low	Soil	NFA-Unconditional Closure
6327	North Am Moving & Storage Inc	2122 Bremer Dr	FORT WAYNE	IN	Medium	Soil	NFA-Unconditional Closure
7961	Rea Magnet Wire	4300 New Haven Avenue	FORT WAYNE	IN	Low	Soil	Discontinued (active)
2120	Gladieux Trading & Marketing Fort Wayne	4133 New Haven Ave	FORT WAYNE	IN	Low	Soil	Discontinued (active)
20886	Alro Steel	4929 New Haven	FORT WAYNE	IN	Low	Soil	Discontinued (active)
					Medium	Soil, Groundwater	NFA-Unconditional Closure
1306	Speedway #8526	6244 Lincoln Hwy E	FORT WAYNE	IN	Medium	Soil, Groundwater	Active
					Medium	Soil, Groundwater	Discontinued (active)
8015	Ryder Truck Rental Inc	5225 New Haven Ave	FORT WAYNE	IN	Low	Soil	Discontinued (active)
					Medium	Soil	NFA-Unconditional

UST FACILITY ID	NAME	STREET ADDRESS	CITY	STATE	PRIORITY DESCRIPTION	AFFECTED AREA DESCRIPTION	DESCRIPTION
							Closure
15228	Poinsatte Motors Inc East	6507 Us 30 East	FORT WAYNE	IN	Low	Soil	No Paper File
2993	Clark Oil & Refining #0653	6925 SR 930 E	FORT WAYNE	IN	Medium	Soil, MTBE, Groundwater	NFA-Unconditional Closure
6464	Tokheim Corporation	1600 Wabash Avenue	FORT WAYNE	IN	Low	Soil	NFA-Unconditional Closure
24221	Dave Klopfenstein	1501 Lincoln Hwy E	New Haven	IN	Low	Soil	NFA-Unconditional Closure
6336	New Haven Wire & Cable Inc	1605 Sr E	New Haven	IN	Medium	Soil, Groundwater	Active
9269	Home Lumber Of New Haven Inc	2101 Sr 14 E	New Haven	IN	Low	Soil	Discontinued (active)
10330	Section Shop Roundhouse	Hartzell	FORT WAYNE	IN	Medium	Soil, Groundwater	Discontinued (active)
2122	Cloverleaf Union 76	4335 Us 30 E	FORT WAYNE	IN	High	Surface Water, Soil, MTBE, Groundwater, Free Product, Ecologically Sensitive Area	Active
5210	Roundy's Lake End Sales Division	6916 E Nelson Rd	FORT WAYNE	IN	High	Soil, Groundwater, Free Product	NFA-Unconditional Closure
3439	Lancorp Inc	1314 Meyer Rd	FORT WAYNE	IN	Low	Soil	Discontinued (active)
2332	Penske Truck Leasing Fort Wayne	5250 Old Maumee Rd	FORT WAYNE	IN	Low	Soil	NFA-Unconditional Closure

UST FACILITY ID	NAME	STREET ADDRESS	CITY	STATE	PRIORITY DESCRIPTION	AFFECTED AREA DESCRIPTION	DESCRIPTION
1711	United Parcel Service	4930 Old Maumee Rd	FORT WAYNE	IN	Low	Soil	NFA-Unconditional Closure
24342	Taylor-Blackburn Battery Warehouse	1802 Maumee Ave	FORT WAYNE	IN	Low	Soil	NFA-Unconditional Closure
20031	Tuthill Corporation	2110 Summit St	New Haven	IN	Low	Soil	Discontinued (active)
19632	Abandoned Station	1736 Maumee Ave	FORT WAYNE	IN	Low	Soil	Discontinued (active)
15008	Omnisource Corp	3101 Maumee Ave	FORT WAYNE	IN	Low	Soil	NFA-Unconditional Closure
10133	Omnisource Corp	3101 Maumee Ave	FORT WAYNE	IN	High	Soil, Free Product	Active
					Low	Soil, MTBE	Active
					Low	Soil	Discontinued (active)
					Low	Soil	NFA-Unconditional Closure
6260	Zent's	6806 Parrot Road	FORT WAYNE	IN	Low	Soil	NFA-Unconditional Closure
24628	Comcast Former Tower	1431 Rose Ave	New Haven	IN	Low	Soil	NFA-Unconditional Closure

UST FACILITY ID	NAME	STREET ADDRESS	CITY	STATE	PRIORITY DESCRIPTION	AFFECTED AREA DESCRIPTION	DESCRIPTION
1961	Fort Wayne Water Pollution Control	2601 Dwenger Ave	FORT WAYNE	IN	Low	Soil	NFA-Unconditional Closure
					Medium	Soil, MTBE, Groundwater, Free Product, Drinking Water	NFA-Unconditional Closure
8671	Aalco Distributing Company Inc.	909 Grant Avenue	FORT WAYNE	IN	Medium	Soil, MTBE, Groundwater	NFA-Unconditional Closure
18802	Jack F Eiser Sales Company Incorporated	820 Schick St	FORT WAYNE	IN	Low	Soil	Discontinued (active)
14231	Do Mccomb & Sons Funeral Homes I	1140 Lake Ave	FORT WAYNE	IN	Low	Soil	Discontinued (active)
11803	Speedway NO 5505	1222 N Coliseum Blvd	FORT WAYNE	IN	Medium	Soil, Groundwater	Active
18841	Wpc Plant Lagoons	5500 Lake Ave	FORT WAYNE	IN	Low	Soil	NFA-Unconditional Closure
14608	Crossroad Ft Wayne Children Home	2525 Lake Ave	FORT WAYNE	IN	Low	Soil	NFA-Unconditional Closure
638	Speedway #5158	4101 Lake Ave	FORT WAYNE	IN	Low	Soil	NFA-Unconditional Closure
18029	VA Medical Center	2121 Lake Ave	FORT WAYNE	IN	High	Soil, Groundwater, Free Product	Active
14765	Charter Beacon Hospital	1720 Beacon St	FORT WAYNE	IN	Low	Soil	NFA-Unconditional Closure

UST FACILITY ID	NAME	STREET ADDRESS	CITY	STATE	PRIORITY DESCRIPTION	AFFECTED AREA DESCRIPTION	DESCRIPTION
5464	Marathon Unit #2492	3606 E State Blvd	FORT WAYNE	IN	Low	Soil	NFA-Unconditional Closure
					Medium	Soil, Groundwater	NFA-Unconditional Closure
10636	Jiffy Lube	3129 E State Blvd	FORT WAYNE	IN	Low	Soil	Discontinued (active)
5420	Georgetown Marathon	6230 E State Blvd	FORT WAYNE	IN	Medium	Soil, Groundwater	NFA-Unconditional Closure
					Low	Soil	NFA-Unconditional Closure
139	Georgetown Shell	6321 E State Blvd	FORT WAYNE	IN	Low	Soil	Discontinued (active)
15468	Fire Station #14	3400 Reed Rd	FORT WAYNE	IN	Low	Soil	NFA-Unconditional Closure
11861	Lassus Bros Oil Handy Dandy #15	5545 Stellhorn Rd	FORT WAYNE	IN	Low	Soil	Discontinued (active)
					Medium	Soil	NFA-Unconditional Closure
129	Shell Oil Maplewood	6132 Stellhorn Rd	FORT WAYNE	IN	Low	Soil	Discontinued (active)
					Medium	Soil, Groundwater	NFA-Unconditional Closure

UST FACILITY ID	NAME	STREET ADDRESS	CITY	STATE	PRIORITY DESCRIPTION	AFFECTED AREA DESCRIPTION	DESCRIPTION
16217	Doc Rickers	6230 Stellhorn	FORT WAYNE	IN	Medium	Soil, Groundwater	Active
					Medium	Groundwater	Active
					Low	Vapors, Surface Water, Soil, Groundwater	NFA-Unconditional Closure
5430	Marathon Oil #2188	6303 Stellhorn Rd	FORT WAYNE	IN	High	Utility Lines, Soil, Groundwater	Discontinued (active)
					Medium	Soil, MTBE, Groundwater	NFA-Conditional Closure
14942	Mim Service	2201 E Washington Blvd	FORT WAYNE	IN	Medium	Soil	Active

NFA – No Further Action

Table 3.45: Brownfields Located in the Bullerman Ditch Sub-watershed

Site #	Name	Address	City	County	Financial Assistance	Other Actions	ERC (NR-Not Required	Land Use Restriction(s), Contaminants of Concern	Remediation Date for ERC and/or Closure Letter
4960018	Bowser Pump Plant	2513 Holton Ave	Fort Wayne	Allen	Remediation Grant Award 12/01/2005 Loan 04/05/1999	No Further Action Letter 10/25/2006, Site Status Letter 09/05/2002, Site Status Letter 07/31/2001	Yes	Maintain 12 inches of cover (Metals, VOCs, SVOCs in soil and VOCs in groundwater)	02/18/2003 and 11/27/2002
4081202	Connor Corp.	2701 Dwenger Ave	Fort Wayne	Allen		Petroleum Determination Letter 02/11/2009	NR		
4070614	CWEPA City of Fort Wayne	Comm-unity Wide	Fort Wayne	Allen	Federal Grant Matching 2007	Oversight	NR		
4111207	Former Clover-leaf Union 76	4335 SR 930	Fort Wayne	Allen		Comfort Letter 10/04/2012	Yes	No Residential, water wells, maintain affected area and manage soil (TPH in soil, VOCs in groundwater)	
4100905	Industrial Ware-house Facility	6916 Nelson Rd	New Haven	Allen		Site Status Letter 03/18/2011	Yes	No Groundwater Extraction	4/19/2011

*ERC – Environmental Restrictive Covenant

Table 3.46: Combined Sewer Overflow Outfalls in the Bullerman Ditch Sub-watershed

Site #	Location of Outfall	Latitude	Longitude	Receiving Water
1	487' SE of Paul Stemmler Pkwy	41.080472	-85.007694	Martin Drain
64	610' N of Northside Dr and Glazie Ave; east bank	41.074417	-85.084472	Maumee River
60	670' NE of Greenwall Ave and Maumee Ave	41.0785	-85.095222	Unnamed Ditch to Maumee River
58	390' NW of Edsall Ave and Dwenger Ave	41.079694	-85.100028	Maumee River
39	120' North of Hanna St and Berry St	41.080778	-85.129889	Maumee River
55	430' North of N Anthony Blvd and Wayne St	41.081306	-85.11475	Maumee River
50	100' North of Coombs St and Herbert St	41.083972	-85.123111	Maumee River
57	Stormwater Lifstation Wet Well	41.084222	-85.108028	Maumee River
48	350' West of Edgewater and Garfield	41.086139	-85.1175	Maumee River
62	200' West of Lavern Ave and State Blvd	41.097361	-85.094472	Baldwin Ditch
61	200' West of Lavern Ave and State Blvd	41.097389	-85.094472	Baldwin Ditch
2	3,350' West of Coliseum Blvd and 3,500' South of Lake Avenue	41.045	-85.0559	Maumee River
3	900' East of Pemberton Dr, and 1,600 South of Lake Avenue	41.0507	-85.0632	Wigman Drain
80	250' East, NE of Pemberton Dr and Niagara Dr	41.0457	-85.0644	Maumee River

Figure 3.20: Land Use in the Bullerman Ditch Sub-watershed

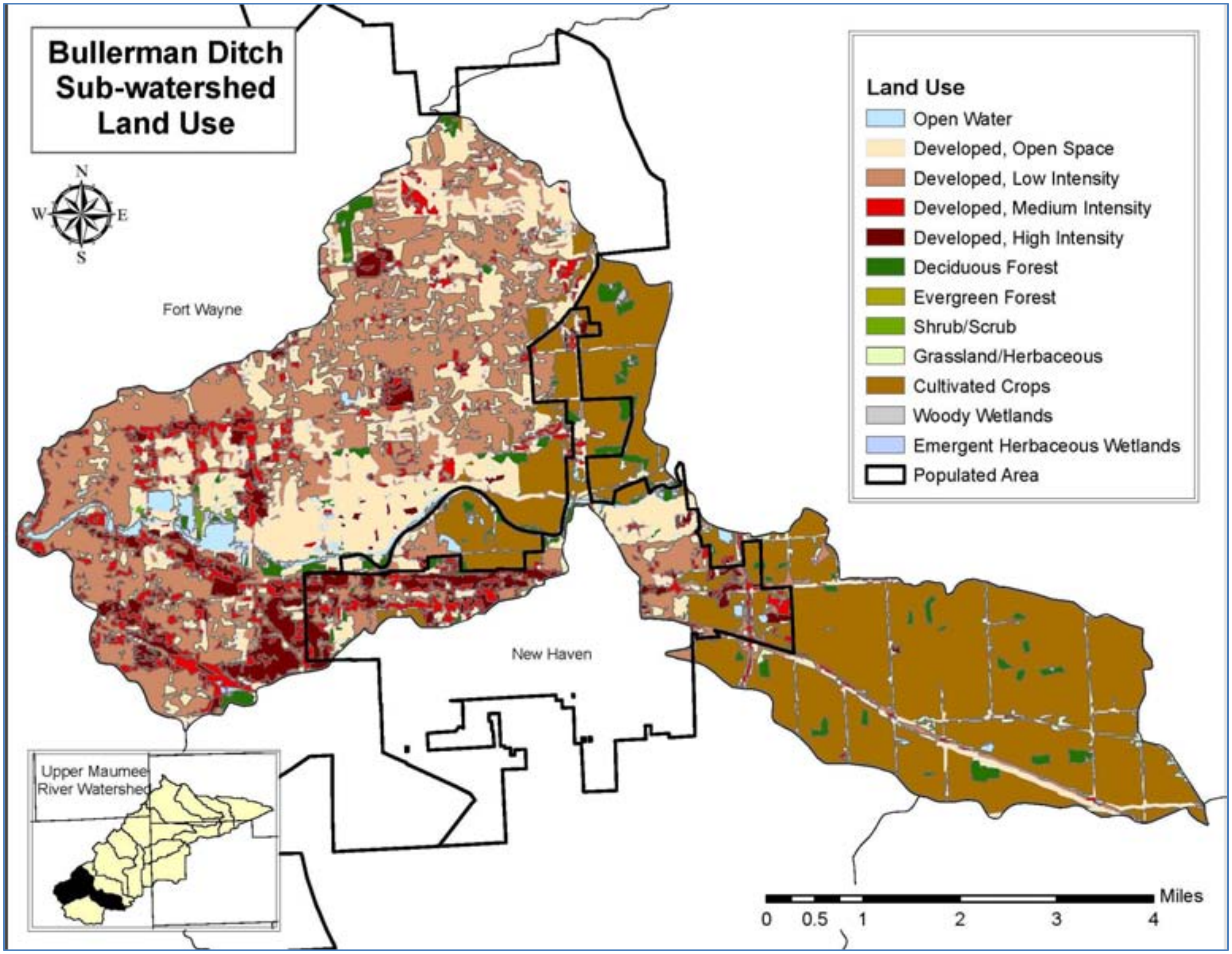


Figure 3.21: Windshield Survey Observations in the Bullerman Ditch Sub-watershed

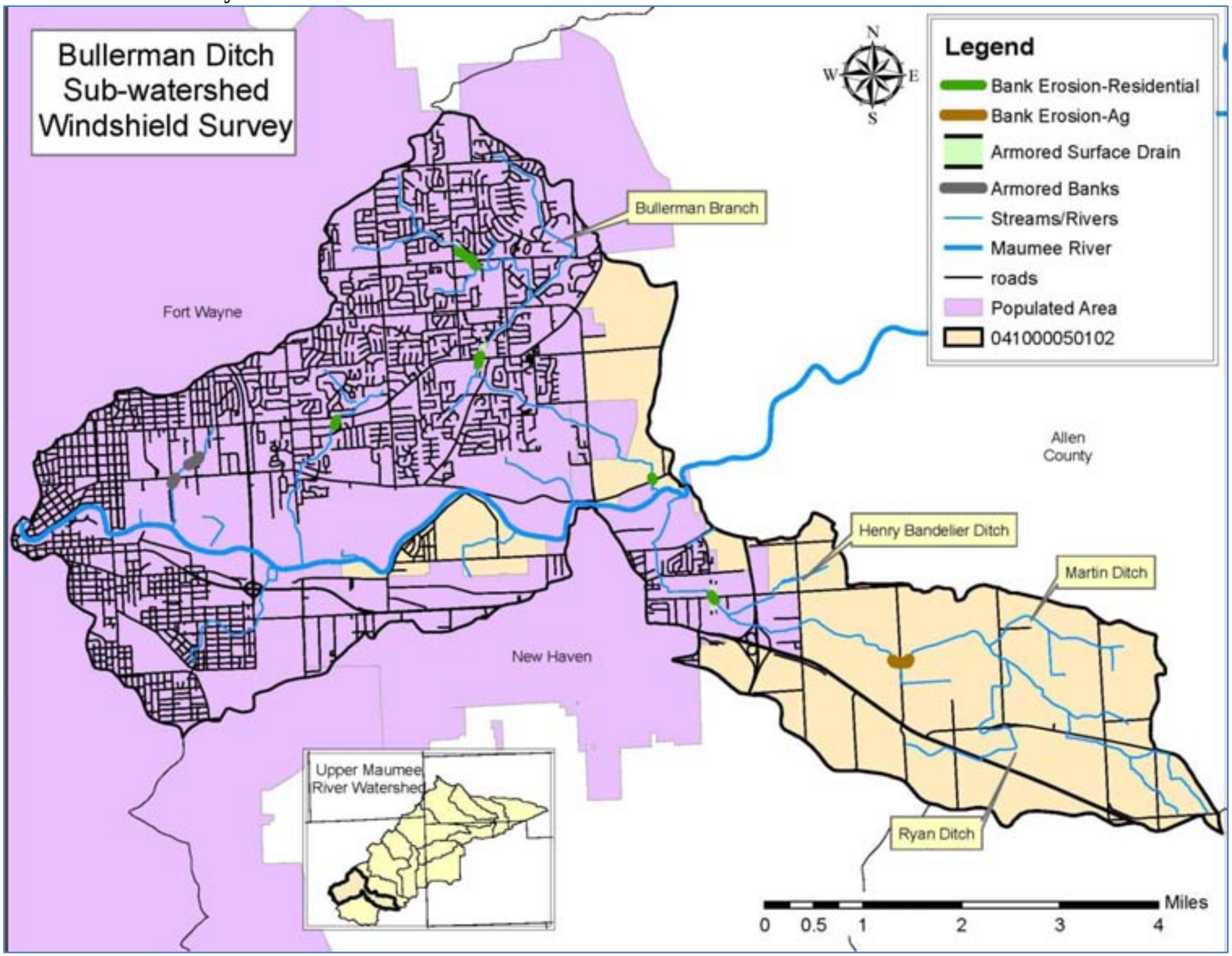
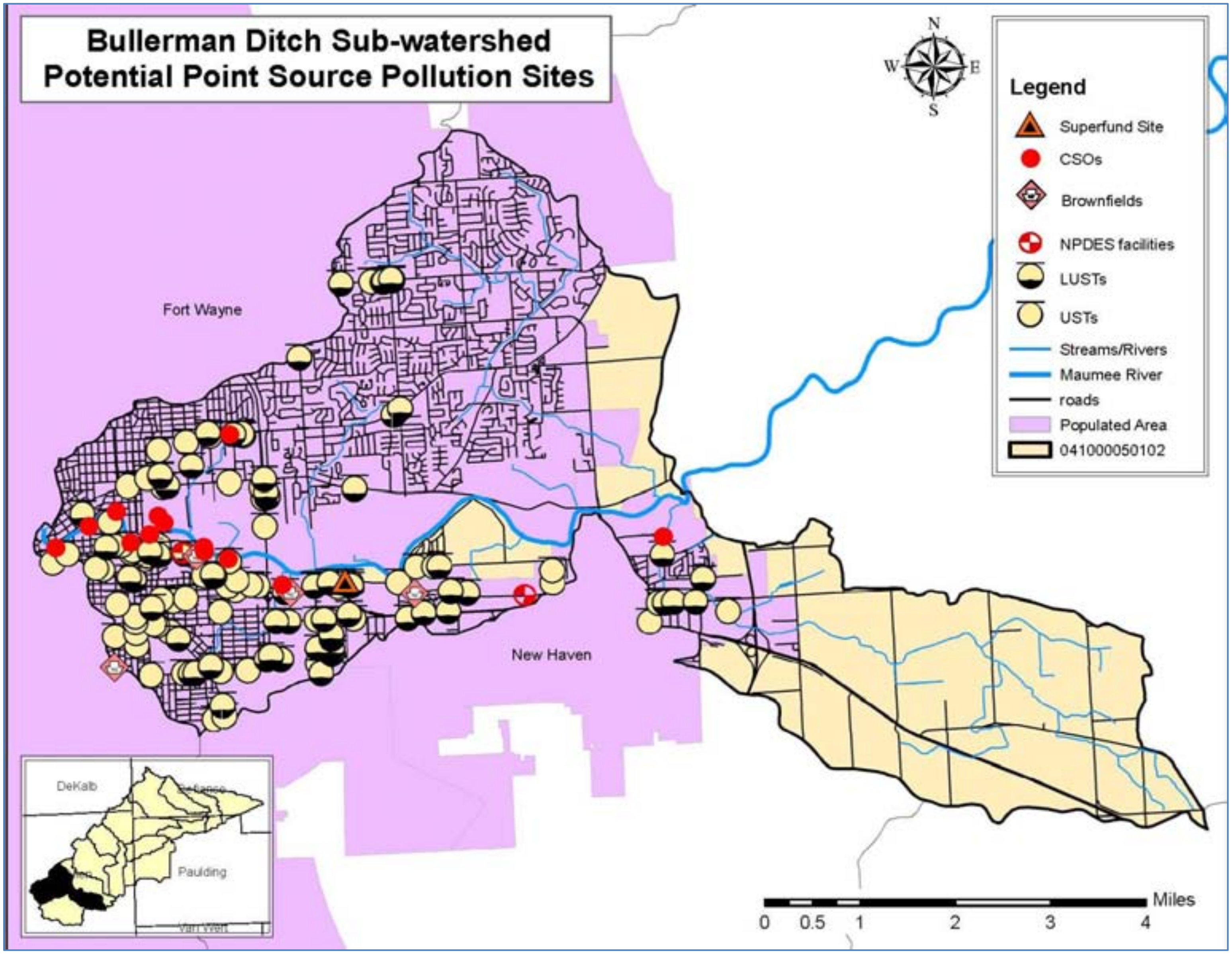


Figure 3.22: Point Source Pollution Sites in the Bullerman Ditch Sub-watershed



Water quality data collected in the Bullerman Ditch sub-watershed at five different locations indicate there is a problem with *E. coli* with an average measurement of over 100 CFU/100 ml in the watershed. The high *E. coli* readings may be due to the number of CSOs in the watershed. IDEM's sample site one is located downstream of four CSOs and is very close to one of the CSOs. Site one also had the highest reading for E. coli. IDEM's sample site two is located downstream of seven CSOs, though it is located at least a mile from the nearest CSO, giving the E. coli time to dilute in Maumee River. Fort Wayne measured E. coli at Landin Rd which is located downstream of 14 of the CSOs in the watershed and E. coli measurements at that site were the second highest in the watershed. There were a few spikes in E. coli levels at the project sample site (310) which may be due to the agricultural area which drains into that point or from failing on-site waste systems present in the rural areas of the watershed. The 14 CSOs present in the watershed may also be the reason that nutrient and sediment average levels were above the target levels set by this project. The City of Fort Wayne had a minimum of 27 CSO events occur at one or more CSO outfalls between January and July 2012; eleven of those events occurred during the recreational season in which the project was sampling water quality.

Nutrient and sediment levels exceeded the target levels set by this project at all water sample sites. Again, this could be due to the 14 CSOs present in the watershed. However, it is also likely that fertilizer and pet waste from the urban areas of the watershed are a source of the excess nutrients and sediment.

3.4.3 Sixmile Creek Sub-watershed Land Use

The primary influence on water quality in the Sixmile Creek sub-watershed is agriculture with over 75% of the land being classified as agricultural by the USGS. Table 3.47 shows the percentage of Sixmile Creek Sub-watershed that is in each land use and Figure 3.22 is a map showing the delineation of land use in the sub-watershed. Using National Land Cover Data acquired from the USGS and analyzed in ArcGIS, 75.12% of the land use in Sixmile Creek sub-watershed is in production with 73.76% of that being used strictly for cultivated crops, and over 18% of the watershed is developed due to the Northeastern portion of Fort Wayne city limits being located within the Sixmile Creek sub-watershed. However, only 3.2% of the developed land is either a medium or high intensity developed area.

There were three locations identified as potential problems during the windshield survey conducted in 2012 in the Sixmile Creek sub-watershed. Two locations totaling approximately 8,215 feet of streambank are eroding along tributaries in agricultural areas of the Sixmile Creek sub-watershed. One location was observed to have large tile drains and no buffer at a stream running through a golf course. The large tile drains and no buffer allow for the excess fertilizer which is common practice at many golf courses, to run directly into the stream. It is not clear if the tile system at this location would allow most excess nutrients to bypass the buffer system, however, streambank stabilization and/or streambank buffer BMPs will need to be installed in these identified areas to prevent future erosion of the banks and to filter many pollutants out prior to stormwater reaching open water sources. Table 3.48 shows the observations that were made during the windshield survey and the approximate number of feet that will need to be remediated to improve water quality in the Sixmile Creek sub-watershed and Figure 3.23 shows the location of each of the observations.

There are a few potential point sources of pollution in the Sixmile Creek sub-watershed. There are five USTs located in the Sixmile Creek sub-watershed, with three of those being LUSTs. However, all of the LUSTs have been closed except for the one located on Edgerton Rd which is still leaking and potentially contaminating soil and groundwater. If the contents held in any of the USTs leak it can leach through the soil and reach groundwater contaminating drinking water wells of local residents, or leach into surface waters and decrease water quality and affect aquatic life.

There is one Confined Feeding Operation located in Sixmile Creek sub-watershed on the eastern border of the watershed. Due to the size of the operation, it must follow certain state guidelines to manage the waste produced on site. Though, there is potential for spills and/or leaks from the manure holding facilities or while being transferred to other farms as fertilizer. Table 3.49 defines the CFO located within Sixmile Creek. There are no NPDES permitted facilities, brownfields, or CSOs located within the Sixmile Creek sub-watershed. The LUSTs located in Sixmile Creek sub-watershed are listed in Table 3.50 which tells the location of the LUST, its priority for cleanup and the area that is affected by the leak. Note that some facilities may be listed in the table more than once due to the fact that there may have been multiple instances of the UST leaking. Figure 3.24 shows the location of each of the point sources of pollution.

Table 3.47: Land Use in the Sixmile Creek Sub-watershed

Open Water	Dev. Open Space	Dev. Low Intensity	Dev. Medium Intensity	Dev. High Inten-sity	Decid-uous Forest	Ever-green Forest	Mixed Forest	Shrub/ Scrub	Grass-land/Herb-aceous	Pasture/ Hayland	Row Crops	Woody Wetland	Emergent Herb-aceous Wetlands	Total	Unit
182.94	1422.53	847.52	388.614	171.102	527.776	1.007	2.52	10.112	210.64	208.041	11,404.37	60.724	22.99	15460.9	Acres
1.18%	9.20%	5.48%	2.51%	1.1%	3.41%	<1%	<1%	<1%	1.36%	1.35%	73.8%	<1%	<1%	100%	%

Table 3.48: Windshield Survey Observations in the Sixmile Creek Sub-watershed

Observation	Bank Erosion (Agriculture)	Mowed Banks-Tiled
Number	8215.25 ft	881.45 ft

Table 3.49: Confined Feeding Operations in the Sixmile Creek Sub-watershed

Operation	Sub-watershed	Designation	Animal Type	Animal #
W R Farms	Sixmile Creek	CFO	Swine	1,495

Table 3.50: Leaking Underground Storage tanks in the Sixmile Creek Sub-watershed

UST FACILITY ID	INCIDENT NUMBER	NAME	STREET ADDRESS	CITY	COUNTY	PRIORITY DESCRIPTION	AFFECTED AREA DESCRIPTION	DESCRIPTION
17479	200402505	Dla New Haven Depot	15411 Dawkins Road	New Haven	Allen	Medium	Soil, Groundwater	NFA-Unconditional Closure
	199002504							NFA-Unconditional Closure
	199002516							NFA-Unconditional Closure
18992	199406521	ISCI - New Haven	15202 Edgerton Rd T-209	New Haven	Allen	Medium	Soil, Groundwater	Active
19645	200007500	Meijer Gas Station NO 138	10305 Maysville Rd	FORT WAYNE	Allen	Medium	Soil, MTBE, Groundwater	NFA-Unconditional Closure

Figure 3.23: Land Use in the Sixmile Creek Sub-watershed

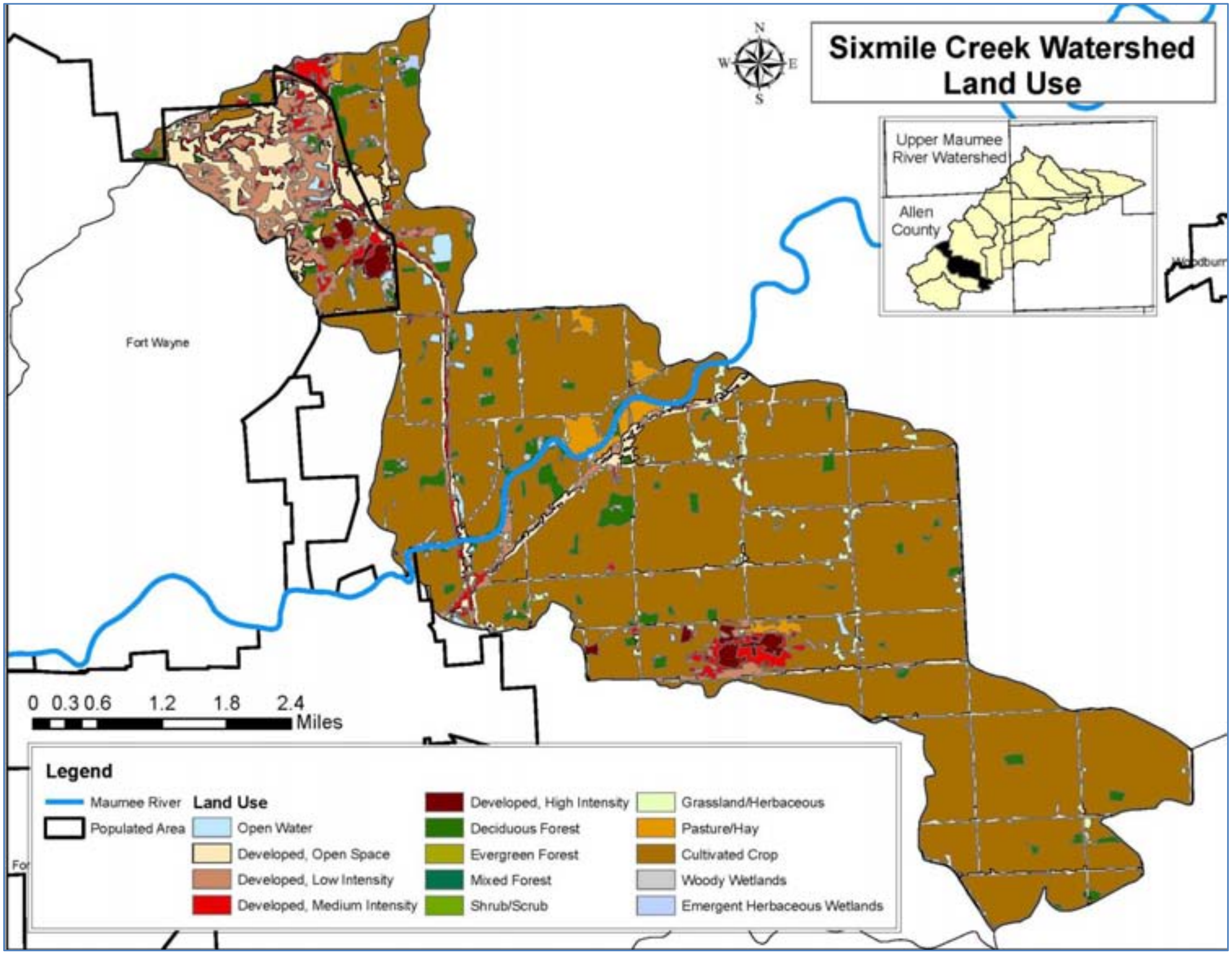


Figure 3.24: Windshield Survey Observations in the Sixmile Creek Sub-watershed

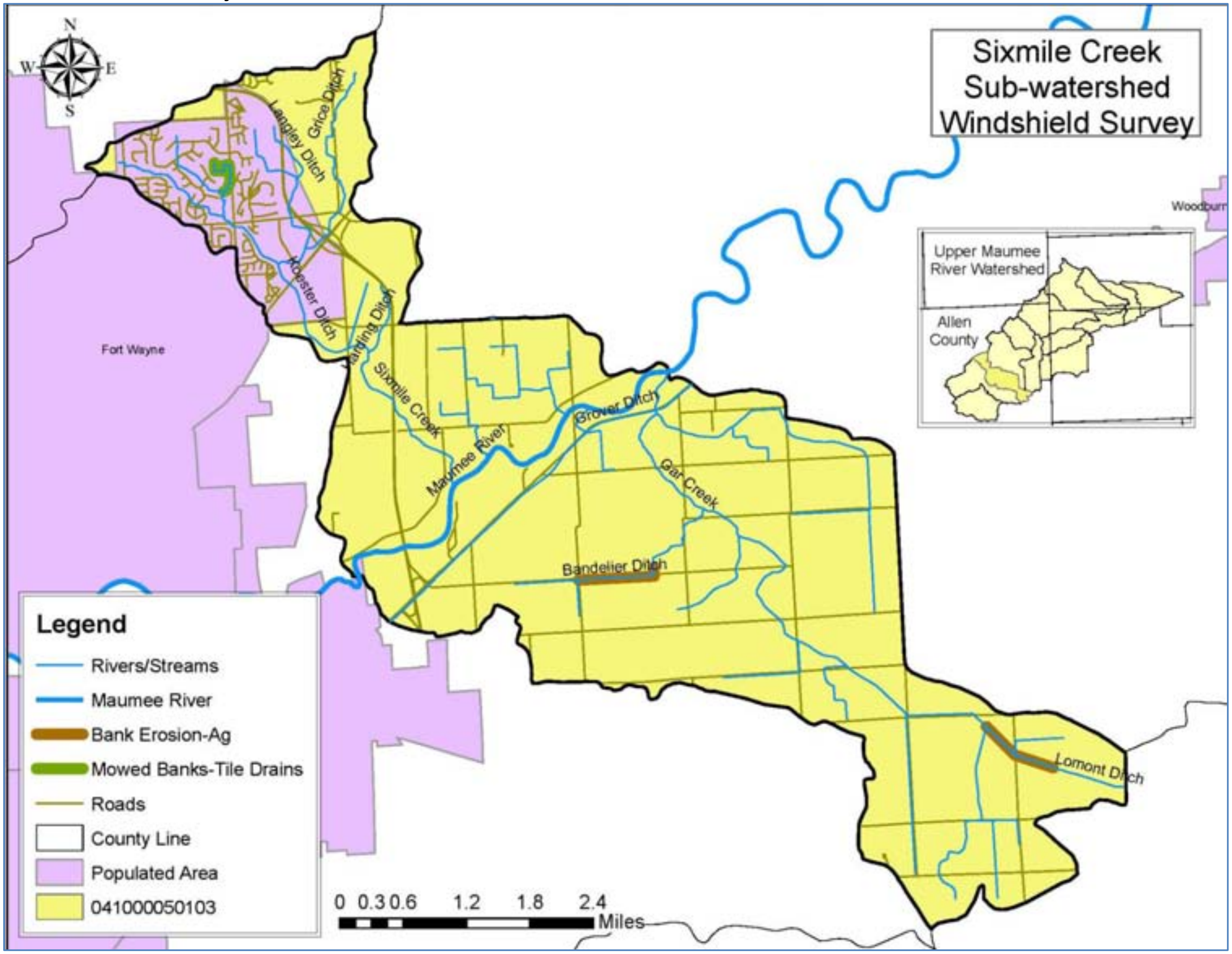
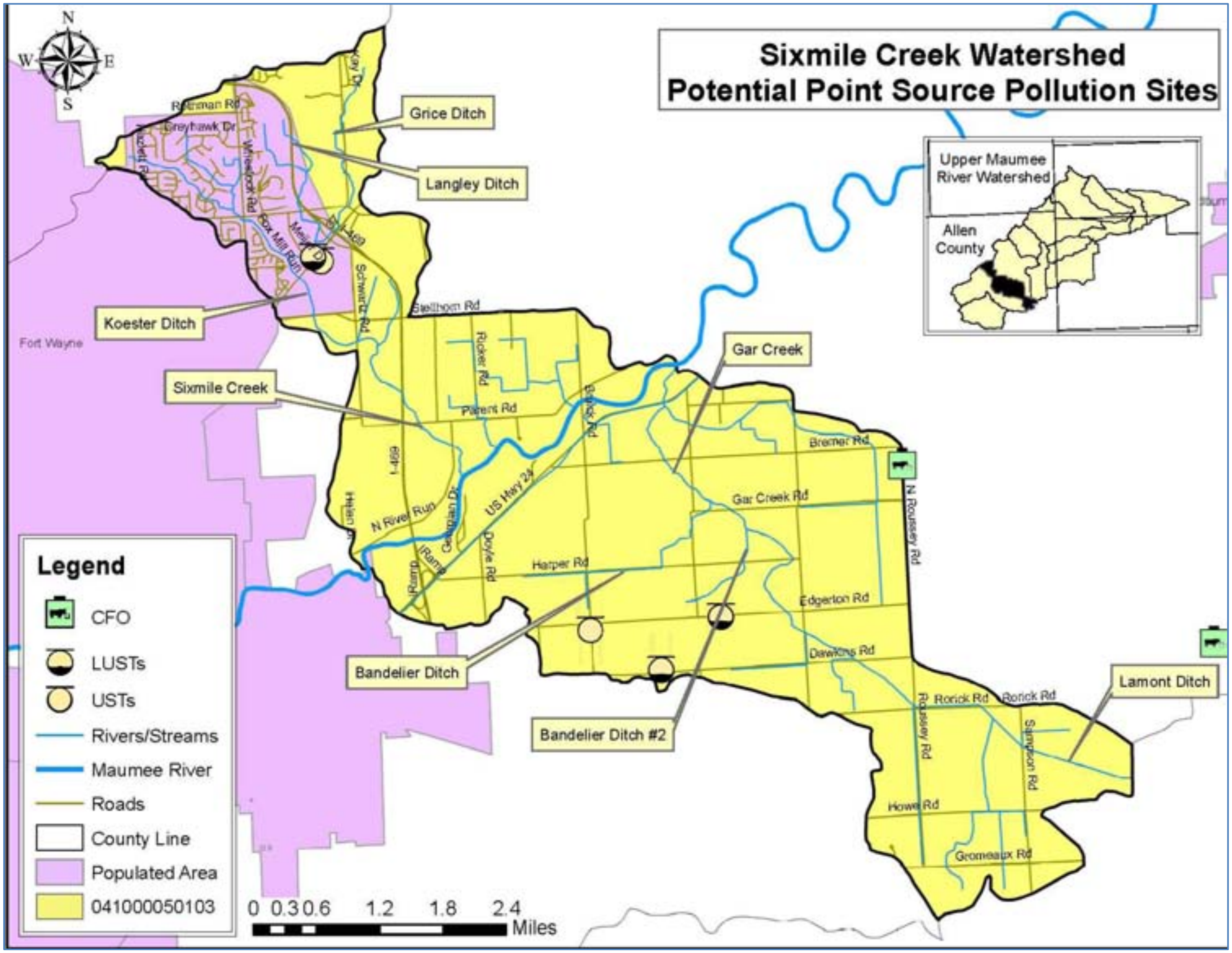


Figure 3.25: Point Source Pollution Sites in the Sixmile Creek Sub-watershed



3.4.4 Bottern Ditch Sub-watershed Land Use

The primary influence on water quality in the Bottern Ditch sub-watershed is agriculture with over 86% of the land being classified as agricultural by the USGS. Table 3.51 shows the percentage of Bottern Ditch Sub-watershed that is in each land use and Figure 3.25 is a map showing the delineation of land use in the sub-watershed. Using National Land Cover Data acquired from the USGS and analyzed in ArcGIS, 86.5% of the land use in Bottern Ditch sub-watershed is in production with 68.74% of that being used strictly for cultivated crops and 17.76% is classified as pasture or hayland. Less than 9% of the watershed is classified as developed. Woodburn, IN is just east of the watershed, so there is a small portion of Woodburn's population in the watershed as well. However, less than 1% of the developed land is either a medium or high intensity developed area.

There were 54 locations identified as potential problems during the windshield survey conducted in 2012 in the Bottern Ditch sub-watershed. The majority of those sites were found scattered throughout the agricultural area of the watershed with 18 locations being identified as agricultural induced streambank erosion totaling over 24,100 ft of streambank exhibiting erosion problems and 19 locations where livestock have direct access to a stream or ditch as their water source or to pass between pastures. It is important to note that much of the agricultural area of the Bottern Ditch sub-watershed is home to a large Amish community where using the resources available such as an open water source to water livestock, is common practice. There were also two residential sites with moderate to severe erosion and grass mowed to the streambank, one site where a farm equipment sales center is adjacent to the stream inducing slight streambank erosion, one site that has become a trash depository along the streambank, and four locations (2 urban and 2 agriculture sites) where the streambank has been armored with rip rap or cemented to try to prevent erosion of the bank. However, armored banks often move water faster and have the potential to induce bank erosion downstream. Finally, there are four sites where there is evidence of polluted runoff from barnyards, including one with a concrete drain from the barnyard, directly to the ditch, and there are four locations where the pasture fields are within close proximity to the streambank allowing for polluted runoff to reach open water without much filtering beforehand.

There was one location identified during the windshield survey where it was evident that a chemical herbicide was used to kill vegetation along the streambank. Though only one location was identified during the survey, it is believed that this is a prevalent problem throughout the watershed and should be addressed through education and outreach efforts. Table 3.52 shows the observations that were made during the windshield survey and the approximate number of feet that will need to be remediated to improve water quality in the Bottern Ditch sub-watershed and Figure 3.26 shows the location of each of the observations.

There are a few potential point sources of pollution in the Bottern Ditch sub-watershed. There are nine USTs located in the Bottern Ditch sub-watershed, with four of those being LUSTs.

However, only one business currently has active LUSTs which are still leaking and potentially contaminating soil and groundwater. If the contents held in any of the USTs leak it can leach through the soil and reach groundwater contaminating drinking water wells of local residents, or leach into surface waters and decrease water quality and affect aquatic life. Table 3.53 which tells the location of the LUST, its priority for cleanup and the area that is affected by the leak. Note that some facilities may be listed in the table more than once due to the fact that there may have been multiple instances of the UST leaking.

There are two NPDES permitted facilities located in the Bottern Ditch sub-watershed. Both facilities are located around Woodburn, IN. The Goodrich Tire plant has had two effluent exceedances between 2009 and 2012. However, the issue has since been cleared up and no enforcement actions were necessary. Table 3.54 lists the NPDES permitted facilities located in the Bottern Ditch sub-watershed. There are no brownfields, or CSOs located within the Bottern Ditch sub-watershed. The LUSTs located in Bottern Ditch sub-watershed are listed in Figure 3.27 shows the location of each of the point sources of pollution.

Table 3.51: Land Use in the Bottern Ditch Sub-watershed

Open Water	Dev. Open Space	Dev. Low Intensity	Dev. Medium /High Intensity	Barren Land	Deciduous Forest	Evergreen Forest and shrub/ scrub	Grassland/ Herbaceous	Pasture/ Hayland	Cultivated Crops	Woody and Emergent Herb-aceous Wetland	Total	Unit
240.44	1,183.67	302.59	52.97	3.36	883.32	67.38	97.80	3,860.58	14,937.73	102.18	21,732.1	Acres
1.10%	5.45%	1.39%	<1%	<1%	4.06%	<1%	<1%	17.76%	68.74%	<1%	100.00%	%

Table 3.52: Windshield Survey Observations in the Bottern Ditch Sub-watershed

Observation	Bank Erosion (Agriculture)	Bank Erosion (Urban)	Bank erosion (Commercial)	Armored Banks	Livestock Access	Illegal Dump Site	Residential Chemical Use	Barnyard Runoff	Pasture Runoff
Number	24,104.66 ft	1,721.23 ft	251.91 ft	222.06 ft	19	1	1	4	4

Table 3.53: Leaking Underground Storage Tanks in the Bottern Ditch Sub-watershed

UST FACILITY ID	INCIDENT NUMBER	NAME	STREET ADDRESS	CITY	STATE	ZIP	COUNTY	PRIORITY DESCRIPTION	AFFECTED AREA DESCRIPTION	DESCRIPTION
19466	199108565	Norfolk & Western Railroad	1900 S Rousy Rd	Edgerton	IN	46787	Allen	Low	Soil	Discontinued (active)
16785	200504510	Country Oasis	16817 Us 24 E	Woodburn	IN	46797	Allen	Medium	Soil, Groundwater	Active
								High	Soil, Groundwater, Free Product	Active
17563	200201503	Hanson Aggregates	17831 Hwy 24 E	Woodburn	IN	46707	Allen	Low	Soil	NFA-Unconditional Closure
15200	199806544	Harlan Blk Plnt &Filling Station	16205 Sr 37	Harlan	IN	46743	Allen	Low	Soil	NFA-Unconditional Closure

Table 3.54: NPDES Facilities in the Bottern Ditch Sub-watershed

Permit Name	Permit #	County Name	Street Address	City	State Code	State Water Body Name	Effluent Exceedance–3 yrs (Substance)	Enforcement Actions (I=informal; F=formal) (5 yrs)
BF Goodrich Tire Manufacturing	IN0000507	Allen	18906 US 24 E	Woodburn	IN	Maumee River	2 (NonRNCV, TSS)	0
The Country Oasis	ING080256	Allen	16817 East US 24	Woodburn	IN	Grover Ditch	0	0

Figure 3.26: Land Use in the Bottern Ditch Sub-watershed

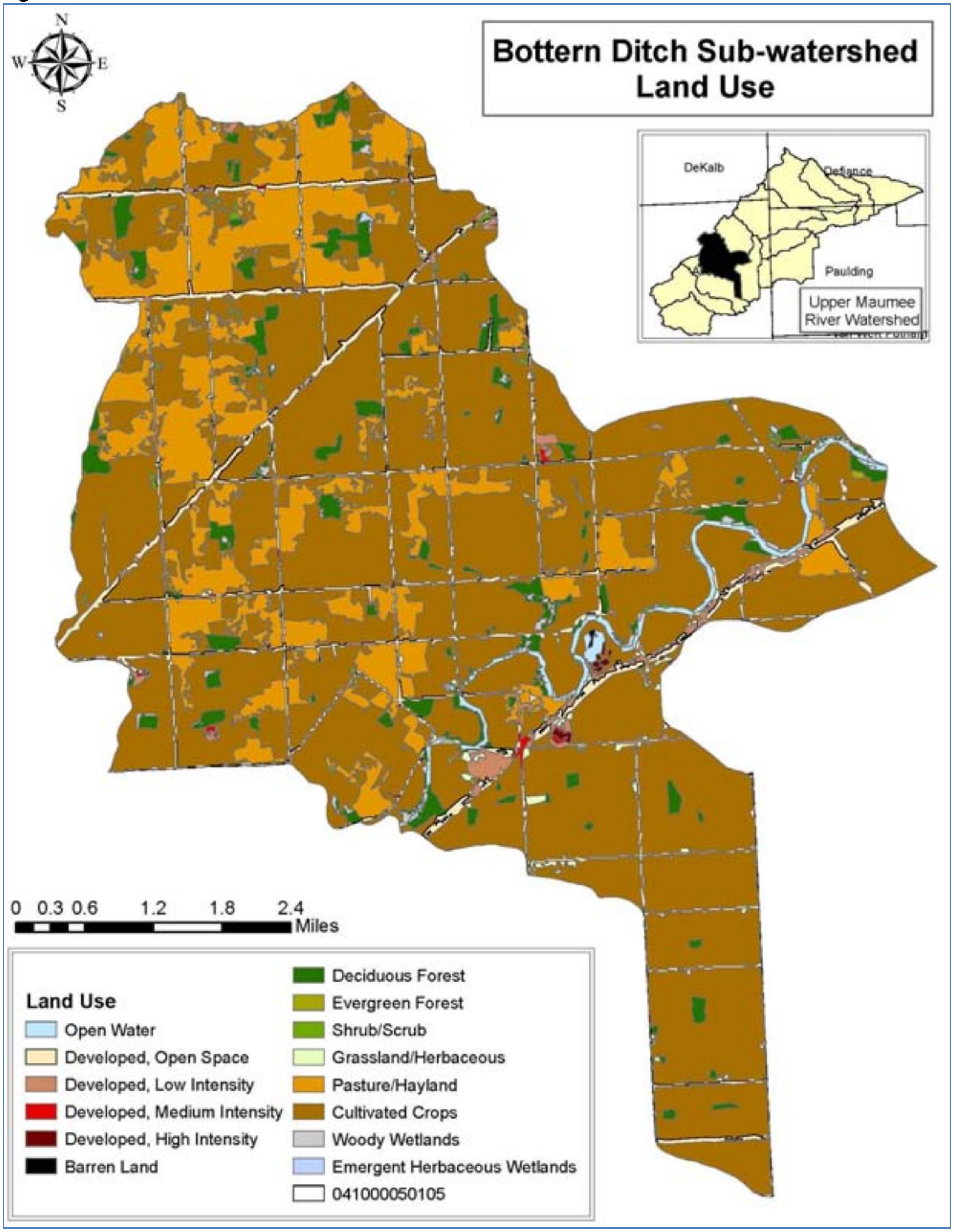


Figure 3.27: Windshield Survey Observations in the Bottern Ditch Sub-watershed

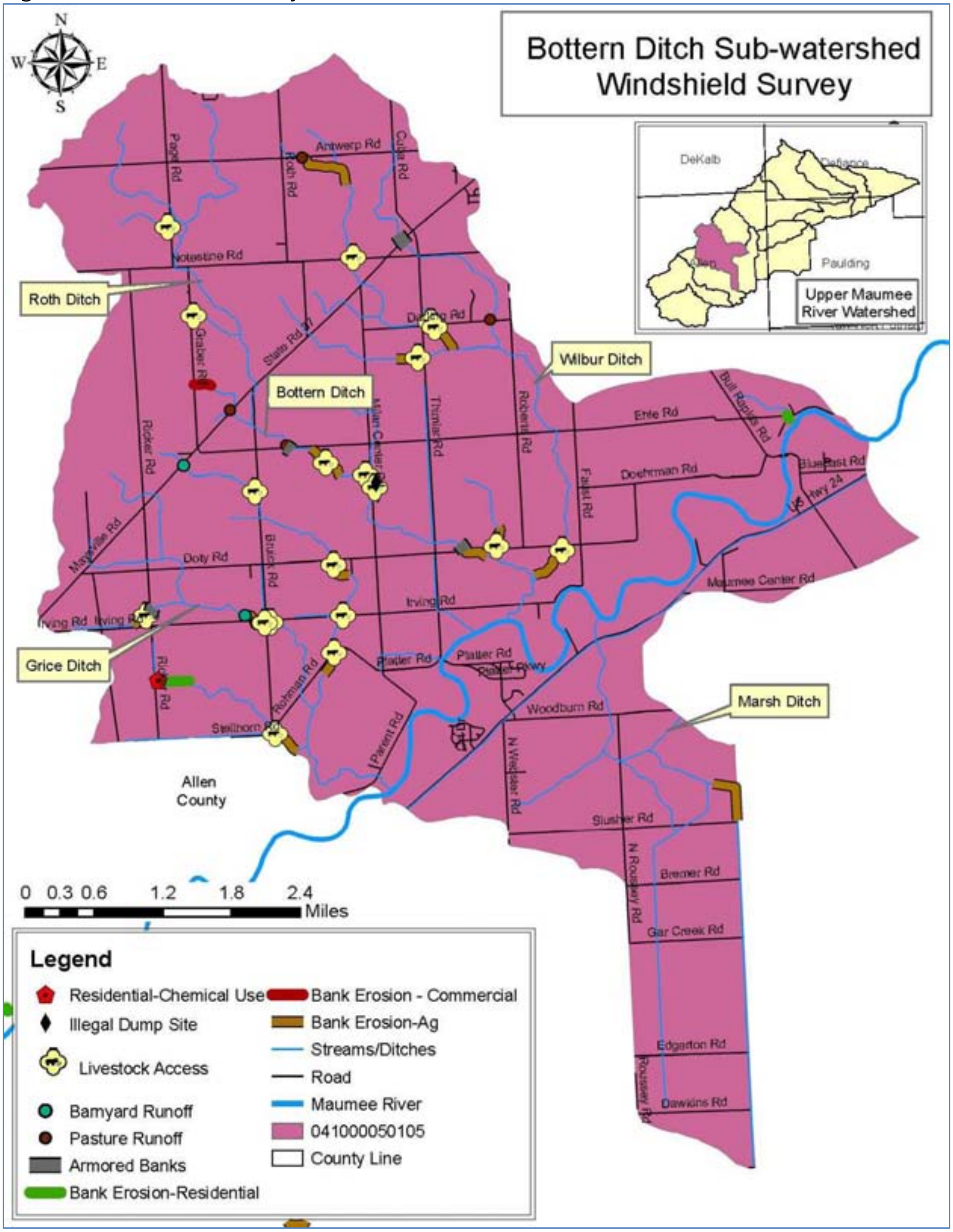
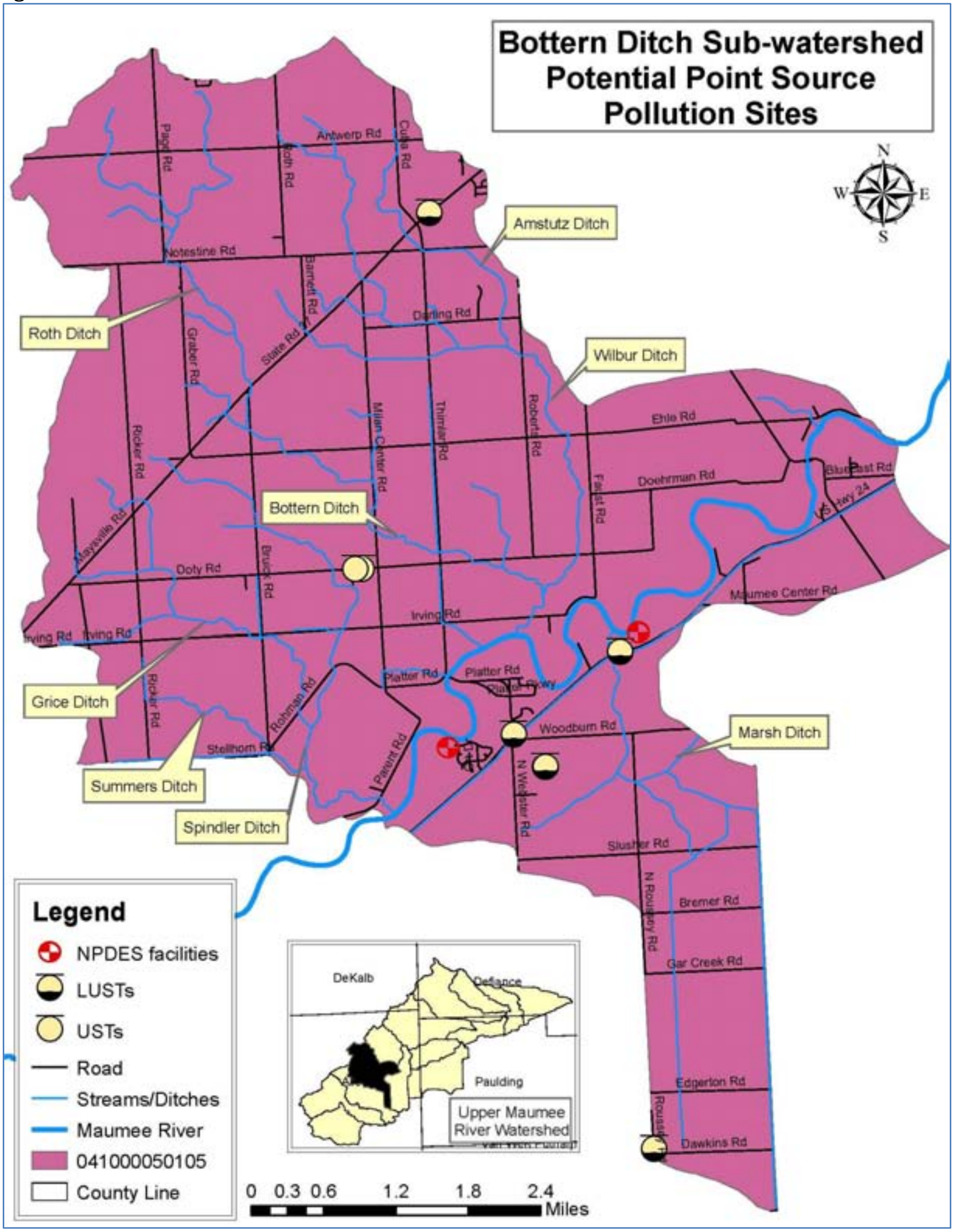


Figure 3.28: Potential Point Source Pollution Sites in the Bottern Ditch Sub-watershed



3.4.5 Black Creek Sub-watershed Land Use

The primary influence on water quality in the Black Creek sub-watershed is agriculture with nearly 90% of the land being classified as agricultural by the USGS. Table 3.55 shows the percentage of Black Creek Sub-watershed that is in each land use and Figure 3.28 is a map showing the delineation of land use in the sub-watershed. Using National Land Cover Data acquired from the USGS and analyzed in ArcGIS, 89.9% of the land use in Black Creek sub-watershed is in production with 76.76% of that being used strictly for cultivated crops and 13.18% is classified as pasture or hayland. Less than 7% of the watershed is classified as developed. The small village of Harlan is located in the Black Creek sub-watershed with a population of 1,634 according to the 2010 US Census. However, less than 2% of the developed land is populated since nearly 5% of the developed land is considered to be open space.

There were 27 locations identified as potential problems during the windshield survey conducted in 2012 in the Black Creek sub-watershed. The majority of those sites were found scattered throughout the agricultural area of the watershed with 3 locations being identified as agricultural induced streambank erosion totaling over 3,700 ft of streambank exhibiting erosion problems, 5 locations where livestock have direct access to a stream or ditch as their water source, five locations exhibiting runoff from a barnyard or pasture and two locations where gullies were formed due to stormwater surface runoff on agricultural fields. It is important to note that much of the agricultural area of the Black Creek sub-watershed is also home to a large Amish community where using the resources available such as an open water source to water livestock, is common practice.

The location where a high amount of algae was observed on Killian Creek may have been due to the tile drain from the adjacent pasture, or to excessive fertilizer being used on the adjacent residential lawn. It should be noted that the water near the tile outlet on Bull Rapids Rd was a murky white color, which is often indicative of high phosphorus levels though this cannot be confirmed as water testing has not taken place at this site. Table 3.56 shows the observations that were made during the windshield survey and the approximate number of feet, where applicable, that will need to be remediated to improve water quality in the Black Creek sub-watershed and Figure 3.29 shows the location of each of the observations.

There are a few potential point sources of pollution in the Black Creek sub-watershed including eight USTs, with four of those being LUSTs. However, only one business currently has an active LUST which is still leaking and potentially contaminating soil. If the contents held in any of the USTs leak it can leach through the soil and reach groundwater contaminating drinking water wells of local residents, or leach into surface waters and decrease water quality and affect aquatic life. Table 3.57 tells the location of the LUST, its priority for cleanup and the area that is affected by the leak. There are five CFOs located in the Black Creek sub-watershed, four of which are CAFOs. Table 3.58 identifies which CAFOs are located in the Black Creek sub-watershed. There are no brownfields, or CSOs located within the Black Creek sub-watershed. The LUSTs located in Black Creek sub-watershed are delineated in Figure 3.30.

Table 3.55: Land Use in the Black Creek Sub-watershed

Open Water	Dev. Open Space	Dev. Low Intensity	Dev. Medium Intensity	Dev. High Intensity	Deciduous Forest	Shrub/ Scrub	Grassland/ Herbaceous	Pasture / Hayland	Cultivated Crops	Woody and Emergent/ Herbaceous Wetland	Total	Unit
9.81	595.5	183.76	31.59	8.41	627.86	65.53	11.26	1619.03	9,061.28	70.95	12,285	Acres
<1%	4.84%	1.50%	<1%	<1%	5.11%	<1%	<1%	13.18%	76.76%	<1%	100.00%	%

Table 3.56: Windshield Survey Observations in the Black Creek Sub-watershed

Observation	Bank Erosion (Ag.)	Bank Erosion (Urban)	Bank erosion (Natural)	Gully Erosion	Armored Banks	Armored Surface Drain	Livestock Access	High Algae	Res. Chemical Use	Barnyard Runoff	Pasture Runoff	Pipe Outlet
Number	3,705.5 ft	3,432.1 ft	124.9 ft	98.5 ft	116.5 ft	39.3 ft	5	1	1	2	3	3

Table 3.57: Leaking Underground Storage Tanks in the Black Creek Sub-watershed

UST FACILITY ID	INCIDENT NUMBER	NAME	STREET ADDRESS	CITY	STATE	COUNTY	PRIORITY DESCRIPTION	AFFECTED AREA DESCRIPTION	DESCRIPTION
5093	199507521	Harlan Marathon	17013 SR 37 N	Harlan	IN	Allen	Low	Soil	NFA-Unconditional Closure
19775	199512500	Lll Building	16833 Antwerp Rd	Harlan	IN	Allen	Low	Soil	Active
13569	199008613	Irving Ready Mix Inc	20231 Sr 37	Grabill	IN	Allen	Low	Soil	Discontinued (active)
5802	199311504	American Tower - Grabill	17119 Hurshtown Rd	Grabill	IN	Allen	Low	Soil	Discontinued (active)

Table 3.58: Confined Feeding Operations in the Black Creek Sub-watershed

Operation	Sub-watershed	Designation	Animal Type	Animal #
James and Rosa Lengacher	Black Creek	CFO	Broilers	53,000
Mark S Rekeweg	Black Creek	CAFO	Finishers/Nursery Pigs	7,000/1,000
Impressive Pork Production Inc	Black Creek	CAFO	Finishers	4,800
Schlatter Farms LLC	Black Creek	CAFO	Finishers	4,000
Mark S Rekeweg	Black Creek	CAFO	Grow-Finisher	2,000

Figure 3.29: Land Use in the Black Creek Sub-watershed

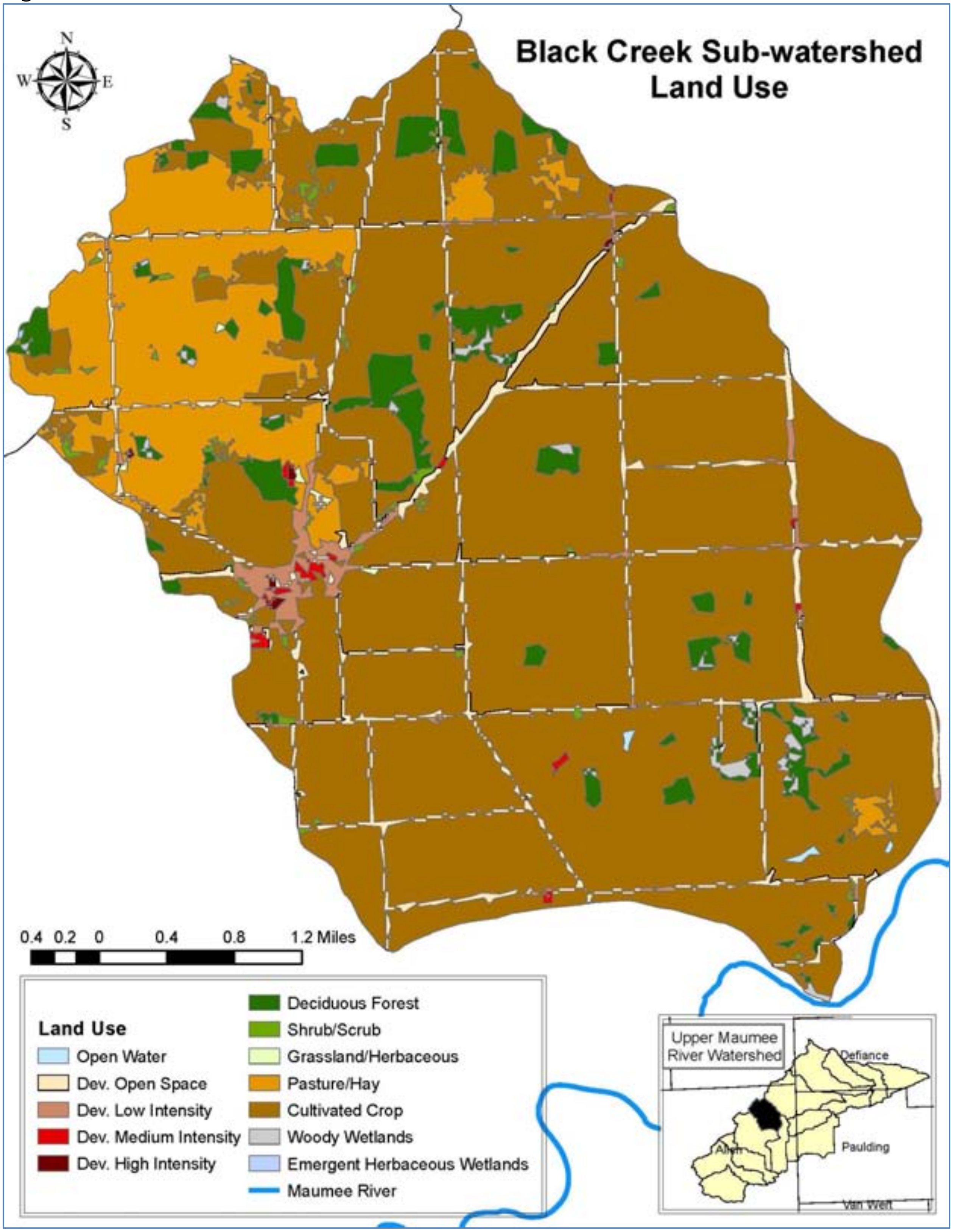


Figure 3.30: Windshield Survey Observations in the Black Creek Sub-watershed

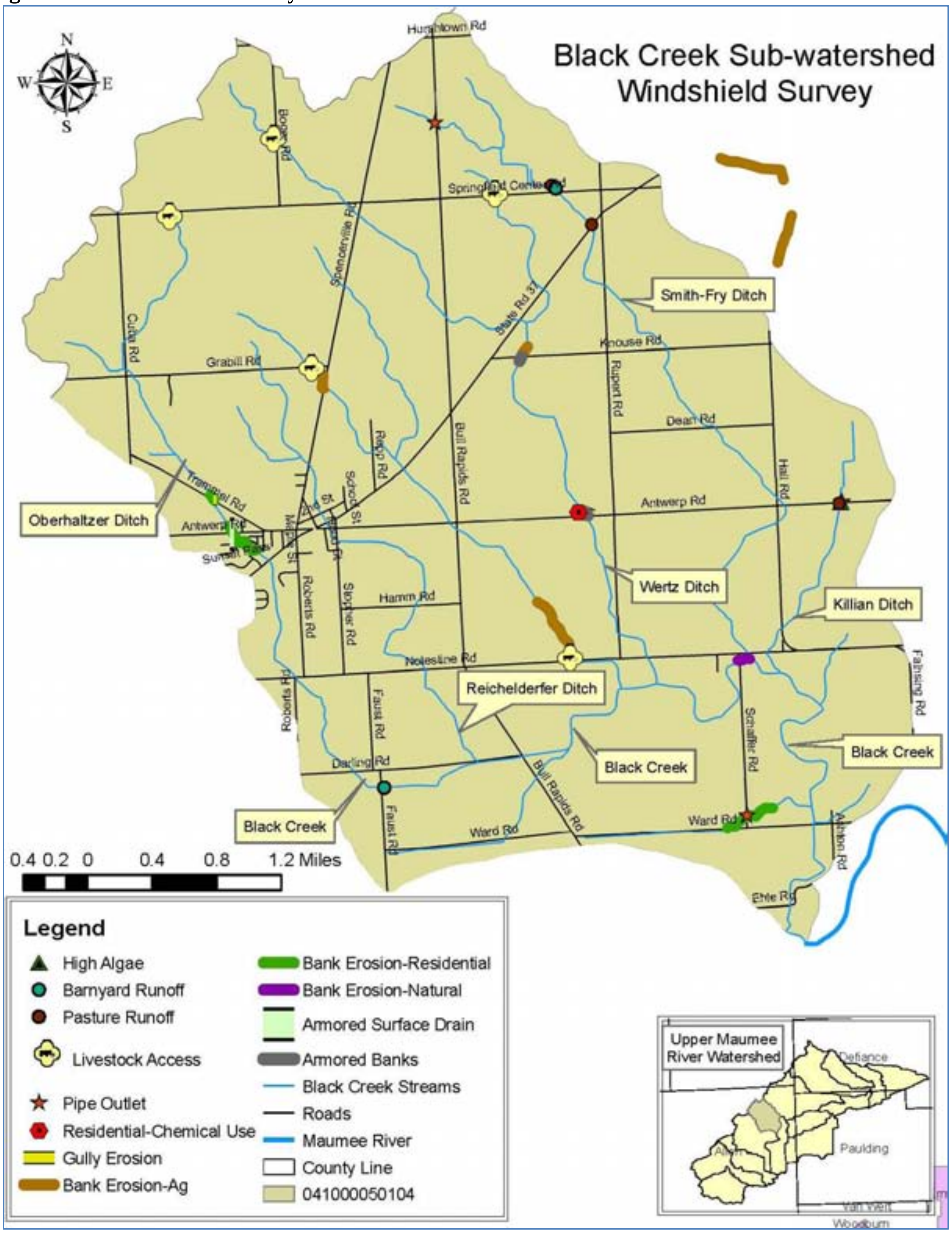
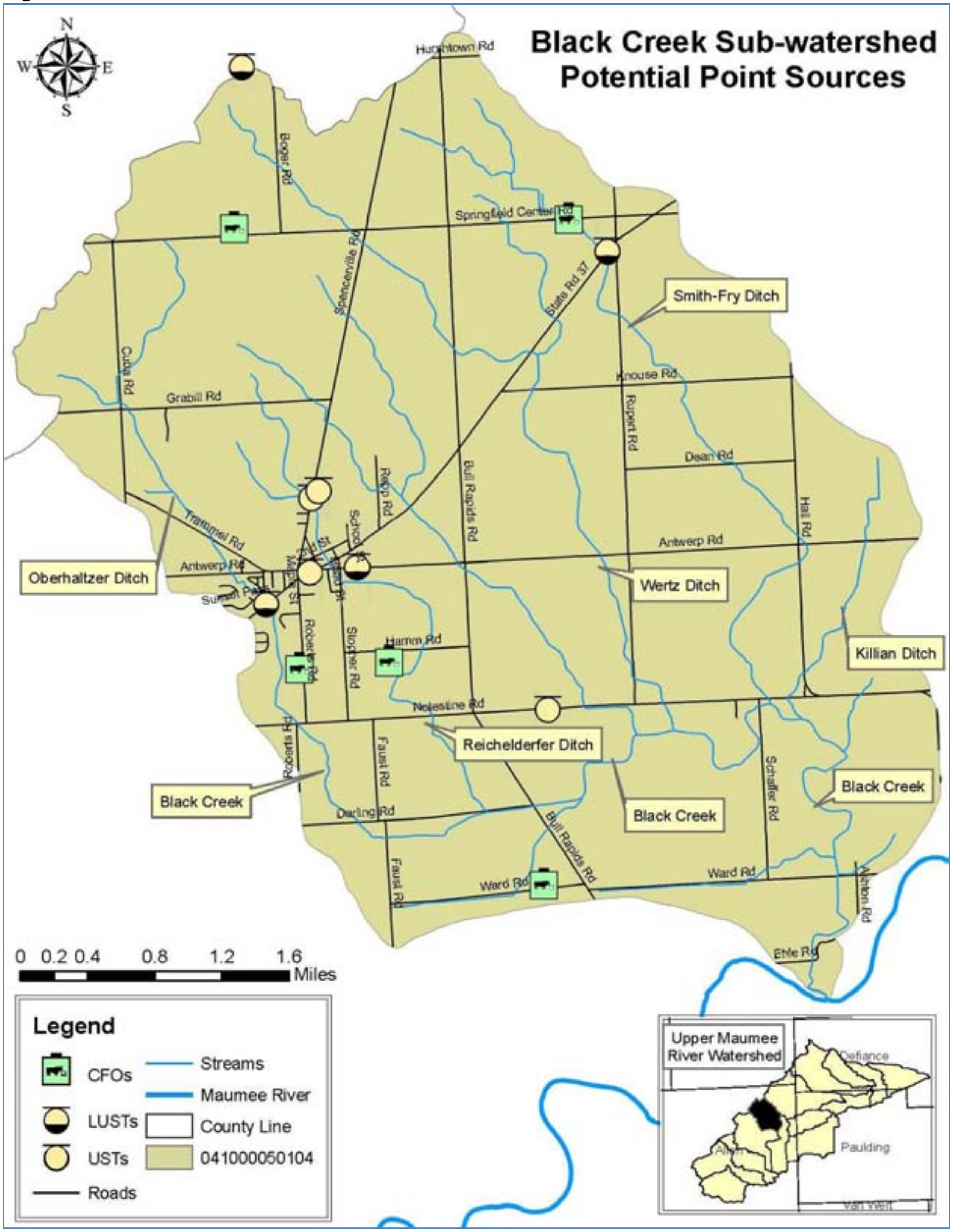


Figure 3.31: Potential Point Source Pollution Sites in the Black Creek Sub-watershed



3.4.6 Marsh Ditch Sub-watershed Land Use

The primary influence on water quality in the Marsh Ditch sub-watershed is agriculture with nearly 90% of the land being classified as agricultural by the USGS. Table 3.59 shows the percentage of Marsh Ditch Sub-watershed that is in each land use and Figure 3.31 is a map showing the delineation of land use in the sub-watershed. Using National Land Cover Data acquired from the USGS and analyzed in ArcGIS, approximately 88% of the land use in Marsh Ditch sub-watershed is in production with 87.22% of that being used strictly for cultivated crops and <1% is classified as pasture or hayland. Less than 9% of the watershed is classified as developed. The small town of Woodburn, IN is located in the Marsh Ditch sub-watershed with a population of 1,520 according to the 2010 US Census. However, less than 4% of the developed land comprises the majority of the population since over 5% of it is considered to be open space.

There were five locations identified as potential problems during the windshield survey conducted in 2012 in the Marsh Ditch sub-watershed. All of the sites can be attributed to urban, residential issues including two gutter downspouts that drain directly to the ditch and have induced moderate streambank erosion around the outlets and the outlet from the Woodburn WWTP where the water appears murky and severe erosion is present. There is over 1,135 ft of streambank eroding where streambank stabilization BMPs can improve the water quality and integrity of the streambank. Table 3.60 shows the observations that were made during the windshield survey and the approximate number of feet, where applicable, that will need to be remediated to improve water quality in the Marsh Ditch sub-watershed and Figure 3.32 shows the location of each of the observations.

There are a few potential point sources of pollution present in the Marsh Ditch sub-watershed including the NPDES permitted facilities Woodburn WWTP and Hanson Aggregates, a rock quarry, which are outlined in Table 3.61. It should be noted that the Woodburn WWTP has had 39 exceedances of its regulated discharges over the past three years. There are six USTs located in the Marsh Ditch sub-watershed, with two of those being LUSTs. Only one of the LUSTs is still active, however that LUST has the potential to contaminate surface water, ground water, soil, and the Woodburn Wellhead Protection Area so it is very important that the leak be remediated as soon as possible. If the contents held in any of the USTs leak it can leach through the soil and reach groundwater contaminating drinking water wells of local residents, or leach into surface waters and decrease water quality and affect aquatic life. Table 3.62 tells the location of the LUSTs, their priority for cleanup and the area that is affected by the leak. Finally, there are two CFOs located within the Marsh Ditch sub-watershed which are outlined in Table 3.63. There are no brownfields, or CSOs located within the Marsh Ditch sub-watershed. All potential point source pollution sites are delineated in Figure 3.33.

Table 3.59: Land Use in the Marsh Ditch Sub-watershed

Open Water	Dev. Open Space	Dev. Low Intensity	Dev. Medium and High Intensity	Barren Land	Deciduous Forest	Shrub/ Scrub	Grassland/ Herbaceous	Pasture/ Hayland	Cultivated Crops	Woody and Emergent Herbaceous Wetlands	Total	Unit
164.2	660.32	325.12	82.76	26.78	149.08	1.12	100.74	24.02	10,803.47	48.48	12386.07	Acres
1.33%	5.33%	2.62%	<1%	<1%	1.20%	<1%	<1%	<1%	87.22%	<1%	100.00%	%

Table 3.60: Windshield Survey Observations in the Marsh Ditch Sub-watershed

Observation	Bank Erosion (Residential)	Bank erosion (Commercial)	Pipe Outlet
Number	725.74 ft	409.49 ft	3

Table 3.61: NPDES permitted Facilities in the Marsh Ditch Sub-watershed

Permit Name	Permit #	County Name	Street Address	City	State Code	State Water Body Name	Effluent Exceedances -3 yrs (Substances)	Enforcement Actions (I=informal; F=formal) (5 yrs)
Hanson Aggregates Midwest Inc	ING490049	Allen	22821 Dawkins Rd	Woodburn	IN	Edgerton Carson Ditch	0	0
Woodburn WWTP	IN0021407	Allen	23304 Tile Mill Rd	Woodburn	IN	Maumee River	39 (BOD, TSS)	4(I)

Table 3.62: Leaking Underground Storage Tanks in the Marsh Ditch Sub-watershed

UST FACILITY ID	INCIDENT NUMBER	NAME	STREET ADDRESS	CITY	STATE	COUNTY	PRIORITY DESCRIPTION	AFFECTED AREA DESCRIPTION	DESCRIPTION
13010	199810537	United Oil	4611 Bull Rapids Rd	Woodburn	IN	Allen	Medium	Wellhead Protection Area, Surface Water, Soil and Groundwater	Active
13206	199510516	Knoblauch Construction Inc	22610 Tile Mill Rd	Woodburn	IN	Allen	Low	Soil	NFA-Uncond. Closure

Table 3.63: Confined Feeding Operations in the Marsh Ditch Sub-watershed

Operation	Sub-watershed	Designation	Animal Type	Animal #
Richard and David Hartman	Marsh Ditch	CFO	Nursery Pigs/Finishers	1800 / 720
Brenneke Dairy	Marsh Ditch	CFO	Dairy	505

Figure 3.32: Land Use in the Marsh Ditch Sub-watershed

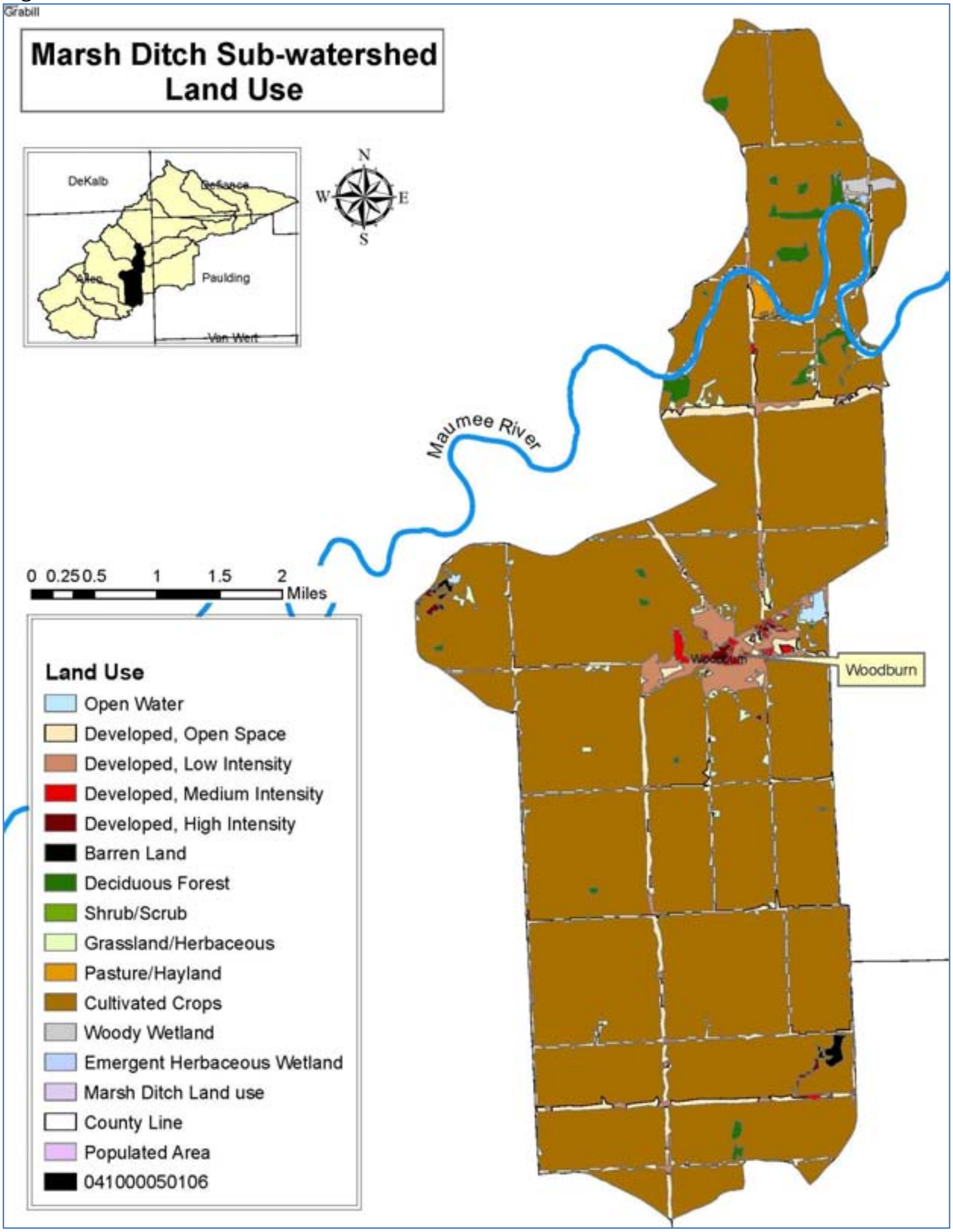


Figure 3.33: Windshield Survey Observations in the Marsh Ditch Sub-watershed

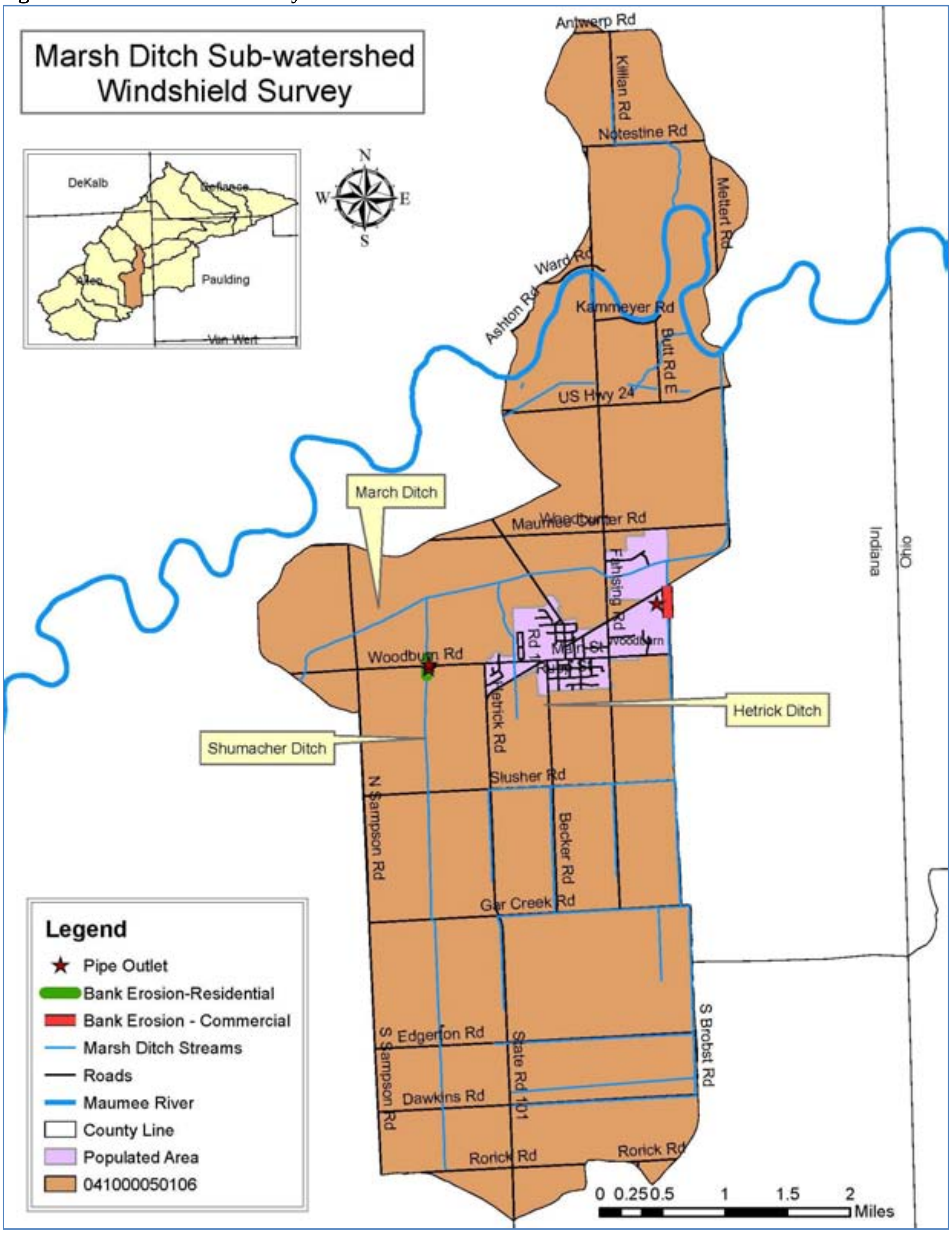
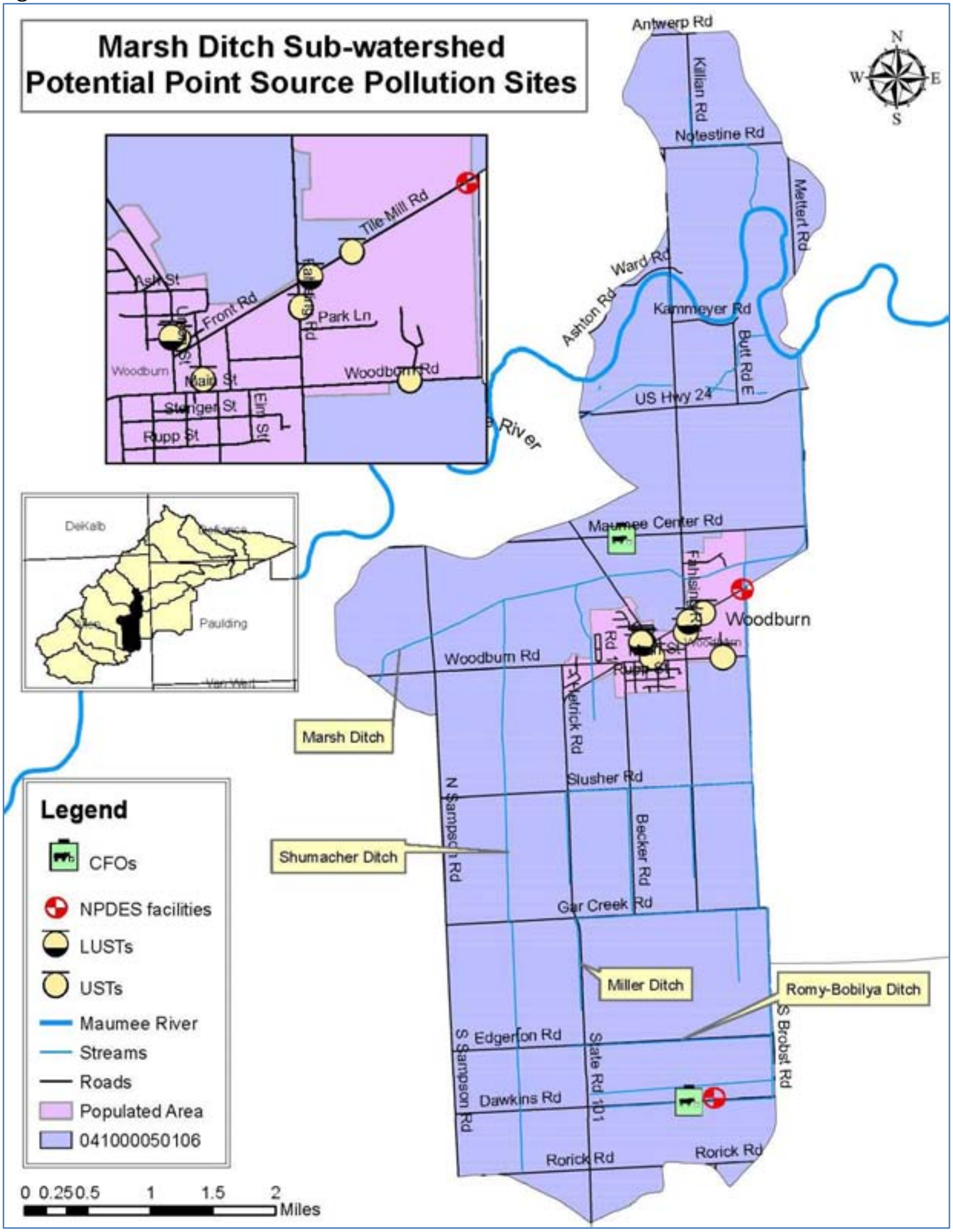


Figure 3.34: Potential Point Source Pollution Sites in the Marsh Ditch Sub-watershed



3.4.7 Marie DeLarme Sub-watershed Land Use

The primary influence on water quality in the Marie DeLarme sub-watershed is agriculture with nearly 87% of the land being classified as agricultural by the USGS. Table 3.64 shows the percentage of Marie DeLarme Sub-watershed that is in each land use and Figure 3.34 is a map showing the delineation of land use in the sub-watershed. Using National Land Cover Data acquired from the USGS and analyzed in ArcGIS, 86.72% of the land use in this sub-watershed is in production with 82.96% being classified as cultivated crops and 3.79% is classified as pasture or hayland. Only 5% of the watershed is classified as developed. The most Southwestern tip of Hicksville, OH is located within the Marie DeLarme sub-watershed, however less that 1% of the watershed is considered to be developed with any intensity.

There were 26 locations identified as potential problems during the windshield survey conducted in 2012 in the Marie DeLarme sub-watershed. Nearly all the sites are scattered throughout the agricultural landscape. It should be noted that there is a large Amish population present in the western portion of the Marie DeLarme sub-watershed who use mostly conventional farming techniques. There is one Amish run chicken house located in the sub-watershed, where proper manure storage could not be seen from the road and may pose a risk to the adjacent stream. The most significant amount of agricultural streambank erosion observed during the windshield survey was in the Marie DeLarme sub-watershed which needs nearly 20,000 ft of streambank stabilization. There were also two locations observed where livestock had direct access to open water which allows for direct deposit of animal waste into the water, as well as streambank erosion. One significant tile outlet, which drained a wheat field in 2012, and was surrounded by very high algae levels in the stream, was observed. There was one residential property where the riparian area and streambank appeared to have been sprayed with a broadcast herbicide. Finally, one field was observed that presented gully and rill erosion from the road to the ditch, as well as from the crop field to the ditch.

It should be noted that most of the road side ditches located in the Marie DeLarme sub-watershed exhibited erosion issues and rip rap is a common practice seen throughout the watershed used to stabilize banks. However, if not maintained, the rip rap can become a problem to the stream ecosystem. There were two locations where streambank erosion was due primarily to a lack of buffer along residential property situated within the rural landscape. Table 3.65 shows the observations that were made during the windshield survey and the approximate number of feet, where applicable, that will need to be remediated to improve water quality in the Marie DeLarme sub-watershed and Figure 3.35 shows the location of each of the observations.

There is only one potential point source of pollution present in the Marie DeLarme sub-watershed. There is one UST located in Allen County. This UST has not ever been reported to have leaked and is not expected to cause a problem to the surrounding environment. Figure 3.36 delineates the location of the UST. There are no NPDES facilities, brownfields, or CSOs located within the Marie DeLarme sub-watershed.

Table 3.64: Land Use in the Marie DeLarme Sub-watershed

Open Water	Dev. Open Space	Dev. Low Intensity	Dev. Medium and High Intensity	Deciduous Forest	Evergreen/ Mixed Forest	Grassland/ Herbaceous and Shrub/ Scrub	Barren Land	Pasture/ Hayland	Cultivated Crops	Woody and Emergent Herbaceous Wetland	Total	Unit
81.78	1541.4	86.95	19.45	1948.46	15.91	31.75	5.52	1246.52	27308.38	632.76	32918.88	Acres
<1%	4.68%	<1%	<1%	5.92%	<1%	<1%	<1%	3.79%	82.96%	1.92%	100.00%	%

Table 3.65: Windshield Survey Observations in the Marie DeLarme Sub-watershed

Observation	Bank Erosion (Agriculture)	Bank Erosion (Residential)	Gully Erosion	Armored Banks	Livestock Access	High Algae	Residential Chemical Use	Pasture Runoff	Pipe Outlet	AFO Runoff
Number	19967.28 ft	1,748.54 ft	260.28 ft	279.19 ft	2	1	1	1	1	1

Figure 3.35: Land Use in the Marie DeLarme Sub-watershed

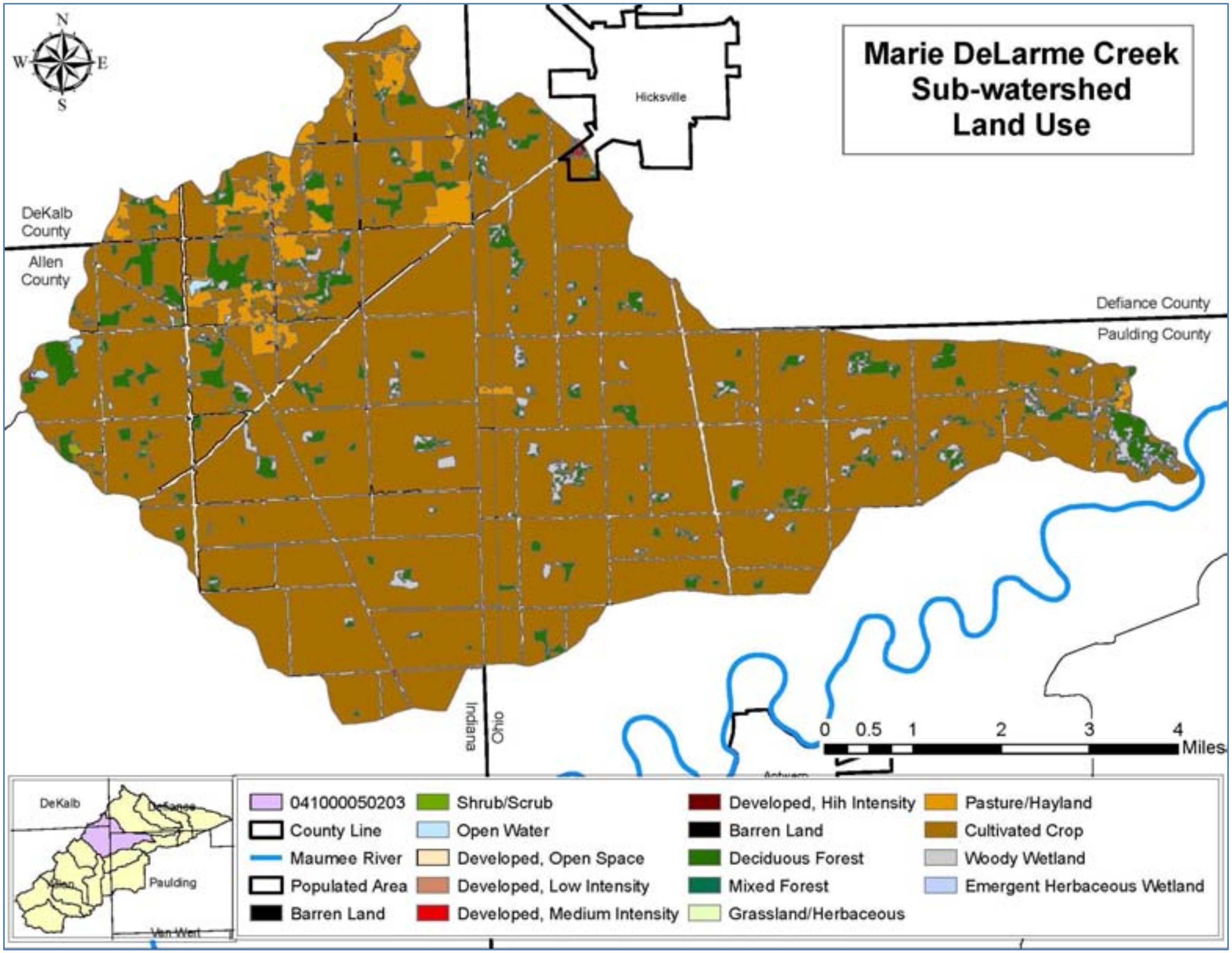


Figure 3.36: Windshield Survey Observations in the Marie DeLarme Sub-watershed

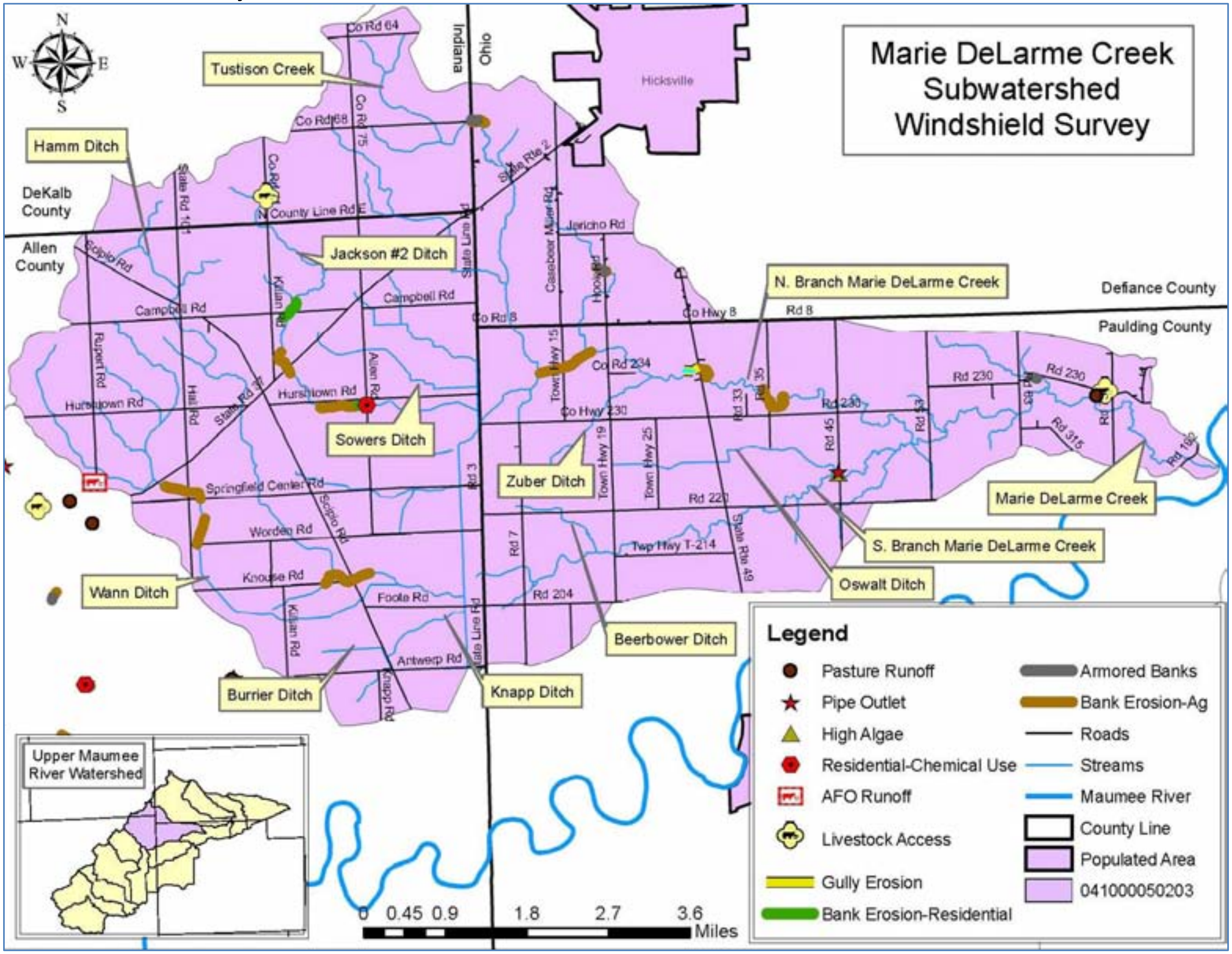
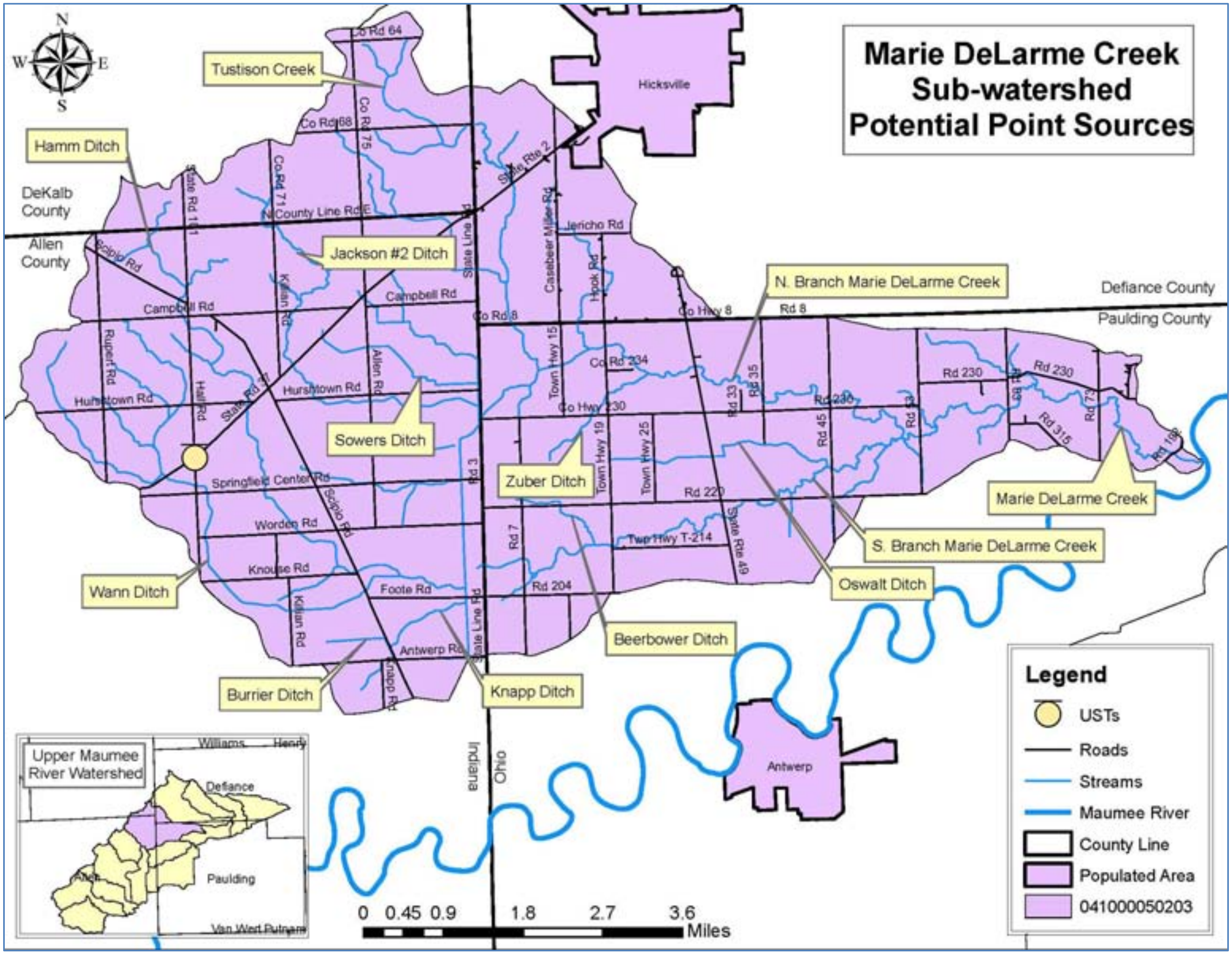


Figure 3.37: Potential Point Sources of Pollution in the Marie DeLarme Sub-watershed



3.4.8 North Chaney Ditch Sub-watershed Land Use

The primary influence on water quality in the North Chaney Ditch sub-watershed is agriculture with nearly 78% of the land being classified as agricultural by the USGS. Table 3.66 shows the percentage of North Chaney Ditch Sub-watershed that is in each land use and Figure 3.37 is a map showing the delineation of land use in the sub-watershed. Using National Land Cover Data acquired from the USGS and analyzed in ArcGIS, approximately 77.12% of the land use in North Chaney Ditch sub-watershed is in production with 76.91% of that being used strictly for cultivated crops. 13.38% of the watershed is classified as developed, with nearly 9% of developed land being classified as open space, which means that less than 20% of the land is impervious. The village of Antwerp is located in the watershed with a population of 1,733. However, medium and high intensity developed areas make up less than 1% of the watershed.

There were eight locations identified as potential problems during the windshield survey conducted in 2012 in the North Chaney Ditch sub-watershed. The majority of the problems, while scattered throughout the rural community, are related to residential or commercial properties including severe erosion at a golf course located at River Rd, and turf lawns with bank erosion due to a lack of buffer and one area at Rd 192 and Rd 45 where gravel was placed at the curve of the ditch and may be contributing to the bank erosion. Finally, there was one location where a tile drain was present which was leaking a black liquid during a drought. It may be assumed that the pipe is draining an on-site sewage disposal system. The final location is a horse pasture that is directly adjacent to a ditch. Table 3.67 shows the observations that were made during the windshield survey and the approximate number of feet, where applicable, that will need to be remediated to improve water quality in the North Chaney Ditch sub-watershed and Figure 3.38 shows the location of each of the observations.

There are several potential point sources of pollution in the North Chaney Ditch sub-watershed. There are five USTs located in Antwerp, OH, all of which are considered LUSTs by the state of Ohio. There is also one NPDES permitted facility that discharges into the Maumee River located NE of Antwerp. Table 3.68 is a list of the LUSTs located within the North Chaney Ditch sub-watershed. Note that some facilities may be listed in the table more than once due to the fact that there may have been multiple instances of the UST leaking. Table 3.69 lists the NPDES permitted facility located within the watershed. Figure 3.39 shows the location of each of the potential point sources located within the North Chaney Ditch sub-watershed.

Table 3.66: Land Use in the North Chaney Ditch Sub-watershed

Open Water	Dev. Open Space	Dev. Low Intensity	Dev. Medium and High Intensity	Barren Land	Deciduous Forest	Mixed Forest	Grassland/ Herbaceous and Shrub and Scrub	Pasture / Hayland	Cultivated Crops	Woody and Emergent/ Herbaceous Wetland	Total	Unit
563.46	1120.68	472.84	85.72	1.01	448.82	2.99	115.38	25.96	9651.8	60.83	12549.5	Acres
4.49%	8.93%	3.77%	<1%	<1%	3.58%	<1%	<1%	<1%	76.91%	<1%	100.00%	%

Table 3.67: Windshield Survey Observations in North Chaney Ditch Sub-watershed

Observation	Bank Erosion (Commercial)	Bank Erosion (Residential)	Armored Banks	Pasture Runoff	Tile Drain Discharge
Number	74.15 ft	68.16 ft	137.28 ft	1	1

Table 3.68: Leaking Underground Storage Tanks in the North Chaney Ditch Sub-watershed

FACILITY ID	INCIDENT NUMBER	NAME	STREET ADDRESS	CITY	STATE	COUNTY	Tank Contents	DESCRIPTION
63000016	N00001	Liberty Fuel Stop	506 E River RT 24	Antwerp	OH	Paulding	Gasoline/Diesel	NCR
63000018	N00001	Antwerp Pit Stop	310 W River St	Antwerp	OH	Paulding	Gasoline/Diesel	NFA/REM
	N00002						Gasoline	NFA/REM
63000039	N00001	Pop-N-Brew Drive Thru	102 N Main St	Antwerp	OH	Paulding	Unknown	NFA/REM
63009821	N00001	Dana Corporation	US 24 Near SR 49	Antwerp	OH	Paulding	Unknown	NFA
69002331	N00001	Smith Building	ST RT 49-Main St	Antwerp	OH	Paulding	Used Oil/Gasoline	NFA/REM

NFA = No Further Action; REM = Removed; NCR = No Closure Report Sent

Table 3.69: NPDES Permitted Facilities in the North Chaney Ditch Sub-watershed

Permit Name	Permit #	County Name	Street Address	City	State Code	State Water Body Name	Effluent Exceedances-3 yrs (Substance)	Enforcement Actions (I=informal; F=formal) (5 yrs)
Boston Weatherhead Div. DANA Co.	OH0002713	Paulding	5278 US 24E	Antwerp	OH	Maumee Cemetery Ditch	12 (trichloroethylene, Vinyl chloride, cis-1,2 -dichloroethylene	0

Figure 3.38: Land Use in the North Chaney Ditch Sub-watershed

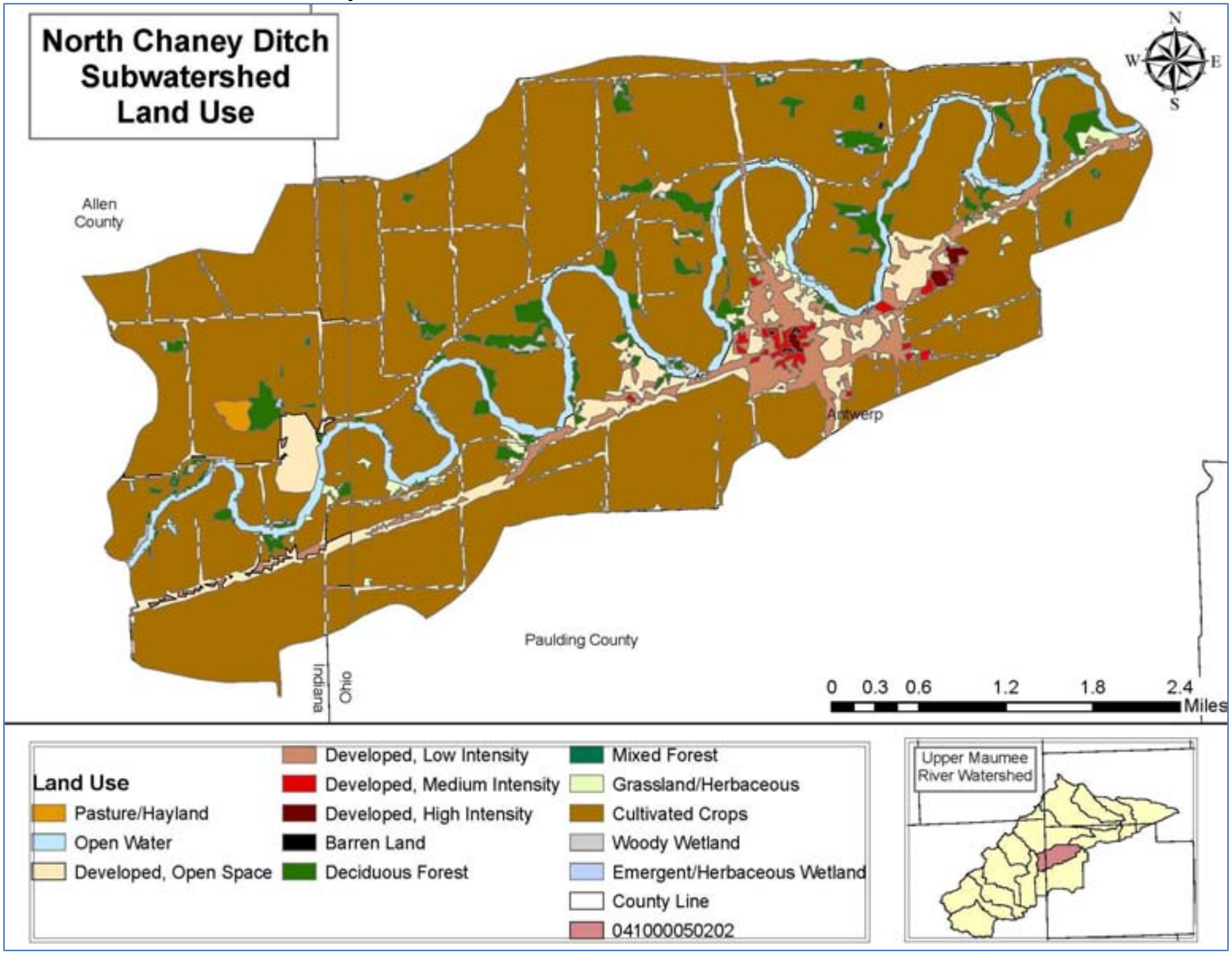


Figure 3.39: Windshield Survey Observations in the North Chaney Ditch Sub-watershed

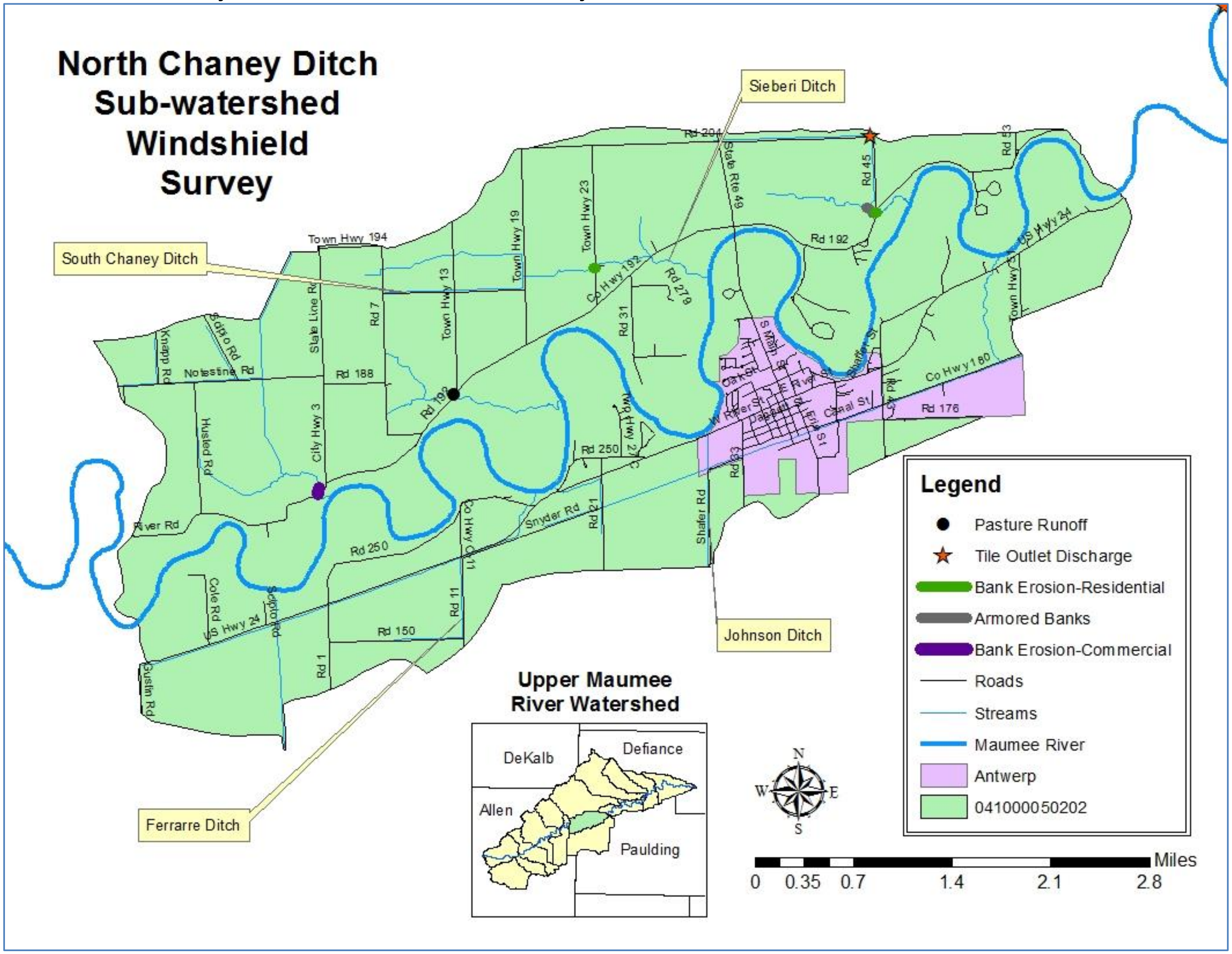
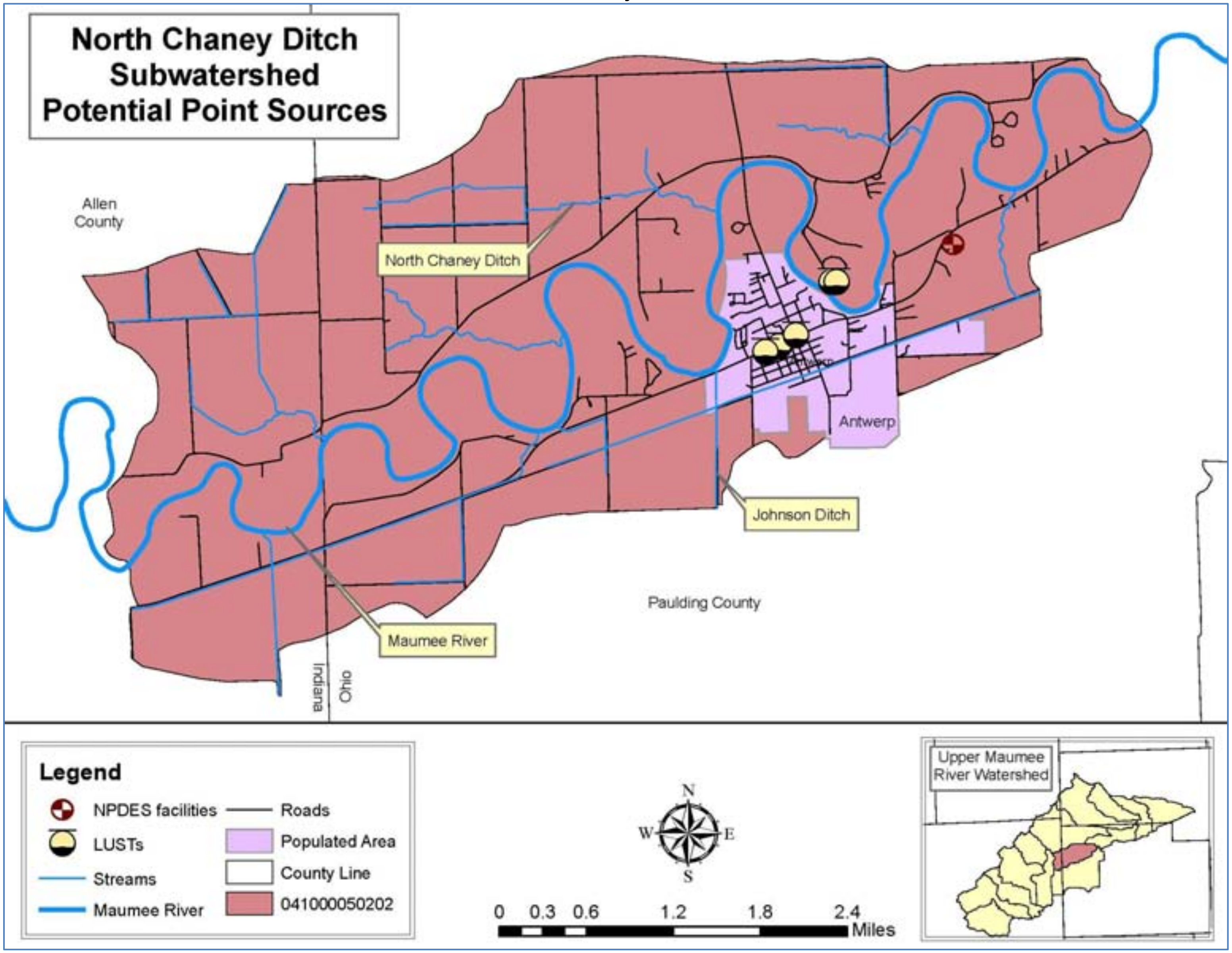


Figure 3.40: Potential Point Source Pollution Sites in the North Chaney Ditch Sub-watershed



3.4.9 Zuber Cutoff Sub-watershed Land Use

The primary influence on water quality in the Zuber Cutoff sub-watershed is agriculture with 95% of the land being classified as agricultural by the USGS. Table 3.70 shows the percentage of Zuber Cutoff Sub-watershed that is in each land use and Figure 3.40 is a map showing the delineation of land use in the sub-watershed. Using National Land Cover Data acquired from the USGS and analyzed in ArcGIS, approximately 94% of the land use in Zuber Cutoff sub-watershed is used strictly for cultivated crops. Zuber Cutoff sub-watershed is located along the border of Woodburn, IN and Antwerp, OH which may account for the developed areas located within the watershed, however less than 5% of the watershed is considered to be developed. It is important to note that the majority of the waterways located within the Zuber Cutoff sub-watershed have been channelized, as is evident in Figure 3.40 where the straightness of the waterways can be observed. Channelizing the streams allow for quick movement of the water to prevent flooding, however this activity can exacerbate flooding issues downstream, as well as increase pollution in the water by not allowing any to settle out on the natural floodplain and degrade aquatic habitat.

There were nine locations identified as potential problems during the windshield survey conducted in 2012 in the Zuber Cutoff sub-watershed. All of the issues observed were due to unsustainable agricultural practices including a lack of riparian buffer, and conventional tillage. There were nine locations where there was moderate to severe bank erosion totaling over 3,600 feet of damaged streambank. There were also two areas with severe gully erosion leading to a ditch which totals 475 ft of gully erosion. Finally there was one location that was a cattle farm with what appeared to be inadequate manure storage for the number of cattle present. Table 3.71 shows the observations that were made during the windshield survey and the approximate number of feet, where applicable, that will need to be remediated to improve water quality in the Zuber Cutoff sub-watershed and Figure 3.41 shows the location of each of the observations.

There are a few potential point sources of pollution in the Zuber Cutoff sub-watershed. There is one UST located east of Woodburn, IN, though there are no LUSTs in the watershed. There are three NPDES permitted facilities that discharge into tributaries of the Maumee River. Table 3.72 lists the NPDES permitted facilities located within the watershed. There are also two Confined Feeding Operations located within Zuber Cutoff sub-watershed and both of the CFOs are considered to be CAFOs due to their size and are regulated by the OEPA. Table 3.73 lists the CFOs located within the sub-watershed. Figure 3.42 shows the location of each of the potential point sources of pollution located within the Zuber Cutoff sub-watershed.

Table 3.70: Land Use in the Zuber Cutoff Sub-watershed

Open Water	Dev. Open Space	Dev. Low Intensity	Dev. Medium Intensity	Dev. High Intensity	Deciduous Forest	Shrub/ Scrub	Grassland/Herbaceous	Cultivated Crops	Emergent Herbaceous Wetlands	Total	Unit
5.79	989.76	130.94	13.82	4.23	81.57	1.4	139.43	23248.56	2.23	24,617.73	Acres
<1%	4.02%	<1%	<1%	<1%	<1%	<1%	<1%	94.44%	<1%	100%	%

Table 3.71: Windshield Survey Observations in the Zuber Cutoff Sub-watershed

Observation	Bank Erosion (Agriculture)	Gully Erosion	Barnyard Runoff
Number	3,634.48 ft	475.78 ft	1

Table 3.72: NPDES Permitted Facilities in the Zuber Cutoff Sub-watershed

Permit Name	Permit #	County Name	Street Address	City	State Code	State Water Body Name	Effluent Exceedances (3 yrs)	Enforcement Actions (I=informal; F=formal) (5 yrs)
Antwerp WWTP	OH0022195	Paulding	CR 43 and 176	Antwerp	OH	North Creek	11	0
Flat Land Dairy	OH0130559	Paulding	6787 CR 144	Antwerp	OH	South Creek	incomplete DMR	
Zylstra Dairy LTD	OH0132799	Paulding	11753 Rd 21	Antwerp	OH	Unnamed Tributary to South Creek	incomplete DMR	

Table 3.73: Confined Feeding Operations in the Zuber Cutoff Sub-watershed

Operation	Sub-watershed	Designation	Animal Type	Animal #
Zylstra Dairy	Zuber Cutoff	CAFO	Dairy	1,400
Flatland Dairy, LLC	Zuber Cutoff	CAFO	Dairy	2,400

Figure 3.41: Land Use in the Zuber Cutoff Sub-watershed

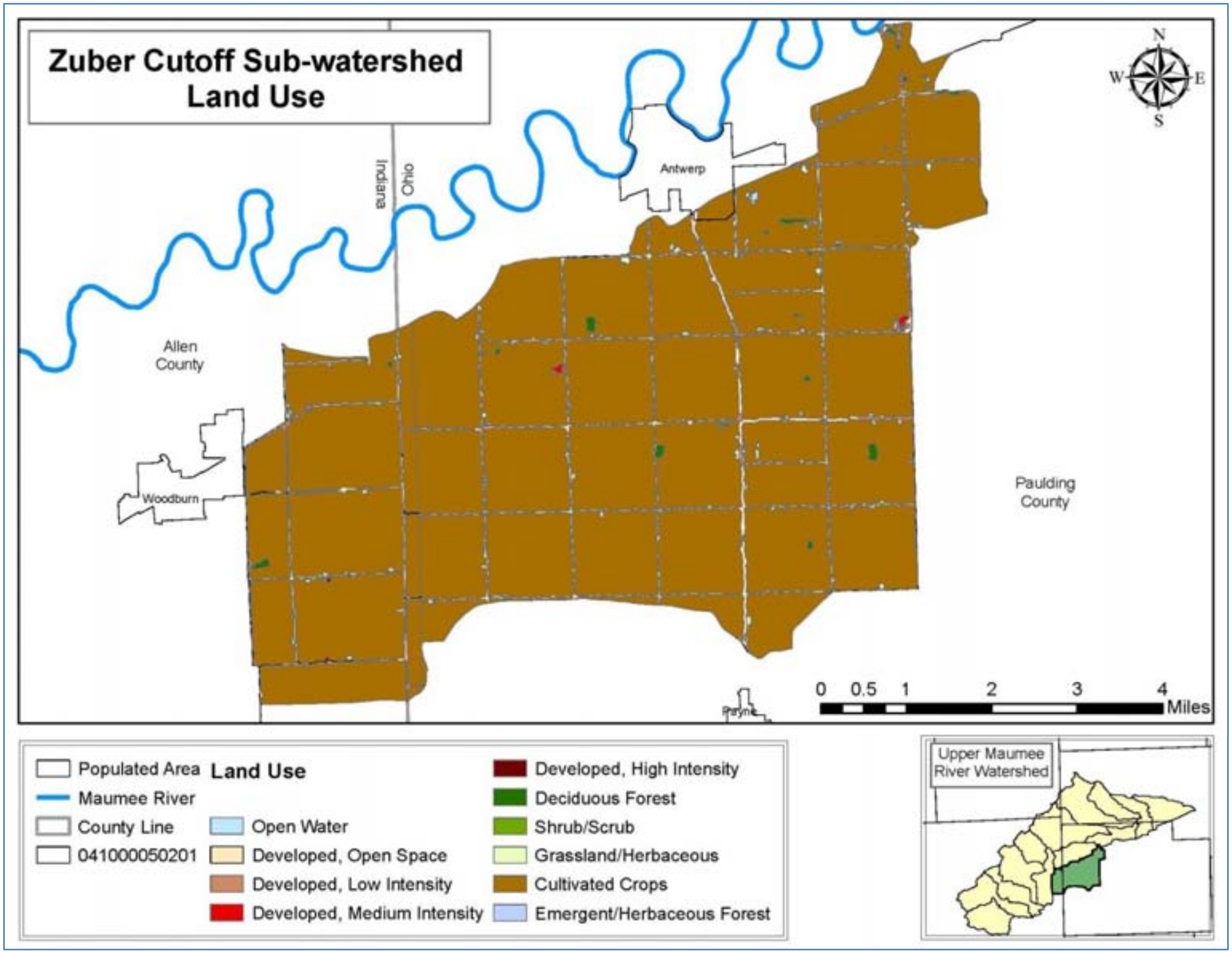


Figure 3.42: Windshield Survey Observations in the Zuber Cutoff Sub-watershed

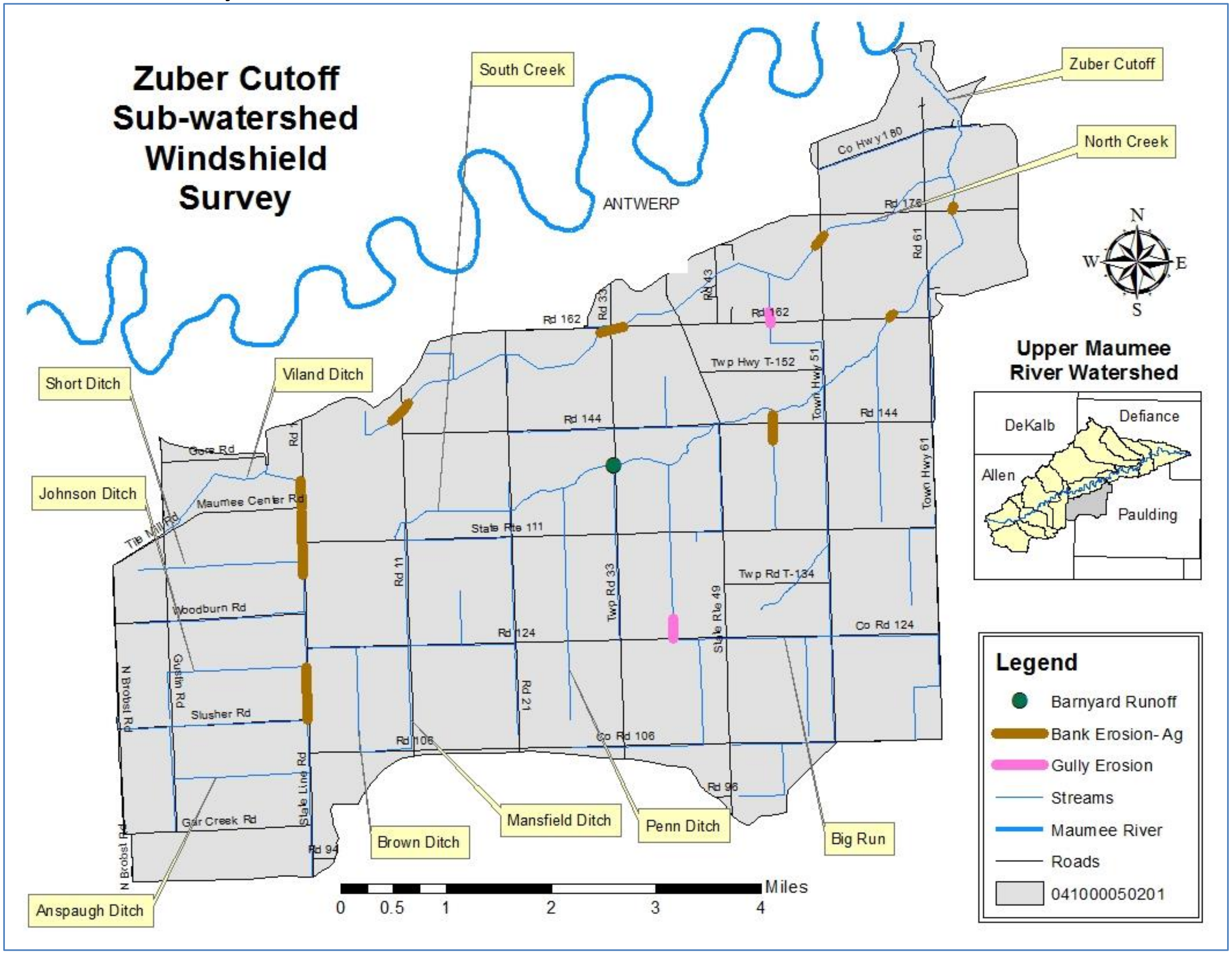
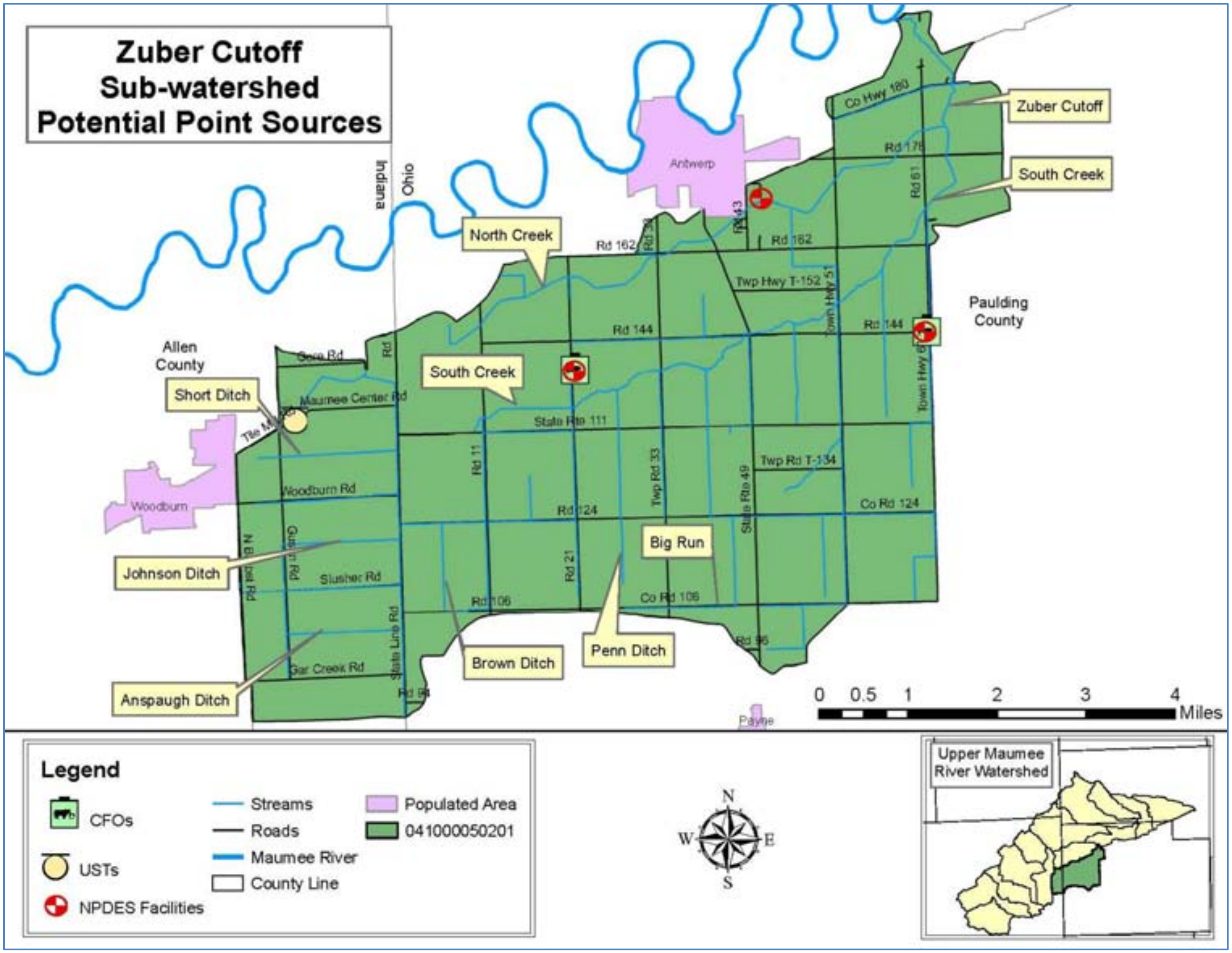


Figure 3.43: Potential Point Sources of Pollution in the Zuber Cutoff Subwatershed



3.4.10 Gordon Creek Sub-watershed Land Use

The primary influence on water quality in the Gordon Creek sub-watershed is agriculture with nearly 85% of the land use being classified as agricultural by the USGS. Table 3.74 shows the percentage of Gordon Creek sub-watershed that is in each land use and Figure 3.44 is a map showing the delineation of land use in the sub-watershed. Using National Land Cover Data acquired from the USGS and analyzed in ArcGIS, approximately 84.62% of the land use in Gordon Creek sub-watershed is in production with 73.84% used strictly for cultivated crops and the rest used as pasture/hayland.

Nearly 7.5% of the Gordon Creek sub-watershed is considered to be developed though the majority of the developed land (4.83%) has less than 20% impervious cover. The village of Hicksville, OH (population – 3,568) is located within the Gordon Creek sub-watershed.

There were 23 locations identified as potential problems during the windshield survey conducted in 2012 in the Gordon Creek sub-watershed. Many of the potential problems observed in the watershed were located within the agricultural area involving unsustainable agriculture practices including a lack of riparian buffer, and conventional tillage. There were eight locations where there was moderate to severe bank erosion totaling over 1,521 feet of damaged streambank. There were three locations where manicured, residential lawns with no buffer to the stream may have contributed to over 160 ft of stream bank erosion. There was one location where a large pile of garbage was found along the stream bank. This location has apparently become a local refuse dump site. There was one location where a large field tile was draining, while all other tiles were dry. This site should be investigated further as it was draining during a drought season which is unusual. One site was noted with possible livestock access. The ditch running through the pasture was dry so it is not clear if the pasture has been tiled or not and should be investigated further. One location with the potential for pasture runoff to enter the stream was noted during the windshield survey. This site was a horse farm where the pasture fence was nearly to the edge to the streambank with little to no buffer. Three small log jams were noted during the windshield survey. There were no major issues found surrounding the log jams, though log jams can grow in size in a short amount of time causing stream bank erosion and flooding issues. One automobile scrap yard was noted directly adjacent to stream bank with little to no buffer present. It is possible that runoff from the scrap yard could include gasoline, diesel, antifreeze and other chemicals that could be toxic to aquatic life and pollute the stream. Finally, there were two sites noted during the survey where it appeared that rip rap was used to prevent streambank erosion, however, moderate to severe erosion was still present. Table 3.75 shows the observations that were made during the windshield survey and the approximate number of feet, where applicable, that will need to be remediated to improve water quality in the Gordon Creek sub-watershed and Figure 3.45 shows the location of each of the observations.

There are several potential point sources of pollution in the Gordon Creek sub-watershed. There are 18 USTs located within the sub-watershed, with the majority of those centered within or around the Hicksville political boundary. These sites pose a threat to both ground and surface water. If the contents held in any of the facilities leak it can leach through the soil and reach groundwater contaminating drinking water wells of local residents, or leach into surface waters and decrease water quality and affect aquatic life. Seventeen of the 18 USTs located in the Gordon Creek sub-watershed are considered to be LUSTs with two of those tanks still active and leaking their contents and posing a significant risk to ground and/or surface water. Table 3.76 is a list of the LUSTs located within the Gordon Creek sub-watershed, the tank contents (if known) and their current status.

There are two NPDES permitted facilities that discharge into tributaries of the Maumee River located within the Gordon Creek sub-watershed. Table 3.77 lists the NPDES permitted facilities located within the watershed. As can be seen in the table, the Discharge Monitoring Report submitted to the regulating state agency from the Middle Gordon Creek Subdivision WWTP was incomplete and the DMRs from the Hicksville WWTP showed nine incidences of effluent exceeding the permit levels which resulted in two enforcement actions by the OEPA.

Finally the Hicksville WWTP controls five CSO outlets in the watershed. Hicksville has developed a Long Term Control Plan to separate the combined sewer system which is slated to be completed by 2029. Table 3.78 lists the five CSO outfalls located in Hicksville, OH. Figure 3.46 shows the location of all potential point sources in Gordon Creek sub-watershed.

Table 3.74: Land Use in the Gordon Creek Sub-watershed

Open Water	Dev. Open Space	Dev. Low Intensity	Dev. Medium Intensity	Dev. High Intensity	Deciduous Forest	Evergreen Forest/ Mixed Forest	Shrub/ Scrub	Pasture/ Hayland	Cultivated Crops	Woody and Emergent/ Herbaceous Wetland	Total	Unit
38.19	1393.09	589.05	119.18	49.61	1553.33	2.5/1.69	1.46	3105.66	21276.25	682.86	28808.68	Acres
<1%	4.83%	2.04%	<1%	<1%	5.39%	<1%	<1%	10.78%	73.84%	2.37%	100 %	%

Table 3.75: Windshield Survey Observations in the Gordon Creek Sub-watershed

Observation	Bank Erosion (Agriculture)	Bank Erosion (Residential)	Armored Banks	Residential Chemical Use	Pasture Runoff	Tile Outlet Drain	Log Jam	Junk Yard	Illegal Dump Site	Livestock Access
Number	1,521.23 ft	160.78 ft	325.86 ft	2	1	1	3	1	1	1

Table 3.76: Leaking Underground Storage Tanks in the Gordon Creek Sub-watershed

UST FACILITY ID	INCIDENT NUMBER	NAME	STREET ADDRESS	CITY	STATE	COUNTY	TANK CONTENTS	DESCRIPTION
20010017	N00001	Jim Schmidt Chevy Oldsmobile	608 W High St	Hicksville	OH	Defiance	Gasoline	Active
20000114	N00001	Lassus Brothers	225 E High St	Hicksville	OH	Defiance	Gasoline, Diesel, or Kerosene	Active
20000056	N00001	Hicksville Spee-D-Mart	200 W High St	Hicksville	OH	Defiance	Gasoline	NFA-Closed
20000012	N00001	Bob's Auto Repair	111 W High St	Hicksville	OH	Defiance	Unknown	NFA-Closed

UST FACILITY ID	INCIDENT NUMBER	NAME	STREET ADDRESS	CITY	STATE	COUNTY	TANK CONTENTS	DESCRIPTION
20000088	N00001	Hicksville Marathon	101 W High St	Hicksville	OH	Defiance	Gasoline	NFA-Closed
20000014	N00001	Hicksville Building Loan	100 N Main St	Hicksville	OH	Defiance	Gasoline	NFA-Closed
20003628	N00001	Hicksville Bulk Plant	501 Railroad St	Hicksville	OH	Defiance	Gasoline	NFA-Closed
20004926	N00001	Slattery Oil Co. Inc	306 Defiance Ave	Hicksville	OH	Defiance	Diesel	NFA-Confirmed Leak
20009993	N00001	Unknown (Impacts at Charles Tav)	300 Defiance Ave	Hicksville	OH	Defiance	Unknown	NFA-Closed
20000115	N00001	Commercial Intertech Corp	373 Meuse Argonne	Hicksville	OH	Defiance	Unknown	NFA-Closed
20000008	N00001	ODOT Hicksville Outpost	St Rt 8	Hicksville	OH	Defiance	Diesel	NFA-Closed
	N00002							NFA-Confirmed Leak
20000087	N00001	Slattery Oil-Cougar	506 High St	Hicksville	OH	Defiance	Gasoline, Diesel, or Kerosene	NFA-Confirmed Leak
	N00002							
20009539	N00001	Defiance County Highway Garage	Clemmer Rd	Hicksville	OH	Defiance	Gasoline	NFA-Closed

Table 3.77: NPDES Permitted Facilities in the Gordon Creek Sub-watershed

Permit Name	Permit #	County Name	Street Address	City	State Code	State Water Body Name	Effluent Exceedance - 3 yrs (Substance)	Enforcement Actions (I=informal ; F=formal) (5 yrs)
Middle Gordon Creek subdiv WWTP	OH0053465	Defiance	W side of SR 49	Hicksville	OH	Gordon Creek	incomplete DMR	
Hicksville WWTP	OH0025771	Defiance	500 S Bryan	Hicksville	OH	Mill Creek	9 (BOD, Hg, NH3, oil and grease, TSS)	2 (I)

Table 3.78: Combined Sewer Overflows in Gordon Creek Sub-watershed

Facility Name	Permit #	County	Location	Outfall #	Receiving Stream
Hicksville WWTP	2PB00042	Defiance	Ogden St Overflow	2	Unnamed Tributary to Mill Creek
			Mill Creek #1 Overflow	4	Mill Creek
			Mill Creek #2 Overflow	5	Mill Creek
			Mill Creek #3 Overflow	6	Mill Creek
			E of CSO 5 on Mill Creek	7	Mill Creek

Figure 3.44: Land Use in the Gordon Creek Sub-watershed

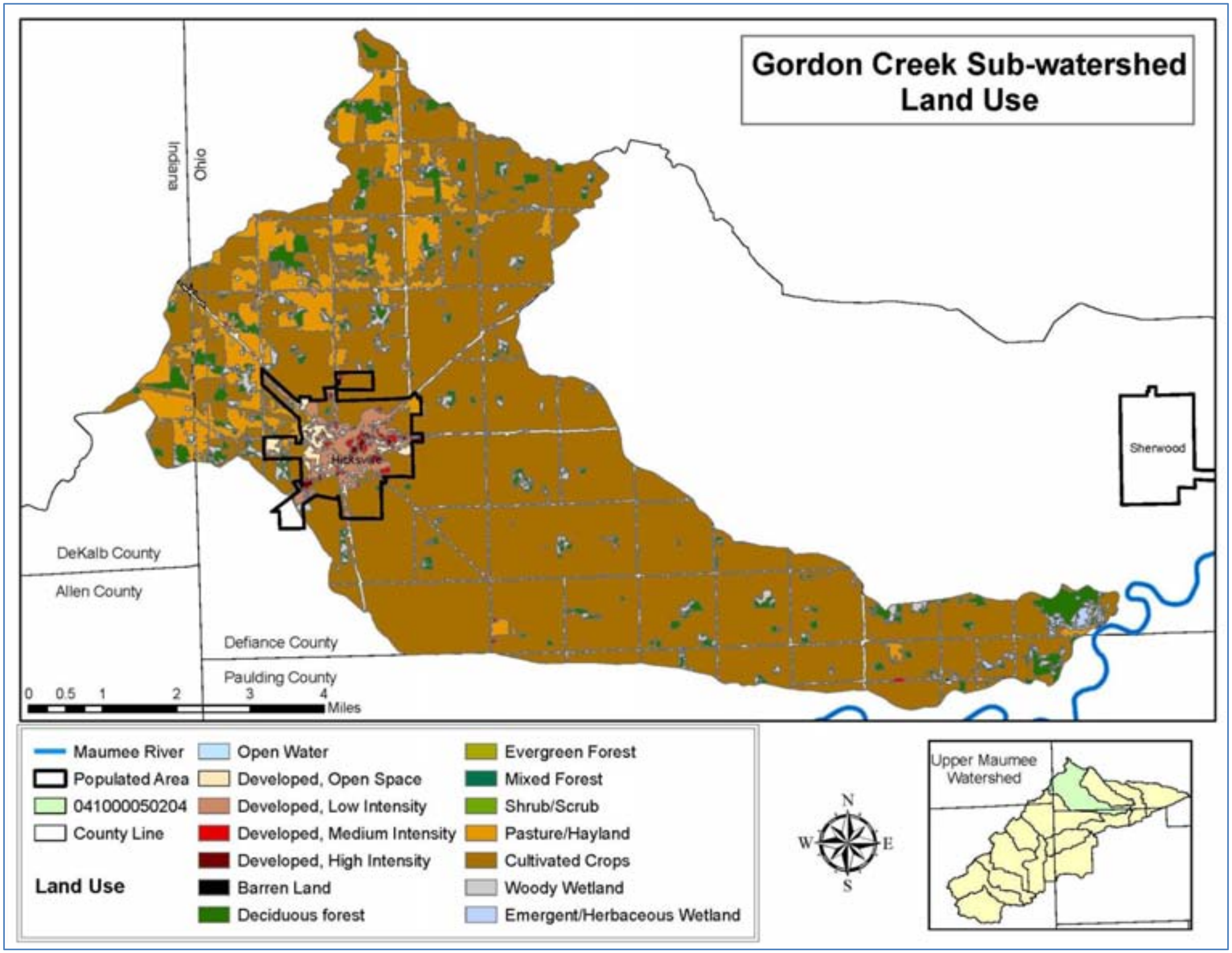


Figure 3.45: Windshield Survey Observations in the Gordon Creek Sub-watershed

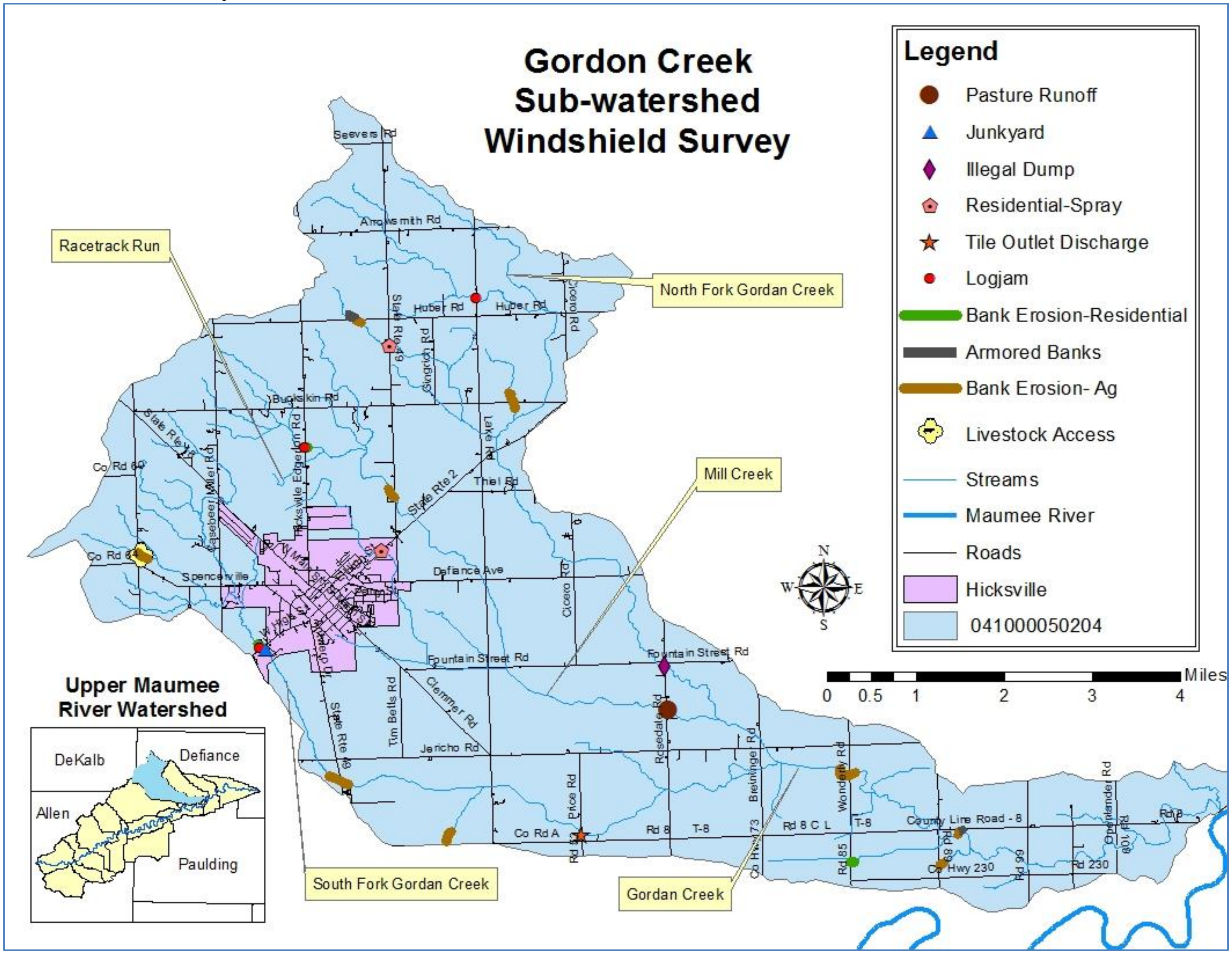
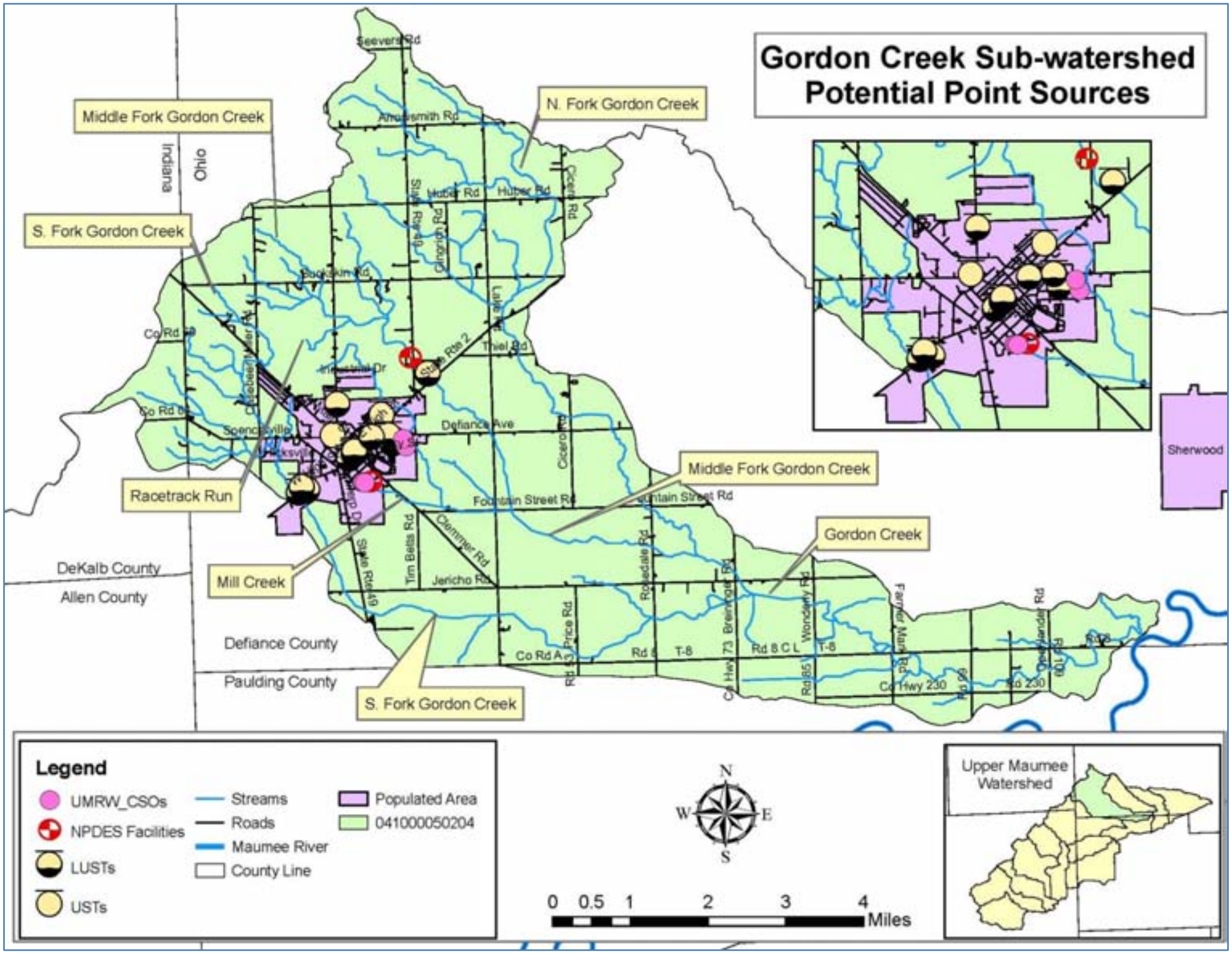


Figure 3.46: Potential Point Sources in the Gordon Creek Sub-watershed



3.4.11 Sixmile Cutoff Sub-watershed Land Use

The primary influence on water quality in the Sixmile Cutoff sub-watershed is agriculture with over 76% of the land use being classified as agricultural by the USGS. Table 3.79 shows the percentage of Sixmile Cutoff sub-watershed that is in each land use and Figure 3.47 is a map showing the delineation of land use in the sub-watershed. Using National Land Cover Data acquired from the USGS and analyzed in ArcGIS, approximately 76.28% of the land use in Sixmile Cutoff sub-watershed is in production with 75.61% used strictly for cultivated crops and the remaining percentage of land being pasture and/or hayland.

Nearly 10.6% of the Sixmile Cutoff sub-watershed is considered to be developed though the majority of the developed land (7.44%) has less than 20% impervious cover. The small village of Cecil, OH (population – 187) is located within the Sixmile Cutoff sub-watershed.

There were five locations identified as potential problems during the windshield survey conducted in 2012 in the Sixmile Cutoff sub-watershed. Two of the locations, totaling nearly 374 feet, are eroding stream banks surrounded by agriculture land with the one located on Co. Hwy 206 being a prime location for the installation of a two-stage ditch to prevent future erosion of the streambank and restore the floodplain. There are also two locations totaling 96.49 ft of stream bank erosion surrounded by manicured, residential lawns. Finally, there was one location where a tile outlet was identified leaking a black fluid to an unnamed tributary to the Maumee River, this could be possible septic system discharge. Table 3.80 lists the windshield observations and Figure 3.48 is a map showing the approximate location of each of the potential problem sites.

There are six potential point sources of pollution in the Sixmile Cutoff sub-watershed. There are three USTs, with all of those being considered LUSTs by the state overseeing agency. These sites pose a threat to both ground and surface water. If the contents held in any of the facilities leak it can leach through the soil and reach groundwater contaminating drinking water wells of local residents, or leach into surface waters and decrease water quality and affect aquatic life. Table 3.81 is a list of the LUSTs located within the Sixmile Cutoff sub-watershed, the tank contents (if known) and their current status.

There are three NPDES permitted facilities that discharge into the Maumee River located within the Sixmile Cutoff sub-watershed. Table 3.82 lists the NPDES permitted facilities located within the watershed. As can be seen in the table, all of the facilities discharge directly into the Maumee River and each of the facilities has had at least one enforcement action and multiple times of effluent exceeding the permit limit in the last three years. Figure 3.49 shows the location of all potential point sources in Sixmile Cutoff sub-watershed.

Table 3.79: Land Use in the Sixmile Cutoff Sub-watershed

Open Water	Dev. Open Space	Dev. Low Intensity	Dev. Medium and High Intensity	Barren Land	Deciduous Forest	Grassland/ Herbaceous	Pasture/ Hayland	Cultivated Crops	Woody and Emergent/ Herbaceous Wetlands	Total	Unit
466.0	746.3	296.67	19.31	6.83	667.88	96.42	66.87	7,589.37	82.86	10038.54	Acres
4.64%	7.44%	2.96%	<1%	<1%	6.65%	<1%	<1%	75.61%	<1%	100%	%

Table 3.80: Windshield Survey Observations in the Sixmile Cutoff Sub-watershed

Observation	Bank Erosion (Agriculture)	Bank Erosion (Residential)	Tile Outlet
Number	373.89 ft	96.49 ft	1

Table 3.81: Leaking Underground Storage Tanks in the Sixmile Cutoff Sub-watershed

UST FACILITY ID	INCIDENT NUMBER	NAME	STREET ADDRESS	CITY	STATE	COUNTY	TANK CONTENTS	DESCRIPTION
63009828	N00001	C&J Country Market	17746 SR 127	Cecil	OH	Paulding	Gasoline	Active
63006974	N00001	Vagabond Village	13173 US Rt 24	Cecil	OH	Paulding	Gasoline, Diesel, or Kerosene	NFA-Closed
	N00002							No Closure Report Letter Sent
63009826	N00001	18 Wheeler Truck Stop	133886 US Rt 24	Cecil	OH	Paulding	Unknown	Active

Table 3.82: NPDES Permitted Facilities in the Sixmile Cutoff Sub-watershed

Permit Name	Permit #	County Name	Street Address	City	State Code	State Water Body Name	Effluent Exceedances - 3 yrs (Substance)	Enforcement Actions (I=informal; F=formal) (5 yrs)
Brentwood MHP	OH0130061	Paulding	North of US 24, 1mile	Cecil	OH	Maumee River	8 (BOD, NH3, TSS)	1 (I)
Cecil WWTP	OH0029238	Paulding	17228 CR 105	Cecil	OH	Maumee River	60 (BOD, Chlorine, Fecal coliform, E. coli, NH3, TSS)	4 (I) 1(F)
Vagabond Village	OH0132462	Paulding	13173 US 24	Cecil	OH	Maumee River	109 (BOD, Fecal coliform, NH3, DO, TSS)	4 (I)

Figure 3.47: Land Use in the Sixmile Cutoff Sub-watershed

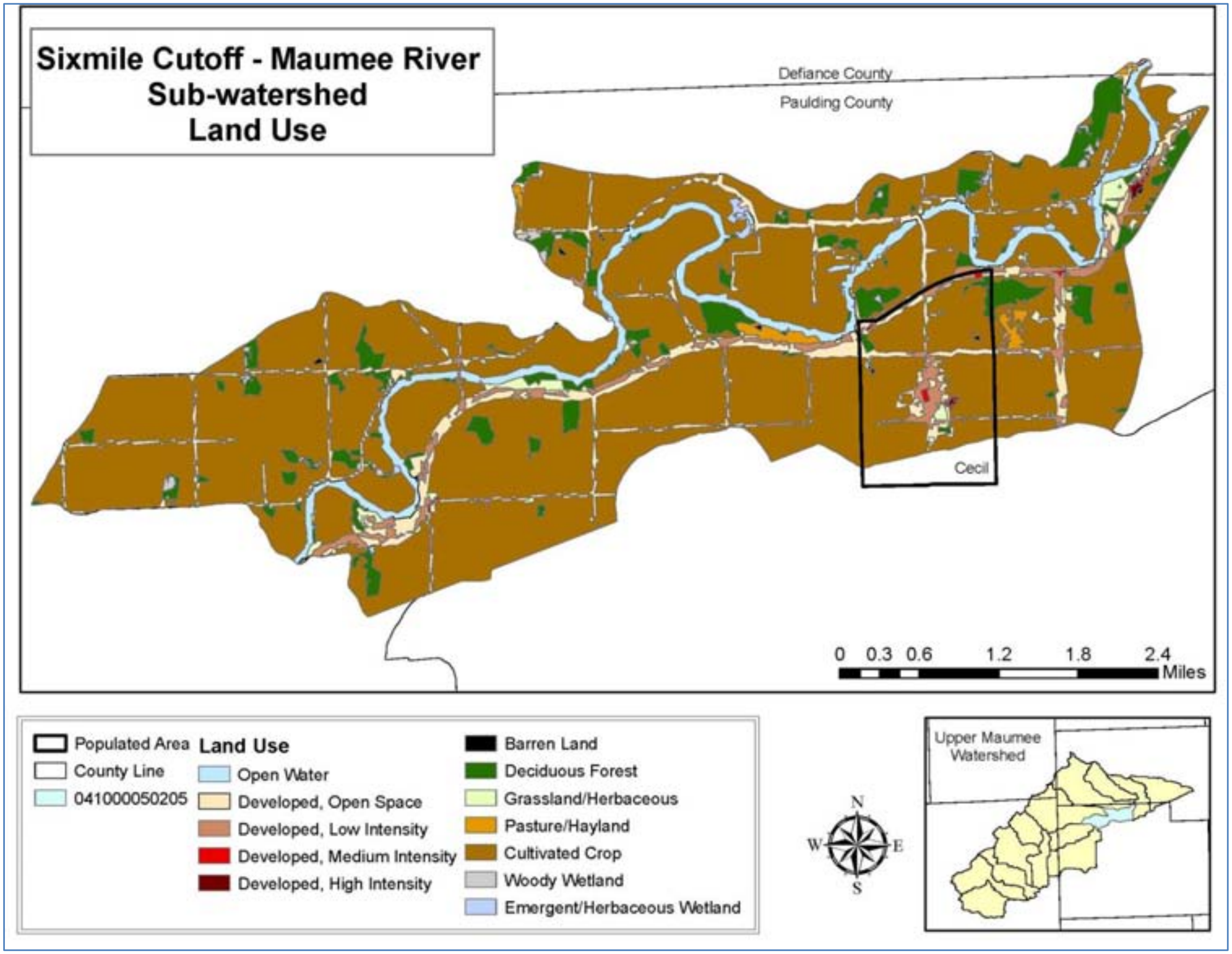


Figure 3.48: Windshield Survey Observations in the Sixmile Cutoff Sub-watershed

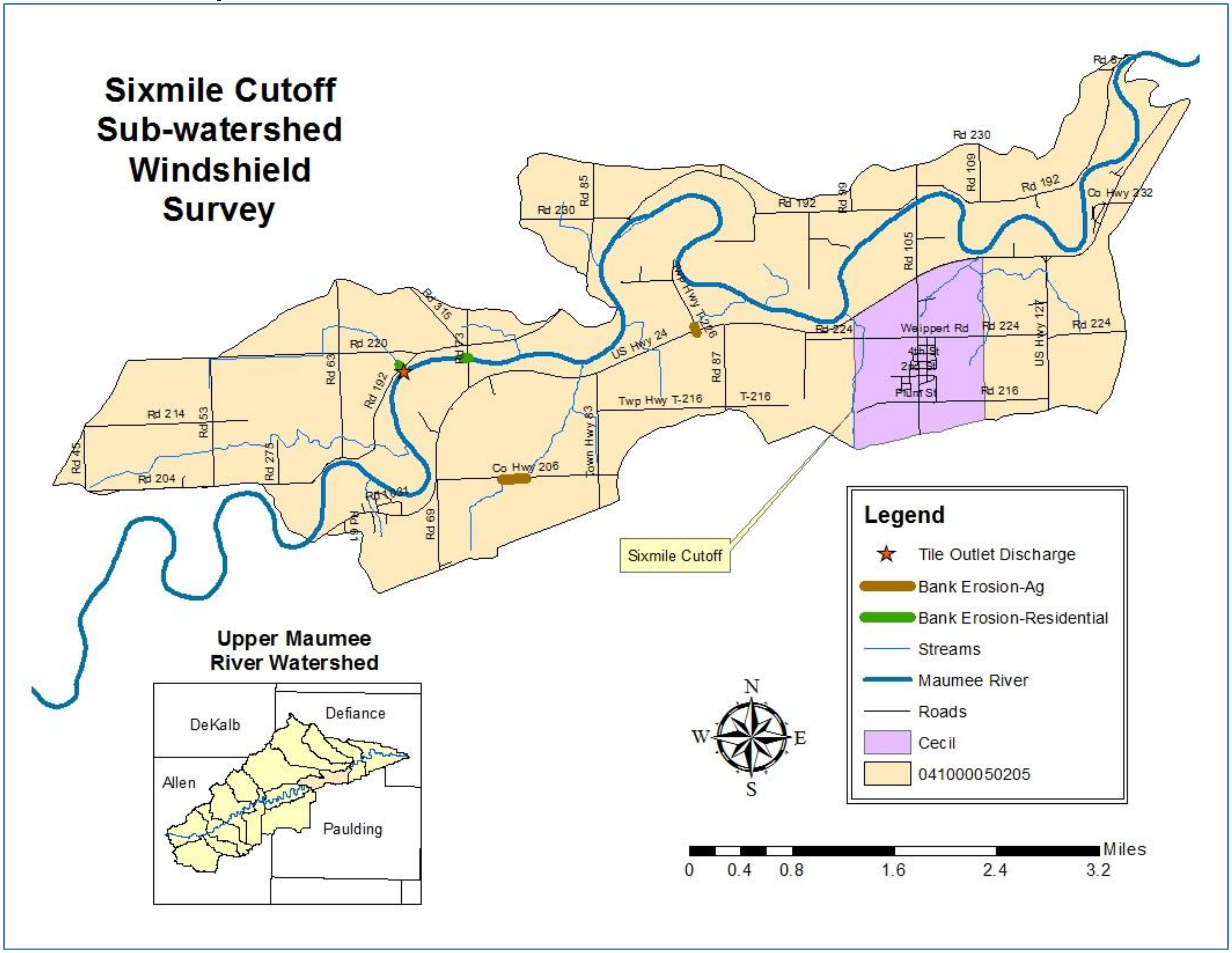
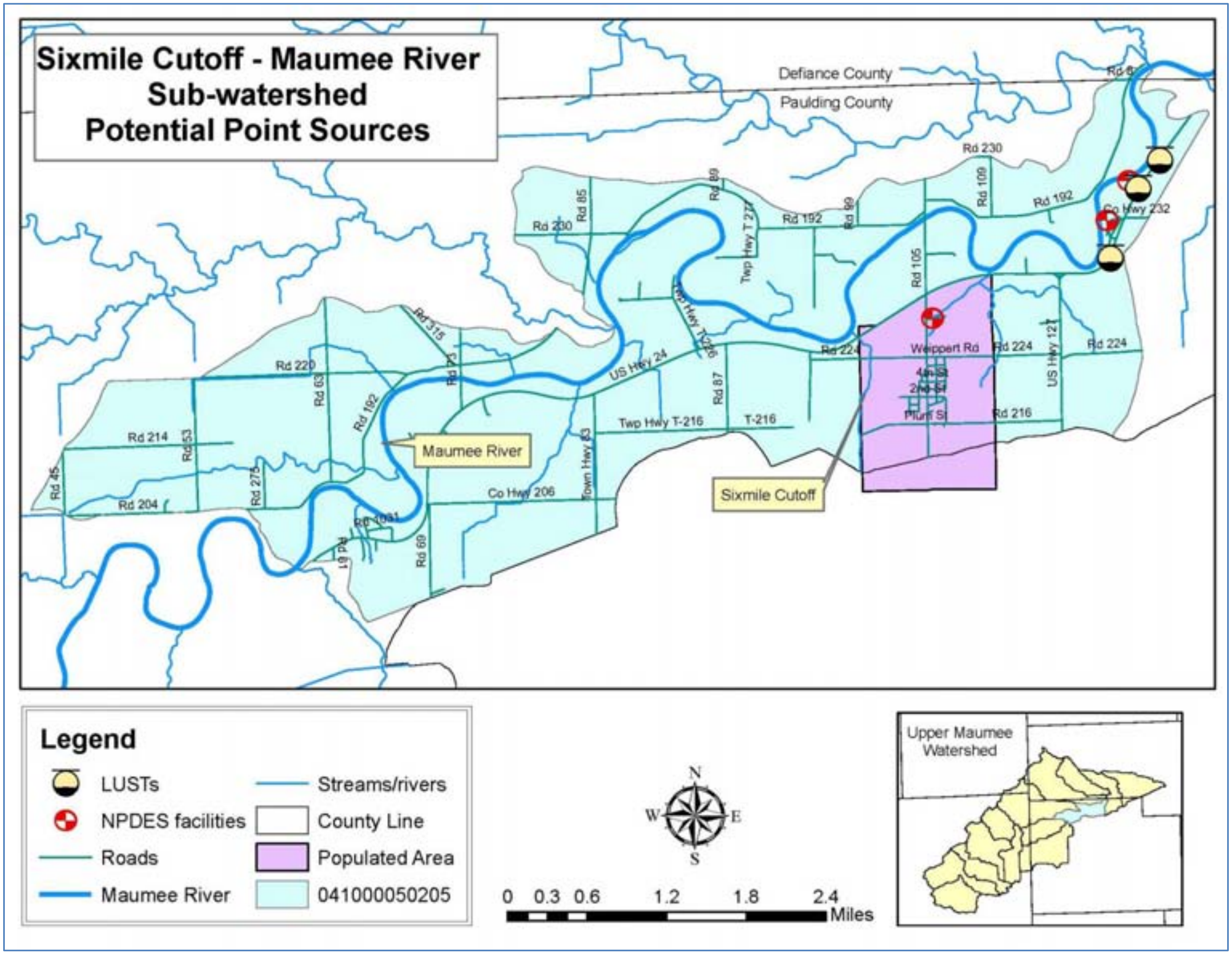


Figure 3.49: Potential Point Sources of Pollution in the Sixmile Cutoff Sub-watershed



3.4.12 Platter Creek Sub-watershed Land Use

The primary influence on water quality in the Platter Creek sub-watershed is agriculture with nearly 89% of the land use being classified as agricultural by the USGS. Table 3.83 shows the percentage of Platter Creek Sub-watershed that is in each land use and Figure 3.50 is a map showing the delineation of land use in the sub-watershed. Using National Land Cover Data acquired from the USGS and analyzed in ArcGIS, approximately 88.49% of the land use in Platter Creek sub-watershed is in production with 87.87% used strictly for cultivated crops and the remaining percentage of land being pasture and/or hayland primarily used for livestock rearing.

Nearly 5.5% of the Platter Creek sub-watershed is considered to be developed though the majority of the developed land (4.72%) has less than 20% impervious cover indicating mostly turf lawns. Mark Center, a very small, unincorporated populated area is located in Platter Creek sub-watershed which likely accounts for the small percentage of developed land in the watershed. There is not a centralized sewer system within Mark Center, therefore this is likely a concentrated area of onsite sewage treatment systems situated on soil that is considered "very limited" for septic placement.

There were fifteen locations identified as potential problems during the windshield survey conducted in 2012 in the Platter Creek Sub-watershed. Seven of the sites, totaling over 3,753 feet, are eroding stream banks surrounded by agriculture land. One site also had horse access to the stream along with the barnyard sloping down into the stream with no vegetation present on the banks. The streambank erosion site on Jericho Rd to the east of Openlander Rd may be an ideal location for a two-stage ditch to be installed to prevent continual stream bank erosion at this site. There is also streambank erosion taking place within a forested riparian area, however this is likely due to the log jam in the stream. There is one site of streambank erosion adjacent to a residential lawn that is mowed directly to the streambank which may contribute to the 100 ft of erosion present. There is one location where rip rap was placed along the road to direct runoff to the ditch, however the rip rap appears to be ineffective as erosion is present at this site. One site with very high algae in the stream was observed during the survey. This site was adjacent to a residential, manicured lawn that was mowed directly up to the streambank. The high algae may indicate an issue with septic leachate or excessive fertilizer use. Finally, a location was identified during the windshield survey where rock and dirt was piled in front of a road culvert to keep water from entering the crop field. This practice may cause erosion and flooding downstream. Table 3.84 lists the windshield observations and Figure 3.51 is a map showing the approximate location of each of the potential problem sites.

There are six potential point sources of pollution in the Platter Creek sub-watershed. There are two USTs, both of which are considered LUSTs by the state overseeing agency. These sites pose a threat to both ground and surface water. If the contents held in any of the facilities leak it can leach through the soil and reach groundwater contaminating drinking water wells of local residents, or leach into surface waters and impair water quality and affect aquatic life. Both of the LUSTs have been closed and are no longer leaking. Table 3.85 is a list of the LUSTs located within the Platter Creek sub-watershed, the tank contents (if known) and their current status.

There is one NPDES permitted facility that discharges into Platter Creek, a tributary to the Maumee River. Table 3.86 lists the NPDES permitted facility located within the Platter Creek sub-watershed. As can be seen in the table, Vissers Dairy, a CAFO, is the only permitted facility and submitted an incomplete DMR to the regulating state agency. It should be noted that not all CFOs are issued a NPDES permit; only those facilities that will be discharging a regulated substance into open water.

There are a total of three animal feeding operations in the Platter Creek sub-watershed. Two of the facilities are not required to have an NPDES permit as they are regulated by the Ohio Department of Agriculture only. Table 3.87 lists the AFOs, the type of facility it is, what animals are housed at the facility and the number of animals at the facility. Figure 3.52 shows the location of all potential point sources in Platter Creek sub-watershed.

It is important to note that Hillandale Farms, a chicken operation, has applied for and was granted permission by the state of Ohio to build a chicken house that will hold 4 million layers in Platter Creek. Construction on the building has not begun, however road improvements leading to the farm have been made. This CAFO will be regulated by the Ohio Department of Agriculture and will not need an NPDES permit as the farm will have large impoundments to hold all waste until it can be utilized on farmland as fertilizer, and will not discharge to the waters of the State.

Table 3.83: Land Use in the Platter Creek Sub-watershed

Open Water	Dev. Open Space	Dev. Low Intensity	Dev. Medium and High Intensity	Barren Land	Deciduous Forest	Grassland/ Herbaceous	Pasture/ Hayland	Cultivated Crops	Woody Wet-land	Emergent Herbaceous Wetlands	Total	Unit
1.12	654.1	60.08	27.76	0.24	584.52	1.23	86.55	12,179.55	228.56	37.64	13861 .36	Acres
<1%	4.72%	<1%	<1%	<1%	4.22%	<1%	<1%	87.87%	1.65%	<1%	100%	%

Table 3.84: Windshield Survey Observations in the Platter Creek Sub-watershed

Observation	Bank Erosion (Agriculture)	Bank erosion (Natural)	Bank Erosion (Residential)	Livestock Access	Barnyard Runoff	Log Jam	Earthen Barrier /Dam	High Algae	Armored Banks
Number	3,753.50 ft	482.57 ft	100.23 ft	1	1	1	1	1	224.54 ft

Table 3.85: Leaking Underground Storage Tanks in the Platter Creek Sub-watershed

UST FACILITY ID	INCIDENT NUMBER	NAME	STREET ADDRESS	CITY	STATE	COUNTY	TANK CONTENTS	DESCRIPTION
20000397	N00001	Mark Store	10422 Farmers Mark Rd	Mark Center	OH	Defiance	Unknown	NFA-Closed
20003625	N00001	Central Local School	100075 Farmers Mark Rd	Mark Center	OH	Defiance	Deisel	NFA-Closed

Table 3.86: NPDES Permitted Facilities in the Platter Creek Sub-watershed

Permit Name	Permit #	County Name	Street Address	City	State Code	State Water Body Name	Effluent Exceedances (3 yrs)	Enforcement Actions (I=informal; F=formal) (5 yrs)
Vissers Dairy	OH0137979	Defiance	09711 Breininger Rd	Mark Center	OH	Platter Creek	incomplete DMR	

Table 3.87: Animal Feeding Operations in the Platter Creek Sub-watershed

Operation	Sub-watershed	Designation	Animal Type	Animal #
5 C Farms	Platter Creek	CAFF	Beef	3,350
Pheasant Run Farms	Platter Creek	CAFF	Swine	7,100
Vissers Dairy, LLC	Platter Creek	CAFO	Dairy	1,600
CAFF-Concentrated Animal Feeding Facility regulated by the Ohio Department of Agriculture CAFO-Concentrated Animal Feeding Operation regulated by the Ohio Environmental Protection Agency				

Figure 3.50: Land Use in the Platter Creek Sub-watershed

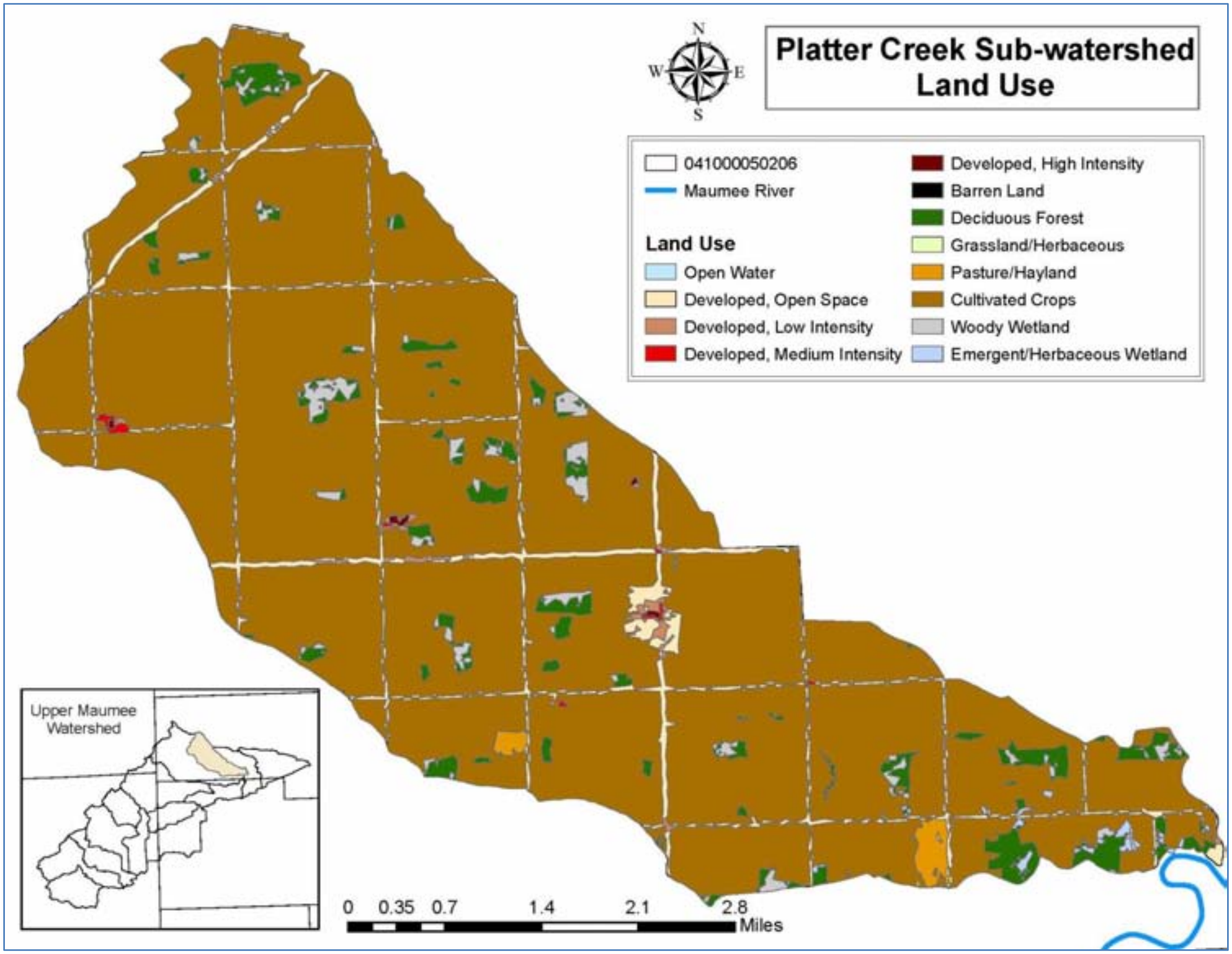


Figure 3.51: Windshield Survey Observations in the Platter Creek Sub-watershed

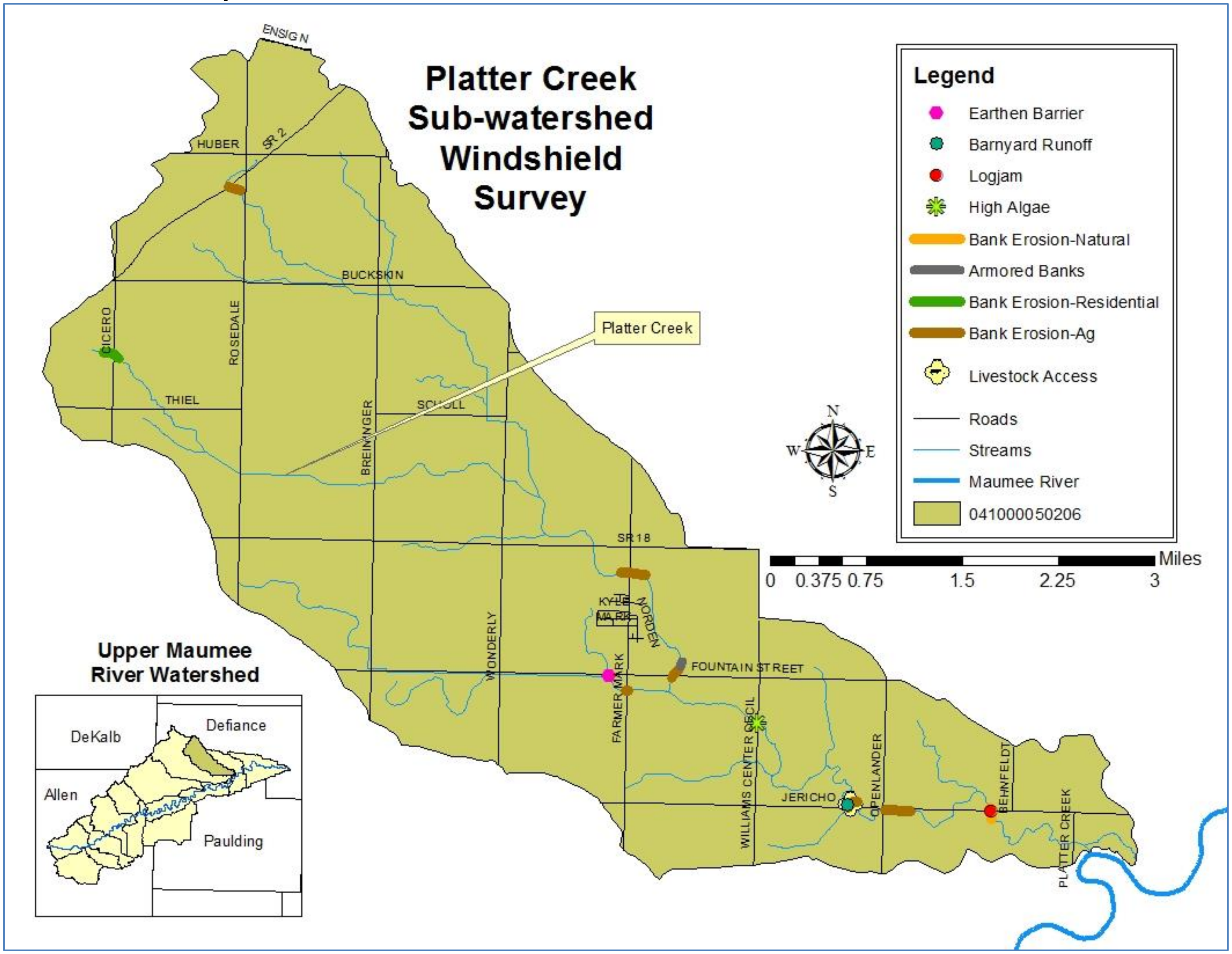
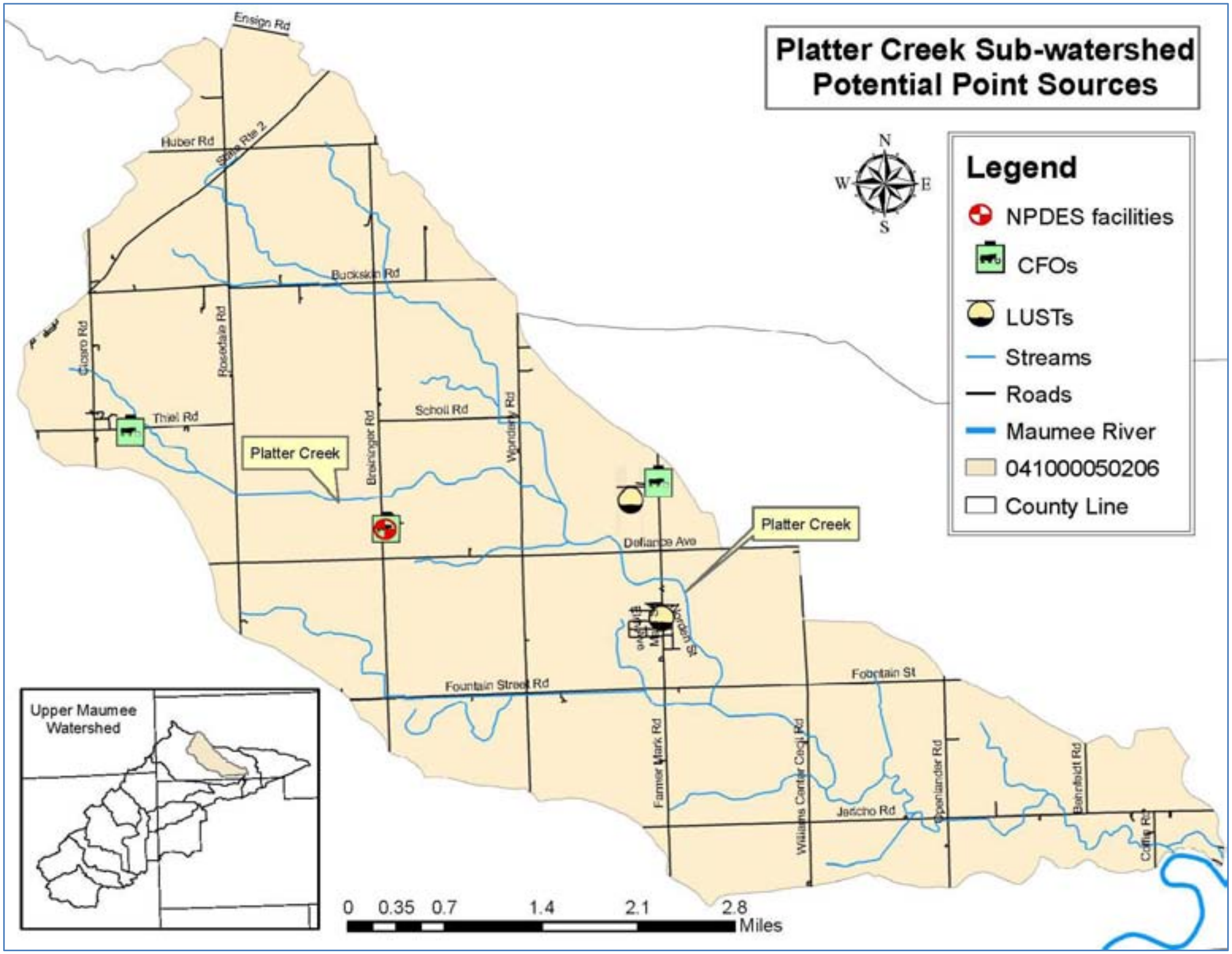


Figure 3.52: Potential Point Sources of Pollution in the Platter Creek Sub-watershed



3.4.13 Sulphur Creek Sub-watershed Land Use

The primary influence on water quality in the Sulphur Creek sub-watershed is agriculture with 83.10% of the land use being classified as agricultural by the USGS. Using National Land Cover Data acquired from the USGS and analyzed in ArcGIS, approximate percentages of each type of land use was determined and is shown in Table 3.88. Figure 3.53 shows the delineation of each type of land use within the Sulphur Creek sub-watershed.

Over 7.5% of the Sulphur Creek sub-watershed is considered to be developed though the majority of the developed land (5.23%) has less than 20% impervious cover indicating mostly turf lawns, parks or cemeteries. The Village of Sherwood is located within the Sulphur Creek sub-watershed and had a population of 823 in 2011. Sherwood has four small parks within the village boundaries which may account for the percentage of land considered to be developed, open space. Sherwood does have a centralized sewer system so septic discharge within the Village limits should not be an issue.

There were fifteen sites identified as potential problems during the windshield survey conducted in 2012 in the Sulphur Creek Sub-watershed. Three of the sites, totaling over 831 feet, are eroding stream banks surrounded by agriculture land. One residential site had nearly 223 feet of stream bank erosion possibly due to very little to no riparian buffer present. There were two large log jams observed, both of which resulted in additional bank erosion. There was one location where rip rap from under the bridge had come loose and fallen into stream which may disrupt the aquatic ecosystem. There was also a small horse farm that had the potential for runoff from the pasture field to reach open water due to its proximity to the streambank. A common practice seen throughout the agricultural community in Paulding County is digging a large ditch/gully through crop land to transport stormwater away from fields. These sites are marked on the map in Figure 3.54 as "Gully Erosion". A grassed waterway may be better suited to effectively move stormwater from the fields, to conserve soil and prevent polluted runoff from the fields. Table 3.89 lists the observations that were made during the windshield survey and the approximate number of feet, where applicable, that will need to be remediated to improve water quality in the Sulphur Creek sub-watershed.

There are fourteen potential point sources of pollution in the Sulphur Creek sub-watershed including thirteen USTs and one NPDES permitted facility. Most of the point sources of pollution are in or directly adjacent to the village of Sherwood. Seven of the USTs are considered to be leaking by the regulating state agency and have been closed. One site was suspected to be leaking, but that suspicion was disproved. If the contents held in any of the USTs leak it can leach through the soil and reach groundwater contaminating drinking water wells of local residents, or leach into surface waters and decrease water quality and affect aquatic life. Table 3.90 is a list of LUSTs located within Sulphur Creek, the tank contents and their current status.

The Village of Sherwood WWTP is the only NPDES permitted facility located within the Sulphur Creek sub-watershed. The WWTP has had 62 violations within the past three years but has only received five informal enforcement actions. Many of the violations were for not submitting reports, however, the WWTP did have a limit violation for pH every quarter. There were also significant violations for NH_3, BOD, and TSS. Table 3.91 lists the NPDES permitted facility located within the Sulphur Creek sub-watershed. Figure 3.55 shows the location of all potential point sources in Sulphur Creek sub-watershed.

Table 3.88: Land Use in the Sulphur Creek Sub-watershed

Open Water	Developed, Open Space	Developed, Low Intensity	Developed, Medium Intensity	Barren Land	Deciduous Forest	Grassland/ Herbaceous	Cultivated Crops	Woody Wetland	Total	Unit
173.94	609.59	250.71	25.73	9.8	635.11	51.09	9,677.06	212.27	11645.3	Acres
1.49%	5.23%	2.15%	<1%	<1%	5.45%	<1%	83.10%	1.82%	100.00%	Percent

Table 3.89: Windshield Survey Observations in the Sulphur Creek Sub-watershed

Observation	Bank Erosion (Agriculture)	Bank Erosion (Residential)	Bank erosion (Natural)	Gully Erosion	Armored Banks	Pasture Runoff	Log Jam
Number	831.75 ft	222.78 ft	436.57 ft	869.57 ft	42.07 ft	1	2

Table 3.90: Leaking Underground Storage Tanks in the Sulphur Creek Sub-watershed

UST FACILITY ID	INCIDENT NUMBER	NAME	STREET ADDRESS	CITY	STATE	COUNTY	TANK CONTENTS	DESCRIPTION
20002657	N00001	Sherwood Marathon	542 Harrison St	Sherwood	OH	Defiance	Gasoline	NFA-Closed
	N00002							Release Disproved
20000070	N00001	Village Food	14023 St Rt 18	Sherwood	OH	Defiance	Kerosene	NFA-Closed
20000032	N00001	Lee's Market	09979 Openlander Rd	Sherwood	OH	Defiance	Gasoline	NFA-Closed
	N00002							
20000120	N00001	Mid City Products, Inc	St Rt 18	Sherwood	OH	Defiance	Used Oil	NFA-Closed

UST FACILITY ID	INCIDENT NUMBER	NAME	STREET ADDRESS	CITY	STATE	COUNTY	TANK CONTENTS	DESCRIPTION
20003627	N00001	Central Local School	405 N Harrison St	Sherwood	OH	Defiance	Gasoline	NFA-Closed
20010010	N00001	Friends and Neighbors in Home Heal	212 N Harrison St	Sherwood	OH	Defiance	Gasoline	NFA-Closed
20010012	N00001	Vacant Building	205 N Harrison St	Sherwood	OH	Defiance	Gasoline	NFA-Closed

Table 3.91: NPDES Permitted Facilities in the Sulphur Creek Sub-watershed

Permit Name	Permit #	County Name	Street Address	City	State Code	State Water Body Name	Effluent Exceedances - 3 yrs (Substance)	Enforcement Actions (I=informal; F=formal) (5 yrs)
Village of Sherwood	OH0020281	Defiance	Coy Rd south of the B&O	Sherwood	OH	Sulphur Creek	62 (BOD, NH3, DO, TSS, pH)	5(I)

Figure 3.53: Land Use in the Sulphur Creek Sub-watershed

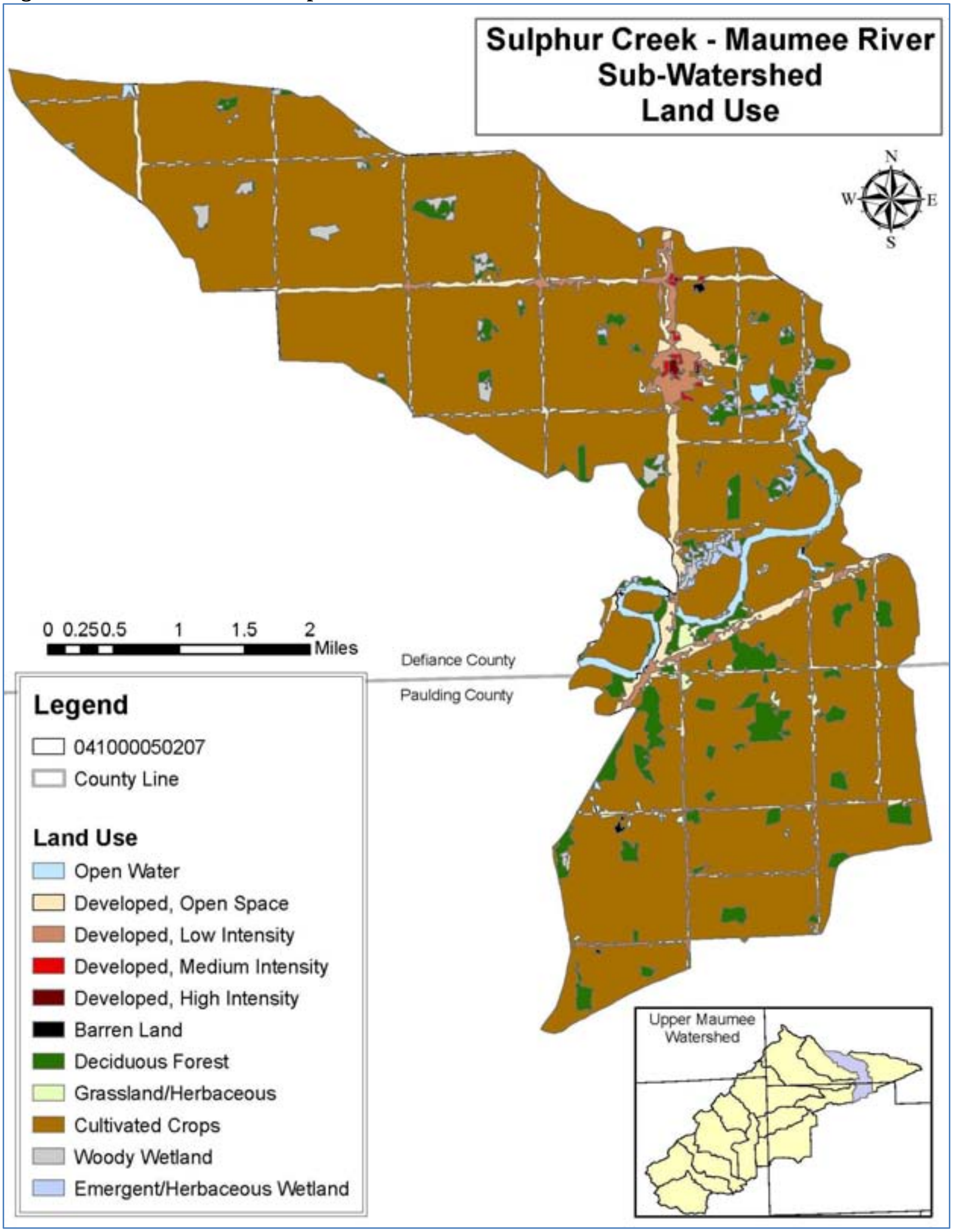


Figure 3.54: Windshield Survey Observation in the Sulphur Creek Sub-watershed

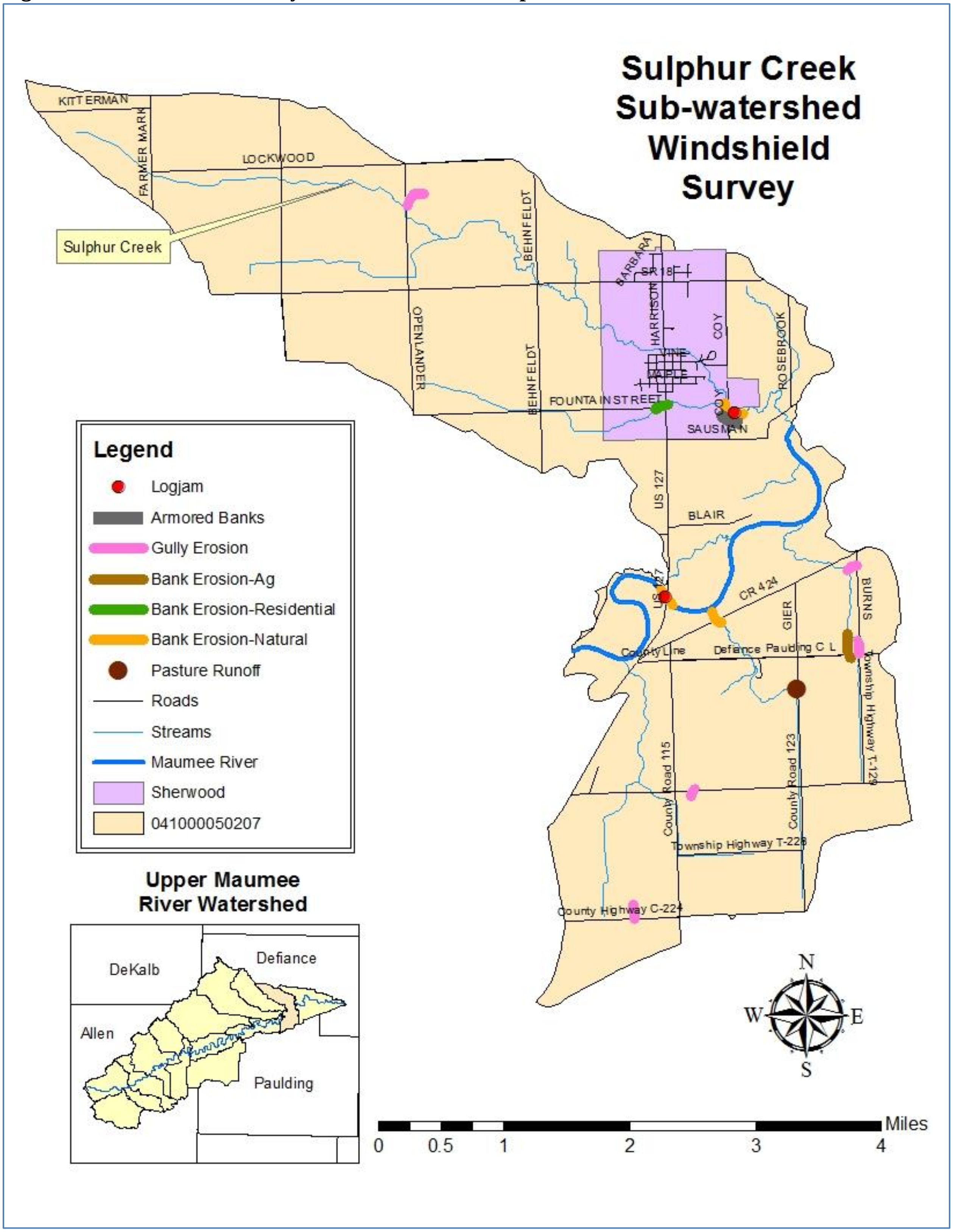
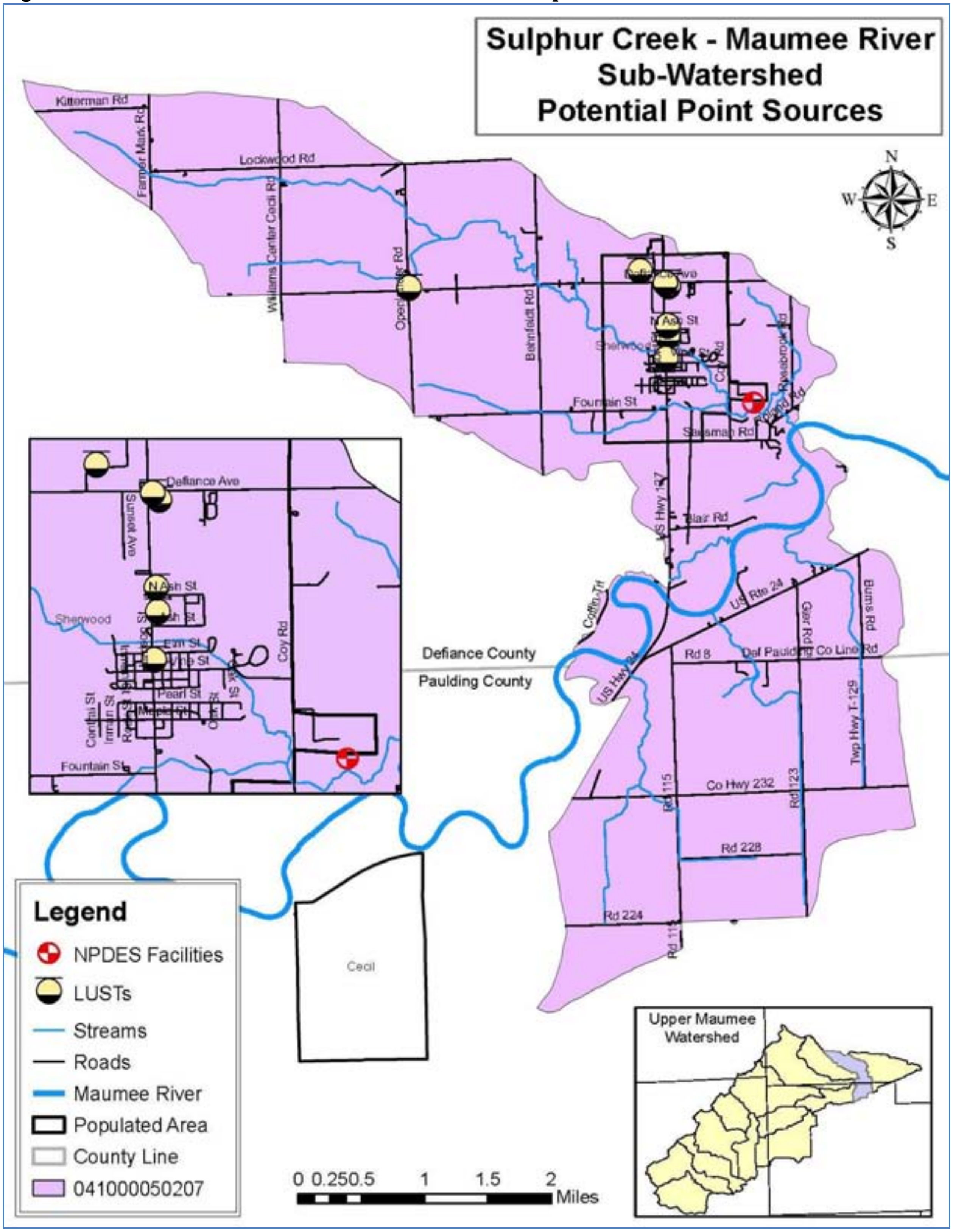


Figure 3.55: Potential Point Sources of Pollution in the Sulphur Creek Sub-watershed



3.4.14 Snooks Run Sub-watershed Land Use

The primary influence on water quality in the Snooks Run sub-watershed is agriculture with 72.84% of the land use being classified as agricultural by the USGS with over 70% of that being solely in row crops and the rest being classified as pasture/hayfield. Using National Land Cover Data acquired from the USGS and analyzed in ArcGIS, approximate percentages of each type of land use was determined and is shown in Table 3.92. Figure 3.56 shows the delineation of each type of land use within the Snooks Run sub-watershed.

Approximately 8.77% of the Snooks Run sub-watershed is considered to be developed though the majority of the developed land (6.46%) has less than 20% impervious cover indicating mostly turf lawns, parks or cemeteries. The most western portion of the City of Defiance (population 16,622) is located in the Snooks Run sub-watershed. However, the portion of Defiance within the watershed boundaries is mostly small clusters of homes and industry.

Defiance does have a centralized sewer system so septic discharge within the city limits should not be an issue. However, Defiance does have CSOs that discharge into the Lower Maumee River Watershed. So, while a portion of the City of Defiance is located within the Upper Maumee River Watershed boundaries, much of the stormflow discharges downstream through the municipal combined sewer system. Therefore, it is important to educate the urban community on urban water management. The Defiance County MS4 coordinator has been working within the community to educate the public on urban stormwater issues, and to encourage the use of urban BMPs and therefore, could be an ideal partner with this project.

There were fifteen sites identified as potential problems during the windshield survey conducted in 2012 in the Snooks Run Sub-watershed. Five of the sites, totaling over 807 feet, are eroding stream banks surrounded by agriculture land. Two sites were identified in Snooks Run that had moderate sized gullies present possibly due to conventionally tilled crop fields. Three sites were identified where it appeared that livestock had access to open water. One location was a very limited access site, though erosion was still present and other options are available to completely eliminate livestock access to open water. There was also one site with a moderate sized log jam which could result in bank erosion and two sites had rip rap thrown along the banks to try to prevent erosion, though these sites were beginning to erode since the bank armor was not maintained. There were two locations where a high amount of algae was observed which can be more common during drought years due to the fact that the water is stagnant. Both sites were located in streams surrounded by row crops and one site had a visible tile drain discharge point into the stream. Table 3.93 shows the observations that were made during the windshield survey and the approximate number of feet, where applicable, that will need to be remediated to improve water quality in the Snooks Run sub-watershed.

There are nine potential point sources of pollution in the Snooks Run sub-watershed including eight USTs, seven of which were considered to be leaking by the state regulating agency and have been closed. Underground storage tanks can pose a threat to both ground and surface water. If the contents held in any of the facilities leak it can leach through the soil and reach groundwater contaminating drinking water wells of local residents, or leach into surface waters and decrease water quality and affect aquatic life. Table 3.94 is a list of LUSTs located within Snooks Run sub-watershed, the tank contents, and their current status.

Table 3.92: Land Use in the Snooks Run Sub-watershed

Open Water	Dev. Open Space	Dev. Low Intensity	Dev. Medium and High Intensity	Barren Land	Deciduous Forest	Evergreen Forest	Grassland/ Herbaceous	Pasture/ Hayland	Cultivated Crops	Woody Wetland	Total	Unit
442.6	1029.6	273.12	95.31	7.17	2092.45	6.28	69.92	387.33	11,227.11	314.61	15945 .53	Acres
2.78%	6.46%	1.71%	<1%	<1%	13.12%	<1%	<1%	2.43%	70.41%	1.97%	100. %	%

Table 3.93: Windshield Survey Observations in the Snooks Run Sub-watershed

Observation	Bank Erosion (Agriculture)	Gully Erosion	Armored Banks	High Algae	Log Jam	Livestock Access
Number	807.07 ft	699.57 ft	50.70 ft	2	1	3

Table 3.94: Leaking Underground Storage Tanks in the Snooks Run Sub-watershed

UST FACILITY ID	INCIDENT NUMBER	NAME	STREET ADDRESS	CITY	STATE	COUNTY	TANK CONTENTS	DESCRIPTION
20000048	N00001	ODOT Defiance County Garage	2340 N Baltimore	Defiance	OH	Defiance	Kerosene	NFA-Closed
	N00002							NFA-Closed
20000074	N00001	Ohio State Highway Patrol Post	2351 N Baltimore	Defiance	OH	Defiance	Gasoline	NFA-Closed
20000217	N00001	GH Voigt Co	1050 Atlantic St	Defiance	OH	Defiance	Gasoline	NFA-Closed
20000054	N00001	Coca-Cola Bottling Co	2100 Baltimore	Defiance	OH	Defiance	Unknown	NFA-Closed

UST FACILITY ID	INCIDENT NUMBER	NAME	STREET ADDRESS	CITY	STATE	COUNTY	TANK CONTENTS	DESCRIPTION
20000147	N00001	BP Oil Co #69265	2003 Baltimore	Defiance	OH	Defiance	Gasoline	NFA-Closed
20009974	N00001	Reagle Auto Serv	1990 Baltimore	Defiance	OH	Defiance	Unknown	NFA-Closed
20008735	N00001	Pag Realty	1640 Baltimore	Defiance	OH	Defiance	Used Oil	NFA-Closed
20005214	N00001	City of Defiance St Dept	1450 Baltimore	Defiance	OH	Defiance	Unknown	NFA-Closed

Figure 3.56: Land Use in the Snooks Run Sub-watershed

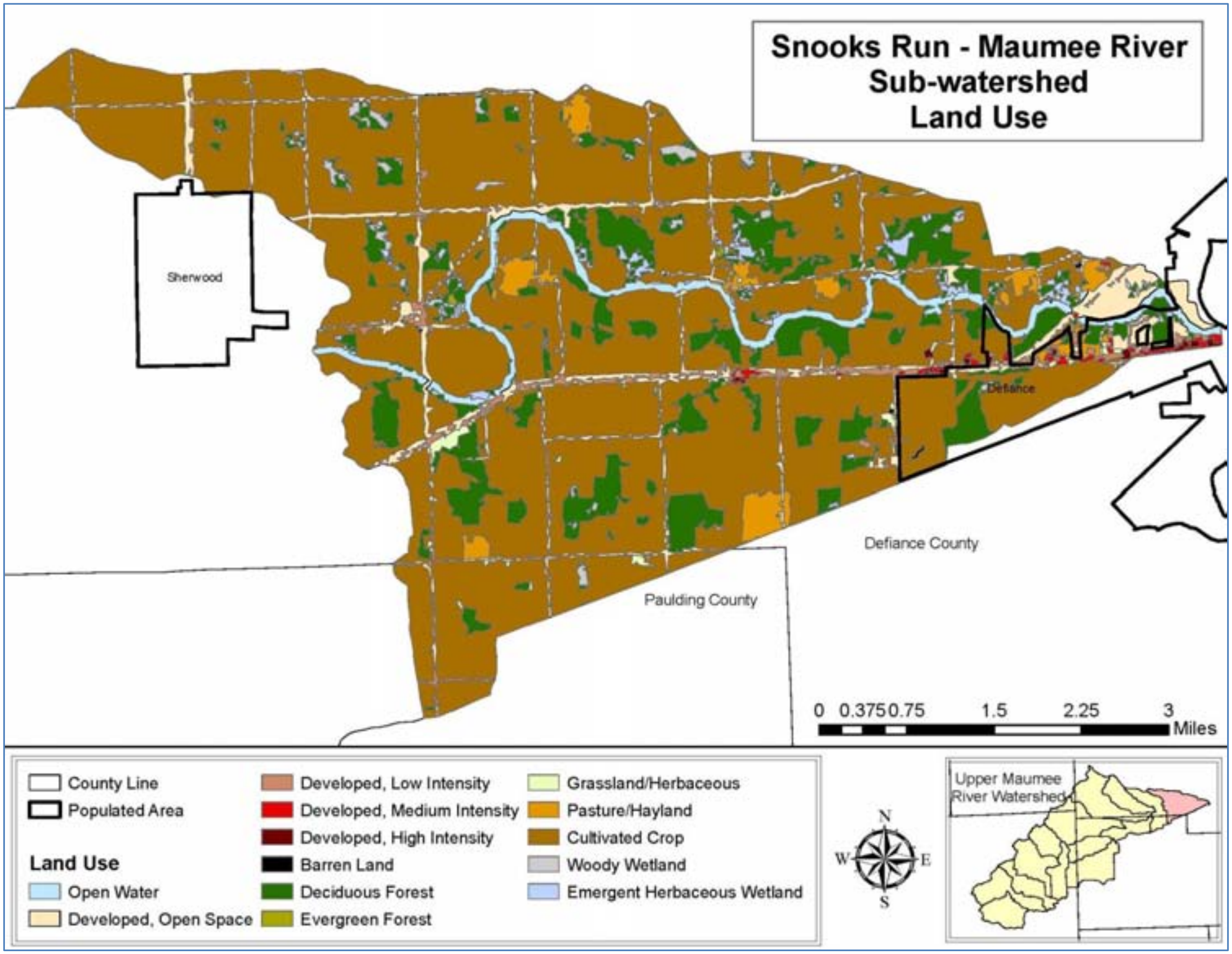


Figure 3.57: Windshield Survey Observations in the Snooks Run Sub-watershed

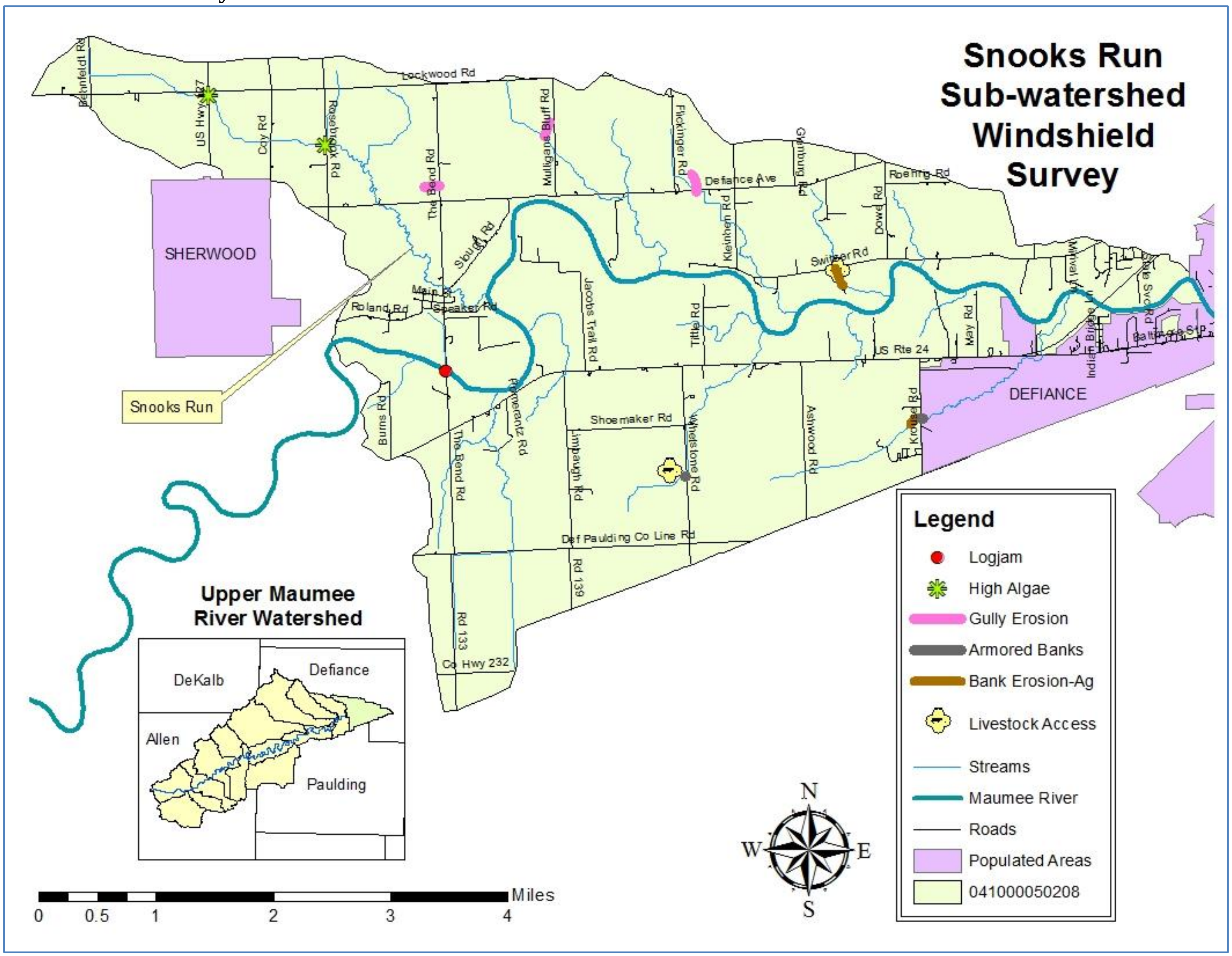
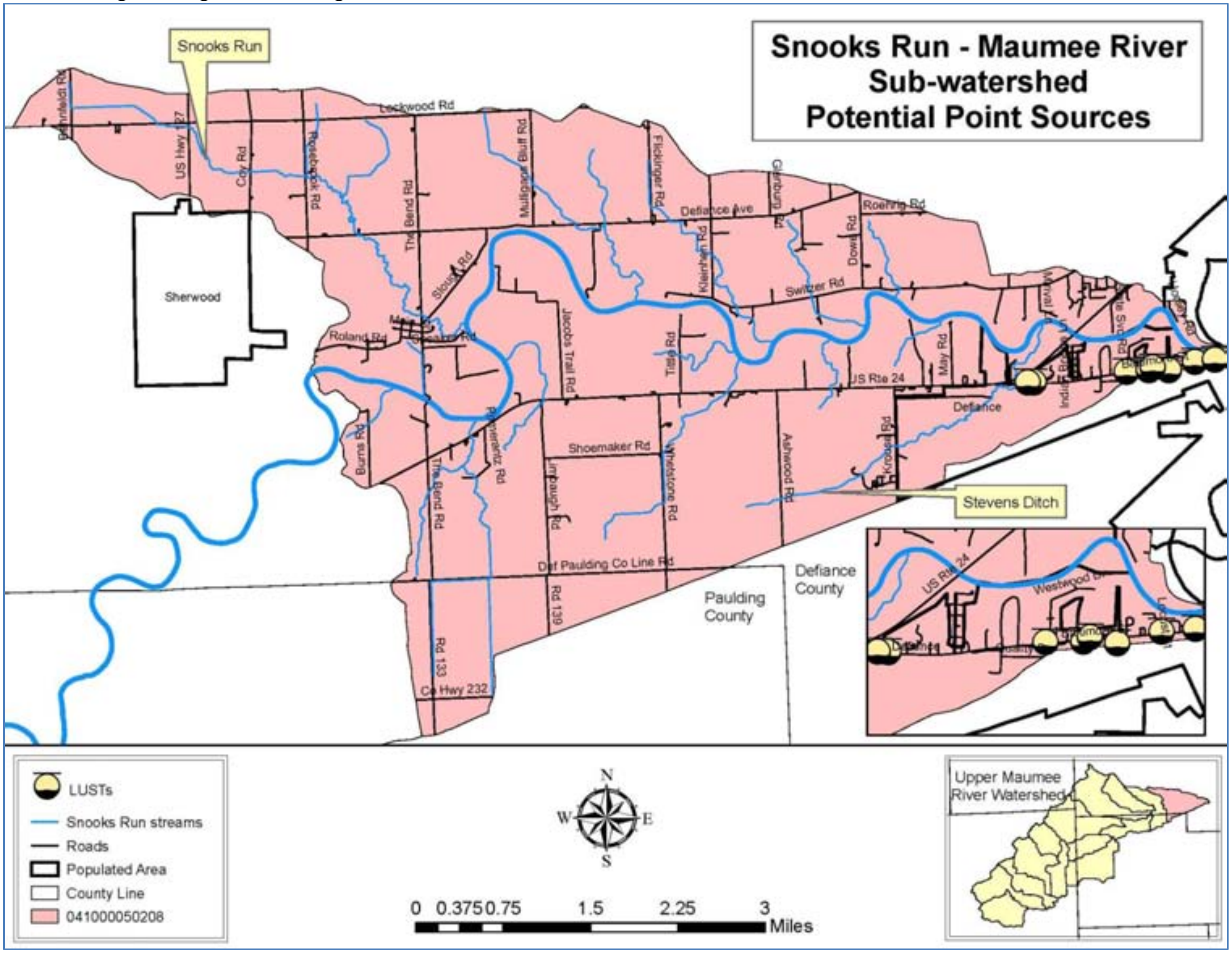


Figure 3.58: Leaking Underground Storage Tanks in Snooks Run Sub-watershed



3.5 Watershed Inventory Summary

To better understand the water quality problems in the Upper Maumee River Watershed and what influences may be contributing to those problems, a map was developed outlining the water quality issues in each sub-watershed, as well as showing the results of the land use inventory, specifically those sites that were identified during the windshield survey, as well as other points of interest that may be contributing to the degradation of water quality (Figure 3.59). As can be seen in the figure, *E. coli,* nutrients, and turbidity levels were elevated in nearly every sub-watershed that water quality samples were taken from. It should be noted that water quality samples taken in Ohio were all from the main stem of the Maumee River and therefore, may not show water quality problems that would be evident in smaller tributaries due to the volume of water in the Maumee that dilutes pollution. However, it is significant to note that all samples taken from the Maumee River indicate a problem with nutrients, and samples taken from North Chaney Ditch and Snooks Run indicate a sediment issue as well.

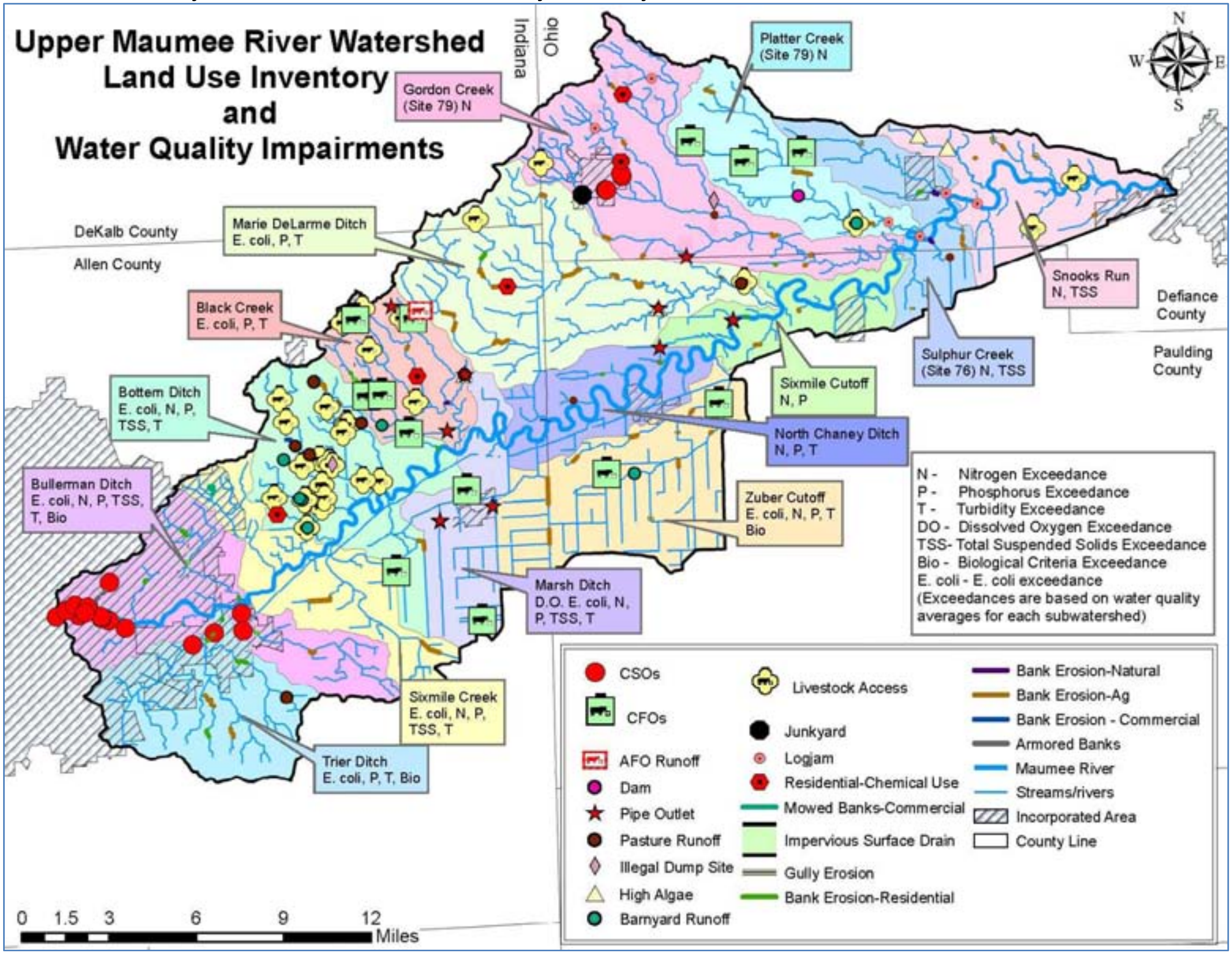
After examining water quality and land uses throughout the UMRW it can be determined that the problems and concerns contributing to water quality impairments within the watershed are fairly homogenous throughout the project area, with the exception of the larger urban areas with CSOs and high amounts of imperviousness.

Land uses throughout the watershed are primarily row crops, and a few pasture fields. The soils within the project area are ideal for row crops as they are nutrient rich soils, however there is a significant amount of conventional tillage still being utilized which may explain the high turbidity levels found in water samples throughout the watershed. Since so much of the watershed is rural, it can be assumed that on-site sewage treatment is prevalent throughout the watershed. This poses a threat to water quality as 97% of the soils in the watershed are classified as not suitable for septic placement. Allen County Health Department's estimate of nearly 9,000 septic systems at risk of, or are, failing in the county further justifies the assumption that leaking septic systems may be contributing to bacteria, nutrient, and sediment contamination of water ways.

The windshield survey revealed several possible contributors to the degradation of water quality in the UMRW including mowed residential and commercial lawns that have little to no riparian buffer. Often times, stormwater runoff from urban areas can carry bacteria from pet waste and excess fertilizer and pesticides. There are also several golf courses and cemeteries located in the project area that may contribute to water pollution from fertilizer, pesticides, a lack of riparian buffer and wildlife waste. Some more direct sources of pollution identified during the windshield survey are; 31 sites where livestock have direct access to open water, 72,849.63 feet of streambank erosion within the agricultural community and 14,850.86 feet of streambank erosion within the urban community and 735.55 feet of streambank erosion within a commercial setting, 11 tile drains that were discharging during a drought season when all other tile drains were dry, and 20 sites of either barnyard or pasture runoff discharging to open water. Each of these sites and observations made during the windshield survey provide a direct means for pollution to enter surface water and can be remediated with the implementation of BMPs.

A final and definite contributor to pollution in the Maumee River and its tributaries are the 21 CSOs that discharge into the Maumee River or its tributaries during wet weather events, as well as the additional 30 CSOs located upstream from the Maumee River in the St. Marys and St. Joseph Rivers. When the CSOs discharge they deposit storm water from urban areas which carry fertilizer, sediment, salt, pesticides, bacteria, oil, and a multitude of other urban pollutants, as well as raw sewage directly to surface waters.

Figure 3.59: Water Quality Concerns and Land Use Inventory Summary for the UMRW



3.6 Analysis of Stakeholder Concerns

Stakeholders in the Upper Maumee River Watershed expressed concerns regarding water quality and land uses during the public meeting held in 2012 and additional concerns were raised after performing the watershed inventory. These concerns are outlined in Table 3.95, as well as whether or not the concerns are supported by the collected data, quantifiable, outside the scope of this project, and whether or not the steering committee would like to focus on the concerns. A survey was disseminated to all members of the UMRW steering committee to form a general consensus on whether or not the concern was outside the scope of this project and whether or not the group would like to focus efforts on the concern in the WMP or in the future. Eight steering committee members responded to the survey and it was agreed that none of the concerns were outside of the scope of this project. However, the group decided to not focus efforts on, urban contamination sites, flooding issues or log jams as these issues are being addressed by other government agencies. Urban contamination sites in particular LUSTs, Brownfields, Superfund Sites, and most NPDES permitted facilities are regulated by its respective state agency and/or the US EPA and the steering committee felt that its efforts would be better spent focusing on non-point sources of pollution. However, it should be noted that the steering committee agreed that many practices that will address NPS issues, including reducing stormwater flow, will help with flood issues, as well as possibly decrease the frequency and size of log jams.

Table 3.95: Analysis of Stakeholder Concerns

Concerns	Supported by Data?	Evidence	Able to Quantify?	Outside Scope?	Group Wants to Focus On?
Flooding	Yes	All riparian areas of the Maumee River are considered to be high risk for flooding in IN and are considered to be located within the 100 year floodplain in OH. All incorporated areas within the watershed are located partially within a floodplain. Several log jams, which often contribute to flooding were observed during the windshield survey. Three major floods have taken place within the watershed over the past decade.	Yes	No	No
Log Jams	Yes	Seven log jams were observed during the windshield survey. Stakeholders have observed log jams throughout the watershed at different times.	Yes	No	No
Stream Bank Erosion	Yes	88,436 feet of eroded streambanks were observed through windshield and desktop surveys conducted in 2012. Nearly all of the sub-watersheds, with the exception of Gordon Creek, Platter Creek, Sixmile Cutoff, and Sulphur Creek, tested high for TSS and/or turbidity. High measurements of these parameters may indicate streambank erosion upstream of the sample site.	Yes	No	Yes
Lack of Riparian Buffer	Yes	Many streams and ditches scattered throughout the watershed observed during the 2012 windshield survey lacked an adequate buffer to properly filter out pollutants and slow storm flow. The Riparian Buffer desktop survey revealed that 71% of parcels in the agricultural community have a buffer of less than 60' with 57% of that being a buffer of less than 20'.	Yes	No	Yes

Concerns	Supported by Data?	Evidence	Able to Quantify?	Outside Scope?	Group Wants to Focus On?
Recreational Opportunities and Safety	Yes	There are only three boat launches managed by the DNR located within the Maumee River Watershed. There is one canoe launch at Moser Park managed by New Haven. There are a total of six parks in the watershed that are located near the river, however there is limited access for fishing, boating and general recreating on the river.	Yes	No	Yes
Segmented/ Lack of Forested Areas	Yes	Only 4.92% of the watershed is classified as forested. The land use map on page 38 shows how segmented the forested areas are. There are three species on the endangered species list for the four counties of the UMRW that rely on forested areas for their habitat and the continued segmentation of their habitat may have contributed to them being listed.	Yes	No	Yes
Lack of Water Education/Out reach	No	There was not an organization focused solely on the Upper Maumee River Watershed until the Upper Maumee Watershed Partnership was formed in 2009. As per State law each CSO community must develop a plan to educate the public on water quality and stormwater management. Those communities include Fort Wayne, New Haven, Hicksville, and Defiance. The Allen County Partnership for Water Quality provides education and outreach on water quality issues throughout Allen County. It is not clear how much of the water quality education reaches the public.	No	No	Yes
Rural regulated ditches	Yes	There are 534.35 miles of ditches managed by the county regulating agency. Several streams and ditches have been dredged and straightened and at least one stream was noted as being recently dredged with all vegetation removed from the riparian area during the 2012 windshield survey.	Yes	No	Yes

Concerns	Supported by Data?	Evidence	Able to Quantify?	Outside Scope?	Group Wants to Focus On?
Combined Sewer Overflows	Yes	Fort Wayne has 43 CSOs discharging to the St. Joesph, St. Marys, and Maumee Rivers, all of which eventually flow to the Maumee River. 16 of those 43 CSOs discharge into the Maumee River. New Haven has Four CSOs and Hicksville has five CSOs.	Yes	No	Yes
Need for Wetland Protection / Restoration	Yes	59% of the soils in the watershed are classified as hydric by the NRCS which is likely due to a large portion of the Great Black Swamp that was located within the Ohio portion of the watershed. The Ohio DNR estimates that 90% of the wetlands in Ohio have been drained and converted to farm land as currently only 3% of the watershed is classified as wetland.	Yes	No	Yes
Increase in Impervious Surfaces	Yes	The number of building permits issued in 2010 through 2012 has been on a steady decline. However, current trends indicate that construction is picking up which inevitably will increase imperviousness in the watershed.	Yes	No	Yes
Urban Contamination Sites	Yes	There are 19 NPDES permitted facilities, six brownfields, one superfund site, and 131 leaking underground storage tanks located within the UMRW. It should be noted that of the 19 NPDES permitted facilities, there were three facilities that have never had a compliance issue.	Yes	No	No
Need for More Water Quality Studies/ Planning Efforts	Yes	The US Army Corp of Engineers wrote a WMP for the Upper Maumee to provide watershed, city, and county planners with a tool to help restore, protect, and promote sustainable uses of water resources and the surrounding land within the Western Lake Erie Basin. However, the WMP was very vague and did not provide enough detail to properly address water quality issues adequately. The TMDL that was written by IDEM in 2006 is also very vague and is now outdated as the trends in the watershed are continuously changing. Finally, most other studies are federal requirements that address more point sources than the primary water quality concern of this project.	Yes	No	Yes

Concerns	Supported by Data?	Evidence	Able to Quantify?	Outside Scope?	Group Wants to Focus On?
Increasing Hypoxic Zone in WLEB	No	Federal interest in the Great Lakes has begun to move toward Lake Erie due to the growing algal bloom along the Western Lake Erie coast. DRP has not been sampled in the watershed though Total Phosphorus exceeded target levels in all sub-watersheds, except for those where samples were taken from the mainstem only. Sediment (Turbidity and/or TSS) exceeded the target level in all sub-watersheds except Gordon Creek, Platter Creek, and Sixmile Cutoff.	Yes	No	Yes
Increase in Dissolved Reactive Phosphorus	No	No samples have been taken to measure DRP by any organization as of May 2013.	No	No	Yes
Fish and Wildlife Habitat	Yes	There are nine species of fish, wildlife, and birds on the federal endangered species list. Excessive sediment was found in water quality samples in all sampled sub-watersheds except for Sulphur Creek and Sixmile Cutoff. Sediment can bury aquatic habitat, clog fish lungs, and smother eggs and nests on streambeds. There are 46 invasive species of fish, mussels, and vegetation found within the four counties of the UMRW which can use up resources and take over prime habitat that indigenous species rely on.	Yes	No	Yes
Soil Erosion and Sedimentation	Yes	Total suspended solids or turbidity were found to exceed target levels in all sampled sub-watersheds in the UMRW except for Gordon Creek, Platter Creek, and Sixmile Cutoff. Macroinvertebrate scores were low in Trier Ditch, Bullerman Ditch, and Zuber Cutoff. This may be due to sedimentation smothering their habitat. 88,436 feet of eroded streambanks, and 2,403.70 feet of gully erosion was observed through windshield and desktop surveys conducted in 2012. Approximately 36% of corn fields and 16% of bean fields are conventionally tilled which leads to soil loss and sedimentation of surface waters.	Yes	No	Yes

Concerns	Supported by Data?	Evidence	Able to Quantify?	Outside Scope?	Group Wants to Focus On?
Unbuffered Tile Inlets	Yes	A specific inventory of tile inlets was not conducted though many unbuffered tile inlets were observed during the 2012 windshield survey.	No	No	Yes
Structures within Floodplain	Yes	The entire UMRW is at some risk of flooding, though the area directly adjacent to the Maumee River in Indiana is considered to be at high risk of flooding which includes Fort Wayne and New Haven. Woodburn is surrounded by streams that are at a high risk of flooding. The land directly adjacent to the Maumee River and many of its tributaries in Ohio are considered to be within the 100 year flood plain. Antwerp, Hicksville, Sherwood, and Defiance are all located within the 100 year floodplain. Nearly all populated areas within the UMRW is located within a flood plain which poses a threat to water quality when structures are flooded and contaminants leach into the water.	Yes	No	Yes
Failing or Straight pipe Septic Systems	Yes	Four sites were observed during the 2012 windshield survey that may be direct discharge from a septic system. The Allen County Health Department estimates that nearly 9,000 (50%) of the septic systems in Allen County are, or are at risk of failing. It is estimated that 25%-30% of the septic systems in Ohio are failing. 96% of the watershed soils are considered to be very limited, and 1% of the soils are considered somewhat limited for the placement of septic systems.	Yes	No	Yes
Storm Water Control	Yes	There have been three major floods in the Maumee River Watershed within the past decade. There are Long Term Control Plans (LTCPs) in place in Fort Wayne, New Haven, Hicksville, and Defiance to separate sewers and to educate the public on storm water control methods. The number of CSO events have not decreased within the CSO communities since the development of the LTCPs)	Yes	No	Yes

Concerns	Supported by Data?	Evidence	Able to Quantify?	Outside Scope?	Group Wants to Focus On?
Decrease in Desirable Fish Species	Yes	There are no fish on the Federal endangered species list within the UMRW, though there are 21 species of fish listed on the Indiana and/or Ohio State Endangered Species list. There are four species of invasive fish that can be found within the four counties of the UMRW.	Yes	No	Yes
Rivers / Streams / Watershed Listed as "impaired" by Regulating State Agency	Yes	Indiana Department of Environmental Management has 35 stream segments listed as impaired in the 2012 Integrated Report and Ohio has eight sub-watershed listed as impaired in the 2012 Integrated Report.	Yes	No	Yes
Barnyard Runoff into Surface Water	Yes	All sub-watersheds that had tributaries to the Maumee River sampled for E.coli exceeded the E.coli standard. While all barnyards located within the UMRW were not examined closely, there were eight locations where barnyard runoff observed during the 2012 windshield survey.	Yes	No	Yes
Livestock Access to Open Water	Yes	All sub-watersheds that had tributaries to the Maumee River sampled for E.coli exceeded the E.coli standard. While all sites with livestock within the UMRW were not observed during the windshield survey of 2012, there were 31 sites where livestock were seen with direct access to open water. Most of the sites were located within the Bottern Ditch sub-watershed where water quality measurements exceeded the target level for nutrients, TSS, T and E.coli.	Yes	No	Yes

Sample Site	Subwatershed
173	West Fork-West Branch
175	Clear Fork-East Branch
172	Nettle Creek-Nettle Creek
133	Bear Creek-Nettle Creek
135	West Fork-West Branch
126	Clear Fork-East Fork
129	Nettle Creek-Nettle Creek
132	Bear Creek-Nettle Creek
131	Bear Creek-Nettle Creek

4.0 Pollution Sources and Loads

4.1 Potential Causes of Water Quality Problems

In this section concerns identified by stakeholders in the watershed and through the watershed inventory will be linked to problems found through the watershed investigation. Additionally, potential causes for the problems identified will be expressed. Finally, potential sources will be identified. Table 4.1 shows the connection between those concerns the stakeholders have chosen to focus efforts on, problems found in the watershed, and the potential causes of those problems. Table 4.2 takes it a step further by identifying potential sources to the problems found in the watershed.

Table 4.1: Concerns, Problems, Potential Causes

Concern(s)	Problem	Potential Cause(s)
- Lack of Water Education/Outreach - Rural legal drains - Combined Sewer Overflows - Failing straight pipe septic systems - Rivers/streams listed as "impaired" by the state regulating office - Structures in the floodplain - Recreation opportunities and safety - Barnyard runoff into surface water - Stormwater control - Livestock access to open water - Unbuffered tile inlets	High levels of E. coli were discovered in areas streams after reviewing historic and current water quality data	- E. coli levels exceed the state standard - Area producers are unaware of the water quality threat of not having adequate manure storage - There is a lack of education and outreach regarding septic management - There has been little effort to address urban issues in the watershed - There is a lack of education and outreach regarding urban stormwater issues - Area producers are unaware of the water quality threat of allowing livestock direct access to open water

Concern(s)	Problem	Potential Cause(s)
- Lack of water education/outreach - Rural legal drains - Combined sewer overflows - Failing or straight pipe septic systems - Rivers/streams listed as impaired by state regulating agency - Barnyard runoff into surface streams - Livestock access to open water - Unbuffered tile inlets - Decrease in desirable fish species - Increase in DRP - Stormwater control - Increasing Hypoxic Zone	Area streams have nutrient levels exceeding the target level set by this project Area streams have nutrient levels exceeding the target level set by this project	- Nitrogen levels exceed the target set by this project - Phosphorus levels exceed the target set by this project - There is a lack of education and outreach regarding septic maintenance - There is a lack of education and outreach regarding water quality issues - There has been little effort to address urban issues in the watershed - Area producers are unaware of the cumulative effects of best management practices
- Failing or straight pipe septic systems - Rivers/streams listed as "Impaired" by the State regulating agency - Structures in the floodplain	Historic design and lack of maintenance of septic systems is an issue in the watershed	- There is a lack of education and outreach regarding septic system maintenance
- Need for wetland protection/restoration - Rivers/streams listed as "impaired" by the State regulating agency - Unbuffered tile inlets - Soil erosion and sedimentation - Barnyard runoff into surface water - Livestock access to open water - Increasing Hypoxic Zone - Stream bank erosion - Fish and Wildlife habitat - Lack of riparian buffers - Increase in DRP - Segmented/lack of forested areas	Best management practices to limit nonpoint source pollution are underutilized in the watershed	- There is a lack of education and outreach regarding the benefits of best management practices - Area producers are unaware of the cumulative effects of best management practices
- Stream bank erosion - Lack of riparian buffers - Rural legal drains - Combined Sewer Overflows		- Turbidity and TSS levels exceed the target set by this project - There has been little effort to

Concern(s)	Problem	Potential Cause(s)
- Need for wetland protection/restoration - Structures in the floodplain - Increase in impervious surfaces - Urban contamination sites - Need for more water quality studies/planning efforts - Fish and wildlife habitat - Soil erosion and sedimentation - Unbuffered tile inlets - Storm water control - Decrease in desirable fish species - Barnyard runoff into surface water - Livestock access to open water	Area streams have turbidity levels that exceed the target set by this project Area streams have turbidity levels that exceed the target set by this project	address urban issues in the watershed - There is a lack of education and outreach regarding stormwater management - Non-functional instream structures that promote streambank erosion and log jams - Area producers are unaware of the cumulative effects of best management practices - There is a lack of education and outreach regarding water quality issues - There is a lack of education and outreach regarding septic maintenance - Area producers are unaware of the water quality threat of allowing livestock direct access to open water - There is a lack of education and outreach regarding the benefits of best management practices
- Stream Bank Erosion - Lack of Riparian Buffers - Rural Legal Drains - Combined Sewer Overflows - Increase in Impervious Surfaces - Urban Contamination Sites - Increase in DRP - Fish and Wildlife Habitat - Soil Erosion and Sedimentation - Unbuffered Tile Inlets - Failing or Straight Pipe Septic Systems - Storm Water Control - Decrease in Desirable Fish Species - Structures in the Floodplain	Sections of the Maumee River and its tributaries are listed as impaired on the OH or IN 303(d) list	- There has been little effort to address urban issues in the watershed - There is a lack of education and outreach regarding the benefits of best management practices - There is a lack of education and outreach regarding septic system maintenance - Area producers are unaware of the cumulative effects of best management practices - Area producers are unaware of the water quality threat of allowing livestock direct

Concern(s)	Problem	Potential Cause(s)
- Rivers/Streams listed as "Impaired" by State Regulating Agency - Urban Contamination Sites - Recreational Opportunities and Safety - Barnyard Runoff into Surface Streams - Livestock Access to Open Water		access to open water - Area producers are unaware of the water quality threat of not having adequate manure storage - Nitrogen, phosphorus, turbidity, TSS, and E. coli levels exceed the targets set by this project
- Stream bank erosion - Lack of riparian buffer - Segmented/Lack of forested areas - Need for wetland protection/restoration	There are ten endangered and/or threatened species on the Federal Endangered Species list	- Nitrogen, phosphorus, and DO (Marsh Ditch only) exceeded the target set by this project, thus lowering the quality of aquatic habitat - Turbidity and TSS exceed the target set by this project - Lack of riparian buffer - Land conversion / segmentation
- Storm water control - Combined Sewer Overflows - Increase in impervious surfaces - Recreational opportunities and safety - Decrease in desirable fish species - Rivers/streams listed as “impaired” by the State regulating agency	CSOs discharge untreated sewage directly into the Maumee River and its tributaries	- There has been little effort to address urban issues in the watershed - There has been little pressure put on administrators of the municipal LTCPs to address stormwater issues - There is a lack of education and outreach regarding stormwater management
- Recreational Opportunities and safety - Lack of water education / outreach - Need for more water quality studies/planning efforts - Decrease in desirable fish species	There are few water related recreational opportunities in the Maumee River Watershed to help shed light on the importance of water quality.	- There has been little advocacy to install more water recreational opportunities within the Upper Maumee Watershed - There are few studies focusing on water related opportunities in the watershed

4.2 Potential Sources Resulting in a Water Quality Problem

Now that stakeholder concerns have been linked to water quality problems and potential causes of those problems, and a thorough watershed inventory has been conducted, sources to the problems can be outlined. Outlining the sources to the problems found in the watershed will help to narrow the land area of where to focus efforts which will have the greatest impact on improving water quality.

Table 4.2: Problems, Causes, and Sources

Problem	Potential Cause(s)	Potential Source(s)
High levels of *E. coli* were discovered in area streams after reviewing historic and current water quality data.	E. coli levels exceed the state standard Areas producers are unaware of the water quality threat of not having adequate manure storage There is a lack of education and outreach regarding septic management There has been little effort to address urban issues in the watershed There is a lack of education and outreach regarding urban stormwater issues Area producers are unaware of the water quality threat of allowing livestock direct access to open water	Fort Wayne has 43 CSOs that discharge to the Maumee River and its tributaries, with 15 of those discharging directly into the UMRW (Bullerman Ditch sub-watershed New Haven has one CSO that discharges to the Maumee River and Hicksville has five CSOs that discharge to a tributary of the Maumee River (Bullerman Ditch and Gordon Creek sub-watersheds) Improperly placed and/or faulty septic systems scattered throughout the project area Livestock with direct access to open water, 31 sites were identified during the windshield survey Bottern Ditch, Black Creek, Marie DeLarme, Gordon Creek, Platter Creek, and Snooks Run sub-watersheds) 13 CFOs (Platter Creek, Zuber Cutoff, Sixmile Creek, Marsh Ditch, and Black Creek sub-watersheds) Barnyard or Pasture runoff problems were identified at 20 locations during the windshield survey (Bottern Ditch, Black Creek, Zuber Cutoff, Platter Creek, Marie DeLarme, North Chaney Ditch, Gordon Creek, Sulphur Creek, Trier Ditch sub-watersheds) Pet waste in urban areas including Fort Wayne, New Haven, Woodburn, Antwerp, Hicksville, Cecil, Sherwood and Defiance According to the Allen County Health Department approximately 9000 septic systems are currently at risk of failing within the County, and a study conducted in Ohio

Problem	Potential Cause(s)	Potential Source(s)
High levels of *E. coli* were discovered in area streams after reviewing historic and current water quality data.		estimates that 25% - 30% of systems within Ohio are currently are failing There are eight waste water treatment plants located in the watershed that discharge to waters of the state
Area streams have nutrient levels that exceed the target level set by this project	- Nitrogen levels exceed the target set by this project - Phosphorus levels exceed the target set by this project - There is a lack of education and outreach regarding septic maintenance - There is a lack of education and outreach regarding water quality issues - There has been little effort to address urban issues in the watershed - Area producers are unaware of the cumulative effects of best management practices	- Lack of proper management measures on agriculture land on PHEL and HEL in the watershed (8.9% and <1%, respectively) - According to the Allen County Health Department approximately 9000 septic systems are currently at risk of failing within the County, and a study conducted in Ohio estimates that 25% - 30% of systems within Ohio are currently are failing - 49 CSOs that discharge to the Maumee River or its tributaries (Bullerman Ditch and Gordon Creek) - 13 CFOs (Platter Creek, Zuber Cutoff, Sixmile Creek, Marsh Ditch, and Black Creek) - Barnyard or Pasture runoff problems were identified at 20 locations during the windshield survey (Bottern Ditch, Black Creek, Zuber Cutoff, Platter Creek, Marie DeLarme, North Chaney Ditch, Gordon Creek, and Sulphur Creek) - 73% of the watershed is in cultivated crops which often are fertilized to promote plant growth. Unsustainable farming techniques increase fertilizer runoff - 14% of the watershed is developed. Over fertilizations of turf grass leads to excess fertilizer runoff

Problem	Potential Cause(s)	Potential Source(s)
Historic design and lack of maintenance of septic systems is an issue in the watershed.	- There is a lack of education and outreach regarding septic system maintenance	- Over 96% of the soil in the watershed is considered "very limited" and 1% of the soil in the watershed is considered "somewhat limited" for the placement septic systems - There is a lack of education and outreach regarding septic system placement and maintenance throughout the watershed - According to the Allen County Health Department approximately 9,000 septic systems are currently at risk of failing within the County, and a study conducted in Ohio estimates that 25% - 30% of systems within Ohio are currently are failing
Best Management Practices to limit nonpoint source pollution are underutilized in the watershed	- There is a lack of education and outreach regarding the benefits of best management practices - Area producers are unaware of the cumulative effects of best management practices	- There is a lack of education and outreach regarding the benefits of agricultural BMPs - Federal and local funding for the implementation of agricultural BMPs and management measures has been cut significantly over the past five years
Area streams have turbidity levels that exceed the target level set by this project	- Turbidity and TSS levels exceed the target set by this project - There has been little effort to address urban issues in the watershed - There is a lack of education and outreach regarding stormwater management - Non-functional instream structures that promote streambank erosion and log jams - Area producers are unaware of the cumulative effects of best management practices - There is a lack of education and outreach regarding water quality issues	- 49 CSOs that discharge to the Maumee River or its tributaries (Bullerman Ditch and Gordon Creek and St. Joseph and St. Marys Watersheds) - Improperly placed and/or faulty septic systems placed throughout the project area (estimates over 9,000 systems) - Livestock with direct access to open water; 31 sites were identified during the windshield survey (Bottern Ditch, Black Creek, Marie DeLarme, Gordon Creek, Platter Creek, and Snooks Run) - Barnyard or Pasture runoff problems were identified at 20 locations during the windshield survey (Bottern Ditch, Black Creek, Zuber Cutoff, Platter Creek, Marie DeLarme, North Chaney Ditch, Gordon Creek, Sulphur Creek, Trier Ditch sub-watersheds)

Problem	Potential Cause(s)	Potential Source(s)
Area streams have turbidity levels that exceed the target level set by this project	- There is a lack of education and outreach regarding septic maintenance - Area producers are unaware of the water quality threat of allowing livestock direct access to open water - There is a lack of education and outreach regarding the benefits of best management practices	- 13 Confined Feeding Operations (Platter Creek, Zuber Cutoff, Sixmile Creek, Marsh Ditch, Black Creek) - Lack of proper management measures on agricultural land on PHEL and HEL in the watershed (8.9% and <1%, respectively) - 40% of corn and 20% of beans are conventionally tilled - The windshield survey revealed 88,436 feet of streambank erosion - The windshield survey revealed over 2,400 feet of gully erosion in agriculture fields - 57% of parcels adjacent to open water have less than a 10 foot buffer and 70% of parcels adjacent to open water have less than a 60 foot buffer - There are eight WWTPs located in the watershed that discharge to waters of the state
Sections of the Maumee River and its tributaries are listed on the IN or OH 303(d) list	- There has been little effort to address urban issues in the watershed - There is a lack of education and outreach regarding the benefits of best management practices - There is a lack of education and outreach regarding septic system maintenance - Area producers are unaware of the cumulative effects of best management practices - Area producers are unaware of the water quality threat of allowing livestock direct access to open water - Area producers are unaware of the water quality threat of not having adequate manure storage - Nitrogen, phosphorus, turbidity, TSS,	- 49 CSOs that discharge to the Maumee River or its tributaries (Bullerman Ditch and Gordon Creek and St. Joseph and St. Marys Watersheds) - Improperly placed and/or faulty septic systems placed throughout the project area (estimates over 9,000 systems) - Livestock with direct access to open water; 31 sites were identified during the windshield survey (Bottern Ditch, Black Creek, Marie DeLarme, Gordon Creek, Platter Creek, and Snooks Run) - Barnyard or Pasture runoff problems were identified at 20 locations during the windshield survey (Bottern Ditch, Black Creek, Zuber Cutoff, Platter Creek, Marie DeLarme, North Chaney Ditch, Gordon Creek, Sulphur Creek, Trier Ditch sub-watersheds) - 13 Confined Feeding Operations (Platter Creek, Zuber Cutoff, Sixmile Creek, Marsh Ditch, Black Creek) - Lack of proper management measures on agricultural

Problem	Potential Cause(s)	Potential Source(s)
Sections of the Maumee River and its tributaries are listed on the IN or OH 303(d) list	and E. coli levels exceed the targets set by this project	land on PHEL and HEL in the watershed (8.9% and <1%, respectively) - 40% of corn and 20% of beans are conventionally tilled - 57% of parcels adjacent to open water have less than a 10 foot buffer and 70% of parcels adjacent to open water have less than a 60 foot buffer - The windshield survey revealed 88,436 feet of streambank erosion - The windshield survey revealed over 2,400 feet of gully erosion in agriculture fields - There are 18 NPDES permitted facilities that discharge into the Maumee River or its tributaries (Trier Ditch – 1, Bullerman Ditch – 2, Bottern Ditch – 2, Marsh Ditch – 2, North Chaney Ditch – 1, Zuber Cutoff – 3, Gordon Creek – 2, Sixmile Cutoff – 3, Platter Creek – 1, Sulphur Creek -1) - There are 148 LUSTs located within the UMRW with 50 of those tanks still actively leaking (Sub-watersheds - Trier Ditch-7, Bullerman Ditch - 31, Sixmile Creek - 1, Bottern Ditch - 3, Black Creek - 3, Marsh Ditch - 1, Gordon Creek - 2, Sixmile Cutoff - 2) - There are eight waste water treatment plants located in the watershed that discharge to waters of the state - (Marsh Ditch, Sixmile Cutoff, Gordon Creek, Bullerman - Ditch, Sulphur Creek, North Chaney Ditch)
There are ten (10) endangered and/or threatened species on the Federal Endangered Species list	- Nitrogen, phosphorus, and DO (Marsh Ditch only) exceeded the target set by this project, thus lowering the quality of aquatic habitat - Turbidity and TSS exceed the target set by this project - Lack of riparian buffer - Land conversion / segmentation	- The UMRW has lost a significant amount of wetlands and currently less than 1.5% of the watershed is considered to be wetland - Same sources as listed above contributing to high turbidity levels in the water which can suffocate aquatic life and smother aquatic habitat - Less than 5% of the watershed is considered to be forested

Problem	Potential Cause(s)	Potential Source(s)
CSO's discharge untreated sewage directly into the Maumee River and its tributaries	- There has been little effort to address urban issues in the watershed - There has been little pressure put on administrators of the municipal LTCPs to address stormwater issues - There is a lack of education and outreach regarding stormwater management	- 49 CSOs that discharge to the Maumee River or its tributaries (Bullerman Ditch and Gordon Creek and St. Joseph and St. Marys Watersheds) - There is a lack of education and outreach regarding stormwater management and impacts o water quality from CSO discharges
There are few water related recreational opportunities in the Maumee River Watershed to help shed light on the importance of water quality	- There has been little advocacy to install more water recreational opportunities within the Upper Maumee Watershed - There are few studies focusing on water related opportunities in the watershed	- There has been little advocacy to install more water recreational opportunities within the Upper Maumee River Watershed - There are few studies focusing on water related recreational opportunities in the watershed

4.3 Pollution Loads and Necessary Load Reductions

Water quality samples were taken from eight sub-watersheds within the project area in 2012 by the Allen County SWCD. However, the SWCD did not have the resources to collect water quality samples from all sub-watersheds. For that reason, this project worked with Purdue University to use their newly calibrated Soil and Water Assessment Tool (SWAT) model to determine current loads for each HUC 12 located within the UMRW. Using the SWAT model for all sub-watersheds will allow the accuracy of the data to be consistent throughout the watershed. Current pollution loads were determined for the fourteen Upper Maumee River sub-watersheds using the SWAT model, and when compared to the water quality targets set by the UMRW steering committee and outlined in Section 3, the model provides detail on how much pollution loads will need to be reduced to meet the targets set by this project.

Current pollution loads and load reductions were analyzed for nitrogen, total phosphorus, and sediment only, as *E.coli* loads cannot be accurately determined, and loads determined for the other parameters measured as part of this project would not be useful to this project. However, it is important to note that *E. coli* is a major concern of the UMRW steering committee and *E.coli* totals will be presented here as well. Table 4.3 is a reminder of the target concentrations for each of the parameters of concern that were set by this project's steering committee. Tables 4.4 through 4.7 show the current and target loads and load reductions needed for nitrogen, total phosphorus, and sediment. As can be seen in the following tables, load reductions were necessary in all sub-watersheds for total phosphorus and sediment and in seven of the sub-watersheds for nitrogen.

Table 4.3: Target Concentrations for Parameters of Concern

Parameter of Concern	Target Concentration
Nitrate+Nitrite	<1.6 mg/l
Total Phosphorus	<0.08 mg/l
Dissolved Reactive Phosphorus	< 0.05 mg/l
E. coli	<235 CFU/100 ml
Total Dissolved Solids	< 750 mg/l
Total Suspended Solids	< 25 mg/l
Turbidity	< 10 NTU

Table 4.4: Nitrogen Pollution Load Reductions to Meet Target Loads

Sub-watershed			Nitrate+Nitrite N (tons/year)		
Code	Name	Mean Flow (ft^3/sec)	Current	Target	Reduction Needed
41000050101	Trier Ditch	40.44	40.52	63.70	-
41000050102	Bullerman Ditch	51.65	35.21	81.35	-
41000050103	Sixmile Creek	33.91	41.86	53.41	-
41000050104	Black Creek	25.18	29.66	39.65	-
41000050105	Bottern Ditch	48.43	52.68	76.27	-
41000050106	Marsh Ditch	23.65	50.31	37.24	13.06
41000050201	Zuber Cutoff	50.12	124.47	78.93	45.54
41000050202	North Chaney Ditch	22.68	40.10	35.73	4.38
41000050203	Marie DeLarme Creek	69.75	113.67	109.85	3.81
41000050204	Gordon Creek	63.66	90.91	100.27	-
41000050205	Sixmile Cutoff	24.36	46.99	38.36	8.63
41000050206	Platter Creek	31.51	58.50	49.63	8.87
41000050207	Sulphur Creek	26.80	48.66	42.21	6.45
41000050208	Snooks Run	39.73	60.76	62.58	-
		Total	**834.30**	**869.17**	**90.74**

Table 4.5: Total Phosphorus Load Reductions to Meet Target Loads

Sub-watershed			TP (tons/year)		
Code	Name	Mean Flow (ft^3/sec)	Current	Target	Reduction Needed
41000050101	Trier Ditch	40.44	31.89	3.18	28.71
41000050102	Bullerman Ditch	51.65	12.01	4.07	7.94
41000050103	Sixmile Creek	33.91	14.76	2.67	12.09
41000050104	Black Creek	25.18	15.67	1.98	13.68
41000050105	Bottern Ditch	48.43	14.52	3.81	10.71
41000050106	Marsh Ditch	23.65	10.24	1.86	8.37
41000050201	Zuber Cutoff	50.12	32.04	3.95	28.10
41000050202	North Chaney Ditch	22.68	6.44	1.79	4.66
41000050203	Marie DeLarme Creek	69.75	37.21	5.49	31.71
41000050204	Gordon Creek	63.66	44.23	5.01	39.22
41000050205	Sixmile Cutoff	24.36	16.92	1.92	15.00
41000050206	Platter Creek	31.51	25.94	2.48	23.46
41000050207	Sulphur Creek	26.80	29.61	2.11	27.50
41000050208	Snooks Run	39.73	27.54	3.13	24.41
		Total	**319.01**	**43.46**	**275.55**

Table 4.6: Sediment Load Reductions to Meet Target Loads

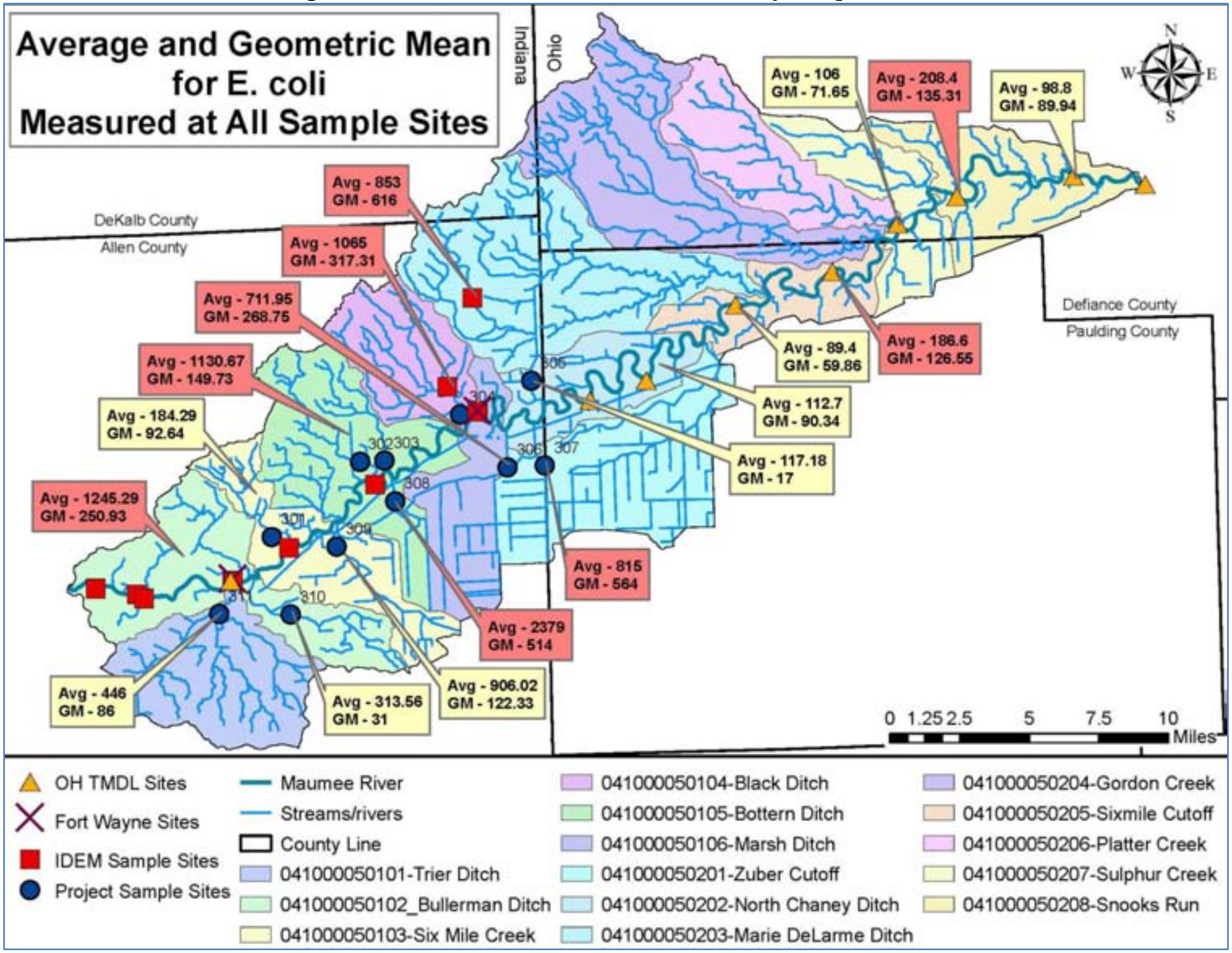
Sub-watershed			Sediment (tons/year)		
Code	Name	Mean Flow (ft^3/sec)	Current	Target	Reduction Needed
41000050101	Trier Ditch	40.44	27358.15	995.26	26362.89
41000050102	Bullerman Ditch	51.65	6905.37	1271.06	5634.31
41000050103	Sixmile Creek	33.91	7332.15	834.50	6497.64
41000050104	Black Creek	25.18	8675.44	619.54	8055.90
41000050105	Bottern Ditch	48.43	6632.02	1191.72	5440.30
41000050106	Marsh Ditch	23.65	4298.34	581.94	3716.40
41000050201	Zuber Cutoff	50.12	12625.18	1233.33	11391.86
41000050202	North Chaney Ditch	22.68	1695.48	558.21	1137.27
41000050203	Marie DeLarme Creek	69.75	21160.31	1716.42	19443.89
41000050204	Gordon Creek	63.66	21469.49	1566.71	19902.77
41000050205	Sixmile Cutoff	24.36	10560.55	599.37	9961.18
41000050206	Platter Creek	31.51	10846.79	775.48	10071.31
41000050207	Sulphur Creek	26.80	33804.57	659.48	33145.09
41000050208	Snooks Run	39.73	19160.92	977.76	18183.16
		Total	**192524.76**	**13580.79**	**178943.97**

Table 4.7: Dissolved Reactive Phosphorus Reductions to Meet Target Loads

HUC12		Mean Flow (ft^3/sec)	Dissolved Reactive Phosphorus (Tons/yr)		
Code	Name		Current Load	Target Load	Reduction Needed
41000050101	Trier Ditch	40.44	11.94	1.99	9.95
41000050102	Bullerman Ditch	51.65	4.07	2.54	1.53
41000050103	Sixmile Creek	33.91	9.45	1.67	7.78
41000050104	Black Creek	25.18	12.19	1.24	10.95
41000050105	Bottern Ditch	48.43	4.18	2.38	1.80
41000050106	Marsh Ditch	23.65	3.24	1.16	2.08
41000050201	Zuber Cutoff	50.12	3.92	2.47	1.46
41000050202	North Chaney Ditch	22.68	3.31	1.12	2.19
41000050203	Marie DeLarme Creek	69.75	5.03	3.43	1.60
41000050204	Gordon Creek	63.66	4.65	3.13	1.52
41000050205	Sixmile Cutoff	24.36	3.83	1.20	2.64
41000050206	Platter Creek	31.51	8.81	1.55	7.26
41000050207	Sulphur Creek	26.80	4.44	1.32	3.12
41000050208	Snooks Run	39.73	5.11	1.96	3.16
		Total	**84.18**	**27.16**	**57.02**

Even though load reductions cannot be determined for *E. coli* it is important to understand the magnitude of the problem it poses to the health of the watershed. Therefore, Figure 4.1 shows the average CFU of *E. coli* at each of the drainage areas associated with a current or historic sample site located within the UMRW. The geometric mean for *E. coli* is also shown for each drainage area as the geometric mean provides a clearer look at the typical condition of the area by taking out the samples of extreme outliers. However, the average *E. coli* CFU provides information as to whether or not *E. coli* can be an issue in the area. Those cells highlighted in pink in Figure 4.1 are those with geometric mean that exceeds the target level set by this project.

Figure 4.1: E. coli Levels of the Drainage Area to Historic and Current Water Quality Sample Sites



5.0 Critical Areas

5.1 Critical Areas to Focus Implementation Efforts

Critical areas are defined by IDEM as areas that have been identified through historical studies, land use information, and water quality data, in the project area as needing implementation efforts to improve current water quality or mitigate the impact of potential sources of NPS to protect water quality. Identifying critical areas and goals to address those critical areas will focus efforts in the watershed on the areas that will have the greatest impact on improving water quality in the UMRW. This Section will identify the critical areas located within the UMRW project area and outline the goals necessary to address those critical areas. Please note that if there are several areas that are considered critical for a particular practice or parameter, a “priority” ranking has been assigned to those areas so that implementation efforts will be focused on the areas that will have the biggest impact on water quality first. Once all possible implementation efforts have been exhausted in Priority Area 1, efforts will be focused on Priority Area 2, and so on.

5.1.1 Stream Buffer Width at Headwater Streams and Bank Erosion Critical Areas

The UMRW Steering Committee expressed concern regarding streambank erosion and the lack of riparian buffers throughout the project area. It should be noted here that the lack of riparian buffer can lead to increased erosion of streambanks.

The windshield and computer based survey of stream buffers revealed that many of the streams in the watershed lack an adequate buffer to filter runoff before it enters the stream or supply suitable habitat for wildlife. Over 71% of the parcels adjacent to open water in the UMRW have a stream buffer of less than 60 feet in width and 57% of parcels adjacent to open water have a stream buffer of less than 10 feet in width.

Stream buffers are important to water quality as vegetated buffers help to slow the velocity of storm flow which allows time for sediment, much of which carries other pollutants attached to the soil particles, to settle out before entering the stream, as well as helps keep soil in place to prevent stream bank erosion. With the majority of streams in the watershed having inadequate buffers, the steering committee has decided to make stream buffer installation a priority of the project.

Previous studies indicate that the majority of the pollution found in water comes from headwater streams. For that reason, the steering committee has decided to make all stream buffers less than 60 feet in width at headwater streams critical for the installation of riparian buffer strips. The steering committee has also decided to follow the NRCS recommended widths for an adequate riparian buffer. The NRCS recommends that land with a slope of 0 – 2% have a minimum of a 20 foot buffer, land with a slope of 2 – 4% have a minimum of a 40 foot buffer, and land with a slope greater than 4% have a minimum buffer of 60 feet. Slope in relation to stream buffers has not been inventoried at this time and will be assessed on a case by case basis at the time of implementation, at which time priority will be given to those areas where the most significant runoff and erosion potential exists.

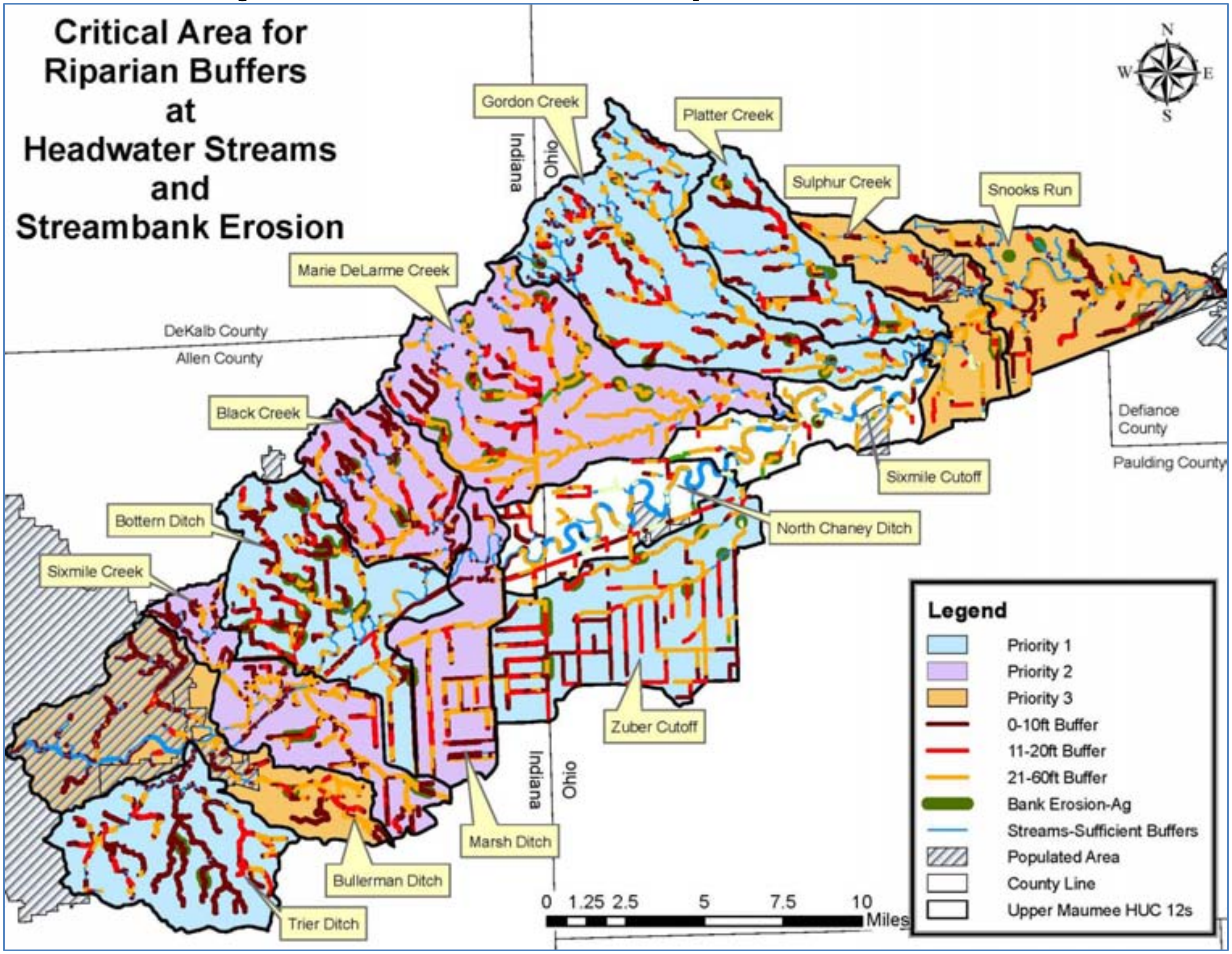
The windshield survey conducted in 2012 in the UMRW revealed more than 72,846 linear feet of stream bank erosion along streams within the agricultural landscape in the UMRW. This streambank erosion may be due to a lack of adequate riparian buffer to slow the velocity and erosive power of stormwater, producers farming up to the streambank, the lack of adoption of conservation tillage practices, or other conventional farming techniques. Management measures will need to be taken to address the areas identified during the windshield survey, and any future bank erosion sites to prevent further erosion and sedimentation of the stream.

Figure 5.1 is a map showing the location of the land parcels with a riparian buffer of less than 60 feet, as well as the location of streambank erosion that was observed during the windshield survey. As can be seen in the map, streambank erosion was observed at, or directly downstream of where the riparian buffer is less than 60 feet, and more often found at or downstream of a buffer of less than 20 feet. Based on the information depicted in the map, and necessary load reductions in the HUC 12s, the installation of riparian buffers at headwater streams and streambank erosion remediation will be prioritized per sub-watershed, as outlined in Table 5.1. It should be noted that based on how the buffer inventory was conducted, by an outside source, there is no way to determine the actual stream miles that need a riparian buffer at this time. However, the map below provides a picture of where to start the implementation process in regards to riparian buffers.

Table 5.1: Critical Area for Stream Buffer at Headwaters and Streambank Erosion

Priority	Sub-watershed
Priority 1	Trier Ditch, Zuber Cutoff, Gordon Creek, Platter Creek, Bottern Ditch
Priority 2	Black Creek, Sixmile Creek, Marie DeLarme Creek, Marsh Ditch
Priority 3	Bullerman Dtich, Sulphur Creek, Snooks Run

Figure 5.1: Critical Areas for Agriculture Based Streambank Erosion and Riparian Buffer Width



5.1.2 Urban Pollutant Sources Based Critical Areas

The UMRW Steering Committee voiced several concerns regarding urban land use issues that affect water quality, and urban pollutants including, combined sewer overflows, an increase in imperviousness, urban contamination sites such as industries and commercial areas, structures located within the flood plain and general stormwater management.

Urban pollutants can be much different than those found throughout the agricultural community. For example, fertilizer from urban lawns, golf courses, parks and cemeteries often contains nutrients that are in excess of what the grass typically requires and are more likely to runoff during wet weather events than fertilizers used in agriculture. It is also common to have runoff of heavy metals, oil, gas and other substances from automobiles, and sediment and salts from road de-icing operations. Pet waste left on lawns can make its way into the sewer system or open water and increase *E. coli* and nutrient levels. Wildlife and bird waste, is often a problem in urban retention ponds. Finally, excess stormwater, due to the increase in imperviousness within urban areas, can become a pollutant itself by causing surface and stream bank erosion.

A significant issue in the UMRW is the presence of 21 CSOs located within the watershed, as well as an additional 28 CSOs located upstream of the Maumee River in the St. Joseph and St. Marys Rivers. The increase in impervious surfaces in urban areas, specifically within Fort Wayne, has increased the number of CSO events each year. Fort Wayne's Long Term Control Plan includes plans to construct an underground storage tunnel to convey combined sewers to the waste water treatment plant prior to being discharged back into the river, thus limiting the number of CSO events to four annually (construction to begin in 2017). While this is a significant decrease in the amount of untreated combined sewage entering the river, raw sewage and other urban pollutants will still be discharged directly into the river and effect water quality, aquatic life, and recreational opportunities in the rivers. The cities of New Haven and Hicksville also have an approved LTCP, though they lack the funding and resources of the larger city of Fort Wayne and are not able to control the excess stormwater issue to the same degree. Therefore, additional stormwater management measures will need to be implemented at the individual homeowner level, as well as at commercial sites and new developments that go above and beyond any state mandated stormwater management measures. Fort Wayne's LTCP also includes plans to separate some of the combined sewers so that raw sewage from those areas will never enter the river. However, that also means that stormwater still will not be treated prior to being discharged into the river which indicates an increase in urban polluted runoff entering open water.

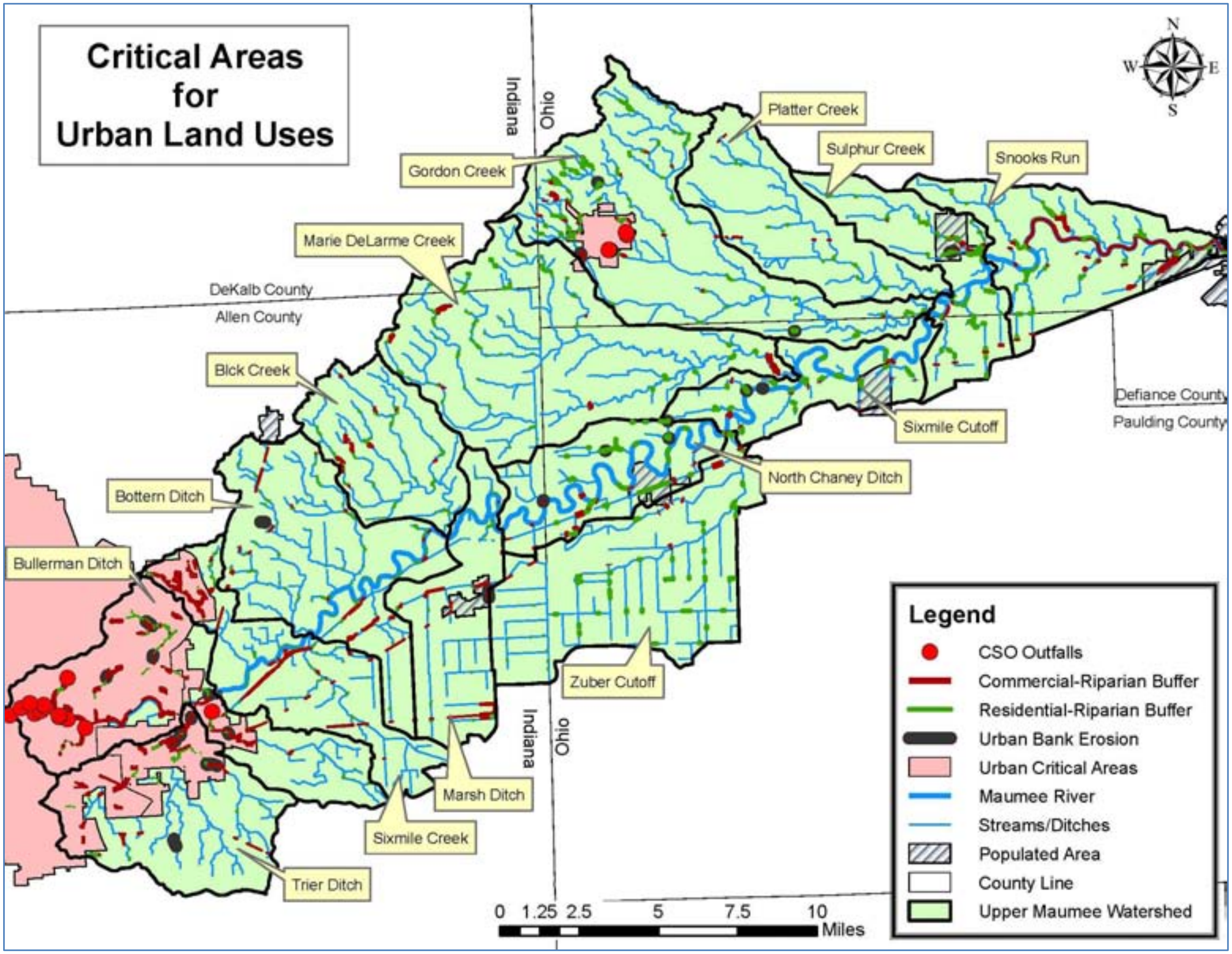
The windshield survey conducted in 2012 in the UMRW revealed more than 14,860 linear feet of stream bank erosion along streams within the urban landscape in the UMRW. This streambank erosion may be due to a lack of adequate riparian buffer to slow the velocity and erosive power of stormwater exacerbated by the increase in imperviousness. Management measures will need to be taken to address areas identified during the windshield survey, and

any future bank erosion sites identified in the urban community to prevent further erosion and sedimentation of the stream.
It was common to see residential properties and industrial sites with little to no riparian buffer throughout the urban areas within the UMRW during the windshield survey conducted in 2012. It was observed that most homeowners mow their lawns directly up to the streambank to maximize their lawn space, and many commercial and industrial facilities did not have a stream buffer as the land is used for parking, or another aspect of the business. The desktop riparian buffer inventory identified residential and commercial property that is located directly adjacent to open water to help focus implementation efforts.

Based on the windshield survey, riparian buffer inventory, and CSO events, the UMRW steering committee has decided to make all CSO communities critical for education and outreach, as well as implementation of stormwater management measures to decrease urban pollutants

While all of Fort Wayne is not located within the UMRW, the Steering Committee believes that implementation efforts should extend beyond the UMRW in Fort Wayne to include the entire Western Lake Erie Basin watershed since Fort Wayne is located at the headwaters of the Maumee River and contributes significantly to the impairment of water quality in the Maumee River through surface flow of storm water carrying pollutants and CSO discharges. Figure 5.2 is a map showing the location of all CSOs within the UMRW and all critical urban areas to focus implementation efforts. (Refer to figure 2.19 on page 59 to see all of Fort Wayne's CSOs).

Figure 5.2: Critical Areas for Urban Land Uses and Combined Sewer Overflows



5.1.3 Livestock / Manure Runoff Based Critical Areas

The UMRW steering committee voiced concern regarding runoff from all animal feeding operations. The concern can be validated by the thirty (30) locations that were observed during the windshield survey where livestock had direct access to open water which poses a direct threat to water quality from soil erosion, and the direct deposit of nutrients and pathogens via animal waste. While only 30 locations were observed during the windshield survey, there could be more areas where livestock are posing a threat to water quality by having direct access to open water that may be identified in the future since only observations made from the road were possible during the windshield survey. There were also 21 sites where manure was noted to have the potential to runoff a livestock operation either from the barnyard or pasture field during the 2012 windshield survey. Without proper manure management at livestock operations, surface and ground water has the potential to become contaminated with excess nutrients and bacteria.

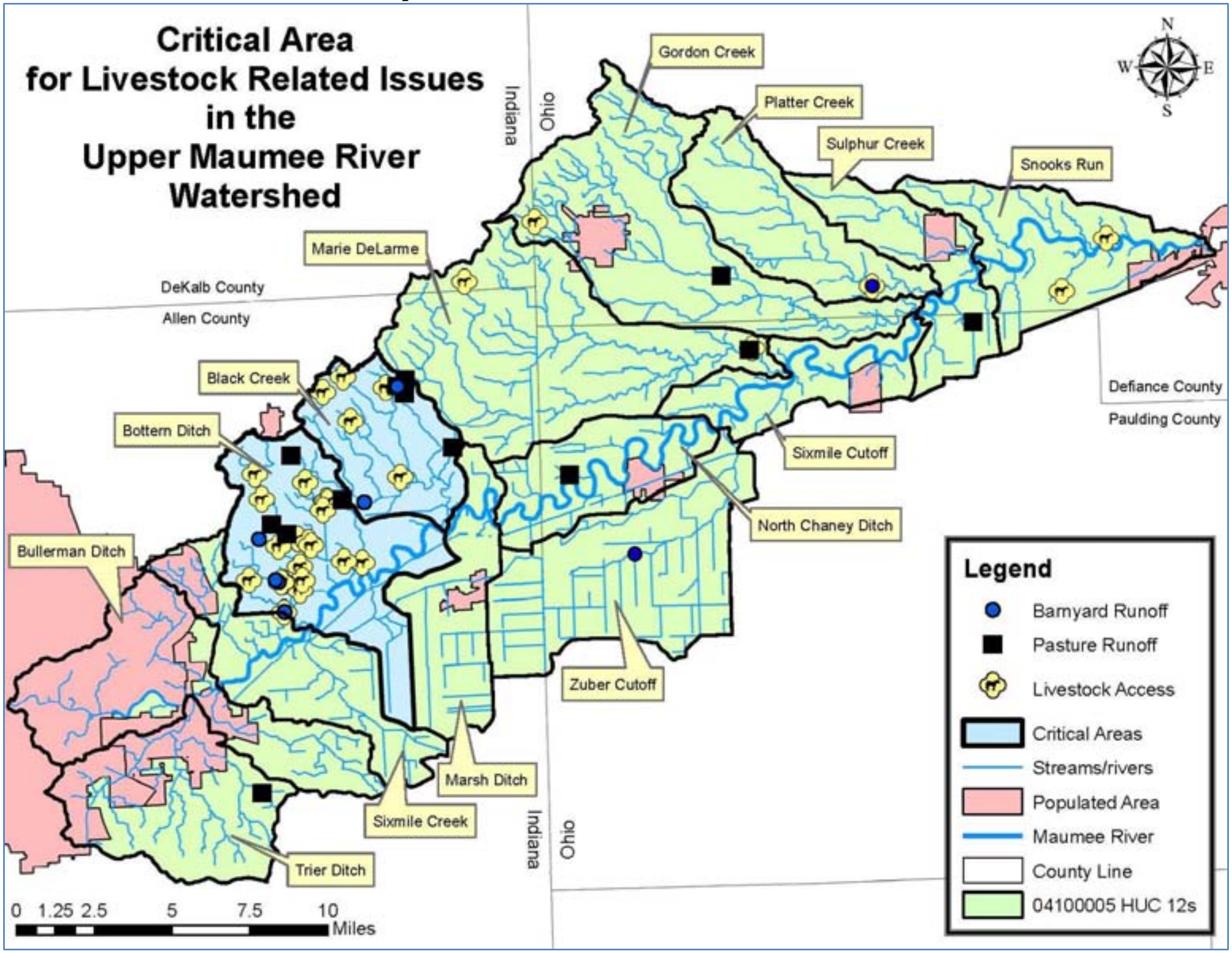
Due to the overwhelming evidence supporting the concern, the UMRW steering committee has made all current and future locations in the project area where livestock have direct access to open water, and all current and future livestock operations that exhibit the potential for manure runoff a priority. Based on water quality data, the SWAT model load reductions, and the number of livestock access and manure runoff potential from identified barnyards and pastures identified during the windshield survey per sub-watershed, Bottern Ditch and Black Creek sub-watersheds are critical for livestock related issues. Table 5.2 lists the number of livestock issues observed during the 2012 windshield survey in Bottern Ditch and Black Creek and Figure 5.3 is a map showing the locations where livestock were seen in, or where livestock access to the water was verified, as well as, all 21 sites where the potential for manure runoff to occur was observed. However, it is important to note that any future locations identified where livestock have direct access to surface water, or manure runoff is a possibility, will also be critical for the implementation of best management practices to permanently remove the potential for manure contamination from livestock within Bottern Ditch and Black Creek.

Table 5.2: Livestock Based Critical Area

Critical Source	Critical Area	Number in CAs
Current and Future Pasture and Barnyard Runoff	Bottern Ditch and Black Creek	14 Sites (2012)[1]
Current and Future Livestock with Direct Access to Open Water	Bottern Ditch and Black Creek	25 Sites (2012)[1]

[1] Total number was derived from the 2012 windshield survey.

Figure 5.3: Critical for Small Scale Livestock Operations



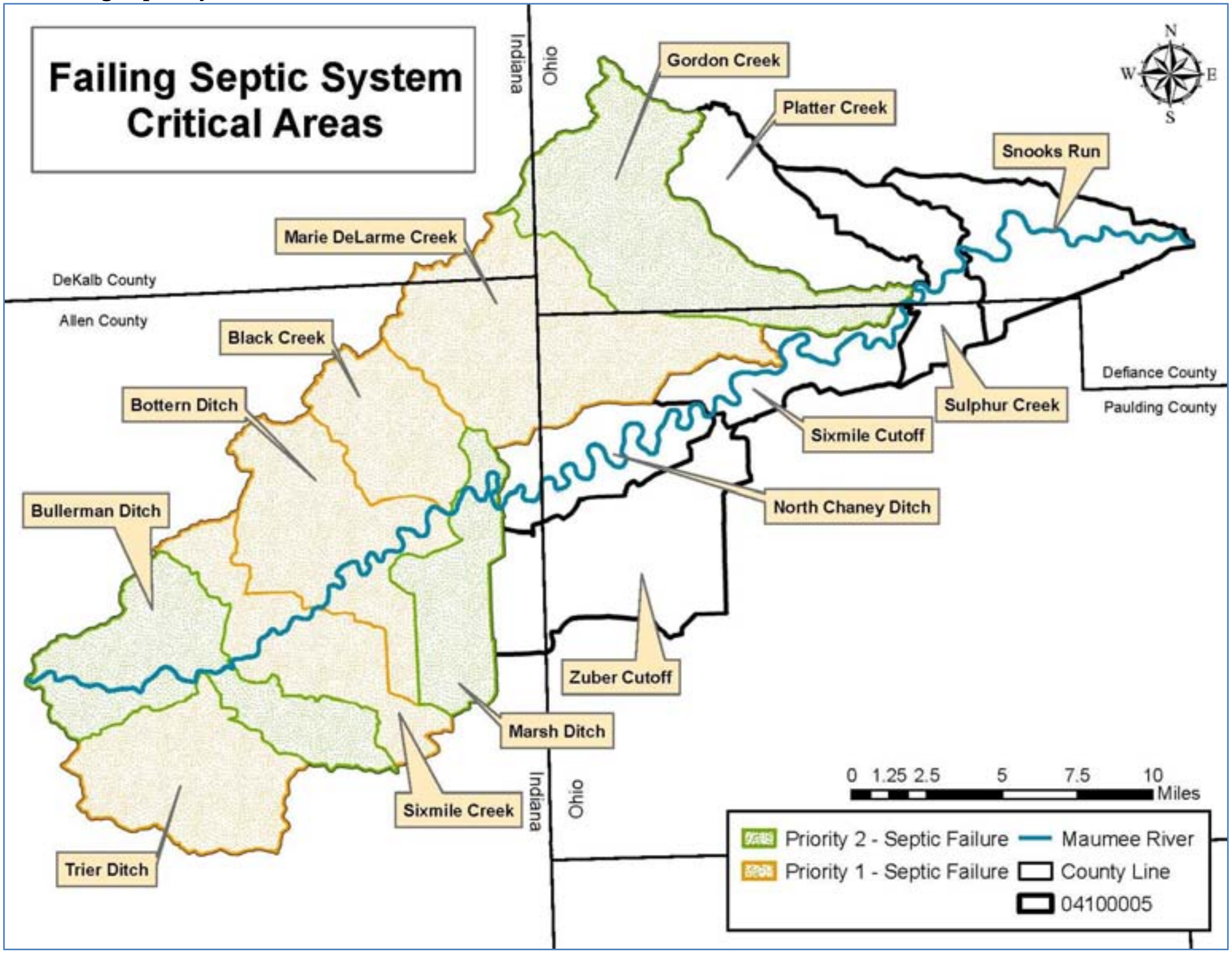
5.1.5 Septic System Critical Areas

Nearly every sub-watershed had sample sites that exceeded the state standard for *E. coli*. Much of the *E. coli* contamination will be addressed in other critical areas including remediating livestock operations that are not utilizing proper manure management practices, and reducing the number of CSO events in urban areas. Another major source of *E. coli* contamination that can be controlled is septic tank leachate, which is also a contributor to DRP and nitrogen. Based on results of the septic tank failure analysis, every sub-watershed is experiencing failures anywhere from 56 households in Sixmile Cutoff to 784 households in Bottern Ditch. Due to the water quality issues that can arise in ground and surface water from septic tanks that are failing, or straight piped to an open ditch it was determined that septic tank education and outreach, and septic tank maintenance, repair and elimination cost assistance will be available in the critical areas outlined in Table 5.3 for septic system failures. *E. coli* was only sampled in the main stem of the Maumee River in sub-watersheds located in Ohio, and due to dilution of those samples, assumptions cannot be made as to whether one sub-watershed has a greater water quality problem from *E. coli* than another. Therefore, prioritization was given based on the estimated number of failing septic systems per sub-watershed. Priority was first given to those sub-watersheds with greater than 300 households estimated to be failing, and second priority was given to those sub-watersheds with between 199 and 300 households estimated to be failing. Figure

Table 5.3: Septic Tank Based Critical Areas

Critical Sub-watershed for E. coli/Septic Systems	Priority
Trier Ditch	1
Sixmile Creek	1
Bottern Ditch	1
Black Creek	1
Marie DeLarme Creek	1
Bullerman Ditch	2
Marsh Ditch	2
Gordon Creek	2

Figure 5.4: Failing Septic System Critical Areas



5.1.6 Pollutant Based Critical Areas

The UMRW Steering Committee expressed concern regarding several problems, land uses and practices that can be observed throughout the watershed that may be contributing to the high nutrient, bacteria, and sediment levels demonstrated by water quality data and the SWAT model. These problems include streambank erosion, lack of riparian buffer, rural legal drains, CSOs, wetland protection and restoration, increase in impervious surfaces, increasing hypoxic zone, soil erosion and sedimentation, unbuffered tile inlets, failing or straight pipe septic systems, barnyard runoff, and livestock with access to open water. Also, the SWAT model indicates nutrient and/or sediment load reductions are necessary to meet target loads in all the sub-watersheds located in the UMRW and the water quality data collected by this project and the OH EPA show exceedances in every sub-watershed for one or more of the following parameters; E. coli, nitrogen, phosphorus, turbidity, or TSS.

The windshield survey conducted as part of this project revealed several areas of concern to help validate stakeholder concerns and are listed in the above critical areas. It was also noted during the survey that many streams and ditches have been straightened and have lost their natural shelf and flood plain and much of the woody riparian area has been cleared. This practice does a great job to quickly move water away from farm fields; however it also increases stream flow causing bank erosion, increases water temperatures, and decreases aquatic and riparian habitat. In addition to those areas, 37% of fields in corn and 16% of fields in beans are conventionally tilled, which allows for surface flow of sediment and fertilizers to discharge into open water and many field tiles were noted as discharging during a drought season. This may indicate that the water table is very high and with heavy precipitation, these field tiles could discharge at a greater rate, exacerbating existing bank erosion surrounding the tile outlets as well as carry excess nutrients to open water more easily. Furrows are another common means of transporting excess water from farm fields within the watershed. The furrows also transport sediment and other pollutants to open water as well as can cause severe bank erosion.

For the reasons listed above, the UMRW Steering Committee has decided to make certain sub-watersheds critical based on actual water quality data and the results of the SWAT model. In light of the excessive plant growth issues occurring each year in the Western Lake Erie Basin at the mouth of the Maumee River and several hundreds of yards out to open water, it was decided that focus should be placed on controlling the phosphorus (total and dissolved reactive) runoff prior to addressing nitrogen. However, it should be noted that many practices that will be implemented to address P, will also address N runoff.

DRP and total phosphorus often originate from different sources. While TP finds its way to open water through septic system leachate, over application of lawn fertilizers, and WWTP effluent, the main mechanism for TP to reach open water is from sediment runoff. TP attaches to soil particles and as the soil moves over land or through field tiles, the TP moves with it. Therefore, sediment issues will need to be addressed to make a significant impact on TP.

DRP, on the other hand, does not attach to soil particles and is free flowing, and readily available for plant uptake within the water column. DRP is typically transported to open water through field tiles within the agricultural community, manure runoff, and septic system leachate. Therefore, those sources of DRP will need to be addressed to meet water quality targets for DRP.

Sediment Based Critical Area

Based on available water quality data collected in the watershed, the SWAT model, and landuse data collected through windshield and desktop surveys the sub-watersheds listed in Table 5.4 are considered to be critical for addressing sediment.

For those sub-watersheds where actual water quality data was collected for an extended period of time, and from more than just the main stem of the Maumee, the actual water quality data percent exceedance was weighted higher than the SWAT load reduction results. All sub-watersheds located in Ohio that were only sampled six times in the main stem of the Maumee River were ranked based on the SWAT load reduction model. However, those sub-watersheds in Ohio where a TSS or turbidity exceedance was found are weighted as more critical since typically the main stem will have fewer samples that exceed target levels due to dilution. So, if an exceedance was found in the mainstem, it can be assumed that TSS loading is very high.

Finally, the land use inventory was reviewed to help determine the most critical areas for sediment. Bullerman Ditch, Black Creek and Bottern Ditch all had many exceedances for TSS, turbidity, and TP. However, the problems attributing to those exceedances will likely be addressed through the critical areas for urban land uses, and livestock, therefore they were not considered critical based solely on available water quality data and SWAT load reductions.

Priority was assigned to each of the critical sub-watersheds for sediment based on the estimated load reductions from the SWAT model, and whether or not there were water quality exceedances recorded in that sub-watershed from the water quality data that was collected.

Table 5.4: Sediment Based Critical Areas

Critical Sub-watershed for Sediment	TSS/Turbidity % Exceedance	Total P % Exceedance	SWAT Load Reduction Needed (T/yr)	Priority
Trier Ditch	0/75	46	26,362.89	1
Zuber Cutoff	NA/100	43	11,391.86	1
Sixmile Creek	100/73	57	6,497.64	1
Gordon Creek	17/NA	0	19,902.77	1
Sulphur Creek	90/NA	0	33,145.09	1
Snooks Run	50/0	0	18,183.16	1
Marsh Ditch	62/91	22	3,716.4	1
Marie DeLarme Ditch	0/NA	0	19,443.89	2
Platter Creek	17/0	0	10,071.31	2

*NA means that that parameter was not sampled

Dissolved Reactive Phosphorus Based Critical Area

There is not any historic or current water quality data pertaining to DRP within the UMRW. However the SWAT model estimates that a load reduction for DRP is needed in every sub-watershed located within the UMRW. As stated above, DRP often comes from more specific sources than other pollutants such as septic leachate, field tiles, and manure runoff. Based on the SWAT model and windshield and desktop surveys, the sub-watersheds outlined in Table 5.5 are considered to be critical. Those sub-watersheds with an estimated load reduction needed of greater than 2 tons/year are considered to be critical for DRP. Of those sub-watersheds, first priority was assigned to those sub-watersheds with a necessary load reduction of greater than 5 tons/year, then whether or not there are known septic system failures of greater than 199 households within that sub-watershed and/or livestock or manure runoff issues, another major contributor to DRP.

Table 5.5: Dissolved Reactive Phosphorus Based Critical Areas

Critical Sub-watershed for DRP	SWAT Load Reduction Needed (T/yr)	Septic System Failure Estimated at >199 Households	Livestock and/or Manure Runoff Issues	Priority
Trier Ditch	9.95	X		1
Sixmile Creek	7.78			1
Black Creek	10.95	X	X	1
Platter Creek	7.26		X	1
Marsh Ditch	2.08			2
North Chaney Ditch	2.19			2
Sixmile Cutoff	2.64			2
Sulphur Creek	3.12			2
Snooks Run	3.16			2

Figure 5.5 is map of the UMRW with the sub-watersheds that are critical for sediment and DRP. However, to further prioritize the implementation of management measures to address the major pollution issues found within the UMRW, emphasis will be put on addressing DRP first. Therefore, critical sub-watersheds that are ranked as a priority 1 for DRP, or those ranked as a priority 1 or 2 and also a priority 1 for sediment will be addressed before the other critical areas. The sub-watersheds that are considered to be critical for only one parameter, or assigned a priority 2 for both DRP and sediment will be addressed after all implementation efforts have been exhausted in the sub-watersheds that are prioritized as a 1 for implementation. Table 5.6 lists the implementation prioritization for those sub-watersheds deemed critical for sediment and DRP and Figure 5.6 is a map depicting the prioritization.

Table 5.6: Critical Area Prioritization

Critical Sub-watershed for DRP and/or Sediment	Implementation Prioritization
Trier Ditch	1
Sixmile Creek	1
Black Creek	1
Platter Creek	1
Sulphur Creek	1
Snooks Run	1
Marsh Ditch	1
Zuber Cutoff	2
North Chaney Ditch	2
Marie DeLarme Creek	2
Gordon Creek	2
Sixmile Cutoff	2

Figure 5.5: Critical Areas for Sediment and Dissolved Reactive Phosphorus

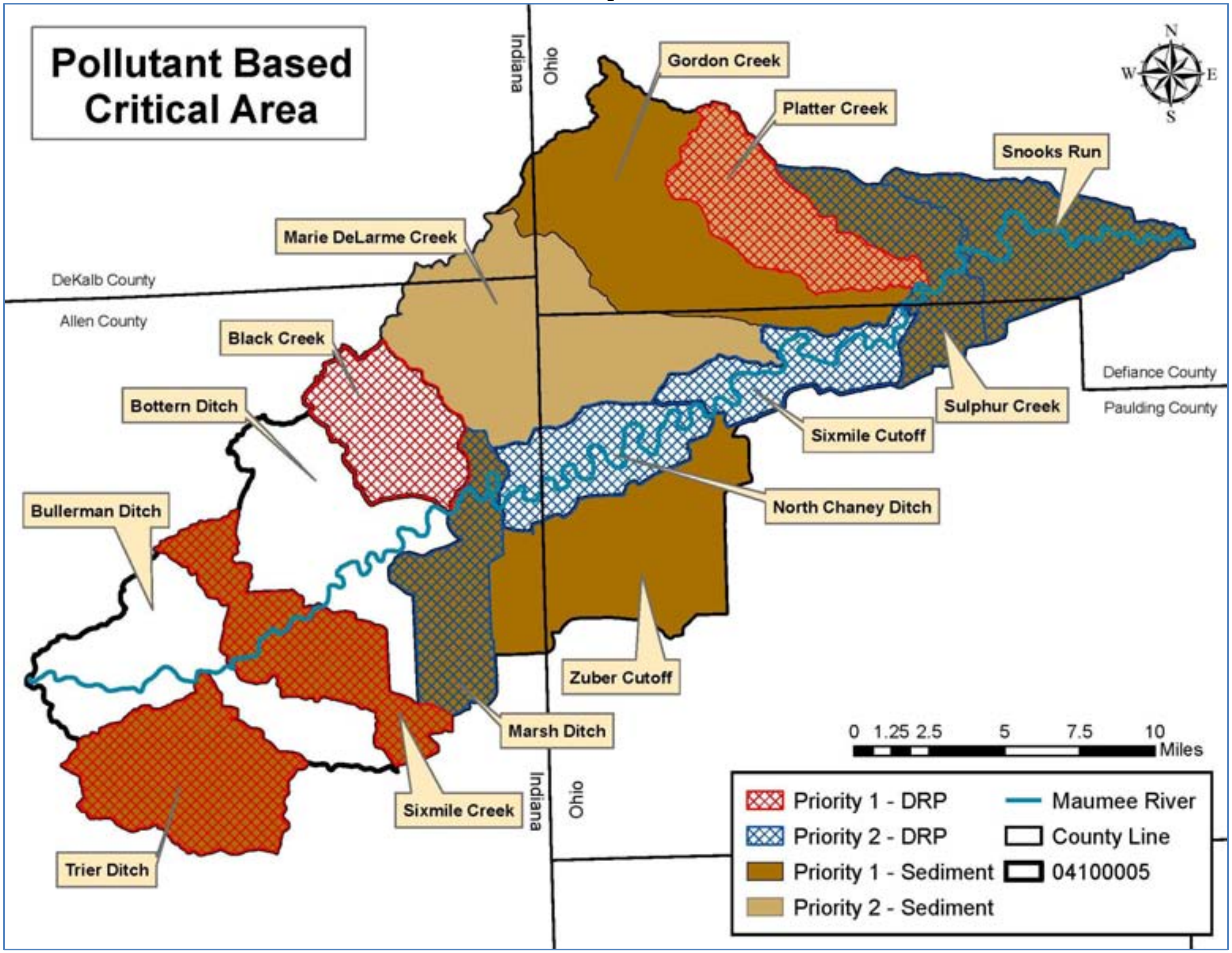
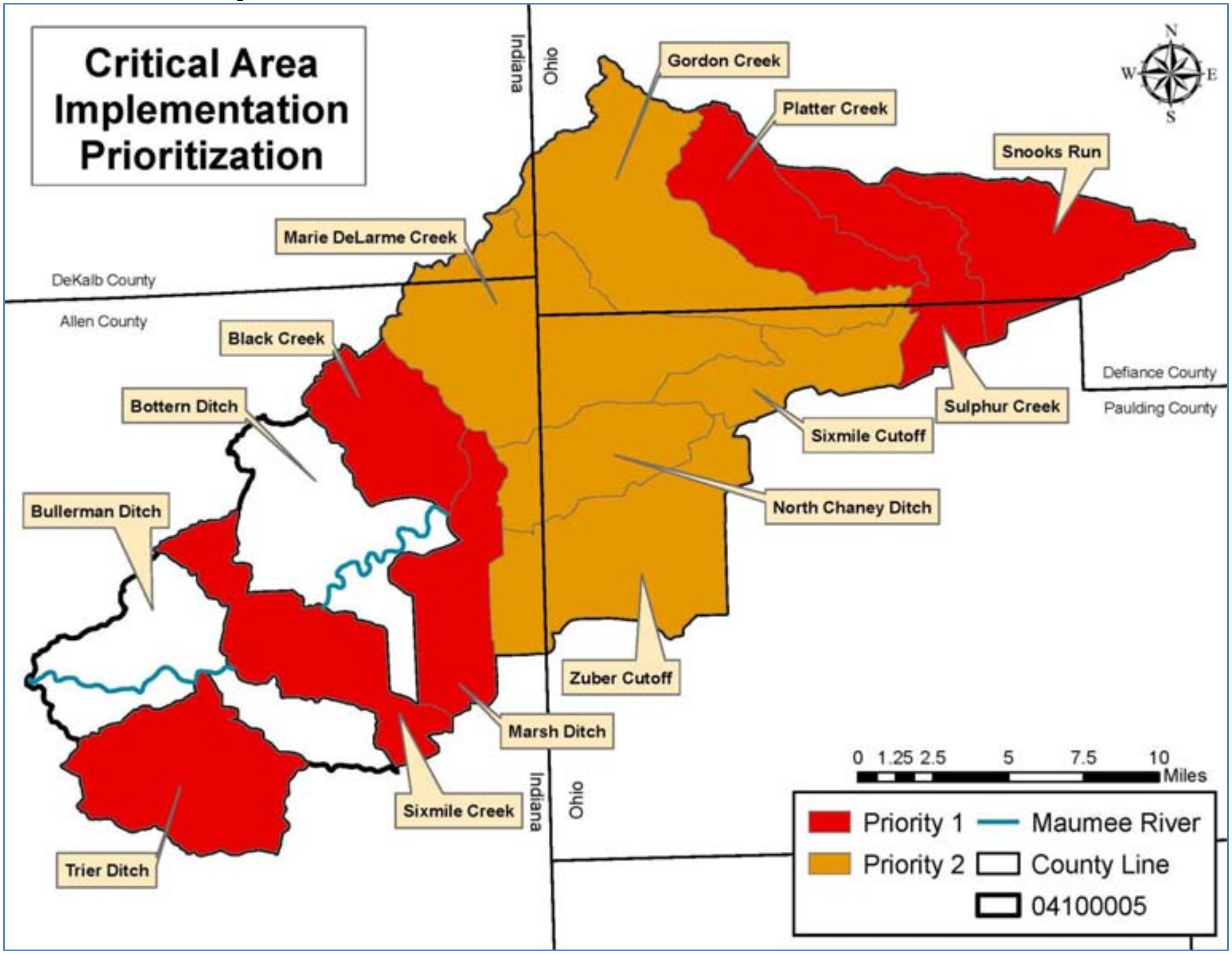


Figure 5.6: Prioritization of Implementation Efforts in Pollutant Based Critical Areas



5.2 Critical Area Summary

The UMRW steering committee looked closely at all available data that has been gathered throughout this watershed investigation and determined that several areas in particular are contributing to NPS and the degradation of water quality within the UMRW. Existing water quality data and the SWAT load reduction model indicates that every sub-watershed within the UMRW is a significant contributor to water quality issues within the Maumee River. However, different sources of pollution are present in each of the sub-watersheds, and therefore, particular sources will be addressed within the critical areas listed below.

- Riparian Buffers at headwater streams and streambank erosion:
    - Priority 1 – Trier Ditch, Zuber Cutoff, Gordon Creek, Platter Creek, Bottern Ditch
    - Priority 2 – Black Creek, Sixmile Creek, Marie DeLarme Creek, Marsh Ditch
    - Priority 3 – Bullerman Ditch, Sulphur Creek, Snooks Run

- Urban Landuses and Combined Sewer Overflows:
    - Surface Flow and volume of Polluted Stormwater, riparian buffers in residential and commercial areas in Fort Wayne, New Haven and Hicksville
    - CSO Discharges in Fort Wayne, New Haven, and Hicksville

- Livestock Operations with Direct Access to Open Water and Potential Manure Runoff
    - Bottern Ditch and Black Creek

- Septic Tank Failures
    - Priority 1 – Trier Ditch, Sixmile Creek, Bottern Ditch, Black Creek, Marie DeLarme Creek
    - Priority 2 - Bullerman Ditch, Marsh Ditch, and Gordon Creek

- Dissolved Reactive Phosphorus and Sediment
    - Priority 1 – Trier Ditch, Sixmile Creek, Black Creek, Marsh Ditch, Platter Creek, Sulphur Creek, Snooks Run
    - Priority 2 – Zuber Cutoff, North Chaney Ditch, Marie DeLarme Creek, Gordon Creek, Sixmile Cutoff

6.0 Goals, Management Measures, and Objectives

6.1 Goal Statements and Progress Indicators

The UMRW steering committee used historic studies, land use, and water quality data, as well as current data, stakeholder input, problems found during the project investigation, and identified critical areas to determine overall goals for the watershed. The overarching goal of the project is to reduce pollutant loads and mitigate pollution sources so that water quality measurements will meet the project's target levels and/or state or federal water quality standards. However, to reach that principle goal of improving the quality of water in the UMRW smaller, more attainable, goals were written. Each of the goal statements in the following Section is written to take small steps toward meeting the main goal of this project. It is also important to be able to measure the progress being made toward meeting each of the goals. Therefore, indicators were determined that will be used as a measurement tool and are listed in the following section as well.

6.1.1 Reduce Nitrogen Loading

The average historic nitrate+nitrite levels measured in the UMRW exceeded the target level in all but four sub-watersheds and TKN, while not measured in every sub-watershed, exceeded target levels in eleven of the fifteen sub-watershed sampled. The SWAT model indicates a load reduction of 10.9% of the current nitrogen loading in the UMRW is needed to meet target levels. The SWAT model results indicate a nitrogen load reduction is needed in Marsh Ditch, Zuber Cutoff, North Chaney Ditch, Marie DeLarme Creek, Sixmile Cutoff, Platter Creek and Snooks Run to meet the overall 10.9% reduction in the watershed. While critical areas were not identified using nitrogen as a factor, as the major concern in the UMRW is phosphorus, many management measures that will be implemented to address phosphorus will also minimize nitrogen loading.

<u>Goal Statement - Nitrogen</u>

The goal of this project is for nitrate+nitrite levels in sampled water to meet the target level of 1.6 mg/L set by this project in 35% of the samples by 2020, 60% of the samples by 2030 and in all samples by year 2044. According to the SWAT model it would require a 10.9% reduction in nitrogen loading.

<u>Indicator</u>

Water quality and social indicators will be used to show the progress toward meeting the goal for nitrogen levels in the UMRW. An administrative goal will also be used to measure the progress toward meeting the goal for nitrogen levels in the UMRW.

<u>Water Quality Indicator</u>

Nitrate+Nitrite will be measured at a minimum monthly throughout the year at the eleven historic sample sites in Indiana and the eight proposed sample sites in Ohio, ideally samples will be measured weekly during the recreational season. Sampling efforts will begin after three to five years of implementation. To determine if the milestones set for the nitrogen goal are being met, it would be expected to see that more water quality samples are meeting the target level for nitrate+nitrite of 1.6 mg/L each year of sampling after three to five years of implementation.

Social Indicator
A post implementation social indicator survey will be conducted to compare to the Ohio State University study *Farmers, Phosphorus, and Water Quality* to learn the degree to which social changes occurred in the UMRW after implementation of the UMRW WMP. It is expected that at least 50% of the survey respondents will have a better understanding of the water quality issues and land use impacts on water quality in the UMRW than did during the first round of returned surveys. The social indicator study will be disseminated after five years of implementation.

Administrative Indicator
The load reductions as a result of best management practices that are installed in the watershed, as determined by the load reduction models, will be monitored to determine if the BMPs that are being installed are working adequately to reduce overall loadings of nitrogen to reach the 10.9% reduction needed to meet the target load.

Administrative Indicator
The number of best management practices that can reduce nitrogen levels that are installed in the watershed will be monitored. Annual goals for each of the various BMPs that can reduce nitrogen levels are described in the Action register in Section 6.3.

6.1.2 Reduce Total Phosphorus Loading

The average historic total phosphorus levels measured in the UMRW exceeded the target level in all sub-watersheds. The SWAT model also indicated that total phosphorus exceeded the target level in all sub-watersheds and subsequent load reductions would be necessary to meet target loads for the watershed. According to the SWAT model a reduction of 86.4% in phosphorus loading will be necessary to meet target phosphorus loads in the UMRW.

Goal Statement – Total Phosphorus
The goal of this project is for total phosphorus levels in sampled water to meet the target level of 0.08 mg/L in all tributaries and 0.3 mg/L in the main channel of the Maumee River set by this project in 16% of the samples by year 2020, 50% of samples by 2030, and in all samples by year 2044. According to the SWAT load reduction model it would require an 86.4% reduction in phosphorus loading.

Indicator
Water quality and social indicators will be used to show the progress toward meeting the goal for total phosphorus levels in the UMRW. An administrative goal will also be used to measure the progress toward meeting the goal for total phosphorus levels in the UMRW.

Water Quality Indicator

Total phosphorus will be measured at a minimum monthly throughout the year at the eleven historic sample sites in Indiana and the eight proposed sample sites in Ohio, ideally samples will be measured weekly during the recreational season. Sampling efforts will begin after three to five years of implementation. To determine if the milestones set for the phosphorus goal are being met, it would be expected to see that water quality samples are showing a decreasing trend in phosphorus loading with more samples meeting the target level for total phosphorus of 0.08 mg/L in tributaries and 0.30 mg/L in the mainstem of the Maumee River each year of sampling after three to five years of implementation.

Social Indicator

A post implementation social indicator survey will be conducted to compare to the Ohio State University study *Farmers, Phosphorus, and Water Quality* to learn the degree to which social changes occurred in the UMRW after implementation of the UMRW WMP. It is expected that at least 50% of the survey respondents will have a better understanding of the water quality issues and land use impacts on water quality in the UMRW than did during the first round of returned surveys. The social indicator study will be disseminated after five years of implementation.

Administrative Indicator

The load reductions as a result of best management practices that are installed in the watershed, as determined by the load reduction models, will be monitored to determine if the BMPs that are being installed are working adequately to reduce overall loading of total phosphorus to reach the 86.4% reduction needed to meet the target load.

Administrative Indicator

The number of best management practices that can reduce total phosphorus levels (as described in Section 6.2) that are installed in the watershed will be monitored. Annual milestones for each of the various BMPs that can reduce phosphorus levels are described in the Action register in Section 6.3.

6.1.3 Reduce Dissolved Reactive Phosphorus

DRP has not historically and is not currently being monitored within the UMRW, however there are plans to begin monitoring this parameter as it is considered the limiting factor to the increased hypoxic zone in the WLEB. For these reasons, Purdue University simulated current DRP loading in the UMRW using their recalibrated SWAT model. According to the SWAT model, DRP exceeds target levels in all sub-watersheds in the UMRW and a 32% decrease in DRP is needed in the watershed to meet target levels. Significant DRP sources in the UMRW include fertilizer and manure surface and tile runoff from agriculture fields, as well as failed, leaking, or straight pipe septic systems.

Goal Statement – Dissolved Reactive Phosphorus

The goal of this project is to have all sampled water within the UMRW meet the target water quality level for DRP of < 0.05 mg/L in 20% of the samples by 2020, 50% of the samples by 2035, and 100% of the samples by 2044. According to the SWAT load reduction model it would require a 32.3% watershed-wide reduction in DRP loading to meet the target load.

Indicator

Water quality and social indicators will be used to show the progress toward meeting the goal for DRP levels in the UMRW. An administrative indicator will also be used to measure the progress toward meeting the goal for sediment levels in the UMRW.

Water Quality Indicator

DRP will be measured at a minimum monthly throughout the year at the eleven historic sample sites in Indiana and the eight proposed sample sites in Ohio, ideally samples will be measured weekly during the recreational season. DRP sampling will begin immediately after funding is acquired, and will continue for a minimum of two years, to help form a baseline loading in the UMRW. Sampling efforts will resume after three to five years of implementation. To determine if the milestones set for the DRP goal are being met, it would be expected to see that water quality samples are showing a decreasing trend in DRP loading with more samples meeting the target level for DRP of 0.05 mg/L each year of sampling after three to five years of implementation.

Social Indicator

A post implementation social indicator survey will be conducted to compare to the Ohio State University study *Farmers, Phosphorus, and Water Quality* to learn the degree to which social changes occurred in the UMRW after implementation of the UMRW WMP. It is expected that at least 50% of the survey respondents will have a better understanding of the water quality issues and land use impacts on water quality in the UMRW than did during the first round of returned surveys. The social indicator study will be disseminated after five years of implementation.

Administrative Indicator

The load reductions as a result of best management practices that are installed in the watershed, as determined by the load reduction models, will be monitored to determine if the BMPs that are being installed are working adequately to reduce overall loading of DRP to reach the 32.3% reduction needed to meet the target load.

Administrative Indicator

The number of best management practices that can reduce DRP levels (as described in Section 6.2) that are installed in the watershed will be monitored. Annual milestones for each of the various BMPs that may reduce DRP levels are described in the Action register in Section 6.3.

6.1.4 Reduce Sediment Loading

The average historic turbidity levels measured in the UMRW exceeded the target level in all sub-watersheds where turbidity samples were taken and TSS levels exceeded the target level in six of the thirteen sub-watersheds that were sampled for TSS. The SWAT model indicated that sediment exceeded the target level in all sub-watersheds and subsequent load reductions would be necessary to meet target loads for the watershed. According to the SWAT model a reduction of 92.9% in sediment loading will be necessary to meet target sediment loads in the UMRW.

Goal Statement – Sediment

The goal of this project is to have all sampled water within the UMRW meet the target water quality level for TSS of 25mg/L in 20% of the samples by 2020, 50% of the samples by 2035, and in all of the samples by 2044. According to the SWAT load reduction model it would require a 92.9% reduction in TSS loading to meet the target load.

Indicator

Water quality and social indicators will be used to show the progress toward meeting the goal for sediment levels in the UMRW. An administrative indicator will also be used to measure the progress toward meeting the goal for sediment levels in the UMRW.

Water Quality Indicator

Turbidity and TDS will be measured at a minimum monthly throughout the year at the eleven historic sample sites in Indiana and the eight proposed sample sites in Ohio, ideally samples will be measured weekly during the recreational season. TSS sampling will begin immediately after funding is acquired, and will continue for a minimum of two years, to help form a baseline loading in the UMRW. Sampling efforts will resume after three to five years of implementation. To determine if the milestones set for the sediment goal are being met, it would be expected to see that water quality samples are showing a decreasing trend in sediment loading with more samples meeting the target level for turbidity of 10.4 NTU and TSS of 25 mg/L each year of sampling after three to five years of implementation.

Social Indicator

A post implementation social indicator survey will be conducted to compare to the Ohio State University study *Farmers, Phosphorus, and Water Quality* to learn the degree to which social changes occurred in the UMRW after implementation of the UMRW WMP. It is expected that at least 50% of the survey respondents will have a better understanding of the water quality issues and land use impacts on water quality in the UMRW than did during the first round of returned surveys. The social indicator study will be disseminated after five years of implementation.

Administrative Indicator

The load reductions as a result of best management practices that are installed in the watershed, as determined by the load reduction models, will be monitored to determine if the BMPs that are being installed are working adequately to reduce overall loading of sediment to reach the 92.9% reduction needed to meet the target load.

Administrative Indicator

The number of best management practices that can reduce sediment levels (as described in Section 6.2) that are installed in the watershed will be monitored. Annual milestones for each of the various BMPs that can reduce sediment levels are described in the Action register in Section 6.3.

6.1.5 Reduce *E. coli* Loading

After analyzing both water quality data collected by this project in 2012 and all historical water quality data, average *E. coli* levels exceeded the state standard of 235 CFU/100ml in all sub-watersheds located within the Indiana portion of the watershed where the majority of samples were taken from tributaries to the Maumee River. It is assumed that E.coli analysis performed by the OEPA as part of their TMDL development did not exceed target levels because samples were taken from the main stem of the river where pollutants can become diluted due to the volume of water. Excessive *E. coli* could be from wildlife, leaking failed or straight pipe on-site waste management, CSO events, WWTPs, or animal operations located within the UMRW.

Goal Statement – *E. coli*

The goal of this project is to have 35% of water quality samples meet the state standard of 235 CFU/100ml for *E. coli* by 2020, 50% meet water quality standards by 2035, and all water quality samples meet the state standard for *E. coli* by 2044.

Indicator

Water quality and social indicators will be used to show the progress toward meeting the goal for *E. coli* levels in the UMRW. An administrative goal will also be used to measure the progress toward meeting the goal for *E. coli* levels in the UMRW.

Water Quality Indicator

E. coli will be measured at a minimum monthly throughout the year at the eleven historic sample sites in Indiana and the eight proposed sample sites in Ohio, ideally samples will be measured weekly during the recreational season. Sampling efforts will begin after three to five years of implementation. To determine if the milestones set for the *E. coli* goal are being met, it would be expected to see that water quality samples are showing a decreasing trend in *E. coli* with more samples meeting the target level for *E. coli* of 235 CFU/100ml for a single sample each year of sampling after three to five years of implementation.

Social Indicator

A post implementation social indicator survey will be conducted to compare to the Ohio State University study *Farmers, Phosphorus, and Water Quality* to learn the degree to which social changes occurred in the UMRW after implementation of the UMRW WMP. It is expected that at least 50% of the survey respondents will have a better understanding of the water quality issues and land use impacts on water quality in the UMRW than did during the first round of returned surveys. The social indicator study will be disseminated after five years of implementation.

Administrative Indicator

The number of best management practices that can reduce E. coli levels that are installed in the watershed will be monitored. Annual milestones for each of the various BMPs that can reduce E. coli levels are described in the Action register in Section 6.3.

6.1.6 Increase Knowledge Regarding On-Site Waste Management

Less than 3% of all soils located within the UMRW are considered acceptable for the installation of on-site waste management facilities, however most residents located in the rural areas of the project area have septic systems to manage their waste water. Many homeowners are unaware of the potential risks to surface and ground water, and their property if the system is not properly maintained. Leaking, failing, or straight pipe septic systems pose a threat to water quality by increasing nutrient, sediment and bacteria levels in the water.

Goal Statement

It is the goal of this project to educate home owners about failing, leaking, and straight pipe septic systems by developing and promoting an education and outreach program regarding septic system placement and maintenance by 2016.

Indicator

Water quality, social, and administrative indicators will be used to show the progress toward meeting the goal for developing and promoting an education program regarding septic systems in the UMRW.

Water Quality Indicator

E. coli and nutrients will be measured at a minimum monthly throughout the year at the eleven historic sample sites in Indiana and the eight proposed sample sites in Ohio, ideally samples will be measured weekly during the recreational season. Sampling efforts will begin after three to five years of implementation. To determine if the education and outreach program is effective, it would be expected to see that water quality samples are showing a decreasing trend in *E. coli* and nutrients in on-site waste disposal education and outreach targeted areas with more samples meeting the target level for *E. coli* and nutrients each year of sampling after three to five years of implementation.

Social Indicator
A pre and post indicator survey regarding septic system functionality and maintenance will be conducted at workshops to determine individuals knowledge regarding septic systems and the amount in which that knowledge increases as a result of the workshop. It would be expected that 75% of the attendants of the workshops would have a better understanding of septic systems after the workshop.

Administrative Indicator
The number of people who attend septic system maintenance workshops will be monitored. It is a goal to have 25% of targeted households show representation at the septic tank outreach events.

Administrative Indicator
The number of failing, leaking, or straight pipe septic systems reported to the local health departments will be monitored. It is expected that the education and outreach program will increase the number of reported septic issues to the health departments.

Administrative Indicator
The number of households that enlist septic system companies to provide regular maintenance and/or repair leaking, failed, and straight-piped septic systems will be monitored. It is expected that the education and outreach program will increase the number of households performing regular septic maintenance and repairing improperly functioning systems. The goal is that at least 30% more maintenance and repairs occur after 3 to 5 years of implementation.

6.1.7 Reduce the Amount of Polluted Stormwater Due to Imperviousness

Stormwater is becoming known as nonpoint source pollution itself, due to the risk it poses to the quality of open water as a result of the increase in impervious surfaces over the past several decades. Impervious surfaces pose a threat to water quality as it allows for a direct conduit for stormwater runoff, carrying many urban pollutants including lawn fertilizer, sediment, salt, wildlife and pet waste, oil and grease and many others, to reach open water. Stormwater runoff also increases the potential for CSO events in Fort Wayne and New Haven, IN and Hicksville, OH which allows for raw sewage and stormwater to be discharged directly into open water without processing.

Goal Statement
It is the goal of this project to partner with CSO communities (Fort Wayne, New Haven, and Hicksville) to implement their Long Term Control Plans by providing stormwater education and outreach by 2016 and offering cost-share assistance on stormwater BMPs by 2018.

Indicator
Water quality, social, and administrative indicators will be used to show the progress toward meeting the goal for reducing the impact of stormwater on water quality in CSO communities.

Water Quality Indicator

E. coli, sediment and nutrients will be measured at a minimum monthly throughout the year at the eleven historic sample sites in Indiana and the eight proposed sample sites in Ohio, ideally samples will be measured weekly during the recreational season. There are currently three sample sites that capture the impact of Fort Wayne and New Haven on water quality and one proposed site to capture the impact of Hicksville on water quality. Sampling efforts will begin after three to five years of implementing the urban stormwater management program. To determine if partnering with municipalities to assist with the implementation of their LTCP and offering an urban cost-share program is successful, it would be expected to see that water quality samples are showing a decreasing trend in *E. coli* and nutrients with more samples meeting the target level for each parameter each year of sampling after three to five years of implementation.

Social Indicator

A pre and post social indicator survey will be conducted in the urban areas within the UMRW to learn the degree in which behavioral changes have been made after five years of implementation of the urban stormwater management program. It is expected that the post-implementation survey will show that at least 30% of the respondents are more aware of the impact stormwater has on water quality and how their actions affect water quality.

Administrative Indicator

The load reductions as a result of best management practices that are installed in the CSO communities in the watershed, as determined by load reduction models, will be Monitored to determine if the BMPs that are being installed are working effectively to reduce overall nutrient, E. coli and sediment loadings from CSO communities.

Administrative Indicator

The number of urban best management practices that can reduce stormwater flow and/or urban pollutants that are installed in the watershed will be monitored. It is a goal to have at least 25% greater enrollment in city stormwater BMP programs after five years of implementation.

Administrative Indicator

The volume of water discharged during CSO events and the number of CSO events that occur each year in Fort Wayne, New Haven, and Hicksville will be monitored to determine if the volume of stormwater discharges and the frequency of events declines at regular intervals after implementation of the urban stormwater management program and the LTCPs (five, ten, and fifteen years).

6.1.8 Mitigate Runoff from Animal Feeding Operations

Both small scale and large animal feeding operations located within the UMRW are a concern as they are a threat to water quality from sediment and fecal runoff, as well as nutrient loads to surrounding ditches. The windshield survey identified several points of concern where there is the potential for open water to become contaminated due to improper management of livestock and/or livestock waste.

Goal Statement

It is the goal of this project to exclude all current and future livestock from open water and eliminate the potential for polluted runoff from barnyards and pasture fields from reaching open water by 2034.

Indicator

Water quality, social, and administrative indicators will be used to show the progress toward meeting the goal for excluding all livestock from open water and mitigating potential runoff from barnyards and pastures in the UMRW.

Water Quality Indicator

E. coli, sediment and nutrients will be measured at a minimum monthly throughout the year at the eleven historic sample sites in Indiana and the eight proposed sample sites in Ohio, ideally samples will be measured weekly during the recreational season. Sampling efforts will begin after three to five years of implementation. To determine if livestock management techniques are effective it is expected to see that water quality samples are showing a decreasing trend in sediment, *E. coli* and nutrients with more samples meeting the target level for each parameter each year of sampling after three to five years of implementation.

Social Indicator

A post implementation social indicator survey will be conducted to compare to the Ohio State University study *Farmers, Phosphorus, and Water Quality* to learn the degree to which social changes occurred in the UMRW after implementation of the UMRW WMP. It is expected that at least 50% of the survey respondents will have a better understanding of the water quality issues and land use impacts on water quality in the UMRW than did during the first round of returned surveys. The social indicator study will be disseminated after five years of implementation.

Administrative Indicator

The load reductions as a result of best management practices that are installed in the watershed, as determined by load reduction models, will be monitored to determine if the BMPs that are being installed are working adequately to reduce overall loading of sediment and nutrients to reach the reductions needed to meet the target loads.

Administrative Indicator

The number of livestock exclusion BMPs and other BMPs to reduce the impact of barnyard and pasture runoff, as well as the potential volume of manure being contained at each site in which a livestock BMP is implemented in the watershed will be monitored.

6.1.9 Promoting Recreation and Water Quality on the Maumee River

The safe recreation on the Maumee River and its tributaries is a concern due to the inadequate water quality in the watershed, as well as the fact that there are not well documented water trail maps. A particular concern for recreation on the Maumee River is the 21 CSOs located within the UMRW and the additional 30 CSOs located along the St. Marys and St. Joseph Rivers, upstream of the Maumee River in Fort Wayne as well as structures in the floodplain which can deposit contaminates and dangerous objects in the river during or after major flood events.

Goal Statement

It is the goal of this project to promote an education and outreach program throughout the UMRW regarding safe recreation on the Maumee River that puts emphasis on the water quality and surrounding land uses of the river by 2020. The education and outreach program will focus on issues to be aware of while in the river, how to avoid accidents, when to avoid contact with the water, such as after CSO events and during high water events, and how various land uses effect water quality within the UMRW.

Indicator

Social and administrative indicators will be used to measure the success toward meeting the goal of promoting a safe river recreating education and outreach program.

Social Indicators

A pre and post indicator survey regarding water quality and how land uses effect water quality will be conducted at workshops to determine individuals knowledge regarding the water quality of the river and how individual actions effect water quaity and the amount in which that knowledge increases as a result of the workshop. It would be expected that 75% of the attendants of the workshops would have a better understanding of the river and what actions may decrease water quality in the river.

Administrative Indicator

The number of people who attend outreach programs regarding the river will be monitored.

Administrative Indicator

An education brochure regarding river recreation and the water quality of the river will be produced and disseminated by 2020.

6.1.10 Increase the Use of Riparian Buffers/Filter Strips

The land use and riparian buffer inventory performed in 2013 revealed that 70% of the parcels adjacent to open water have a riparian buffer of less than 60 feet wide with 57% of those parcels having less than a 10 foot buffer. The buffer inventory could not verify if the buffers were woody or not. However, it is known that riparian buffers have the ability to slow the velocity of stormwater runoff thus allowing time for the water, and the pollutants it carries to absorb into the soil or settle out prior to reaching open water. Forested riparian buffers can provide more storm flow absorption as a medium sized tree is estimated to soak up over 2,300 gallons of water annually.

Goal Statement

It is the goal of this project to have at least 20% of parcels adjacent to open water at headwater stream to have a minimum of a 20 foot riparian buffer by 2020, 50% of parcels have a minimum of a 20 foot buffer by 2035, and 75% of parcels have a minimum of a 20 foot buffer by 2044. Five percent of the buffers will be forested riparian buffers.

Indicator

Administrative indicators will be used to measure the success toward meeting the goal of increasing the installation and usage of riparian buffers at headwater streams.

Administrative Indicator

The number of landowners who install a minimum of a 20 foot riparian buffer will be measured. It is expected that the installation of riparian buffers will increase annually to meet the goal set by this project.

Administrative Indicator

The total acreage draining into a 20 foot riparian buffer and the percentage of forested riparian buffer that is installed each year will be measured. Annual milestones for the installation of riparian buffers is described in the Action Register in Section 6.3.

Administrative Indicator

A revised desktop buffer inventory will be conducted in 2030, halfway through the implementation phase on the UMRW project, to determine if the project is nearing the goal of 50% of parcels adjacent to a headwater streams having a minimum of a 20 foot riparian buffer.

6.1.11 Waste Water Treatment Plants that Exceed NPDES Permit Targets

There are currently six Municipal WWTPs located within the UMRW including those located in Antwerp, Cecil, Hicksville, and Sherwood, Ohio, and Fort Wayne and Woodburn, Indiana. There are also three WWTPs belonging to residential subdivisions or truck stops located within the UMRW including those at Brentwood mobile home park, Middle Gordon Creek subdivision, and Vagabond Village truck stop. Many of these entities have reported discharge exceedances beyond the allowable amount outlined in their NPDES permits. Of significant note are Cecil WWTP which has exceeded 60 times in the past three years, Vegabond Village which has exceeded 109 times in the past three years, Sherwood which is exceeded 62 times in the past three years, and Woodburn which has exceeded 39 times in the past three years. A spike in nutrient, bacteria, and sediment levels is typically observed downstream when WWTPs discharge in excess of the allowable amount per their NPDES permit. This is of significant concern not only for aquatic life and recreational purposes, but there is a community located downstream from each of these facilities that acquire their drinking water from the river.

Goal Statement

It is the goal of this project to work with WWTP operators within the UMRW to ensure exceedances of permitted amounts of effluent are not discharged into open water and reduce permit exceedances by 15% by 2020, 50% by 2030, and completely by 2044.

Indicator

Administrative indicators will be used to measure the success toward meeting the goal of working with WWTP operators within the UMRW to ensure future effluent exceedances do not occur.

Administrative Indicator

The number of WWTP operators and community leaders reached to discuss options to prevent future exceedances will be monitored. It is expected that contact with each WWTP representative will be made within 12 months and meetings will take place biennially.

Administrative Indicator

The total number of exceedances at each WWTP, each year will be monitored with the expectation that the number of exceedances will decline annually to meet the goals for WWTPs.

6.2 Management Practices to Address Critical Areas and Accomplish Goals

In order to address the concerns leading to the designation of the above mentioned critical areas, best management practices and conservation measures will need to be taken. The UMRW Steering Committee considered the plethora of management practices and measures available to address the critical area concerns and determined that certain practices will have the greatest impact on the water quality in the critical areas and will be the focus of phase two of the UMRW project. In the table below, several practices and measures are outlined, and the predicted load reduction is presented for each BMP. Load reduction estimates were determined using either the Region 5, STEP-L or SWAT models and assumptions that were used to determine the load reductions in each of the models is outlined in the table as well. It should be noted that load reductions for DRP can only be predicted by the SWAP model therefore, the load reductions estimated using the Region 5 and STEP-L models do not have load reductions listed for DRP. The model that was used to determine load reductions for each practice is identified in the table below, and an more in depth explanation of the BMPs and assumptions used in each model is presented in Section 7 of this WMP. The following list is not all inclusive and other practices and management measures may be added to the list in the future.

Table 6.1: Management Measures to Address Critical Areas and Project Goals

Critical Area	Reason for Being Critical	BMP or Management Measure	Assumptions Used	Estimated Load Reduction per BMP			
				Sediment	Total Phosphorus	DRP	Nitrogen
Priority 1 Trier Ditch, Sixmile Creek, Black Creek, Marsh Ditch, Platter Creek, Sulphur Creek, Snooks Run Priority 2 Zuber Cutoff, North Chaney Ditch, Marie DeLarme Creek, Gordon Creek, Sixmile Cutoff	DRP and Sediment	Agriculture, Urban, and Septic System Education Program		N/A	N/A	N/A	N/A
		Septic System Workshop		N/A	N/A	N/A	N/A
		Nutrient / Pesticide Management	Estimated 20% reduction of fertilizer and pesticides provided by Purdue University on a per acre basis	0.614 ton/yr	1.10 lbs/yr	+ 0.029 lbs/yr	6.67 lbs/yr
		Cover Crops (Cereal Rye)[3]	Planted a day after harvest. Cover crop killed and left as residue on field, one week prior to next crop planting	1.41 ton/yr	2.39 lbs/yr	+ 0.06 lbs/yr	13.23 lbs/yr
		Two-stage ditch[1]	1000 linear foot with a depth of 10'	80 ton/yr	80 lbs/yr	***	160 lbs/yr
		Conservation Tillage/Mulch Till[3]	Presented on a per acre basis	0.30 ton/yr	0 lbs/yr	+ 0.21 lbs/yr	1.61 lbs/yr
		Conservation Tillage/No-Till[3]	Presented on a per acre basis	0.49 ton/yr	0.51 lbs/yr	+ 0.04 lbs/yr	2.99 lbs/yr
		Blind Inlets		***	***	***	***
		Wetland (Restoration/Creation)	100 acres contributing area/BMP	5.93 ton/yr	8 lbs/yr	***	48 lbs/yr
		Drainage Water Management		***	***	***	***
		Soil Amendments (Gypsum)[5,6]	Presented on a per acre basis	0.47 ton/yr	1.49 lbs/yr	0.44 lbs/yr	***
		Grassed Waterway[1]	Used LR model for gully stabilization, 300 linear feet with a depth of 1'	14.4 ton/yr	8 lbs/yr	***	48 lbs/yr

Critical Area	Reason for Being Critical	BMP or Management Measure	Assumptions Used	Estimated Load Reduction per BMP			
				Sediment	Total Phosphorus	DRP	Nitrogen
Priority 1 Trier Ditch, Sixmile Creek, Black Creek, Marsh Ditch, Platter Creek, Sulphur Creek, Snooks Run Priority 2 Zuber Cutoff, North Chaney Ditch, Marie DeLarme Creek, Gordon Creek, Sixmile Cutoff	DRP and Sediment	Native Vegetation Planting (Switch Grass)[3]	Continuously grown, with one time planting. 75% is harvested and urea is applied annually at 122 kg/ha	2.3 ton/yr	5.50 lbs/yr	1.0 lbs/yr	24.87 lbs/yr
		Repair/replace Leaking On-Site Waste Disposal Systems	4 people per household who use 60 gallons of water per day	248.2 lbs/yr	6.5 lbs/yr	***	55 lbs/yr
		Filter Strip/Saturated Buffer[3]	1 acre of contributing area/BMP	1.75 ton/yr	2.17 ton/yr	0.196 lbs/yr	10.35 lbs/yr
		Remove In-water Nonfunctional Structures		***	***	***	***
		Annual Ag. And Urban Workshops/Field Days		N/A	N/A	N/A	N/A
Priority 1 Trier Ditch, Zuber Cutoff, Gordon Creek, Platter Creek, Bottern Ditch Priority 2 Black Creek, Sixmile Creek, Marie DeLarme Creek, Marsh Ditch Priority 3	Headwater Riparian Buffers and Streambank Erosion (Nitrogen, Phosphorus, Sediment)	Riparian Buffers[1]	LR model for streambank protection was used for 1000 linear feet on both banks of the stream	190 ton/yr	190 lbs/yr	***	320 lbs/yr
		Streambank Stabilization[1]	1000 linear feet of stabilization on both banks	160 ton/yr	160 lbs/yr	***	320 lbs/yr
		Grade Stabilization Structure[1]	Gully Stabilization LR model was used assuming a 300 linear foot structure	32.4 ton/yr	32.4 lbs/yr	***	64.8 lbs/yr
		Drainage Water Management		***	***	***	***
		Blind Inlets		***	***	***	***

Critical Area	Reason for Being Critical	BMP or Management Measure	Assumptions Used	Estimated Load Reduction per BMP			
				Sediment	Total Phosphorus	DRP	Nitrogen
Bullerman Ditch, Sulphur Creek, Snooks Run		Filter Strip[3]	1 acre of contributing area/BMP	1.75 ton/yr	2.17 lbs/yr	0.196 lbs/yr	10.35 lbs/yr
		Two-stage ditch[1]	1000 linear feet with a depth of 10'	80 ton/yr	80 lbs/yr	***	160 lbs/yr
Fort Wayne, New Haven, and Hicksville	Urban Landuses and CSOs (Nitrogen, Phosphorus, *E. coli*, and Sediment)	Riparian Buffer (Commercial)[2]	LR model for Vegetated Filter Strip was used with 10 acres of contributing land	0.1 ton/yr	0.5 lbs/yr	***	4.0 lbs/yr
		Riparian Buffer (Residential)[2]	LR model for Vegetated Filter Strip was used with 1 acre of contributing land	0.1 ton/yr	0.1 lbs/yr	***	0.3 lbs/yr
		Two-stage ditch		***	***	***	***
		Streambank Stabilization		***	***	***	***
		Education Program on Benefits of Riparian Buffers		N/A	N/A	N/A	N/A
		Rain Barrels[2]	1 Acre contributing area to a 50 gallon rain barrel	0.2 ton/yr	0.15 lbs/yr	***	0.81 lbs/yr
		Cisterns (Commercial)[2]	15 acre contributing area to a 300 gallon cistern	0.2 ton/yr	1 lbs/yr	***	1.0 lbs/yr
		Monthly Street Sweeping[2]	Monthly in all urban areas	399 ton/yr	1014.7 lbs/yr	***	0
		Rain Gardens (Residential)[2]	1 acre of contributing area/BMP	0.18 ton/yr	0.1 lbs/yr	***	2 lbs/yr
		Rain Gardens (Commercial)[2]	10 acres of contributing area/BMP	4.63 ton/yr	6 lbs/yr	***	42 lbs/yr
		Green Roof[7]		***	***	***	***
		Blue Roofs		***	***	***	***
		Wetland	10 acres of contributing	4.86	7 lbs/yr	***	28 lbs/yr

Critical Area	Reason for Being Critical	BMP or Management Measure	Assumptions Used	Estimated Load Reduction per BMP			
				Sediment	Total Phosphorus	DRP	Nitrogen
Fort Wayne, New Haven, and Hicksville	Urban Landuses and CSOs (Nitrogen, Phosphorus, *E. coli*, and Sediment)	Restoration/Creation[1]	area/BMP	ton/yr			
		Curb Cuts (In combination with other LID practices)		***	***	***	***
		Bioswale[2]	10 acres of contributing area/BMP	0.1 ton/yr	0.3 lbs/yr	***	0.6 lbs/yr
		Extended Wet Detention[2]	10 acres of contributing area/BMP	0.12 ton/yr	0.59 lbs/yr	***	5.56 lbs/yr
		Infiltration Trench[2]	10 acres of contributing area/BMP	0.2 ton/yr	0.7 lbs/yr	***	4.0 lbs/yr
		Pervious Pavement[2] (Residential)	10 acres of contributing area/BMP	1.13 ton/y	4.35 lbs/yr	***	56.9 lbs/yr
		Pervious Pavement[2] (Commercial)	10 acre of contributing area/BMP	1.68 ton/yr	7.54 lbs/yr	***	79.86
		Native Vegetation Planting		***	***	***	***
		Pet Waste Disposal Receptacle		***	***	***	***
		Structural Storm Water Quality Unit		***	***	***	***
		Wildlife Exclusion at Stormwater Basins		***	***	***	***
		Encourage the Sale of Phosphorus Free Fertilizers at Local Retailers		N/A	N/A	***	N/A
		Urban Fertilizer Education Program		N/A	N/A	***	N/A
		Tree Planting[4]		N/A	N/A	***	N/A

Critical Area	Reason for Being Critical	BMP or Management Measure	Assumptions Used	Estimated Load Reduction per BMP			
				Sediment	Total Phosphorus	DRP	Nitrogen
Bottern Ditch and Black Creek	Livestock Operations (Nitrogen, TP, DRP, E. coli, and Turbidity/ Sediment)	Education Program Geared Toward Livestock Operators		N/A	N/A	***	N/A
		Limited Access Stream Crossing/Exclusion Fencing (along with Streambank Erosion Practices and/or Alternative Watering Facility)[2]	30 head of dairy and/or beef cattle and 10 horses present on 50 acres of agriculture land	9.7 ton/yr	24.1 lbs/yr	***	194.2 lbs/yr
		Rotational Grazing		***	***	***	***
		Manure Holding Facilities / Dry Stack Areas[1]	40 head of dairy cows, 10 young heifers, and 10 horses and <24% paved/BMP	***	129 lbs/yr	***	1,426 lbs/yr
		Comprehensive Nutrient Management		***	***		***
		Runoff Management System[1]	40 head of dairy cows, 10 young heifers, and 10 horses and <24% paved/BMP	***	284 lbs/yr	***	***
		Riparian Buffers of at least 20' adjacent to Barnyards and Pasture Fields[1]	LR model for filter strip on the Feedlot worksheet of the Region 5 LR model was used assuming 40 dairy cows, 10 young heifers, and 10 horses were present with <24% paved	***	183 lbs/yr	***	***

Critical Area	Reason for Being Critical	BMP or Management Measure	Assumptions Used	Estimated Load Reduction per BMP			
				Sediment	Total Phosphorus	DRP	Nitrogen
Priority 1 Trier Ditch, Sixmile Creek, Black Creek, Marsh Ditch, Platter Creek, Sulphur Creek, Snooks Run Priority 2 Bullerman Ditch, Marsh Ditch, Gordon Creek	Septic System Failures (Nitrogen, TP, DRP, Sediment, *E. coli*)	Repair/replace Leaking On-Site Waste Disposal Systems[8]	4 people per household who use 60 gallons of water per day	248.2 lbs/yr	6.5 lbs/yr	***	55 lbs/yr
		Septic System Education and Outreach		N/A	N/A	N/A	N/A

[1]Region 5 Load Reduction Model; [2]STEP-L Load Reduction Model; ***Too many variables, too new of a technology to estimate, or a model does not exist to estimate load reductions; [3]SWAT Load Reduction Model, [4]A medium sized tree is estimated to uptake 2380 gallons of water annually (Center for Urban Forest Research, Pacific Southwest Research Station, USDA Forest Service, Davis, California. July 2002); [5]TP loss estimated to be cut by 57% according to a study in the periodical Agricultural and Food Science, [6]DRP loss is estimated to be cut by 66% and sediment by 56% compared to controls fields reported in the National Soil Erosion Research Laboratory, [7]Extensive Green Roofs have the capacity to absorb 50% of rainfall, [8]Estimates found in the Onsite Wastewater Treatment Systems Manual, US EPA, 2002.

6.3 Action Register to Accomplish Goals

The goals set by the UMRW Steering Committee are ambitious; therefore the steering committee determined objectives to help the project reach the goals set by the steering committee. Each objective has milestones to reach within a certain timeframe to determine the progress toward achieving each of the goals. The following tables are Action Registers which outline the management measures that will need to be implemented in order to reach the goals set for this project. The first Table is a general Action Register for the project as a whole, identifying specific tasks that need to be accomplished to implement the entire WMP including hiring personnel and acquiring funding, providing education and outreach, acquiring necessary partnerships, and developing and promoting a cost-share program. The following Tables are Action Registers for each individual subwatershed to address the critical areas within the subwatershed as identified in Section 5. The Action Registers addressing each of the critical areas outline the number of BMPs that will need to be installed within that subwatershed to reach the necessary load reductions to meet target levels. Milestones are set for each of the BMPs stating how many, and/or what size of BMP will be installed to meet the goals set by this project.

6.3.1 General Action Register to Implement the Watershed Management Plan (Goals 1 – 11)

The following table consists of general objectives that are needed to implement the Upper Maumee River Watershed Management Plan and reach all goals outlined in the WMP including reducing nutrient, sediment, and E. coli loading, increase knowledge regarding on-site waste disposal, reduce the amount of polluted stormwater discharging into the rivers, mitigate runoff from animal feeding operations, promote safe recreation and water quality within the UMRW, increase the use of riparian buffers, and reduce permit exceedances from WWTPs.

Hire Personnel and Acquire Necessary Funding					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Implement the Upper Maumee River Watershed Management Plan	Upper Maumee River Watershed Stakeholders	Within the First Three Years after WMP Approval then ongoing	Hire personnel to implement the WMP (6 months)	$60,000/ year	Allen, DeKalb, Defiance, Paulding SWCD and NRCS offices, Purdue and OSU Extensions, IDEM, IN DNR and ODNR, OEPA (P and TA), Federal Grants such as Great Lakes Commission and Great Lakes Restoration Initiative (P, TA)
			Secure Funding to Implement the WMP including any office overhead and salaries (6 months)	$1,500	
			Secure funding to promote education and outreach programs (6 months)	***	
			Secure Funding to Begin Water Quality Sampling Efforts (3 years)	***	

*** Cost included in salary.

Provide Education and Outreach in Critical Areas					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Develop and Implement an Agriculture Education and Outreach Program	Upper Maumee River Watershed Stakeholders Located within Critical Areas	Within the First 12 Months after WMP Approval then ongoing	Compile an ag. Education/Outreach Plan (6 months)	***	Allen, DeKalb, Defiance, and Paulding County SWCD and NRCS offices (P, TA) Purdue and Ohio State Extensions (P, TA), The Nature Conservancy (P, TA)
			Develop and Disseminate an Ag. Education Brochure (8 months)	$4,000	
			Hold First Annual Ag. BMP Workshop/Field Day (12 months)	$1,500 / year	
			Purchase two billboards/County advertising stream buffers (12 mos)	$7,500/ BMP	

Provide Education and Outreach in Critical Areas					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Develop and Implement an Agriculture Education and Outreach Program Specific to Livestock Operators	Upper Maumee River Watershed Livestock Operators	Within the First 12 Months after WMP Approval then ongoing	Compile a livestock education/outreach plan (4 months)	***	Allen, DeKalb, Defiance, and Paulding County SWCD and NRCS offices (P, TA) Purdue and Ohio State Extensions (P, TA)
			Develop and disseminate a livestock education brochure (6 months)	$2,000	
			Hold first annual pasture walk (12 months)	$500 / year	
			Compile an urban education and outreach plan (12 months)	$4,000	
			Install a Demonstration Limited Access Stream Crossing in an Underserved Community in the Watershed (12 months)	$7,500	
Develop and Implement an Urban Education and Outreach Program	Upper Maumee River Watershed Stakeholders in Critical Areas (Fort Wayne, New Haven, and Hicksville)	Within the First 24 Months after WMP Approval then ongoing	Compile an urban education and outreach plan (12 months)	***	Allen, Defiance, DeKalb and Paulding County Planning Commissions (P) Fort Wayne, New Haven, and Hicksville, Administrators, MS4 coordinators and Decision Makers (P), WLEB Commission (P)
			Develop and disseminate an urban education brochure (12 months)	$4,000	
			Hold first Annual urban BMP Workshop (18 months)	$1,000 / year	
			Install a Demonstration Urban BMP in the Watershed (18 months)	$500 / year	

Provide Education and Outreach in Critical Areas					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Develop and Implement a Septic System Educational Program	Upper Maumee River Watershed Stakeholders who Utilize Septic Systems	Within the First 18 Months after WMP Approval then ongoing	Develop and/or Disseminate a Septic System Maintenance Brochure (18 months)	$4,000	Allen, DeKalb, Defiance, and Paulding County Health Departments and SWCDs (P,TA) Septic Issues, Collaborative Solutions working group (P)
			Hold First Annual Septic System Workshop for homeowners and one for on-site waste disposal installers (18 months)	$1,000/ year	
Implement an Education and Outreach Program Regarding Safe Recreating on the River and General Water Quality	Upper Maumee River Watershed Stakeholders	Within the First 48 Months after WMP Approval then ongoing	Place 15 interpretive signs along the Maumee River Corridor regarding water quality and safe recreating (36 months)	$10,000	Save Maumee Grassroots Organization (P), Maumee Valley Heritage Corridor (P), IN DNR and ODNR (P), NW Ohio River Runners (P), River Greenway Consortium (P), City and County Park Departments (P), Maumee River Basin Commission (P), MRBPLG (P)
			Develop and disseminate brochures regarding recreational opportunities and potential obstacles or threats along the River (36 months)	$4,000	
			Work with Partners to develop a map of recreational opportunities and potential obstacle or threats along the river (36 - 48 months)	$7,500	

Provide Education and Outreach in Critical Areas					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Educate the Public on the Causes of WWTP Exceedances	Upper Maumee River Watershed Stakeholders within a Sewer District	Within the First 18 Months after WMP Approval then ongoing	Work with partners of local WWTPs to provide public tours of the WWT facilities (18 months)	$100/ year	IDEM and OEPA (P, TA), Rural Community Assistance Partnership (RCAP) (P, TA), State and County Health Departments (P, TA), Local WWTP Owners and Operators (P, TA), Urban Waters Initiative (P, TA)
			Develop and disseminate brochures explaining how WWTPs operate (12 months)	$1000/ year	
			Develop and publish two press releases annually explaining WWTP operations and reasons for exceedances of permit limits (12 months)	$100/ year	

*** Cost included in salary.

Partner with Key Organizations to Assist with WMP Implementation					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Partner with Organizations who are Providing Education/Outreach or cost assistance with Septic Issues Partner with Organizations who are Providing Education/Outreach or cost assistance with Septic Issues	Upper Maumee River Watershed Septic System Stakeholders	Within the First 12 Months after WMP Approval	Meet with County Health Departments Annually to Discuss Septic Issues (6 months)	$500/ year	Allen, DeKalb, Defiance, and Paulding County Health Departments and SWCDs (P,TA) *Septic Issues, Collaborative Solutions working group* (P)
			Meet with Other organizations addressing septic issues biannually (6 months)	$500/ year	
			Work with Local Septic System Businesses to offer discounts to stakeholders who sign up for regular septic maintenance including pump-outs and inspections. (12 months)	$500/ year	
Partner with Municipalities and other Organizations who are Providing Education and Outreach or Cost Assistance with Urban Stormwater Issues	Upper Maumee River Watershed Urban Stormwater Stakeholders	Within the First 18 Months after WMP Approval	Make contact with City and County Planners / MS4 Coordinators (6 months)	$300 / year	Allen, Defiance, DeKalb and Paulding County Planning Commissions (P) Fort Wayne, New Haven, and Hicksville, Administrators, MS4 coordinators and Decision Makers (P), WLEB Commission (P)
			Meet with City and County Decision Makers Bi-monthly (8 months)	$300 / year	
			Work with City and County Planners to Encourage Low Impact Design for New Developments (18 months)	$500/ year	
			Partner with organizations that currently provide urban education and outreach (12 months)	$300/ year	

Partner with Key Organizations to Assist with WMP Implementation					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
			Partner with the MRBC and Black Swamp Conservancy to offer assistance promoting their Purchase of Easements and Acquisition of Structures in the Floodplain Programs (12 months)	$1,500/ year	Maumee River Basin Commission and the Black Swamp Conservancy (P, TA)
Partner with Other Organizations Who Encourage Recreating on the Maumee River	Upper Maumee River Watershed Recreation Stakeholders	Within the First 24 Months after WMP approval then ongoing	Make contact with one local organization monthly until all have been reached (24 months)	$400 / year	Save Maumee Grassroots Organization (P), Maumee Valley Heritage Corridor (P), IN DNR and O DNR (P), NW Ohio River Runners (P), River Greenway Consortium (P), City and County Park Departments (P), IN and OH DNR (P), Maumee River Basin Commission (P), MRBPLG (P)
			Meet with Organizations who have agreed to be partners on a quarterly basis (24 months)	$400 / year	
Partner WWTP Owners/ Operators Acquire Funding to Make Necessary Upgrades to the Systems	Upper Maumee River Watershed WWTP Owners/ Operators	Within the First 12 Months after WMP Approval and Ongoing	Make Contact with All Operators of WWTPs with Effluent Exceedances (6 months)	$400/ year	IDEM and OEPA (P, TA), Rural Community Assistance Partnership (RCAP) (P, TA), State and County Health Departments (P, TA), Local WWTP Owners and Operators (P, TA), Urban Waters Initiative (P, TA)
			Meet with WWTP Owners/Operators, and Engineers Biannually to discuss funding options and progress (12 months)	$400/ year	
			Work with WWTP operators to Identify cause of exceedance and possible solutions (12 months)	$1,000/ year	

Develop and Promote Cost-share Programs					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Develop, and Promote a Cost-share Program on BMPs to Reduce Pollutant Loadings	Upper Maumee River Watershed Stakeholders	Within the First 18 Months after WMP Approval	Secure Funding to Implement the Cost-share Program (12 months)	***	Allen, DeKalb, Defiance, and Paulding County SWCD and NRCS Offices and Health Departments (P) Allen County Partnership for Water Quality (P) City and County Parks Departments (P) MS4 Coordinators and LTCP Implementers (P), The Nature Conservancy, MRBC and Black Swamp Conservancy (P, TA), Purdue and Ohio State Extensions (P, TA), Farm Service Agency (P), Tri-State Watershed Partnership (P), Maumee River Watershed Partnership (P), IDEM, INDNR, OEPA, ODNR (P, TA)
			Program Developed for Agriculture Cost Share Opportunities (6 months)	***	
			Develop and disseminate a Ag. Cost-share Brochure (8 months)	$1,500 / year	
			Program Developed for Urban Cost Share Opportunities (12 months)	***	
			Develop and disseminate an Urban Cost-share Brochure (18 months)	$1,500/ year	
			Program Developed for Septic System Repair and Replace Cost-share Opportunities (12 months)	***	
			Develop and disseminate a Septic System Cost-share Brochure (18 months)	$1,500/ year	

*** Cost included in salary.

Milestones for Indicators of Reaching Goals (not covered elsewhere)					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Disseminate and Analyze Social Indicator Study for Producers	Upper Maumee River Watershed Producers	Within 6 Years after WMP Approval	Social Indicator Study Developed and Disseminated (5 years)	$10,000	Allen, DeKalb, Defiance, and Paulding County SWCD and NRCS Offices (P), Ohio State University (P, TA)
			Social Indicator Study Analyzed (6 years)		
Disseminate and Analyze Social Indicator Study for Septic Systems	Upper Maumee River Watershed Stakeholders who Utilize Septic Systems	Within 2 Years after WMP Approval	Social Indicator Study for Septic Systems Developed and Disseminated at Workshops (18 months)	$1,000	Allen, DeKalb, Defiance, and Paulding County SWCDs and Health Departments (P, TA)
			Social Indicator Study Analyzed (24 months)		
Water Quality Sampling	Upper Maumee River Watershed Stakeholders	Within 5 Years after WMP Approval	Water Quality Sampling Begins at 17 Sites for Turbidity, TDS, TSS, Nitrate+Nitrite, TP, DRP, and E. coli at a minimum	$21,000/ year	Allen, DeKalb, Defiance, and Paulding County SWCDs (P), Heidelberg University and Indiana-Purdue University Fort Wayne (P, TA), City of Fort Wayne (P)
Conduct a Desktop Survey of Riparian Buffers	Upper Maumee River Watershed Stakeholders	Within 16 Years of WMP Approval	Desktop Survey of Riparian Buffers within the Upper Maumee River Watershed Completed (15 years)	$6,000	Allen, DeKalb, Defiance, and Paulding County SWCD and NRCS Offices (P), Indiana and Ohio DNR (P, TA)
			Riparian Buffer Survey Analyzed and Compared to the 2012 Survey (16 years)		

6.3.2 Action Registers to Implement Cost-share Program in Each Sub-watershed

The following sub-sections include action registers for the implementation of a cost-share program in each of the 14 HUC 12s located within the Upper Maumee River Watershed. The Action Registers include information regarding the number of BMPs that will be installed annually, the total that will be installed over the next 30 years, the total cost of implementation, as well as the total load reduction that will be achieved should all the BMPs be installed over the next 30 years. It is important to note that only the SWAT model will provide load reductions for DRP, so the expected reduction of DRP after implementation is much greater than what can be determined at this time. Additionally, not all the BMPs that will be implemented within each subwatershed can be modeled in one of the available load reduction models, and therefore, not all BMPs listed in the following Action Registers will have load reductions associated with them.

6.3.2.1 Action Register for Trier Ditch Subwatershed

Trier Ditch Critical For: Riparian Buffers-Priority 1, Urban Landuses and CSOs, Septic Tank Failures - Priority 1, DRP and Sediment - Priority 1										
Partners (P) and Technical Assistance (TA): Allen County SWCD and NRCS Office (P, TA), Purdue Extension Office (P, TA), Farm Bureau (P), The Nature Conservancy (P, TA) Tri-State Watershed Alliance (P), Upper Maumee Watershed Partnership (P, TA), Maumee River Basin Commission (P)										
Objective	**Target Audience**	**Implementation Timeframe**	**Action**	**Milestone**	**Quantity**	**Load Reduction -Nitrogen (lbs)**	**Load Reduction-Phosphorus (lbs)**	**Load Reduction - DRP (lbs)**	**Load Reduction -Sediment (ton)**	**Estimated Cost**
Implement riparian buffer installation	Upper Maumee River Watershed landowners adjacent to headwater streams	Within 30 years after WMP approval	Riparian Buffer	700 lf/year for 30 years	20,000 lf	6400	3,800		3800	$400,000.00
Implement programs to reduce P & Sediment to target loads	Upper Maumee River Watershed landowners and operators		Cover Crops	1000 new acres/year	9000 acres	119070	21510	0	12690	$360,000.00
			Nutrient Management	1000 new acres/year	6000 acres	23568	4152	540	0	$120,000.00
			Gypsum-soil amendments	1000 new acres/year	7000 acres	-	10430	3080	3290	$280,000.00
			Blind Inlets	2-4 structures/year	10 structures	-				$12,000.00

Trier Ditch Critical For: Riparian Buffers-Priority 1, Urban Landuses and CSOs, Septic Tank Failures - Priority 1, DRP and Sediment - Priority 1										
Partners (P) and Technical Assistance (TA): Allen County SWCD and NRCS Office (P, TA), Purdue Extension Office (P, TA), Farm Bureau (P), The Nature Conservancy (P, TA) Tri-State Watershed Alliance (P), Upper Maumee Watershed Partnership (P, TA), Maumee River Basin Commission (P)										
Objective	**Target Audience**	**Implementation Timeframe**	**Action**	**Milestone**	**Quantity**	**Load Reduction -Nitrogen (lbs)**	**Load Reduction-Phosphorus (lbs)**	**Load Reduction - DRP (lbs)**	**Load Reduction -Sediment (ton)**	**Estimated Cost**
Implement programs to reduce P & Sediment to target loads	Upper Maumee River Watershed landowners and operators	Within 30 years after WMP approval	Tile Control Structures (each controlling 20 acres)	10 structures/year for 6 years	60 structures (20 acres each)	9427	1661	216	540	$120,000.00
			Filter Strip/Saturated Buffers	3 sites/year for 3 years	9 sites- 1350 acres/5400 lf	13973	2930	265	2363	$36,000.00
			2-stage ditch	1 project every two years	2 projects (1000 lf on each side or 800 acres)	3728	784		192	$80,000.00
			Livestock Exclusion/pasture project	1 project within the first 3 years	1 project- 20 acres	3880	6880		194	$13,000.00
			Wetlands (Restoration/Creation	10 acres/year for 10 years	100 acres	4800	800		593	$300,000.00
			No Till	1000 acres/year	8000 acres	21120	3870		1710	$200,000.00
			Native Plantings, Conservation Cover	100 aces/year for 6 years	600 acres	14922	3300	600	1380	$210,000.00
			Grassed waterways	1 waterway per year for 9 years	9 grassed waterways	432	72		130	$45,000.00
			Stream bank Stabilization	1 project every two years	3 projects-1000 lf on each side	960	480		480	$100,000.00
			Grade Stabilization Structures	5 structures/year for 4 years	20 (300 lf structure)	1296	648		648	$30,000.00

Trier Ditch Critical For: Riparian Buffers-Priority 1, Urban Landuses and CSOs, Septic Tank Failures - Priority 1, DRP and Sediment - Priority 1										
Partners (P) and Technical Assistance (TA): Allen County SWCD and NRCS Office (P, TA), Purdue Extension Office (P, TA), Farm Bureau (P), The Nature Conservancy (P, TA) Tri-State Watershed Alliance (P), Upper Maumee Watershed Partnership (P, TA), Maumee River Basin Commission (P)										
Objective	**Target Audience**	**Implementation Timeframe**	**Action**	**Milestone**	**Quantity**	**Load Reduction -Nitrogen (lbs)**	**Load Reduction-Phosphorus (lbs)**	**Load Reduction - DRP (lbs)**	**Load Reduction -Sediment (ton)**	**Estimated Cost**
Implement Urban Practices	Upper Maumee River Watershed stakeholders in Fort Wayne and New Haven	Begin within 2 years after WMP approval then ongoing	Rain Gardens (Residential)	Install 10 gardens/year for 15 years	150 gardens	60	3		6	$30,000.00
			Rain Gardens (Commercial)	Install 1 garden/year for 10 years	10 gardens	126	18		14	$20,000.00
			Rain Barrels (Residential)	Install 5 rain barrels/year	150 rain barrels	121	22		30	$1,500.00
			Rain Barrels/Cisterns (Commercial)	Install 1 rain barrel/cistern biennially	15 rain barrels/cisterns	15	15		3	$7,500.00
			Green Roofs	1 roof every 3 years for 15 years	5 roofs					$125,000.00
			Blue Roof	1 roof every 5 years	5 roofs					$60,000.00
			Curb Cuts (in combination with other LID practices)	1 project every year for 5 years	5 projects					$40,000.00
			Wildlife Exclusion at Stormwater Basins	2 exclusion within 3 years/ then 1 biennially	15 exclusion					$200,000.00
			Infiltration Trench	1 trench within 3 years then biennially	14 trench	56	9.8		2.8	$70,000.00

Trier Ditch Critical For: Riparian Buffers-Priority 1, Urban Landuses and CSOs, Septic Tank Failures - Priority 1, DRP and Sediment - Priority 1										
Partners (P) and Technical Assistance (TA): Allen County SWCD and NRCS Office (P, TA), Purdue Extension Office (P, TA), Farm Bureau (P), The Nature Conservancy (P, TA) Tri-State Watershed Alliance (P), Upper Maumee Watershed Partnership (P, TA), Maumee River Basin Commission (P)										
Objective	**Target Audience**	**Implementation Timeframe**	**Action**	**Milestone**	**Quantity**	**Load Reduction -Nitrogen (lbs)**	**Load Reduction-Phosphorus (lbs)**	**Load Reduction - DRP (lbs)**	**Load Reduction -Sediment (ton)**	**Estimated Cost**
Implement Urban Practices	Upper Maumee River Watershed stakeholders in Fort Wayne and New Haven	Begin within 2 years after WMP approval then ongoing	Extended Wet Detention	1 project every 5 years	6 project	33.36	3.54		0.72	$35,000.00
			Pervious Pavement	1 project every 5 years	6 projects- 10 acres each	479.16	45.24		10.08	$45,000.00
			Pet Waste Disposal Receptacles	2 installed in each park	20 receptacles					$4,000.00
			Encourage sale of P Free Fertilizer at Local Retailers							$3,000.00
			Monthly Street Sweeping	Monthly		0	6,088		2,394	$50,000.00
Implement a program to replace and repair septic systems	Homeonwers Utilizing Septic Systems	Begin within 2 years after WMP approval	Repair/replace failing septics	Repair/replace 15 septic systems/year for 20 years	Repair/replace 425 failing septics	23375	2763		53	$4,250,000.0
			TOTAL			**247841.52**	**70284.58**	**4701**	**30523.6**	
			Required Load reduction (from UM Watershed Action Plan)			0	57420	19900	26362	$7,247,000.0 0

6.3.2.2 Action Register for Bullerman Ditch Subwatershed

Bullerman Ditch Critical For: Riparian Buffer - Priority 3, Urban Landuses and CSOs, Septic Tank Failures - Priority 2										
Partners (P) and Technical Assistance (TA): Allen County SWCD and NRCS Offices (P, TA), Purdue Extension (P, TA), Farm Bureau (P), The Nature Conservancy (P, TA) Tri-State Watershed Alliance (P), Upper Maumee Watershed Partnership (P, TA), Maumee River Basin Commission (P)										
Objective	**Target Audience**	**Implementation Timeframe**	**Action**	**Milestone**	**Quantity**	**Load Reduction -Nitrogen (lbs/yr)**	**Load Reduction-Phosphorus (lbs/yr)**	**Load Reduction-DRP (lbs/yr)**	**Load Reduction-Sediment (ton/yr)**	**Estimated Cost**
Implement riparian buffer installation	Upper Maumee River Watershed landowners adjacent to headwater streams	Begin after implementation of Priority 1 and 2 areas then ongoing	Riparian Buffer	500 lf/year for 30 years	15,000 lf	4800	2850		2850	$300,000.00
			Grade Stabilization Structures	5 structures/year for 4 years	20 (300 lf structure)	1296	648		648	$50,000.00
Implement Urban Stormwater Program	Upper Maumee River Watershed landowners in Fort Wayne and New Haven	Begin within 2 years of WMP approval	Rain Gardens (Residential)	Install 10 gardens/year	300 gardens	600	30		54	$60,000.00
			Rain Gardens (Commercial)	Install 1 garden/year	30 gardens	1260	180		138.9	$60,000.00
			Rain Barrels (Residential)	Install 10 rain barrels/year	300 rain barrels	243	45		60	$30,000.00
			Rain Barrels/Cisterns (Commercial)	Install 1 rain barrel/cistern annually	30 rain barrels/cisterns	30	30		6	$15,000.00
			Green Roofs	1 roof every 2 years	15 roofs					$375,000.00
			Blue Roof	1 roof every 2 years	15 roofs					$300,000.00
			Curb Cuts (in combination with other LID practices)	1 within 2 years then 1 project annually for 15 years	16 projects					$75,000.00

Bullerman Ditch Critical For: Riparian Buffer - Priority 3, Urban Landuses and CSOs, Septic Tank Failures - Priority 2										
Partners (P) and Technical Assistance (TA): Allen County SWCD and NRCS Offices (P, TA), Purdue Extension (P, TA), Farm Bureau (P), The Nature Conservancy (P, TA) Tri-State Watershed Alliance (P), Upper Maumee Watershed Partnership (P, TA), Maumee River Basin Commission (P)										
Objective	**Target Audience**	**Implementation Timeframe**	**Action**	**Milestone**	**Quantity**	**Load Reduction -Nitrogen (lbs/yr)**	**Load Reduction-Phosphorus (lbs/yr)**	**Load Reduction-DRP (lbs/yr)**	**Load Reduction-Sediment (ton/yr)**	**Estimated Cost**
			Wildlife Exclusion at Stormwater Basins	2 exclusion within 3 years/ then 1 annually	29 exclusions					$400,000.00
			Infiltration Trench	1 trench biennially	15 trench	60	10.5		3	$75,000.00
			Extended Wet Detention	1 project with 5 years then 1 project biennially	13 project	72.28	1.56		1.56	$75,000.00
			Pervious Pavement	1 project every 3 years	10 projects- 10 acres contributing area each	798.6	754		168	$75,000.00
			Pet Waste Disposal Receptacles	2 installed in each park	20 receptacles					$4,000.00
			Encourage sale of Phosphorus Free Fertilizer at Local Retailers							$3,000.00
			Monthly Street Sweeping	Monthly	N/A	0	12,176		4,788	$50,000.00

Bullerman Ditch Critical For: Riparian Buffer - Priority 3, Urban Landuses and CSOs, Septic Tank Failures - Priority 2										
Partners (P) and Technical Assistance (TA): Allen County SWCD and NRCS Offices (P, TA), Purdue Extension (P, TA), Farm Bureau (P), The Nature Conservancy (P, TA) Tri-State Watershed Alliance (P), Upper Maumee Watershed Partnership (P, TA), Maumee River Basin Commission (P)										
Objective	**Target Audience**	**Implementation Timeframe**	**Action**	**Milestone**	**Quantity**	**Load Reduction -Nitrogen (lbs/yr)**	**Load Reduction-Phosphorus (lbs/yr)**	**Load Reduction-DRP (lbs/yr)**	**Load Reduction-Sediment (ton/yr)**	**Estimated Cost**
Implement a program to replace and repair septic systems	Upper Maumee River Watershed Homeonwers Utilizing Septic Systems	Begin within 2 years of WMP approval	Repair/replace failing septics	Repair/replace 10 septic systems/year for 30 years	Repair/replace 300 failing septics	16500	1950		37	$3,000,000.00
			TOTAL			**25659.88**	**18675.06**	**0**	**8754.46**	
			Required Load reduction (from UM Watershed Action Plan)			0	15880	3060	5634	$4,947,000.00

6.3.2.3 Action Register for Sixmile Creek Subwatershed

Sixmile Creek Critical For: Riparian Buffers - Priority 2, Urban Landuse and CSOs, Septic Tank Failures - Priority 1, DRP and Sediment - Priority 1										
Partners (P) and Technical Assistance (TA): Allen County SWCD and NRCS Offices (P, TA), Purdue Extension (P, TA), Farm Bureau (P), The Nature Conservancy (P, TA) Tri-State Watershed Alliance (P), Upper Maumee Watershed Partnership (P, TA), Maumee River Basin Commission (P), City of Fort Wayne (P)										
Objective	**Target Audience**	**Implementation Timeframe**	**Action**	**Milestone**	**Quantity**	**Load Reduction-Nitrogen (lbs/yr)**	**Load Reduction-Phosphorus (lbs/yr)**	**Load Reduction-DRP (lbs/yr)**	**Load Reduction-Sediment (ton/yr)**	**Estimated Cost**
Implement riparian buffer installation	Upper Maumee River Watershed landowners adjacent to headwater streams	After Implementation of Priority 1 areas	Riparian Buffer	600 lf/year for 30 years	18,000 lf	5760	3420		3240	$360,000.00
Implement programs to reduce Phosphorus & Sediment to target loads	Upper Maumee River Watershed landowners and operators	Within 30 years after WMP approval	Cover Crops	1000 new acres/year	5000 acres	66150	11950	0	7050	$200,000.00
			Nutrient Management	1000 new acres/year	6000 acres		8940	2640	2820	$120,000.00
			Gypsum-soil amendments	1000 new acres/year	7000 acres	-	5950	3080	3290	$280,000.00
			Tile Control Structures (each controlling 20 acres)	10 structures/year for 6 years	60 structures (20 acres each)	6341	888	325	169	$120,000.00
			Filter Strip/Saturated Buffers	3 sites/year for 3 years	9 sites- 1350 acres/5400 lf	13973	2930	265	2363	$36,000.00
			No Till	1000 acres/year	8000 acres	23920	4080		3920	$200,000.00
			Native Plantings, Conservation Cover	100 aces/year for 6 years	600 acres	14922	3300	600	1380	$210,000.00
Implement Urban Stormwater Program	Upper Maumee River Watershed Landowners in Fort Wayne	Within 30 years after WMP approval	Rain Gardens (Residential)	Install 10 gardens/year for 3 years	30 gardens	60	3		6	$6,000.00
			Rain Gardens (Commercial)	Install 1 garden/year for 5 years	5 gardens	126	18		14	$10,000.00

Sixmile Creek Critical For: Riparian Buffers - Priority 2, Urban Landuse and CSOs, Septic Tank Failures - Priority 1, DRP and Sediment - Priority 1										
Partners (P) and Technical Assistance (TA): Allen County SWCD and NRCS Offices (P, TA), Purdue Extension (P, TA), Farm Bureau (P), The Nature Conservancy (P, TA) Tri-State Watershed Alliance (P), Upper Maumee Watershed Partnership (P, TA), Maumee River Basin Commission (P), City of Fort Wayne (P)										
Objective	**Target Audience**	**Implementation Timeframe**	**Action**	**Milestone**	**Quantity**	**Load Reduction-Nitrogen (lbs/yr)**	**Load Reduction-Phosphorus (lbs/yr)**	**Load Reduction-DRP (lbs/yr)**	**Load Reduction-Sediment (ton/yr)**	**Estimated Cost**
Implement Urban Stormwater Program	Upper Maumee River Watershed Landowners in Fort Wayne	Within 30 years after WMP approval	Rain Barrels (Residential)	Install 10 rain barrels for 10 years	30 rain barrels	24.3	4.5		6	$3,000.00
			Rain Barrels/Cisterns (Commercial)	Install 1 rain barrel/cistern a year for 10 years	10 rain barrels/cisterns	10	10		2	$5,000.00
			Curb Cuts (in combination with other LID practices)	1 project within 5 years	1 project					$15,000.00
			Curb Cuts (in combination with other LID practices)	1 project within 5 years	1 project					$15,000.00
			Wildlife Exclusion at Stormwater Basins	1 exclusion within 2 years	1 exclusion					$15,000.00
			Infiltration Trench	1 trench within 5 years	1 trench	4	0.7		0.2	$15,000.00
			Extended Wet Detention	1 project within 5 years	1 project	5.56	0.12		0.12	$7,500.00
			Pervious Pavement	1 project every 5 years for 10 years	2 projects- 10 acres each	159.72	15.08		3.36	$15,000.00
			Pet Waste Disposal Receptacles	2 installed in each park	2 receptacles					$400.00

Sixmile Creek Critical For: Riparian Buffers - Priority 2, Urban Landuse and CSOs, Septic Tank Failures - Priority 1, DRP and Sediment - Priority 1										
Partners (P) and Technical Assistance (TA): Allen County SWCD and NRCS Offices (P, TA), Purdue Extension (P, TA), Farm Bureau (P), The Nature Conservancy (P, TA) Tri-State Watershed Alliance (P), Upper Maumee Watershed Partnership (P, TA), Maumee River Basin Commission (P), City of Fort Wayne (P)										
Objective	**Target Audience**	**Implementation Timeframe**	**Action**	**Milestone**	**Quantity**	**Load Reduction-Nitrogen (lbs/yr)**	**Load Reduction-Phosphorus (lbs/yr)**	**Load Reduction-DRP (lbs/yr)**	**Load Reduction-Sediment (ton/yr)**	**Estimated Cost**
Implement Urban Stormwater Program	Upper Maumee River Watershed Landowners in Fort Wayne	Within 30 years after WMP approval	Encourage sale of Phosphorus Free Fertilizer at Local Retailers							$3,000.00
			Monthly Street Sweeping	Monthly		0	6088.2		2394	$50,000.00
Implement a program to replace and repair septic systems	Homeowners with failing septics	Within 30 years after WMP approval	Repair/replace failing septics	Repair/replace 15 septic systems/year for 20 years	Repair/replace 532 failing septics	15895	1878		36	$5,320,000.00
			TOTAL			**147350.58**	**49,476**	**6910**	**26693.68**	
			Required Load reduction (from UM Watershed Action Plan)			0	24180	15560	6497	$7,005,900.00

6.3.2.4 Action Register for Bottern Ditch Subwatershed

Bottern Ditch Critical For: Riparian Buffer - Priority 1, Livestock Operations, Septic Tank Failures - Priority 1

Partners (P) and Technical Assistance (TA): Allen County SWCD and NRCS Offices (P, TA), Purdue Extension (P, TA), Farm Bureau (P), The Nature Conservancy (P, TA) Tri-State Watershed Alliance (P), Upper Maumee Watershed Partnership (P, TA), Maumee River Basin Commission (P)

Objective	Target Audience	Implementation Timeframe	Action	Milestone	Quantity	Load Reduction- Nitrogen (lbs/yr)	Load Reduction- Phosphorus (lbs/yr)	Load Reduction- DRP (lbs/yr)	Load Reduction- Sediment (ton/yr)	Estimated Cost
Implement riparian buffer installation	Upper Maumee River Watershed landowners adjacent to Headwater streams	Within the first 6 months after WMP approval then ongoing	Riparian Buffer	700 lf/year for 30 years	20,000 lf	6400	3,800		3800	$400,000.00
Implement programs to reduce Phosphorus & Sediment to target loads	Upper Maumee River Watershed landowners and operators		Cover Crops	1000 new acres/year	15000 acres	198450	35850	0	21150	$600,000.00
			Nutrient Management	1000 new acres/year	6000 acres	11664	1548	528	0	$120,000.00
			Gypsum-soil amendments	1000 new acres/year	7000 acres	-	10430	3080	3290	$280,000.00
			Blind Inlets	2-4 structures/year	10 structures	-				$12,000.00
			Tile Control Structures (each controlling 20 acres)	10 structures/year for 6 years	60 structures (20 acres)	4666	619	211	108	$120,000.00
			Filter Strip/Saturated Buffers	3 sites/year for 3 years	9 sites- 1350 acres/5400 lf	13973	2930	265	2363	$36,000.00
			Comprehensive Nutrient Management Plan	4 plans every year for 5 years	19 Plans					$0.00
			Runoff Management System	2 projects every year for 4 years	8 projects		2272			$0.00
			Livestock Exclusion	4 projects every year for 5 years	19 project- 20 acres	3690	460		184	$247,000.00

Bottern Ditch Critical For: Riparian Buffer - Priority 1, Livestock Operations, Septic Tank Failures - Priority 1										
Partners (P) and Technical Assistance (TA): Allen County SWCD and NRCS Offices (P, TA), Purdue Extension (P, TA), Farm Bureau (P), The Nature Conservancy (P, TA) Tri-State Watershed Alliance (P), Upper Maumee Watershed Partnership (P, TA), Maumee River Basin Commission (P)										
Objective	**Target Audience**	**Implementation Timeframe**	**Action**	**Milestone**	**Quantity**	**Load Reduction-Nitrogen (lbs/yr)**	**Load Reduction-Phosphorus (lbs/yr)**	**Load Reduction-DRP (lbs/yr)**	**Load Reduction-Sediment (ton/yr)**	**Estimated Cost**
Implement programs to reduce Phosphorus & Sediment to target loads	Upper Maumee River Watershed landowners and operators	Within the first 6 months after WMP approval then ongoing	Wetlands (Restoration/Creation)	10 acres/year for 10 years	100 acres	4800	800		593	$300,000.00
			No Till	1000 acres/year	8000 acres	23920	4080		3920	$200,000.00
			Grassed waterways	1 waterway per year for 9 years	9 grassed waterways	432	72		130	$45,000.00
			Stream bank Stabilization	1 project every two years	3 projects-1000 lf on each side	960	480		480	$100,000.00
			Grade Stabilization Structures	5 structures/year for 4 years	20 (300 lf structure)	1296	648		648	$50,000.00
Implement a program to replace and repair septic systems	Homeowners with failing septics	Within 30 years after WMP approval	Repair/replace failing septics	Repair/Replace 40 septic systems/year for 20 years	Repair/Replace 784 failing septics	43120	5096		97	$7,840,000.00
			TOTAL			**313371**	**69085**	**4084**	**36763**	
			Required Load reduction (from UM Watershed Action Plan)			0	21420	3600	5440	$10,350,000.00

6.3.2.5 Action Register for Black Creek

Black Creek Critical For: Riparian Buffer - Priority 2, Livestock Operations, Septic Tank Failures - Priority 1										
Partners (P) and Technical Assistance (TA): Allen County SWCD and NRCS Offices (P, TA), Purdue Extension (P, TA), Farm Bureau (P), The Nature Conservancy (P, TA) Tri-State Watershed Alliance (P), Upper Maumee Watershed Partnership (P, TA), Maumee River Basin Commission (P), City of Fort Wayne and New Haven (P)										
Objective	**Target Audience**	**Implementation Timeframe**	**Action**	**Milestone**	**Quantity**	**Load Reduction- Nitrogen (lbs/yr)**	**Load Reduction- Phosphorus (lbs/yr)**	**Load Reduction- DRP (lbs/yr)**	**Load Reduction- Sediment (ton/yr)**	**Estimated Cost**
Implement riparian buffer installation	Upper Maumee River Watershed landowners adjacent to headwater streams	Begin after Implementation in Priority 1 areas then ongoing	Riparian Buffer	600 lf/year for 30 years	18,000 lf	5760	3420		3240	$360,000.00
Implement programs to reduce Phosphorus & Sediment to target loads	Upper Maumee River Watershed landowners and operators	Within 30 years after WMP approval	Cover Crops	1000 new acres/year	3000 acres	39960	7170	0	4230	$120,000.00
			Nutrient Management	1000 new acres/year	3000 acres	9318	1518	318	0	$60,000.00
			Gypsum-soil amendments	1000 new acres/year	4000 acres	-	5950	1760	1880	$160,000.00
			Blind Inlets	2-4 structures/year	10 structures	-				$12,000.00
			Tile Control Structures (each controlling 20 acres)	10 structures/year for 6 years	60 structures (20 acres)	7454	1214	254	256	$120,000.00
			Native Plantings, Conservation Cover	100 aces/year for 6 years	600 acres	14922	3300	600	1380	$360,000.00
			Wetlands (Restoration/Creation)	10 acres/year for 10 years	100 acres	4800	800		593	$300,000.00
			Comprehensive Nutrient Management Plan	2 plans every year for 5 years	10 Plans					

Black Creek Critical For: Riparian Buffer - Priority 2, Livestock Operations, Septic Tank Failures - Priority 1										
Partners (P) and Technical Assistance (TA): Allen County SWCD and NRCS Offices (P, TA), Purdue Extension (P, TA), Farm Bureau (P), The Nature Conservancy (P, TA) Tri-State Watershed Alliance (P), Upper Maumee Watershed Partnership (P, TA), Maumee River Basin Commission (P), City of Fort Wayne and New Haven (P)										
Objective	**Target Audience**	**Implementation Timeframe**	**Action**	**Milestone**	**Quantity**	**Load Reduction-Nitrogen (lbs/yr)**	**Load Reduction-Phosphorus (lbs/yr)**	**Load Reduction-DRP (lbs/yr)**	**Load Reduction-Sediment (ton/yr)**	**Estimated Cost**
Implement programs to reduce Phosphorus & Sediment to target loads	Upper Maumee River Watershed landowners and operators	Within 30 years after WMP approval	2-stage ditch	1 project every two years	2 projects (1000 lf)	320	160		160	$80,000.00
			Filter Strip/Saturated Buffers	3 sites/year for 3 years	9 sites- 1350 acres/5400 lf	13973	2930	265	2363	$36,000.00
			Livestock Exclusion/barnyard project	2 projects every year for 5 years	10 projects- 20 acres	38800	4800		1940	$130,000.00
			No Till	1000 acres/year	8000 acres	23920	4080		3920	$300,000.00
Implement a program to replace and repair septic systems	Homeowners Utilizing Septic Systems	Within 30 years after WMP approval	Repair/replace failing septics	Repair/replace 21 septic systems/year for 20 years	Repair/replace 414 failing septics	22770	2691		51	$4,140,000.00
			TOTAL			**181997**	**38033**	**3197**	**20013**	
			Required Load reduction (from UM Watershed Action Plan)			0	27360	21900	8055	$6,178,000.00

6.3.2.6 Action Register for Marsh Ditch Subwatershed

Marsh Ditch Critical For: Riparian Buffer - Priority 2, Septic Tank Failures - Priority 2, DRP and Sediment - Priority 1										
Partners (P) and Technical Assistance (TA): Allen County SWCD and NRCS Offices (P, TA), Purdue Extension (P, TA), Farm Bureau (P), The Nature Conservancy (P, TA) Tri-State Watershed Alliance (P), Upper Maumee Watershed Partnership (P, TA), Maumee River Basin Commission (P)										
Objective	**Target Audience**	**Implementation Timeframe**	**Action**	**Milestone**	**Quantity**	**Load Reduction-Nitrogen (lbs/yr)**	**Load Reduction-Phosphorus (lbs/yr)**	**Load Reduction-DRP (lbs/yr)**	**Load Reduction-Sediment (ton/yr)**	**Estimated Cost**
Implement riparian buffer installation	Upper Maumee River Watershed landowners adjacent to headwater streams	After implementation in Priority 1 areas then ongoing	Riparian Buffer	600 lf/year for 30 years	18,000 lf	5760	3420		3240	$360,000.00
Implement programs to reduce Phosphorus & Sediment to target loads	Upper Maumee River Watershed landowners and operators	Within 30 years after WMP approval	Cover Crops	1000 new acres/year	3000 acres	39960	7170	0	4230	$120,000.00
			Nutrient Management	1000 new acres/year	3000 acres	7620	644	432	204	$60,000.00
			Gypsum-soil amendments	1000 new acres/year	4000 acres	-	5950	1760	1880	$160,000.00
			Blind Inlets	2-4 structures/year	10 structures	-				$12,000.00
			Tile Control Structures)	10 structures/year for 6 years	60 structures (20 acres)	6096	773	346	122	$120,000.00
			Filter Strip/Saturated Buffers	3 sites/year for 3 years	9 sites- 1350 acres/5400 lf	13973	2930	265	2363	$36,000.00
			No Till	1000 acres/year	4000 acres	11960	2040		1960	$100,000.00
			Native Plantings, Conservation Cover	100 aces/year for 6 years	600 acres	14922	3300	600	1380	$210,000.00
			Stream bank Stabilization	1 project within 3 years	1 project-1000 lf on each side	320	160		160	$100,000.00
			Grade Stabilization Structures	5 structures/year for 4 years	20 (300 lf structure)	1296	648		648	$30,000.00

Marsh Ditch Critical For: Riparian Buffer - Priority 2, Septic Tank Failures - Priority 2, DRP and Sediment - Priority 1										
Partners (P) and Technical Assistance (TA): Allen County SWCD and NRCS Offices (P, TA), Purdue Extension (P, TA), Farm Bureau (P), The Nature Conservancy (P, TA) Tri-State Watershed Alliance (P), Upper Maumee Watershed Partnership (P, TA), Maumee River Basin Commission (P)										
Objective	**Target Audience**	**Implementation Timeframe**	**Action**	**Milestone**	**Quantity**	**Load Reduction-Nitrogen (lbs/yr)**	**Load Reduction-Phosphorus (lbs/yr)**	**Load Reduction-DRP (lbs/yr)**	**Load Reduction-Sediment (ton/yr)**	**Estimated Cost**
Implement a program to replace and repair septic systems	Homeowners with failing septics	Within 30 years after WMP approval	Repair/replace failing septics	Repair 14 septic systems/year for 20 years	Repair 277 failing septics	15235	1801		43	$5,540,000.00
			TOTAL			**117142**	**28836**	**3403**	**16230**	
			Required Load reduction (from UM Watershed Action Plan)			26120	16740	4160	3716	$6,848,000.00

6.3.2.7 Action Register for Marie DeLarme Subwatershed

Marie DeLarme Creek Critical For: Riparian Buffer - Priority 2, Septic Tank Failures - Priority 1, DRP and Sediment - Priority 2

Partners (P) and Technical Assistance (TA): Allen, DeKalb, Defiance, and Paulding County SWCD and NRCS Offices (P, TA), Purdue and Ohio Extensions (P, TA), Farm Bureau (P), The Nature Conservancy (P, TA) Tri-State Watershed Alliance (P), Upper Maumee Watershed Partnership (P, TA), Maumee River Basin Commission (P), The Black Swamp Conservancy (P)

Objective	Target Audience	Implementation Timeframe	Action	Milestone	Quantity	Load Reduction- Nitrogen (lbs/yr)	Load Reduction- Phosphorus (lbs/yr)	Load Reduction- DRP (lbs/yr)	Load Reduction- Sediment (ton/yr)	Estimated Cost
Implement riparian buffer installation	Upper Maumee River Watershed landowners adjacent to headwater streams	After Implementation in Priority 1 areas then ongoing	Riparian Buffer	600 lf/year for 30 years	18,000 lf	5760	3420		3240	$360,000.00
Implement programs to reduce Phosphorus & Sediment to target loads	Upper Maumee River Watershed landowners and operators	Within 30 years after WMP approval and after implementation of Priority 1 areas	Cover Crops	1000 new acres/year	15000 acres	64980	35850	0	2160	$600,000.00
			Nutrient Management	1000 new acres/year	6000 acres	20904	2832	708	0	$120,000.00
			Gypsum-soil amendments	1000 new acres/year	7000 acres	-	10430	3080	3290	$280,000.00
			Blind Inlets	2-4 structures/year	10 structures	-				$12,000.00
			Tile Control Structures	10 structures/year for 6 years	60 structures (20 acres each)	8362	1133	283	245	$120,000.00
			Filter Strip/Saturated Buffers	3 sites/year for 3 years	9 sites- 1350 acres/5400 lf	13973	2930	265	2363	$36,000.00
			2-stage ditch	1 project every two years	2 projects (1000 lf on each side or 800 acres)	320	160		160	$80,000.00
			Livestock Exclusion/barnyard project	2 projects every 3 years	2 projects- 20 acres	7760	13760		388	$26,000.00
			Wetlands (Restoration/Creation)	10 acres/year for 10 years	100 acres	4800	800		593	$300,000.00

Marie DeLarme Creek Critical For: Riparian Buffer - Priority 2, Septic Tank Failures - Priority 1, DRP and Sediment - Priority 2										
Partners (P) and Technical Assistance (TA): Allen, DeKalb, Defiance, and Paulding County SWCD and NRCS Offices (P, TA), Purdue and Ohio Extensions (P, TA), Farm Bureau (P), The Nature Conservancy (P, TA) Tri-State Watershed Alliance (P), Upper Maumee Watershed Partnership (P, TA), Maumee River Basin Commission (P), The Black Swamp Conservancy (P)										
Objective	**Target Audience**	**Implementation Timeframe**	**Action**	**Milestone**	**Quantity**	**Load Reduction-Nitrogen (lbs/yr)**	**Load Reduction-Phosphorus (lbs/yr)**	**Load Reduction-DRP (lbs/yr)**	**Load Reduction-Sediment (ton/yr)**	**Estimated Cost**
Implement programs to reduce Phosphorus & Sediment to target loads	Upper Maumee River Watershed landowners and operators	Within 30 years after WMP approval and after implementation of Priority 1 areas	No Till	1000 acres/year	8000 acres	23920	4080		3920	$2,000,000.00
			Native Plantings, Conservation Cover	100 aces/year for 6 years	600 acres	14922	3300	600	1380	$210,000.00
			Grassed waterways	1 waterway per year for 9 years	9 grassed waterways	432	72		130	$45,000.00
			Stream bank Stabilization	1 project every year for 10 years	10 projects-1000 lf on each side	3,200	1,600		1,600	$100,000.00
			Grade Stabilization Structures	5 structures/year for 4 years	20 (300 lf structure)	1296	648		648	$50,000.00
Implement a program to replace and repair septic systems	Homeowners with failing septics	Within 30 years after WMP approval	Repair/replace failing septics	Repair/replace 22 septic systems/year for 20 years	Repair/replace 435 failing septics	23925	2828		54	$4,350,000.00
			TOTAL			**194554**	**83843**	**4936**	**20171**	
			Required Load reduction (from UM Watershed Action Plan)			7620	63420	3200	19443	$8,689,000.00

6.3.2.8 Action Register for North Chaney Ditch Subwatershed

North Chaney Ditch Critical For: DRP and Sediment - Priority 2										
Partners (P) and Technical Assistance (TA): Allen, and Paulding County SWCD and NRCS Offices (P, TA), Purdue and Ohio Extensions (P, TA), Farm Bureau (P), The Nature Conservancy (P, TA) Tri-State Watershed Alliance (P), Upper Maumee Watershed Partnership (P, TA), Maumee River Basin Commission (P), The Black Swamp Conservancy (P)										
Objective	**Target Audience**	**Implementation Timeframe**	**Action**	**Milestone**	**Quantity**	**Load Reduction-Nitrogen (lbs/yr)**	**Load Reduction-Phosphorus (lbs/yr)**	**Load Reduction-DRP (lbs/yr)**	**Load Reduction-Sediment (ton/yr)**	**Estimated Cost**
Implement programs to reduce Phosphorus & Sediment to target loads	Upper Maumee River Watershed landowners and operators	Begin after WMP approval and after implementation of Priority 1 areas then ongoing	Cover Crops	1000 new acres/year	5000 acres	66150	11950	0	7050	$200,000.00
			Nutrient Management	500 new acres/year	3000 acres	5406	636	594	0	$60,000.00
			Gypsum-soil amendments	1000 new acres/year	3000 acres	-	4470	1320	1410	$120,000.00
			Tile Control Structures (each controlling 20 acres)	10 structures/year for 6 years	60 structures (20 acres each)	4325	509	475	50	$120,000.00
			Filter Strip/Saturated Buffers	3 sites/year for 3 years	9 sites- 1350 acres/5400 lf	13973	2930	265	2363	$36,000.00
			No Till	1000 acres/year	8000 acres	23920	4080		3920	$200,000.00
			Native Plantings, Conservation Cover	100 aces/year for 6 years	600 acres	14922	3300	600	1380	$210,000.00
			Stream bank Stabilization	1 project every two years	3 projects-1000 lf on each side	960	480		480	$100,000.00
			TOTAL			**129656**	**28355**	**3254**	**16653**	
			Required Load reduction (from UM Watershed Action Plan)			8760	9320	4380	1137	$1,046,000.00

6.3.2.9 Action Register for Zuber Cutoff Subwatershed

Zuber Cutoff Critical For: Riparian Buffer - Priority 1, DRP and Sediment - Priority 2										
Partners (P) and Technical Assistance (TA): Allen and Paulding County SWCD and NRCS Offices (P, TA), Purdue and Ohio Extensions (P, TA), Farm Bureau (P), The Nature Conservancy (P, TA) Tri-State Watershed Alliance (P), Upper Maumee Watershed Partnership (P, TA), Maumee River Basin Commission (P), The Black Swamp Conservancy (P)										
Objective	**Target Audience**	**Implementation Timeframe**	**Action**	**Milestone**	**Quantity**	**Load Reduction-Nitrogen (lbs/yr)**	**Load Reduction-Phosphorus (lbs/yr)**	**Load Reduction-DRP (lbs/yr)**	**Load Reduction-Sediment (ton/yr)**	**Estimated Cost**
Implement riparian buffer installation	Upper Maumee River Watershed landowners adjacent to headwater streams	Within 30 years after WMP approval and after implementation of Priority 1 areas	Riparian Buffer	700 lf/year for 30 years	20,000 lf	6400	3,800		3800	$400,000.00
Implement programs to reduce Phosphorus & Sediment to target loads	Upper Maumee River Watershed landowners and operators		Cover Crops	1000 new acres/year	15000 acres	64980	35850	0	2160	$600,000.00
			Nutrient Management	1000 new acres/year	6000 acres	23436	3204	1044	0	$120,000.00
			Gypsum-soil amendments	1000 new acres/year	7000 acres	-	10430	3080	3290	$280,000.00
			Blind Inlets	2-4 structures/year	10 structures	-				$12,000.00
			Tile Control Structures (each controlling 20 acres)	10 structures/year for 6 years	60 structures (20 acres each)	9374	1282	418	191	$120,000.00
			Filter Strip/Saturated Buffers	3 sites/year for 3 years	9 sites- 1350 acres/5400 lf	13973	2930	265	2363	$36,000.00
			2-stage ditch	1 project every two years	2 projects (1000 lf on each side or 800 acres)	320	160		160	$80,000.00
			Livestock Exclusion/barnyard project	1 project within the first 3 years	1 project- 20 acres	3880	6880		194	$13,000.00
			Wetlands (Restoration/Creation)	10 acres/year for 10 years	100 acres	4800	800		593	$300,000.00

Zuber Cutoff Critical For: Riparian Buffer - Priority 1, DRP and Sediment - Priority 2										
Partners (P) and Technical Assistance (TA): Allen and Paulding County SWCD and NRCS Offices (P, TA), Purdue and Ohio Extensions (P, TA), Farm Bureau (P), The Nature Conservancy (P, TA) Tri-State Watershed Alliance (P), Upper Maumee Watershed Partnership (P, TA), Maumee River Basin Commission (P), The Black Swamp Conservancy (P)										
Objective	**Target Audience**	**Implementation Timeframe**	**Action**	**Milestone**	**Quantity**	**Load Reduction-Nitrogen (lbs/yr)**	**Load Reduction-Phosphorus (lbs/yr)**	**Load Reduction-DRP (lbs/yr)**	**Load Reduction-Sediment (ton/yr)**	**Estimated Cost**
Implement programs to reduce Phosphorus & Sediment to target loads	Upper Maumee River Watershed landowners and operators	Within 30 years after WMP approval and after implementation of Priority 1 areas	No Till	200 acres/year for 30 years	6000	17940	3060		2940	$150,000.00
			Native Plantings, Conservation Cover	100 aces/year for 6 years	600 acres	14922	3300	600	1380	$210,000.00
			Grassed waterways	1 waterway per year for 5 years	5 grassed waterways	240	40		72	$45,000.00
			Stream bank Stabilization	1 project every year for nine years	9 projects-1000 lf on each side	2880	1440		1440	$100,000.00
			Grade Stabilization Structures	5 structures/year for 4 years	20 (300 lf structure)	1296	648		648	$5,000.00
			TOTAL			**164441**	**73824**	**5407**	**19231**	
			Required Load reduction (from UM Watershed Action Plan)			91080	56200	2920	11391	$2,471,000.00

6.3.2.10 Action Register for Gordon Creek Subwatershed

Gordon Creek Critical For: Riparian Buffer - Priority 1, Urban Landuses and CSOs, Septic Tank Failures - Priority 2, DRP and Sediment - Priority 2										
Partners (P) and Technical Assistance (TA): DeKalb and Defiance County SWCD and NRCS Offices (P, TA), Purdue and Ohio Extensions (P, TA), Farm Bureau (P), The Nature Conservancy (P, TA) Tri-State Watershed Alliance (P), Upper Maumee Watershed Partnership (P, TA), Maumee River Basin Commission (P), The Black Swamp Conservancy (P)										
Objective	**Target Audience**	**Implementation Timeframe**	**Action**	**Milestone**	**Quantity**	**Load Reduction -Nitrogen (lbs/yr)**	**Load Reduction-Phosphorus (lbs/yr)**	**Load Reduction - DRP (lbs/yr)**	**Load Reduction -Sediment (ton/yr)**	**Estimated Cost**
Implement and promote riparian buffer installation	Upper Maumee River Watershed landowners adjacent to flowing water	Begin after WMP approval then ongoing	Riparian Buffer	2,000 lf/year for 10 years	20,000 lf	6400	3800		3800	$400,000.00
Implement programs to reduce Phosphorus & Sediment to target loads	Upper Maumee River Watershed landowners and operators	Within 30 years after WMP approval and after implementation of Priority 1 areas	Cover Crops	1000 new acres/year	15000 acres	198450	35850	0	21150	$600,000.00
			Nutrient Management	1000 new acres/year	6000 acres	21204	3768	1044	0	$120,000.00
			Gypsum-soil amendments	1000 new acres/year	7000 acres	-	10430	3080	3290	$280,000.00
			Blind Inlets	2-4 structures/year	10 structures	-				$12,000.00
			Tile Control Structures	10 structures/year for 6 years	60 structures (20 acres each)	8482	1507	418	277	$120,000.00
			Filter Strip/Saturated Buffers	3 sites/year for 3 years	9 sites- 1350 acres/5400 lf	13973	2930	265	2363	$36,000.00
			2-stage ditch	1 project every two years	2 projects (1000 lf on each side or 800 acres)	320	160		160	$80,000.00
			Livestock Exclusion	1 project within the first 3 years	1 project- 20 acres	3880	6880		194	$13,000.00

Gordon Creek Critical For: Riparian Buffer - Priority 1, Urban Landuses and CSOs, Septic Tank Failures - Priority 2, DRP and Sediment - Priority 2										
Partners (P) and Technical Assistance (TA): DeKalb and Defiance County SWCD and NRCS Offices (P, TA), Purdue and Ohio Extensions (P, TA), Farm Bureau (P), The Nature Conservancy (P, TA) Tri-State Watershed Alliance (P), Upper Maumee Watershed Partnership (P, TA), Maumee River Basin Commission (P), The Black Swamp Conservancy (P)										
Objective	**Target Audience**	**Implementation Timeframe**	**Action**	**Milestone**	**Quantity**	**Load Reduction -Nitrogen (lbs/yr)**	**Load Reduction-Phosphorus (lbs/yr)**	**Load Reduction - DRP (lbs/yr)**	**Load Reduction -Sediment (ton/yr)**	**Estimated Cost**
Implement programs to reduce Phosphorus & Sediment to target loads	Upper Maumee River Watershed landowners and operators	Within 30 years after WMP approval and after implementation of Priority 1 areas	Wetlands (Restoration/Creation)	10 acres/year for 10 years	100 acres	4800	800		593	$300,000.00
			No Till	1000 acres/year	8000 acres	23920	4080		3920	$200,000.00
			Native Plantings, Conservation Cover	100 aces/year for 6 years	600 acres	14922	3300	600	1380	$210,000.00
			Grassed waterways	1 waterway per year for 9 years	9 grassed waterways	432	72		130	$45,000.00
			Stream bank Stabilization	1 project every two years	3 projects-1000 lf on each side	960	480		480	$100,000.00
			Grade Stabilization Structures	5 structures/year for 4 years	20 (300 lf structure)	1296	648		648	$50,000.00
Implement Urban Stormwater Program	Upper Maumee River Watershed Stakeholders in Hicksville	Begin within 2 years after WMP approval	Rain Gardens (Residential)	Install 10 gardens/year for 3 years	30 gardens	60	3		6	$6,000.00
			Rain Gardens (Commercial)	Install 1 garden/year for 3 years	3 gardens	126	18		14	$6,000.00
			Rain Barrels (Residential)	Install 10 rain barrels for 10 years	30 rain barrels	24.3	4.5		6	$3,000.00
			Rain Barrels/Cisterns (Commercial)	Install 1 rain barrel/cistern a year for 10 years	10 rain barrels/cisterns	3	3		0.6	$5,000.00
			Green Roofs	1 roof within 5 years	1 roof					$15,000.00

Gordon Creek Critical For: Riparian Buffer - Priority 1, Urban Landuses and CSOs, Septic Tank Failures - Priority 2, DRP and Sediment - Priority 2										
Partners (P) and Technical Assistance (TA): DeKalb and Defiance County SWCD and NRCS Offices (P, TA), Purdue and Ohio Extensions (P, TA), Farm Bureau (P), The Nature Conservancy (P, TA) Tri-State Watershed Alliance (P), Upper Maumee Watershed Partnership (P, TA), Maumee River Basin Commission (P), The Black Swamp Conservancy (P)										
Objective	**Target Audience**	**Implementation Timeframe**	**Action**	**Milestone**	**Quantity**	**Load Reduction -Nitrogen (lbs/yr)**	**Load Reduction-Phosphorus (lbs/yr)**	**Load Reduction - DRP (lbs/yr)**	**Load Reduction -Sediment (ton/yr)**	**Estimated Cost**
Implement Urban Stormwater Program	Upper Maumee River Watershed Stakeholders in Hicksville	Begin within 2 years after WMP approval	Blue Roof	1 roof within 7 years	1 roofs					$20,000.00
			Curb Cuts (in combination with other LID practices)	1 project within 5 years	1 projects					$15,000.00
			Wildlife Exclusion at Stormwater Basins	1 exclusion every 2 years for 10 years	5 exclusion					$75,000.00
			Infiltration Trench	1 trench within 5 years	1 trench	4	0.7		0.2	$15,000.00
			Extended Wet Detention	1 project with 5 years	1 project	5.56	0.12		0.12	$7,500.00
			Pervious Pavement	1 project every 5 years	2 projects- 10 acres each	113.8	8.7		2.26	$15,000.00
			Pet Waste Disposal Receptacles	2 installed in each park	6 receptacles					$1,200.00
			Encourage sale of Phosphorus Free Fertilizer at Local Retailers							$3,000.00
			Monthly Street Sweeping	Monthly		0	6088.2		2394	$50,000.00

Gordon Creek Critical For: Riparian Buffer - Priority 1, Urban Landuses and CSOs, Septic Tank Failures - Priority 2, DRP and Sediment - Priority 2										
Partners (P) and Technical Assistance (TA): DeKalb and Defiance County SWCD and NRCS Offices (P, TA), Purdue and Ohio Extensions (P, TA), Farm Bureau (P), The Nature Conservancy (P, TA) Tri-State Watershed Alliance (P), Upper Maumee Watershed Partnership (P, TA), Maumee River Basin Commission (P), The Black Swamp Conservancy (P)										
Objective	**Target Audience**	**Implementation Timeframe**	**Action**	**Milestone**	**Quantity**	**Load Reduction -Nitrogen (lbs/yr)**	**Load Reduction-Phosphorus (lbs/yr)**	**Load Reduction - DRP (lbs/yr)**	**Load Reduction -Sediment (ton/yr)**	**Estimated Cost**
Implement a program to replace and repair septic systems	Homeowners Utilizing Septic Systems	Within 30 years after WMP approval	Repair/replace failing septics	Repair/replace 15 septic systems/year for 20 years	Repair/replace 289 failing septics	15895	1878		36	$2,890,000.00
			TOTAL			**315270.66**	**82709.22**	**5407**	**40844.18**	
			Required Load reduction (from UM Watershed Action Plan)			0	78440	3040	19902	$5,692,700.00

6.3.2.11 Action Register for Sixmile Cutoff Subwatershed

Sixmile Cutoff Critical For: DRP and Sediment - Priority 2										
Partners (P) and Technical Assistance (TA): Paulding County SWCD and NRCS Offices (P, TA), Ohio Extension (P, TA), Farm Bureau (P), The Nature Conservancy (P, TA) Tri-State Watershed Alliance (P), Upper Maumee Watershed Partnership (P, TA), The Black Swamp Conservancy (P)										
Objective	**Target Audience**	**Implementation Timeframe**	**Action**	**Milestone**	**Quantity**	**Load Reduction-Nitrogen (lbs/yr)**	**Load Reduction-Phosphorus (lbs/yr)**	**Load Reduction-DRP (lbs/yr)**	**Load Reduction-Sediment (ton/yr)**	**Estimated Cost**
Implement programs to reduce Phosphorus & Sediment to target loads	Upper Maumee River Watershed landowners and operators	After implementation in Priority 1 areas	Cover Crops	1000 new acres/year	5000 acres	66150	11950	0	7050	$200,000.00
			Nutrient Management	1000 new acres/year	2000 acres	8836	1332	300	0	$40,000.00
			Gypsum-soil amendments	1000 new acres/year	3000 acres	-	4470	1320	1410	$40,000.00
			Blind Inlets	2-4 structures/year	10 structures	-				$12,000.00
			Tile Control Structures	10 structures/year for 6 years	60 structures (20 acres each)	10603	1598	360	382	$120,000.00
			Filter Strip/Saturated Buffers	3 sites/year for 3 years	9 sites- 1350 acres/5400 lf	13973	2930	265	324	$36,000.00
			2-stage ditch	1 project every two years	2 projects (1000 lf on each side or 800 acres)	320	160		160	$80,000.00
			Wetlands (Restoration/Creation)	10 acres/year for 10 years	100 acres	4800	800		593	$300,000.00
			No Till	1000 acres/year	2000 acres	5980	1020		980	$200,000.00
			Native Plantings, Conservation Cover	100 acres/year for 6 years	600 acres	14922	3300	600	1380	$210,000.00
			Grassed waterways	1 waterway per year for 20 years	20 grassed waterways	960	160		288	$100,000.00

Sixmile Cutoff Critical For: DRP and Sediment - Priority 2										
Partners (P) and Technical Assistance (TA): Paulding County SWCD and NRCS Offices (P, TA), Ohio Extension (P, TA), Farm Bureau (P), The Nature Conservancy (P, TA) Tri-State Watershed Alliance (P), Upper Maumee Watershed Partnership (P, TA), The Black Swamp Conservancy (P)										
Objective	**Target Audience**	**Implementation Timeframe**	**Action**	**Milestone**	**Quantity**	**Load Reduction- Nitrogen (lbs/yr)**	**Load Reduction- Phosphorus (lbs/yr)**	**Load Reduction- DRP (lbs/yr)**	**Load Reduction- Sediment (ton/yr)**	**Estimated Cost**
Implement programs to reduce Phosphorus & Sediment to target loads	Upper Maumee River Watershed landowners and operators	After implementation in Priority 1 areas	Stream bank Stabilization	1 project every two years	3 projects- 1000 lf on each side	960	480		480	$100,000.00
			Grade Stabilization Structures	5 structures/year for 4 years	20 (300 lf structure)	1296	648		648	$50,000.00
			TOTAL			**128800**	**28848**	**2845**	**13695**	
			Required Load reduction (from UM Watershed Action Plan)			17260	30000	5280	33145	$1,488,000.00

6.3.2.12 Action Register for Platter Creek Subwatershed

Platter Creek Critical For: Riparian Buffer - Priority 1 and DRP and Sediment - Priority 1										
Partners (P) and Technical Assistance (TA): Defiance County SWCD and NRCS Offices (P, TA), Purdue Extension (P, TA), Farm Bureau (P), The Nature Conservancy (P, TA) Tri-State Watershed Alliance (P), Upper Maumee Watershed Partnership (P, TA), The Black Swamp Conservancy (P)										
Objective	**Target Audience**	**Implementation Timeframe**	**Action**	**Milestone**	**Quantity**	**Load Reduction-Nitrogen (lbs/yr)**	**Load Reduction-Phosphorus (lbs/yr)**	**Load Reduction-DRP (lbs/yr)**	**Load Reduction-Sediment (ton/yr)**	**Estimated Cost**
Implement riparian buffer installation	Upper Maumee River Watershed landowners adjacent to headwater streams	Within 30 years after WMP approval	Riparian Buffer	2,000 lf/year for 10 years	20,000 lf	6400	3800		3800	$400,000.00
Implement programs to reduce Phosphorus & Sediment to target loads	Upper Maumee River Watershed landowners and operators		Cover Crops	1000 new acres/year	5000 acres	66150	11950	0	7050	$200,000.00
			Nutrient Management	1000 new acres/year	6000 acres	23844	4488	1536	0	$120,000.00
			Gypsum-soil amendments	1000 new acres/year	7000 acres		10430	3080	3290	$280,000.00
			Blind Inlets	2-4 structures/year	10 structures					$12,000.00
			Tile Control Structures (each controlling 20 acres)	10 structures/year for 6 years	60 structures (20 acres each)	9538	1795	614	284	$120,000.00
			Filter Strip/Saturated Buffers	3 sites/year for 3 years	9 sites- 1350 acres/5400 lf	13973	2930	265	2363	$36,000.00
			2-stage ditch	1 project every two years	2 projects (1000 lf on each side or 800 acres)	320	160		160	$80,000.00
			Livestock Exclusion/barnyard project	1 project within the first 3 years	1 project- 20 acres	3880	6880		194	$13,000.00

Platter Creek Critical For: Riparian Buffer - Priority 1 and DRP and Sediment - Priority 1										
Partners (P) and Technical Assistance (TA): Defiance County SWCD and NRCS Offices (P, TA), Purdue Extension (P, TA), Farm Bureau (P), The Nature Conservancy (P, TA) Tri-State Watershed Alliance (P), Upper Maumee Watershed Partnership (P, TA), The Black Swamp Conservancy (P)										
Objective	**Target Audience**	**Implementation Timeframe**	**Action**	**Milestone**	**Quantity**	**Load Reduction-Nitrogen (lbs/yr)**	**Load Reduction-Phosphorus (lbs/yr)**	**Load Reduction-DRP (lbs/yr)**	**Load Reduction-Sediment (ton/yr)**	**Estimated Cost**
Implement programs to reduce Phosphorus & Sediment to target loads	Upper Maumee River Watershed landowners and operators	Within 30 years after WMP approval	Wetlands (Restoration/Creation)	10 acres/year for 10 years	100 acres	4800	800		593	$300,000.00
			No Till	1000 acres/year	8000 acres	23920	4080		3920	$200,000.00
			Native Plantings, Conservation Cover	100 aces/year for 6 years	600 acres	14922	3300	600	1380	$210,000.00
			Grassed waterways	1 waterway per year for 9 years	9 grassed waterways	432	72		130	$45,000.00
			Stream bank Stabilization	1 project every two years	3 projects-1000 lf on each side	960	480		480	$100,000.00
			Grade Stabilization Structures	5 structures/year for 4 years	20 (300 lf structure)	1296	648		648	$50,000.00
			TOTAL			**170435**	**51813**	**6095**	**24292**	**$2,166,000.00**
			Required Load reduction (from UM Watershed Action Plan)			17740	46920	14520	10071	

6.3.2.13 Action Register for Sulphur Creek Subwatershed

Sulphur Creek Critical For: Riparian Buffer - Priority 3 and DRP and Sediment - Priority 3										
Partners (P) and Technical Assistance (TA): Defiance and Paulding County SWCD and NRCS Offices (P, TA), Ohio Extension (P, TA), Farm Bureau (P), The Nature Conservancy (P, TA) Tri-State Watershed Alliance (P), Upper Maumee Watershed Partnership (P, TA), The Black Swamp Conservancy (P), ODNR and OEPA (P, TA)										
Objective	**Target Audience**	**Implementation Timeframe**	**Action**	**Milestone**	**Quantity**	**Load Reduction-Nitrogen (lbs/yr)**	**Load Reduction-Phosphorus (lbs/yr)**	**Load Reduction-DRP (lbs/yr)**	**Load Reduction-Sediment (ton/yr)**	**Estimated Cost**
Implement riparian buffer installation	Upper Maumee Watershed landowners adjacent to headwater streams	After implementation of Priority 1 and 2 areas	Riparian Buffer	500 lf/year for 30 years	15,000 lf	4800	2850		2850	$300,000.00
Implement programs to reduce Phosphorus & Sediment to target loads	Upper Maumee River Watershed landowners and operators	Within 30 years after WMP approval	Cover Crops	1000 new acres/year	7000 acres	92610	16730	0	9870	$280,000.00
			Nutrient Management	1000 new acres/year	4000 acres	22864	4048	600	0	$80,000.00
			Gypsum-soil amendments	1000 new acres/year	7000 acres	-	10430	3080	3290	$280,000.00
			Tile Control Structures	10 structures/year for 6 years	60 structures (20 acres each)	13718	2429	360	1051	$120,000.00
			Filter Strip/Saturated Buffers	3 sites/year for 3 years	9 sites- 1350 acres/5400 lf	13973	2930	265	2363	$36,000.00
			No Till	1000 acres/year	3000 acres	8970	1530		1470	$200,000.00
			Native Plantings, Conservation Cover	100 aces/year for 10 years	1000 acres	24870	5500	1000	2300	$350,000.00
			Grassed waterways	300 lf per year for 10 years	10 grassed waterways	480	80		144	$50,000.00
			Stream bank Stabilization	1 project every two years	3 projects-1000 lf on each side	960	480		480	$100,000.00
			TOTAL			**183245**	**47007**	**5305**	**23818**	**$1,796,000.00**
			Required Load reduction (from UM Watershed Action Plan)			12900	55000	6240	33145	

6.3.2.14 Action Register for Snooks Run Subwatershed

Snooks Run Critical For: Riparian Buffer - Priority 3 and DRP and Sediment - Priority 1										
Partners (P) and Technical Assistance (TA): Defiance and Paulding County SWCD and NRCS Offices (P, TA), Ohio Extension (P, TA), Farm Bureau (P), The Nature Conservancy (P, TA) Tri-State Watershed Alliance (P), Upper Maumee Watershed Partnership (P, TA), The Black Swamp Conservancy (P), ODNR and OEPA (P, TA)										
Objective	**Target Audience**	**Implementation Timeframe**	**Action**	**Milestone**	**Quantity**	**Load Reduction-Nitrogen (lbs/yr)**	**Load Reduction-Phosphorus (lbs/yr)**	**Load Reduction - DRP (lbs/yr)**	**Load Reduction-Sediment (ton/yr)**	**Estimated Cost**
Implement riparian buffer installation	Upper Maumee Watershed landowners adjacent to headwater streams	After Implementation of Priority 1 and 2 areas	Riparian Buffer	500 lf/year for 30 years	15,000 lf	4800	2850		2850	$300,000.00
Implement programs to reduce Phosphorus & Sediment to target loads	Upper Maumee River Watershed landowners and operators	Within 30 years after WMP approval	Cover Crops	1000 new acres/year	5000 acres	66150	11950	0	7050	$200,000.00
			Nutrient Management	1000 new acres/year	4000 acres	16800	2672	496	0	$80,000.00
			Gypsum-soil amendments	1000 new acres/year	7000 acres	-	10430	3080	3290	$280,000.00
			Tile Control Structures (each controlling 20 acres)	10 structures/year for 6 years	60 structures60 structures (20 acres each)	10080	1603	298	421	$120,000.00
			Filter Strip/Saturated Buffers	3 sites/year for 3 years	9 sites- 1350 acres/5400 lf	13973	2930	265	2363	$36,000.00
			Livestock Exclusion	1 project within the first 3 years	1 project- 20 acres	3880	6880		194	$13,000.00
			No Till	1000 acres/year	8000 acres	23920	4080		3920	$200,000.00
			Native Plantings, Conservation Cover	100 aces/year for 6 years	600 acres	14922	3300	600	1380	$210,000.00

Snooks Run Critical For: Riparian Buffer - Priority 3 and DRP and Sediment - Priority 1										
Partners (P) and Technical Assistance (TA): Defiance and Paulding County SWCD and NRCS Offices (P, TA), Ohio Extension (P, TA), Farm Bureau (P), The Nature Conservancy (P, TA) Tri-State Watershed Alliance (P), Upper Maumee Watershed Partnership (P, TA), The Black Swamp Conservancy (P), ODNR and OEPA (P, TA)										
Objective	**Target Audience**	**Implementation Timeframe**	**Action**	**Milestone**	**Quantity**	**Load Reduction-Nitrogen (lbs/yr)**	**Load Reduction-Phosphorus (lbs/yr)**	**Load Reduction - DRP (lbs/yr)**	**Load Reduction-Sediment (ton/yr)**	**Estimated Cost**
Implement programs to reduce Phosphorus & Sediment to target loads	Upper Maumee River Watershed landowners and operators	Within 30 years after WMP approval	Grassed waterways	1 waterway per year for 9 years	9 grassed waterways	432	72		130	$45,000.00
			Stream bank Stabilization	1 project every two years	3 projects- 1000 lf on each side	960	480		480	$100,000.00
			TOTAL			**155917**	**47247**	**4739**	**22078**	$1,584,000.00
			Required Load reduction (from UM Watershed Action Plan)			0	48820	6320	18183	

7.0 Potential Annual Load Reductions after Implementation

Actions outlined in Section 6 were determined by taking a combination of aspects of watershed management including how likely it is to get landowners willing to participate in a cost-share program to implement BMPs and the potential load reductions that would result from their implementation. Using the Spreadsheet Tool for Estimating Pollution Load (STEPL), the Region 5 load reduction model, which both can be found at http://it.tetratech-ffx.com/steplweb/, and the recalibrated SWAT model provided by Purdue University, potential load reductions were determined for nitrogen, phosphorus, and sediment on a per BMP per sub-watershed scale.

The two load reduction models available for public use at this time do have some limitations in that not all BMPs can be modeled and as stated earlier in this WMP, estimates for *E. coli* cannot be determined accurately. Therefore, narrative assumptions for the benefit of certain BMPs and possible load reductions will be provided.

It is important to note that assumptions were made for the model inputs as exact acreage of implementation is dependent on the support for participation that is received by landowners in the project area. The load reductions presented in this document are derived from a model and are best guess scenarios only, and only account for the BMPs planned to be installed as part of this project, assuming that no BMPs were in the past, or are currently being used. It is understood throughout the conservation community that load reductions from BMPs have a cumulative effect and that the reductions in pollutant loads will increase exponentially as they are implemented year after year or in combination with multiple BMPs. Accurate load reductions will be determined when the UMRW performs water quality analysis on the 17 proposed sample sites in the UMRW after three to five years of implementation. Table 7.1 shows the estimated load reduction after implementation of the UMRW Action Registers for each of the subwatersheds. As can be seen in Table 7.1, according to estimated load reductions from various models the sediment, total phosphorus and nitrogen target load reductions will be exceeded by the end of the 30 year UMRW Management Plan implementation plan. While the modeled load reductions for DRP do not add up to the necessary reduction, that is likely due to the lack of load reductions for DRP provided by models and it is assumed that the DRP load reduction will also be met.

Table 7.1 Estimated Load Reductions after One Year of Implementation

	Sediment (Tons)	Total Phosphorus (tons)	Nitrogen (tons)	DRP (tons)
Needed	**178,943.97**	**275.55**	**90.74**	**57.02**
Estimate	**319,759.92**	**359.02**	**1237.84**	**30.14**
Delta	**+140,815.95**	**+83.47**	**+1147.10**	**-26.88**

Un-Modeled BMPs Listed in the Action Register

As stated above, not all BMPs that are listed in the UMRW Action Register can be modeled to determine pollutant load reductions as they are either new technologies or there are too many variables involved to give an accurate estimate. Those BMPs are listed below.

Blind Inlets

The UMRW steering committee plans to promote the implementation of blind inlets on crop land with unmanaged tile inlets in those areas deemed critical for nutrients and sediment. Blind inlets are a relatively new technology and research continues to determine how effective the technology is in lessening the pollutant load through tile inlets in crop land. One such study, conducted by the USDA Agriculture Research Service (ARS) in the St. Joseph River Watershed in 2010 indicates that blind inlets do in fact, have a significant impact on the amount of sediment and nutrients released to open water through field tiles. A copy of the study can be found at http://www.ars.usda.gov/research/publications/publications.htm?seq_no_115=267832.

Comprehensive Nutrient Management Plan

The UMRW steering committee plans to promote the use of Comprehensive Nutrient Management Planning (CNMP) in the areas of the UMRW deemed critical for livestock and DRP. A CNMP is a document that explains the current nutrient output of animals on a farm and how to best utilize those nutrients on crop land to promote healthy soils and increase yield while preventing manure runoff from the farm. Since the CNMP will only produce a load reduction if implemented, and each implementation plan in the CNMP is different, load reductions could not be determined.

Drainage Water Management

The UMRW steering committee plans to promote the use of drainage water management in areas deemed critical for nutrients and turbidity throughout the watershed. Drainage Water Management allows landowners to manage the water table under their crop fields to be higher in the summer when water is scarce and lower in the spring when there is an abundance of water. This practice is known to keep nutrients on the fields and can increase crop production as much as 25 bushels of soybeans, and 70 bushels of corn per acre annually, according to the NRCS, National Water Ag Water Management Team. However, this practice is relatively new in comparison to other BMPs, and an accurate model to predict pollutant load reductions is not available at this time. For more information on this practice, visit www.nrcs.usda.gov/wps/portal/nrcs/main/national/water/manage/.

Rotational Grazing

The UMRW steering committee plans to promote the use of rotational grazing in areas of the UMRW that are deemed critical for livestock and DRP. Rotational Grazing is a practice used to improve the health of the livestock, pasture plant and soil health, fish and wildlife habitat, as well as water quality. The University of Illinois Extension Office lists several studies which identify pastures as one of the best options for reducing runoff, erosion, and phosphorus pollution (http://www.livestocktrail.illinois.edu/pasturenet/paperDisplay.cfm?ContentID=6618). The Extension also refers to another study conducted by the Agricultural Research Service (ARS) which showed rainfall better infiltrated pasture land than adjacent wooded areas that were considered “pristine”. For those reasons, it can be expected that implementing rotational grazing at the sites identified as posing a potential threat to water quality within the watershed, and any other sites that are noted in the future, would have a significant impact on the amount of runoff, which has the potential to carry fecal coliform and nutrients, reaching open water sources. Another benefit of rotational grazing is that plants have time to recover between grazing periods, thus increases plant and soil health and decreasing the potential for erosion.

Urban Best Management Practices

Many management practices for urban areas cannot be modeled for potential load reductions due to them being a new technology and the variability between implementation sites. EPA has released a new load reduction model that may determine the best location to put urban BMPs within a critical area, and potential load reductions. However, until a more detailed evaluation of the implementation area for urban pollutants is done, the model will not be useful. However, it may be used during the implementation phase of the UMRW project to determine where the “biggest bang for the buck” will occur when placing BMPs.

8.0 Ohio Coastal Nonpoint Pollution Control Program

This chapter contains the wording from "Guidance for Watershed Projects to address Ohio's Coastal Nonpoint Pollution Control Program" (CNPCP) and specifies how the Upper Maumee River Watershed Management Plan and entities within the Upper Maumee Watershed address the CNPCP management measures.

Per the Coastal Zone Act of 1990, each coastal state is required to submit for approval a Coastal Nonpoint Pollution Control Program to the US EPA and the National Oceanic and Atmospheric Administration (NOAA) with the purpose "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."

Ohio was granted conditional approval of their CNPCP, administered by the ODNR, in 2004. Ohio therefore, requires all WMPs compiled for watersheds located within the Lake Erie Basin to describe how the NPS management measures outlined in the CNPCP will be addressed.

Two of the management measures outlined in the Ohio CNPCP are not applicable to the UMRW. Those measures not applicable are listed below.

Non-applicable Management Measures

1. Roads, Highways, and Bridge Operation and Maintenance (Inter and Intrastate Only)
2. Roads, Highways, and Bridge Runoff Systems (Inter and Intrastate Only)

Inter and Intrastate operated roads, highways and bridges are subject to state rules and regulations. Those transportation corridors that are in development are subject to Rule 5 permitting and those corridors that are already in existence are subject to State's NPDES Stormwater Pollution Prevention Plans and are considered exempt from the CNPCP. Information pertaining to Ohio Department of Transportation's (ODOT) Stormwater Management Plan can be found at http://www.dot.state.oh.us/stormwater/Pages/default.aspx and information pertaining to Indiana Department of Transportation's (INDOT) can be found at http://www.in.gov/indot/2892.htm.

All other management measures outlined in the Ohio CNPCP are applicable to the Upper Maumee River Watershed Management Plan and are listed below.

Applicable Management Measures

1. New Development
2. Watershed Protection
3. Site Development
4. Existing Development
5. New On-Site Disposal Systems
6. Operating On-Site Disposal Systems
7. Planning, Siting, and Developing Roads and Highways

8. Bridge Management (Local Only)
9. Operation and Maintenance of Roads, Highways, and Bridge (Local Only)
10. Runoff Systems for Roads, Highways, and Bridges (Local Only)
11. Channelization and Channel Modification (Physical & Chemical Characteristics of Surface Waters)
12. Channelization and Channel Modification (Instream and Riparian Habitat Restoration)
13. Dams-Protection of Surface Water Quality and In-Stream and Riparian Habitat
14. Streambanks and Shorelines (Note: there are no shore lines in the watershed)

The applicable management measures listed in the Ohio CNPCP are addressed in Section 6 of this WMP entitled: Goals, Objectives and Management Measures. A summary of how those management measures are addressed (or plan to be addressed) within the UMRW is provided below.

8.1 New Development

This management measure is intended to accomplish the following:

1. Decrease the erosive potential of increased runoff volumes and velocities associated with development-induced changes in hydrology.
2. Remove suspended solids and associated pollutants entrained in runoff that results from activities occurring during and after development.
3. Retain hydrological conditions to closely resemble those of the pre-disturbance conditions. (For design purposes, post development peak runoff rate and average volume should be based on a 2yr/24 hour storm.)
4. Preserve natural systems, including in-stream habitat.

Applicability to the Upper Maumee River Watershed

Within the UMRW, the incorporated areas designated as MS4 communities are Fort Wayne and New Haven, Indiana, and Defiance, Ohio as well as the Allen County. These communities are required to develop a Storm Water Quality Management Plan (SWQMP). These plans address new development and stormwater. Although Hicksville is not an MS4 Community, they are proactive in requiring erosion and sediment control and stormwater runoff control in their stormwater rules and regulations.

Storm Water Quality Management Plans can be accessed at:

- City of Defiance, OH: www.cityofdefiance.com/main/images/pdfs/engineering/stormwater/SWMP_6.2009.pdf
- Allen County, IN: www.allencounty.us/images/stories/surveyor/pdfs/Stormwater_Technical_Standards_Manual.pdf

- New Haven, IN: www.cityofnewhaven.com/PublicWorks/TPFiles/Stormwater%20Pollution%20Prevention%20Plan%20Part%201.pdf
- Ft. Wayne, IN: www.in.gov/idem/nps/files/wmp_stmarys_7-184_attch_7_ft_wayne_swqmp.pdf
- Hicksville, OH: www.villageofhicksville.com/infrastructure/wastewater.php

Section 2.6.1 of this WMP outlines local planning documents for Allen County, the City of Defiance, Defiance County, the City of Woodburn and DeKalb County. These plans mandate setbacks from environmentally sensitive areas, as well as require development activities to minimally disturb natural ecosystems.

It is an objective of the UMRW project to work with City and County Planners to address the increase in stormwater and encourage low impact design for new developments. An urban education program is also proposed by the UMRW project to encourage low impact development and demonstrate urban BMPs.

8.2 Watershed Protection

This management measure of the CNPCP is intended to guide development of a watershed protection program to incorporate these practices:

1. Avoid conversion, to the extent practicable, of areas that are particularly susceptible to erosion and sediment loss.
2. Preserve areas that provide important water quality benefits and/or are necessary to maintain riparian and aquatic biota.
3. Site development, including roads, highways, and bridges, to protect, to the extent practicable, the natural integrity of waterbodies and natural drainage systems.

Applicability to the Upper Maumee River Watershed

As stated above, Section 2.6.1 of this WMP outlines local planning documents which begin to lay the foundation for watershed protection by suggesting protection of sensitive areas and encouraging sustainable growth.

Within the UMR WMP, this measure is addressed with objectives to provide education and cost share dollars to implement urban and agricultural BMPs such as low impact development, riparian buffer installation, wetland restoration, native vegetation plantings, and conservation tillage, among many other BMPs outlined in Section 6.3.

8.3 Site Development

This management measure of the CNPCP is intended to guide the planning, designing, and development of sites to:

1. Protect areas that provide important water quality benefits and/or are particularly susceptible to erosion and sediment loss.
2. Limit increase of impervious areas except where necessary.

3. Limit land disturbance activities such as clearing and grading, and cut and fill to reduce erosion and sediment loss.
4. Limit disturbance of natural drainage features and vegetation.

<u>Applicability to the Upper Maumee River Watershed</u>
There are eight population centers located within the UMRW. While growth trends in Ohio counties is on the decline, trends in Allen County show that the population is slated to increase by 20% between 2000 and 2025, according to documentation in *Plan-it Allen*. That amount of population increase would require a 5% increase in housing units between 2000 and 2025. *Plan-it Allen* also projects an increase in the workforce by 36% which would require nearly 70% more work space than was available in 2000 and an additional 8000 acres of land to accommodate the additional work space needed by 2025. Therefore, continued growth in Allen County puts pressure on land resources and has the potential to impact the natural resources of the watershed.

The planning documents outlined in Section 2.6.1 of this WMP will help to protect sensitive areas and existing natural resources by requiring setbacks, easements, and minimize impacts on disturbances of the natural areas during development.

As stated above, the SWQMP for incorporated areas of the UMRW will address stormwater regulations for pre-construction and post-construction. Section 6.3.4 of this WMP Outlines several specific activities that the UMRW project plans to promote as a means to lower the impact of storm flow from urbanized areas and work with local governments to encourage low impact design practices. The UMRW project also has an objective to develop and promote an urban education brochure to encourage best management practices to limit polluted stormflow from urban areas from reaching open water.

8.4 Existing Development

This management measure of the CNPCP is intended to guide communities to:

1. Reduce surface water runoff pollution loadings from areas where development has already occurred.
2. Limit surface water runoff volumes in order to minimize sediment loadings resulting from the erosion of streambanks and other natural conveyance systems.
3. Preserve, enhance or establish buffers that provide water quality benefits along waterbodies and their tributaries.

<u>Applicability to the Upper Maumee River Watershed</u>
There are three incorporated areas in the UMRW that utilize CSOs; Fort Wayne, New Haven, and Hicksville. All three communities currently follow a LTCP to help minimize the number of CSO events that occur each year. The towns of Woodburn, Antwerp, Sherwood, Cecil and the small portion of City of Defiance located in the UMRW do not have CSOs, however stormwater from these areas can directly affect water quality in the Maumee River as the river or a

tributary of the river run through or adjacent to the populated area. Therefore, it is important to try to limit the amount of polluted stormwater discharge or runoff from those towns.

Section 6.3 outlines several objectives and specific actions to reduce stormwater runoff from urban areas, as well as outlines objectives and actions to reduce polluted runoff from agricultural areas.

Specific actions in the UMR WMP to address Watershed Protection management measures in the CNPCP include:

- Meet with City and County Decision Makers to address stormwater and encourage LID practices.
- Provide education and outreach regarding BMPs for urban and agricultural areas.
- Install a Demonstration Urban and Agricultural BMP in the Watershed
- Partner With the MRBC and Black Swamp Conservancy to Purchase Easements
- Install Rain Barrels/Cisterns and rain gardens in urban areas
- Monthly Street Sweeping Program in urban areas of the watershed
- Implement Tree Planting Program
- Implement Wetland Restoration/Creation Projects
- Install Pervious Pavement
- Install Native Vegetation in urban and agricultural areas
- Install a Minimum of a 10 ft Riparian Buffer in urban areas and a 20 ft riparian buffer in agricultural areas
- Install One Green and Blue Roofs
- Install Pet Waste and Trash Receptacles At Parks and/or Along Public Walking Paths
- Install Structural Storm Water Quality Units at High Traffic Areas
- Install Wildlife Exclusion Practices in Stormwater Basins That Drain to Open Water Annually
- Install Cover Crops
- Implement Conservation Tillage
- Install Blind Inlets on 8 Properties Annually
- Enlist Landowners to Implement Nutrient/Pesticide Management
- Enlist landowners to implement soil amendments to improve nutrient uptake
- Install Drainage Water Management Practices
- Install or Repair Grassed Waterways
- Install Streambank Stabilization Practices
- Install Grade Stabilization Structures

8.5 New On-Site Disposal Systems (OSDS)

The management measure of the CNPCP requires that OSDS be sited, designed, and installed so that impacts to waterbodies will be reduced, to the extent practicable. Factors such as soil type, soil depth, depth to water table, rate of sea level rise, and topography must be considered in siting and installing conventional OSDS. The management measure is to:

1. Ensure that new Onsite Disposal Systems are located, designed, installed, operated, inspected, and maintained to prevent the discharge of pollutants to the surface of the ground and to the extent practicable reduce the discharge of pollutants into ground waters that are closely hydrologically connected to surface waters. Where necessary to meet these objectives: (a) discourage the installation of garbage disposals to reduce hydraulic and nutrient loadings; and (b) where low-volume plumbing fixtures have not been installed in new developments or redevelopments, reduce total hydraulic loadings to the OSDS by 25 percent. Implement OSDS inspection schedules for preconstruction, construction, and post-construction.
2. Direct placement of OSDS away from unsuitable areas. Where OSDS placement in unsuitable areas is not practical, ensure that the OSDS is designed or sited at a density so as not to adversely affect surface waters or ground water that is closely hydrologically connected to surface water. Unsuitable areas include, but are not limited to, areas with poorly or excessively drained soils; areas with shallow water tables or areas with high seasonal water tables; areas overlaying fractured bedrock that drain directly to ground water; areas within floodplains; or areas where nutrient and/or pathogen concentrations in the effluent cannot be sufficiently treated or reduced before the effluent reaches sensitive waterbodies;
3. Establish protective setbacks from surface waters, wetlands, and floodplains for conventional as well as alternative OSDS. The lateral setbacks should be based on soil type, slope, hydrologic factors, and type of OSDS. Where uniform protective setbacks cannot be achieved, site development with OSDS so as not to adversely affect waterbodies and/or contribute to a public health nuisance;
4. Establish protective separation distances between OSDS system components and groundwater which is closely hydrologically connected to surface waters. The separation distances should be based on soil type, distance to ground water, hydrologic factors, and type of OSDS;
5. Where conditions indicate that nitrogen-limited surface waters may be adversely affected by excess nitrogen loadings from ground water, require the installation of OSDS that reduce total nitrogen loadings by 50 percent to ground water that is closely hydrologically connected to surface water.

Applicability to the Upper Maumee River Watershed

The majority of the rural community in the UMRW utilizes an OSDS to dispose of their household effluent. However, less than 3% of the soils in the UMRW are considered suitable for an OSDS since 96.4% of the soils are considered to be very limited for OSDS and 1% of the soils are considered to be somewhat limited, requiring significant soil amendment to make them suitable for an OSDS. For that reason, the UMRW project has a goal, outlined in Section 6.1.6 to increase knowledge regarding OSDS, and objectives outlined in Section 6.3.2 to partner with local agencies and organizations to provide education on septic maintenance and placement.

The County Health Departments in Allen, Defiance, Paulding, and DeKalb counties hold data on existing septic systems and review/approve installation of new septic systems. Their requirements for maintenance and approval can be found at their websites:

Defiance: http://www.defiancecohealth.org/Septic_Systems.htm
Allen: http://www.allencountyhealth.com/divisions/pollution?ID=articles1225478688
DeKalb: http://www.dekalbhealth.net/envhealth/septic-systems/
Paulding: http://www.pauldingcountyhealth.com/environmental.html#SewageSeptic

8.6 Operating On-Site Disposal Systems

The purpose of this management measure of the CNPCP is to minimize pollutant loadings from operating OSDS. This management measure requires that OSDS be modified, operated, repaired, and maintained to reduce nutrient and pathogen loadings in order to protect and enhance surface waters. In the past, it has been a common practice to site conventional OSDS in coastal areas that have inadequate separation distances to ground water, fractured bedrock, sandy soils, or other conditions that prevent or do not allow adequate treatment of OSDS-generated pollutants. Eutrophication in surface waters has also been attributed to the low nitrogen reductions provided by conventional OSDS designs.

1. Establish and implement policies and systems to ensure that existing OSDS are operated and maintained to prevent the discharge of pollutants to the surface of the ground and to the extent practicable reduce the discharge of pollutants into ground waters that are closely hydrologically connected to surface waters. Where necessary to meet these objectives, encourage the reduced use of garbage disposals, encourage the use of low-volume plumbing fixtures, and reduce total phosphorus loadings to the OSDS by 15 percent (if the use of low-level phosphate detergents has not been required or widely adopted by OSDS users). Establish and implement policies that require an OSDS to be repaired, replaced, or modified where the OSDS fails, or threatens or impairs surface waters;
2. Inspect OSDS at a frequency adequate to ascertain whether OSDS are failing;
3. Consider replacing or upgrading OSDS to treat effluent so that total nitrogen loadings in the effluent are reduced by 50 percent. This provision applies only:
    - where conditions indicate that nitrogen-limited surface waters may be adversely affected by significant ground water nitrogen loadings from OSDS, and
    - where nitrogen loadings from OSDS are delivered to ground water that is closely hydrologically connected to surface water.

Applicability to the Upper Maumee River Watershed

As stated above, very few soils in the UMRW are suitable for septic placement, however most of the rural community utilizes an OSDS so the UMRW project specifies specific objectives to address leaking, failing, and straight-piped OSDS. Those objectives include:

- Develop and Implement a Septic System Educational Program

- Partner With Local Agencies and Organizations to Provide Education on Septic Maintenance and Placement
- Offer Cost-share Assistance for Septic System Repair/ Replacement/ Elimination
- Develop and Promote a Septic System Maintenance Program, by:
    - Working with Local Septic System Businesses to Offer Discounts to Stakeholders Who Sign up for Regular Septic Maintenance

8.7 Planning, Siting, and Developing Roads and Highways (local only)

The best time to address control of NPS pollution from roads and highways is during the initial planning and design phase. New roads and highways should be located with consideration of natural drainage patterns and planned to avoid encroachment on surface waters and wet areas. Where this is not possible, appropriate controls will be needed to minimize the impacts of NPS runoff on surface waters.

Plan, site, and develop roads and highways to:

1. Protect areas that provide important water quality benefits or are particularly susceptible to erosion or sediment loss;
2. Limit land disturbance such as clearing and grading and cut and fill to reduce erosion and sediment loss; and
3. Limit disturbance of natural drainage features and vegetation.

Applicability to the Upper Maumee River Watershed

The development of new roads can cause a significant risk to surface waters and sensitive areas as heavy equipment is used which has the potential to leak gas and oil, and soil disturbances can increase sedimentation of surrounding water resources. The best time to address these concerns is during the planning phase of the new road at which time, siting and development of the road should be considered to limit any detrimental effects on surrounding sensitive areas and water resources. Environmental impact assessments (EIA) are often required before construction of the new road can take place which will identify any potential harm to the surrounding environment. If, during the EIA, it is found that building a road in a particular location will cause harm to the environment, measures will need to be taken to minimize the impact of the road to the highest degree possible, or the road will need to be sited elsewhere. The use of BMPs during road construction is also very important as it will minimize the effects on water resources by minimizing land disturbances.

8.8 Bridges (local only)

This management measure of the CNPCP requires that NPS runoff impacts on surface waters from bridge decks be assessed and that appropriate management and treatment be employed to protect critical habitats, wetlands, fisheries, shellfish beds, and domestic water supplies. The siting of bridges should be a coordinated effort among the States, the FHWA, the U.S. Coast Guard, and the Army Corps of Engineers. Locating bridges in coastal areas can cause significant erosion and sedimentation, resulting in the loss of wetlands and riparian areas. Additionally, since bridge pavements are extensions of the connecting highway, runoff waters from bridge decks also deliver loadings of heavy metals, hydrocarbons, toxic substances, and deicing chemicals to surface waters as a result of discharge through scupper drains with no overland buffering. Bridge maintenance can also contribute heavy loads of lead, rust particles, paint, abrasive, solvents, and cleaners into surface waters. Protection against possible pollutant overloads can be afforded by minimizing the use of scuppers on bridges traversing very sensitive waters and conveying deck drainage to land for treatment. Whenever practical, bridge structures should be located to avoid crossing over sensitive fisheries and shellfish-harvesting areas to prevent washing polluted runoff through scuppers into the waters below. Also, bridge design should account for potential scour and erosion, which may affect shellfish beds and bottom sediments.

Applicability to the Upper Maumee River Watershed

Pollution from bridge decks can have an impact on water resources. Therefore, the CNPCP requires that bridge maintenance and design be considered to limit the impact on critical habitat, fisheries, shellfish beds, wetlands, and domestic water supplies.

Bridge maintenance is on a regular rotating schedule with the Indiana and Ohio Departments of Transportation for inspection and repair as needed. There are no plans in the near term for bridge development within the UMRW. However, it was noted during the windshield survey conducted in 2012 that the Maplecrest Rd extension bridge connecting Fort Wayne to Lincoln Highway on the western edge of New Haven, IN was nearing completion and many of the sediment control measures that were in place were failing. In 2013, construction began on the Anthony Blvd. bridge crossing the Maumee River east of downtown Fort Wayne. Sediment control measures were in place; however it is common practice to build a “land bridge” crossing the river for heavy equipment to utilize for the destruction and construction of the bridge. This practice aims to decrease scouring of the river bottom by keeping heavy machinery out of the river, but it may increase sedimentation.

Many bridges have surface drains that allow stormwater to drain directly through, or around, the bridge to the open water below. To decrease the amount of sediment reaching open water through bridge drains, the UMRW project has actions outlined in Section 6.3.4 to implement a monthly street sweeping program in all urban areas located within the UMRW.

8.9 Operation and Maintenance of Roads, Highways, and Bridges (local)

This management measure of the CNPCP requires the incorporation of pollution prevention procedures into the operation and maintenance of roads, highways, and bridges to reduce pollutant loadings to surface waters.

Substantial amounts of eroded material and other pollutants can be generated by operation and maintenance procedures for roads, highways, and bridges, and from sparsely vegetated areas, cracked pavements, potholes, and poorly operating urban runoff control structures. This measure is intended to ensure that pollutant loadings from roads, highways, and bridges are minimized by the development and implementation of a program and associated practices to ensure that sediment and toxic substance loadings from operation and maintenance activities do not impair coastal surface waters. The program to be developed, using the practices described in this management measure, should consist of and identify standard operating procedures for nutrient and pesticide management, road salt use minimization, and maintenance guidelines (e.g., capture and contain paint chips and other particulates from bridge maintenance operations, resurfacing, and pothole repairs).

Applicability to the Upper Maumee River Watershed

Operation and maintenance of roads, highways, and bridges is performed by the Indiana or Ohio Department of Transportation, local county, or township. Each entity must follow the good housekeeping rules laid out in their NPDES permit, if one exists. The UMRW project plans to meet with local city and county planners to improve road, highway, and bridge housekeeping and, as mentioned above, and will work with local entities to incorporate a regular street sweeping program.

8.10 Runoff Systems for Roads, Highways, and Bridges (local only)

This management measure of the CNPCP requires that operation and maintenance systems include the development of retrofit projects, where needed, to collect NPS pollutant loadings from existing, reconstructed, and rehabilitated roads, highways, and bridges. Poorly designed or maintained roads and bridges can generate significant erosion and pollution loads containing heavy metals, hydrocarbons, sediment, and debris that run off into and threaten the quality of surface waters and their tributaries. In areas where such adverse impacts to surface waters can be attributed to adjacent roads or bridges, retrofit management projects to protect these waters may be needed (e.g., installation of structural or nonstructural pollution controls). Retrofit projects can be located in existing rights-of-way, within interchange loops, or on adjacent land areas. Areas with severe erosion and pollution runoff problems may require relocation or reconstruction to mitigate these impacts.

Runoff management systems are a combination of nonstructural and structural practices selected to reduce nonpoint source loadings from roads, highways, and bridges. These systems are expected to include structural improvements to existing runoff control structures for water quality purposes; construction of new runoff control devices, where necessary to protect water quality; and scheduled operation and maintenance activities for these runoff control practices. Typical runoff controls for roads, highways, and bridges include vegetated filter strips, grassed swales, detention basins, constructed wetlands, and infiltration trenches.

1. Identify priority and watershed pollutant reduction opportunities (e.g., improvements to existing urban runoff control structures; and
2. Establish schedules for implementing appropriate controls.

Applicability to the Upper Maumee River Watershed

While the majority of the UMRW is agricultural, over 14% of the watershed developed and there are many areas where improvement can be made to mitigate the impact of excessive stormflow. As stated Section 8.4 above, there are 21 CSO outfalls located within the UMRW, with an additional 30 outfalls directly upstream of the Maumee River in major tributaries. Each CSO community has LTCPs to guide implementation efforts to limit the number of annual CSO events. The UMRW project has objectives and specific actions outlined in Section 6.3.4 to reduce the amount of stormwater entering combined sewer systems and to filter pollutants from stormwater prior to it reaching combined sewers. Pollution and excessive storm flow will be reduced by installing the most practical and effective BMPs for any given situation which may include the installation of wetlands, native vegetation, riparian buffers and others. These actions, after implementation, will help the UMRW project meet the milestones of lowering the number of CSO events in Fort Wayne by 48% in ten years, and lowering the number of events in Hicksville and New Haven to no more than one annual event within 10 years.

It should be noted that the City of Defiance, while only a very small portion is located within the UMRW, is currently undertaking a comprehensive review of the sewer collection system and treatment plant in order to determine a more cost-effective approach to implementation. It is anticipated that this plan will incorporate many modifications including the use of green infrastructure in selected areas and will be submitted to the Ohio EPA for approval in 2015.

8.11 Channelization and Channel Modification

8.11.1 Physical & Chemical Characteristics of Surface Waters

The purpose of this management measure in the CNPCP is to ensure that the planning process for new hydromodification projects addresses changes to physical and chemical characteristics of surface waters that may occur as a result of the proposed work. Implementation of this management measure is intended to occur concurrently with the implementation of 8.12 Channelization and Channel Modification (Instream and Riparian Habitat Restoration) Management Measure. For existing projects, the purpose of this management measure is to ensure that the operation and maintenance program uses any opportunities available to improve the physical and chemical characteristics of the surface waters. Changes created by channelization and channel modification activities are problematic if they unexpectedly alter environmental parameters to levels outside normal or desired ranges. The physical and chemical characteristics of surface waters that may be influenced by channelization and channel modification include sediment, turbidity, salinity, temperature, nutrients, dissolved oxygen, oxygen demand, and contaminants.

Implementation of this management measure in the planning process for new projects will require a two-pronged approach:

1. Evaluate, with numerical models for some situations, the types of NPS pollution related to instream changes and watershed development.
2. Address some types of NPS problems stemming from instream changes or watershed development with a combination of nonstructural and structural practices.

8.11.2 Instream and Riparian Habitat Restoration

The purpose of this management measure is to correct or prevent detrimental changes to instream and riparian habitat from the impacts of channelization and channel modification projects. Implementation of this management measure is intended to occur concurrently with the implementation of Section 8.11 Channelization and Channel Modification (Physical & Chemical Characteristics of Surface Waters).

Contact between floodwaters and overbank soil and vegetation can be increased by a combination of setback levees and use of compound-channel designs. Levees set back away from the streambank (setback levees) can be constructed to allow for overbank flooding, which provides surface water contact to important streamside areas (including wetlands and riparian areas). Additionally, setback levees still function to protect adjacent property from flood damage. Compound-channel designs consist of an incised, narrow channel to carry surface water during low (base)-flow periods, a staged overbank area into which the flow can expand during design flow events, and an extended overbank area, sometimes with meanders, for high-flow events. Planting of the extended overbank with suitable vegetation completes the design.

8.11.3 Applicability of Channelization Management Measures to the UMRW

Changes made to existing channels, or channel construction, can impact the integrity of the water system as a whole and may alter wildlife and aquatic habitat and can alter the chemical and physical integrity of the stream channel including, sediment, turbidity, salinity, temperature, nutrients, dissolved oxygen, and other contaminants. For these reasons, the UMRW project plans to work with City and County Planners and County Surveyors and Engineers to implement a method that will maintain the integrity of the stream system, while serving the purpose of moving water from property and farm fields which is typically accomplished by stream channel modification. The UMWP project will also encourage the use of a two-stage ditch design which will limit sedimentation and help to mediate increased nutrients in the stream channel, as well as offer cost-share dollars when possible to implement the two-stage stream design.

Stream buffer width has been determined as a Critical Area in the UMRW as described in Section 5.1 of this WMP. Section 6.3 outlines several objectives and actions to address the issue of inadequate stream buffers in the UMRW including implementing an education program regarding the importance of riparian buffers for water quality and wildlife habitat purposes, offer assistance to purchase conservation easements, and offing cost share dollars to increase stream buffers in agricultural areas to a minimum of 20 feet in width. Section 6.3 of this WMP also outlines actions to increase the riparian buffer width in urban areas to a minimum of 10 feet in width.

8.13 Dams

The purpose of this management measure in the CNPCP is to protect the quality of surface waters and aquatic habitat in reservoirs and in the downstream portions of rivers and streams that are influenced by the quality of water contained in the releases (tailwaters) from reservoir impoundments. Impacts from the operation of dams to surface water quality and aquatic and riparian habitat should be assessed and the potential for improvement evaluated. Additionally, new upstream and downstream impacts to surface water quality and aquatic and riparian habitat caused by the implementation of practices should also be considered in the assessment. The overall program approach is to evaluate a set of practices that can be applied individually or in combination to protect and improve surface water quality and aquatic habitat in reservoirs, as well as in areas downstream of dams. Then, the program should implement the most cost-effective operations to protect surface water quality and aquatic and riparian habitat and to improve the water quality and aquatic and riparian habitat where economically feasible.

Applicability to the Upper Maumee River Watershed

There are two dams located within the Upper Maumee River Watershed and their impact on water quality has not been assessed. Since both dams are at the end of their excepted life span, their relevance and contribution to water quality will be evaluated before they are repaired or replaced.

8.14 Streambanks and Shorelines

Several streambank and shoreline stabilization techniques will be effective in controlling coastal erosion wherever it is a source of nonpoint pollution. Techniques involving marsh creation and vegetative bank stabilization ("soil bioengineering") will usually be effective at sites with limited exposure to strong currents or wind-generated waves. In other cases, the use of engineering approaches, including beach nourishment or coastal structures, may need to be considered. In addition to controlling those sources of sediment input to surface waters which are causing NPS pollution, these techniques can halt the destruction of wetlands and riparian areas located along the shorelines of surface waters. Once these features are protected, they can serve as a filter for surface water runoff from upland areas, or as a sink for nutrients, contaminants, or sediment already present as NPS pollution in surface waters.

Applicability to the Upper Maumee River Watershed

The windshield survey conducted in 2012 in the UMRW revealed 88,436 linear feet of stream bank erosion along streams within the agricultural and urban landscapes. The UMRW project has a goal to WMP specifies to increase riparian buffers by offering cost share to have at least 75% of parcels adjacent to open water to have a minimum of a 20 foot riparian buffer by 2044, with 5% of the buffers being forested riparian buffers. This goal, if accomplished, will help to decrease the amount of streambank erosion in the UMRW.

Additionally, the UMRW project has objectives and other actions outlined in Sections 6.3.1, 6.3.3, 6.3.4, and 6.3.6 to address streambank stabilization issues in the watershed including, remove non-functional in-stream structures, encourage the use of drainage water management, and install grade stabilization structures, among other practices.

9.0 Future Activities

After extensive research conducted over two and a half years in the UMRW, the resulting Watershed Management Plan is full of information regarding common land uses and practices, as well as historic and present day water quality issues found in each subwatershed located within the greater UMRW. However, this information is not common knowledge. The UMRW project will introduce key findings in the WMP and the cost-share program to the public through at least one annual public meeting held in Indiana and Ohio, within months of the final WMP approval by the IDEM, OEPA, ODNR, and US EPA. The meetings will be advertised through local media outlets including newspapers, SWCD, NRCS, and FSA offices. Other means of advertisement will be pursued as well. Letting the UMRW stakeholders know the extent of the water quality problem within the watershed, as well as the watershed's contribution to the algal blooms in the Western Lake Erie Basin, will hopefully illicit concern as well as a willingness to change behaviors to have a positive impact on water quality.

Next steps in the UMRW project is for the Steering Committee to develop cost-share program that will include, at a minimum, those management measures outlined in the Action Register in Section 6.3 of this WMP, and the various incentive levels that will be used to encourage the adoption of those management measures. The Steering Committee will work closely with all Conservation Districts located within the project area, as well as the partners outlined in the Action Register to make sure their cost-share recommendations are realistic for the demographic of the area, and to utilize their help for promoting the cost share program. A key component of the cost-share programs success is the education and outreach aspect of the UMRW project. Field days and workshops regarding agricultural and urban land uses and BMPs will be held annually, as part of this project, however, partnering with other organizations such as other county SWCD and NRCS offices, The Nature Conservancy, the IN and OH DNR, Save Maumee, and smaller non-profit groups that focus on water quality and sustainable land uses, will prove to be integral in promoting practices to improve the health of the UMRW. To help gauge the project's success of the education and outreach program, a follow-up social indicator study will be conducted after five years of implementation and compared to the 2013 study conducted by the Ohio State University College of Food, Agriculture, and Environmental Sciences. Comparing the results of the two studies will help the UMRW project determine if a true impact is being made through the education and outreach program and more producers are aware of their individual impact on water quality or if revisions to the outreach program need to be made to have a greater impact.

It is the goal of the UMRW project that this WMP will be reviewed and utilized by other organizations within the Upper Maumee River Watershed including the Upper Maumee Watershed Partnership, Allen, DeKalb, Defiance, and Paulding County SWCDs, The Nature Conservancy's Western Lake Erie Basin Project, County Drainage Boards, Surveyors and Engineers, City and County Planning Departments, Save Maumee and other organizations concerned about the water quality of the Upper Maumee River Watershed. The UMRW project's first priority will be to obtain funding to pursue the objectives outlined in the Action Register; however we hope to work with other organizations that plan to do the same. As the points of contact for this WMP, the Allen and Defiance County SWCDs will distribute the document to all stakeholder organizations (a distribution list is located at the end of this document), as well as have hard copies of the document available to borrow, or purchase at the SWCD offices located in Fort Wayne, Indiana at 3718 New Vision Drive and Defiance, Ohio at 6879 Evansport Road.

A watershed is continually changing as land uses change, towns begin to expand, new businesses organize in the area, farmland is converted to other uses, or wetlands are drained or moved to accommodate development or farming. These changes in the UMRW particularly have continued to have an enormous impact on the Western Lake Erie Basin. During the writing of this document a massive algal bloom formed in Lake Erie at the mouth of the Maumee River which left nearly 400,000 residents of Toledo without drinking water for two days. The algal bloom in Lake Erie in 2011 was the largest on record and reached from Toledo nearly 100 miles east to Cleveland and was at depths up to 60 feet. Annual harmful algal blooms in Lake Erie could cause catastrophic deaths of aquatic life, seriously impact Toledo's drinking water, and have a major impact of the local economy surrounding Lake Erie. The Maumee River is the largest contributor of sediment and nutrients to Lake Erie, and much of that is coming from the Upper Maumee River Watershed.

As the watershed continues to change so must the actions taken to maintain and/or improve the integrity of the water quality. Therefore, the Upper Maumee River Watershed Management Plan must remain a 'living document' and be updated by the Upper Maumee Watershed Partnership, or its partners, at a minimum, every five years.

References

About Scenic Rivers. Ohio Department of Natural Resources, Division of Watercraft. 2014. 23 January, 2014. <watercraft.ohiodnr.gov/scenicrivers>.

Allen County, Indiana and City of Fort Wayne. ACP-Visioning and Planning, Ltd. Plan-it Allen; A Plan for Land and Living. 27 March, 2007.

American Fact Finder. United States Census Bureau. 11 October. 2012 and 18 February 2014. <factfinder2.census.gov>.

City of Defiance, OH. City of Defiance Strategic Plan and 2030 Land Use Plan. March 2011.

City of Woodburn, IN. Sturtz Public Management Group, LLC. Woodburn Strategic Plan. 9 January, 2013.

Defiance County Commissioners. Brae Birch Institute. Defiance County, OH Comprehensive Plan – 2000. 1 January, 2000.

DeKalb County. Planning Initiative. DeKalb County Comprehensive Plan. 2004

DeKalb County. Commissioners Office. DeKalb County Unified Development Ordinance. 2009

Fish Consumption Advisory. Indiana State Department of Health, 19 April, 2013. <www.in.gov/isdh/23650.htm >.

Her, Young gu. "Modeled Loads for Upper Maumee Sub-watershed." Emailed to Kyle Quandt, Jane Frankenberger, and Sharon Partridge-Domer. 31 October, 2013.

Her, Young gu. "Dissolved Phosphorus of Upper Maumee." Email to Kyle Quandt, Jane Frankenberger, and Sharon Partridge-Domer. 18 December, 2013

History of Sherwood Ohio. Sherwood, Ohio. 12 December, 2013. <www.sherwoodohio.com/sherwood_history.html>.

Iho, Antti and Laukkanen, Marita. "Gypsum Amendment as a Means to Reduce Agricultural Phosphorus Loading: an Economic Appraisal." Agricultural and Food Science 21 (2012) 307-324

Indiana Department of Environmental Management. Office of Water Quality – TMDL Program. Total Maximum Daily Load for E. coli Impairment in the St. Marys River Watershed and Maumee River in Adams and Allen Counties and Total Maximum Daily Load for Impaired Biotic Community Impairment in the St. Marys River Watershed Adams and Allen Counties. 9 June, 2006. 03 April, 2013. <http://www.in.gov/idem/nps/files/tmdl_stmary_finalreport_opt.pdf>.

Indiana Geological Survey: Bedrock Geology of Indiana, 2010. Indiana University; Indiana Geological Survey. 14 April 2011. <http://www.naturalheritageofindiana.org/learn/regions.html>.

Indiana Geological Survey. 2011. Indiana University Bloomington. 23 October, 2012. <igs.indiana.edu/allencounty/surficialgeology.cfm>.

Indiana Map. Indiana Geographic Information Council. 2012-2013. <www.indianamap.org>.

Indiana University Bloomington Libraries. 2010. 23 October, 2012. <www.libraries.iub.edu>.

MyTopo. 2000-2013. A Trimble Company. 2000-2013. 23 October 2012. <www.mytopo.com>.

Maumee Valley Heritage Corridor. 12 December, 2013. <Maumeevalleyheritagecorridor.org>.

National Levee Database. US Army Corps of Engineers, 19 December, 2013. <nld.usace.army.mil>.

National Park Service. U.S. Department of the Interior. 13 June, 2011. 14 January, 2014. <www.nps.gov/nr/>.

Ohio Department of Natural Resources: Physiographic Regions of Ohio. 1998. Ohio Department of Natural Resources: Division of Geological Survey. 14 April 2011. <http://www.dnr.state.oh.us/portals/10/pdf/physio.pdf>.

Ohio Historical Society. State of Ohio. 12 December, 2014. <www.ohiohistory.org>.

SHAARD Database. IN.gov. Indiana Department of Natural Resources. 11 February, 2014. <www.in.gov/dnr/historic/4505.htm>.

United States. Army Corps of Engineers. Western Lake Erie Basin Study: Upper Maumee Watershed Assessment. 3 August, 2009. Buffalo, NY: US Army Corp of Engineers.

United State Environmental Protection Agency. 2007. Ambient Water Quality Criteria Recommendations; Information Supporting the Development of State and Tribal Criteria. River and Streams in Nutrient Ecoregion VI. EPA822-B-00-017. <http://water.epa.gov/scitech/swguidance/standards/criteria/nutrients/upload/2007_09_27_criteria_nutrient_ecoregions_rivers_rivers_6.pdf>

United States Environmental Protection Agency: Michidoh Aquifer. 2011. US Environmental Protection Agency: Region 5. 23 August 2011. <http://www.epa.gov/r5water/gwdw/michindoh/>

United States Fish and Wildlife Service: Endangered Species. October 2011. United States Fish and Wildlife Service. October, 2012. <http://www.fws.gov/midwest/Endangered/clams/white_fc.html>.

United States. House of Representatives. Bill H.R. 6040. 30 July, 2010. 12 December, 2013. <www.gpo.gov/fdsys/pkg/Bills-111hr6040ih/pdf/Bills-11hr6040ih.pdf>.

Western Lake Erie Basin Partnership. WLEB Partnership Strategic Plan. 12 October, 2010. 26 February, 2013. <www.wleb.org>.

Wilson, Robyn, et al. Farmers, Phosphorus and Water Quality: A Descriptive Report of Beliefs, Attitudes and Practices in the Maumee Watershed in Northwest Ohio. Ohio State University. 2013

Quinn, Angie. Personal Interview by Stephanie Singer. 15 January, 2014.

2013 Ohio Sport Fish Health Consumption Advisory. Ohio Environmental Protection Agency. 19 April, 2013. <www.epa.state.oh.us/dsw/fishadvisory/index.aspx>.

Endorsements and Distribution List

We, the undersigned, agree to support the implementation of the Upper Maumee River Watershed Management Plan by partnering with the Upper Maumee River project, offering technical assistance, or pursuing funding of our own to implement the WMP.

Organization	Signature	Title
DeKalb County Soil and Water Conservation District		
Paulding County Soil and Water Conservation District		
Allen County Natural Resource Conservation Service		
DeKalb County Natural Resource Conservation Service		
Defiance County Natural Resource Conservation Service		
Paulding County Natural Resource Conservation Service		
Allen County Surveyors Office		
DeKalb County Surveyor Office		
Defiance County Engineers Office		
Paulding County Engineers Office		
Purdue University Extension		
Ohio State University Extension		
The Nature Conservancy		
Black Swamp Conservancy		
The Maumee River Basin Commission		
Western Lake Erie Basin Commission		
Tri-State Watershed Alliance		
Upper Maumee Watershed Partnership		
City of Fort Wayne		

City of Defiance
City of Woodburn
City of New Haven
Village of Hicksville
Village of Antwerp
Village of Cecil
Village of Sherwood
Allen County Health Department
DeKalb County Health Department
Defiance County Health Department
Paulding County Health Department
The Maumee River Basin Partnership of Local Governments
Save Maumee Grassroots Organization
Maumee Valley Heritage Corridor
Northwest Ohio River Runners
River Greenway Consortium
Allen County Commissioner
DeKalb County Commissioner
Defiance County Commissioner
Paulding County Commissioner
Allen County Parks Department
DeKalb County Parks Department
Defiance County Parks Department

Paulding County Parks Department
Defiance College
Indiana University-Purdue University; Fort Wayne
Heidelberg University
Andersons
Indiana Department of Environmental Management – Office of Water
Ohio EPA – Division of Surface Water
Ohio DNR – Division of Soil Resources