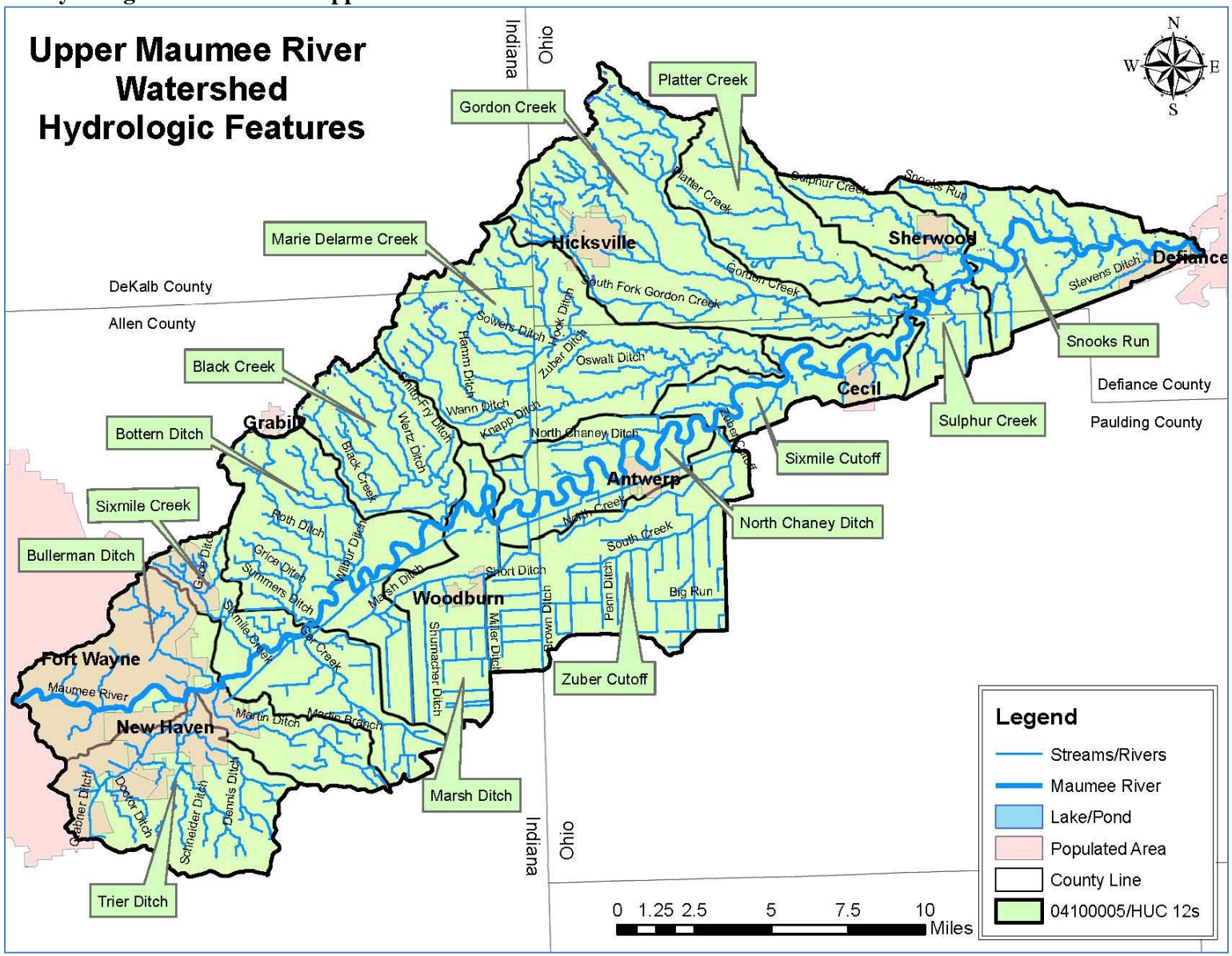
Figure 2.8: Hydrologic Features in the Upper Maumee



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

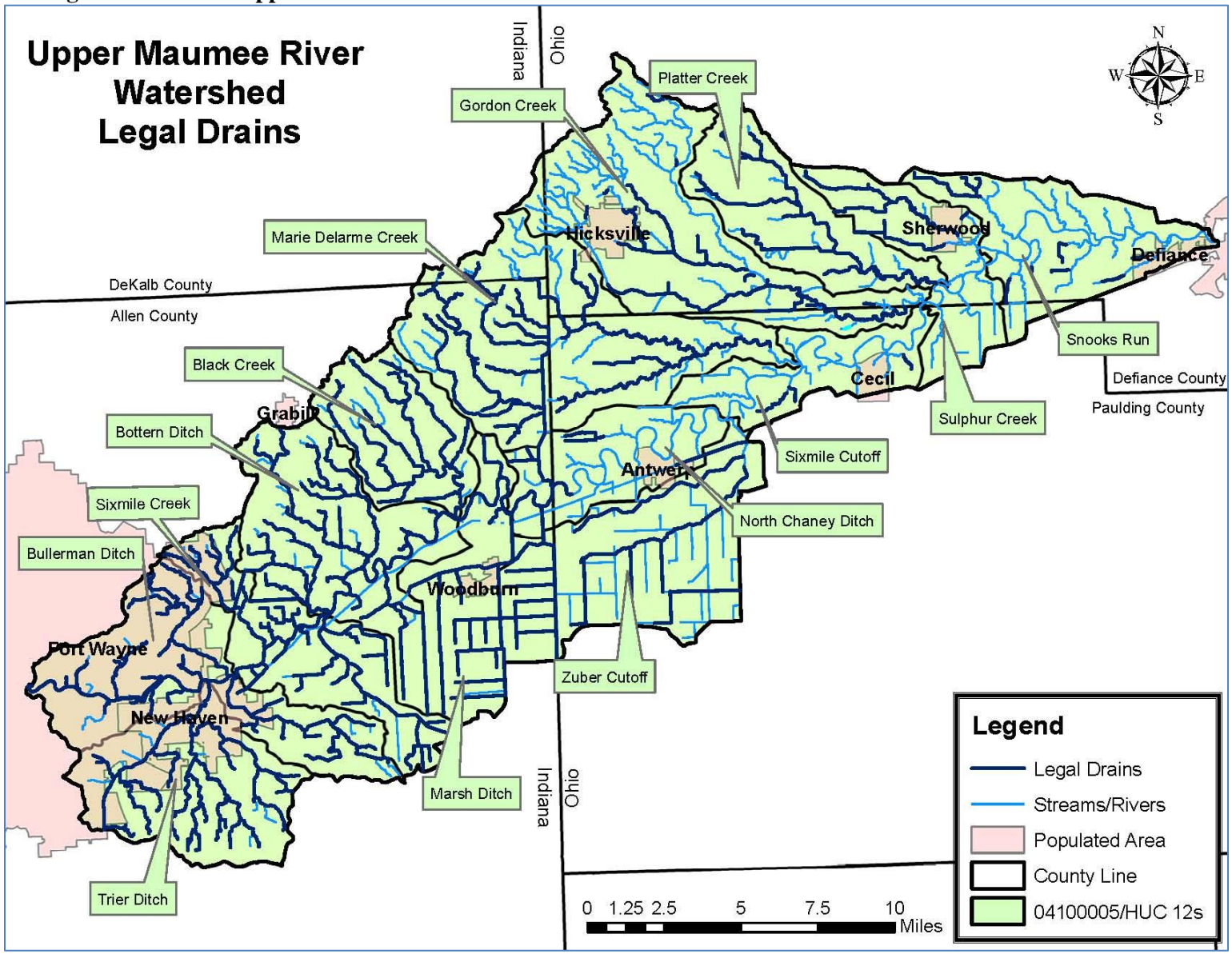
The natural streams, as well as legal drains, within the project area are used as a means to carry excess water from the land so that it may be used for agriculture, commerce, industry, and many other uses. However, due to flooding issues, which was noted as a concern by the watershed's stakeholders, 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

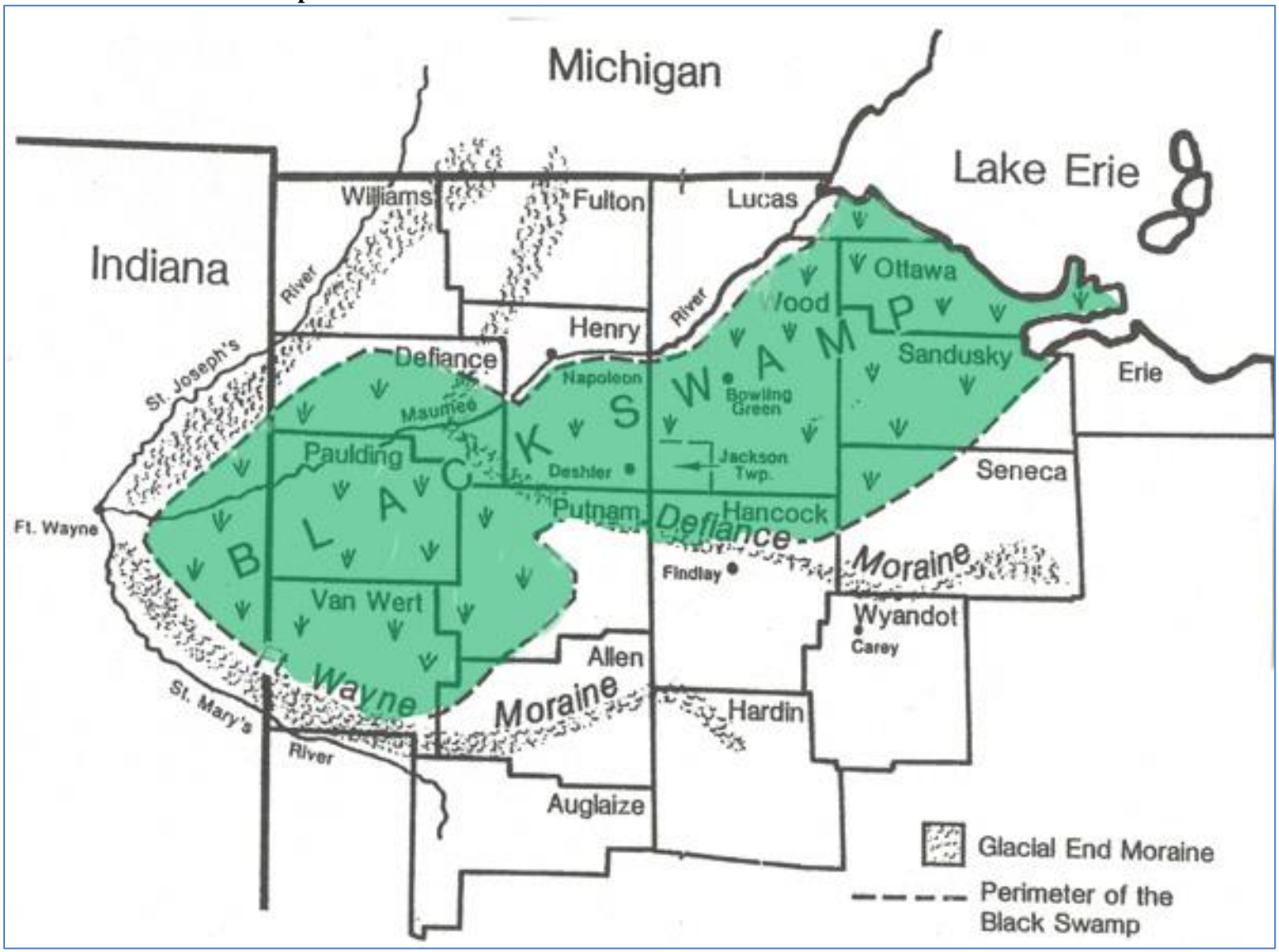


2.4.3 Wetlands

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.

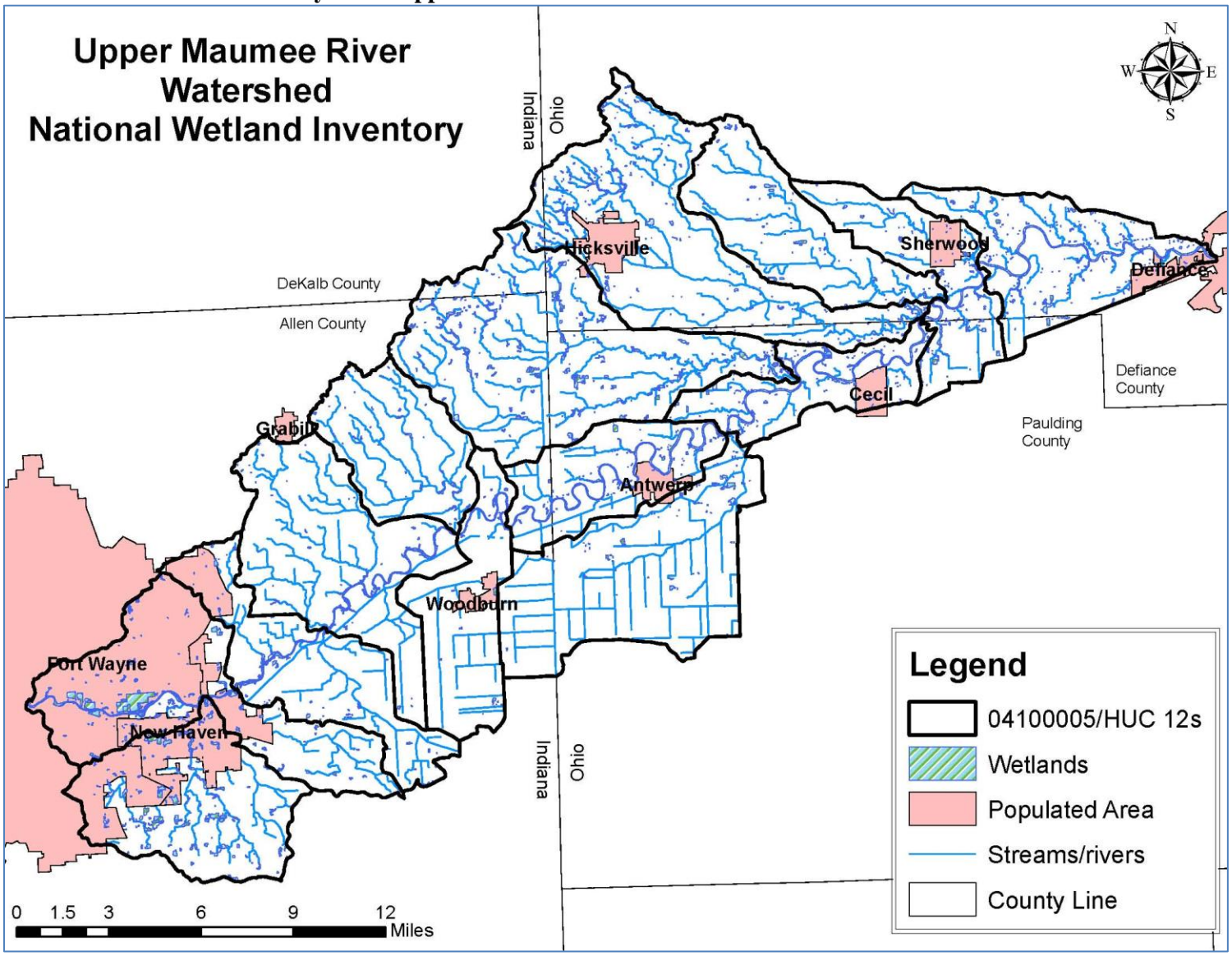
Wetlands play an integral role in our lives as recreation areas for wildlife and bird watching, and fishing, as well as many other recreational past-times. Wetlands also help to lessen the impact of flooding and act as pollution sinks. However, there are few wetlands still present in the UMRW. Ohio DNR 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

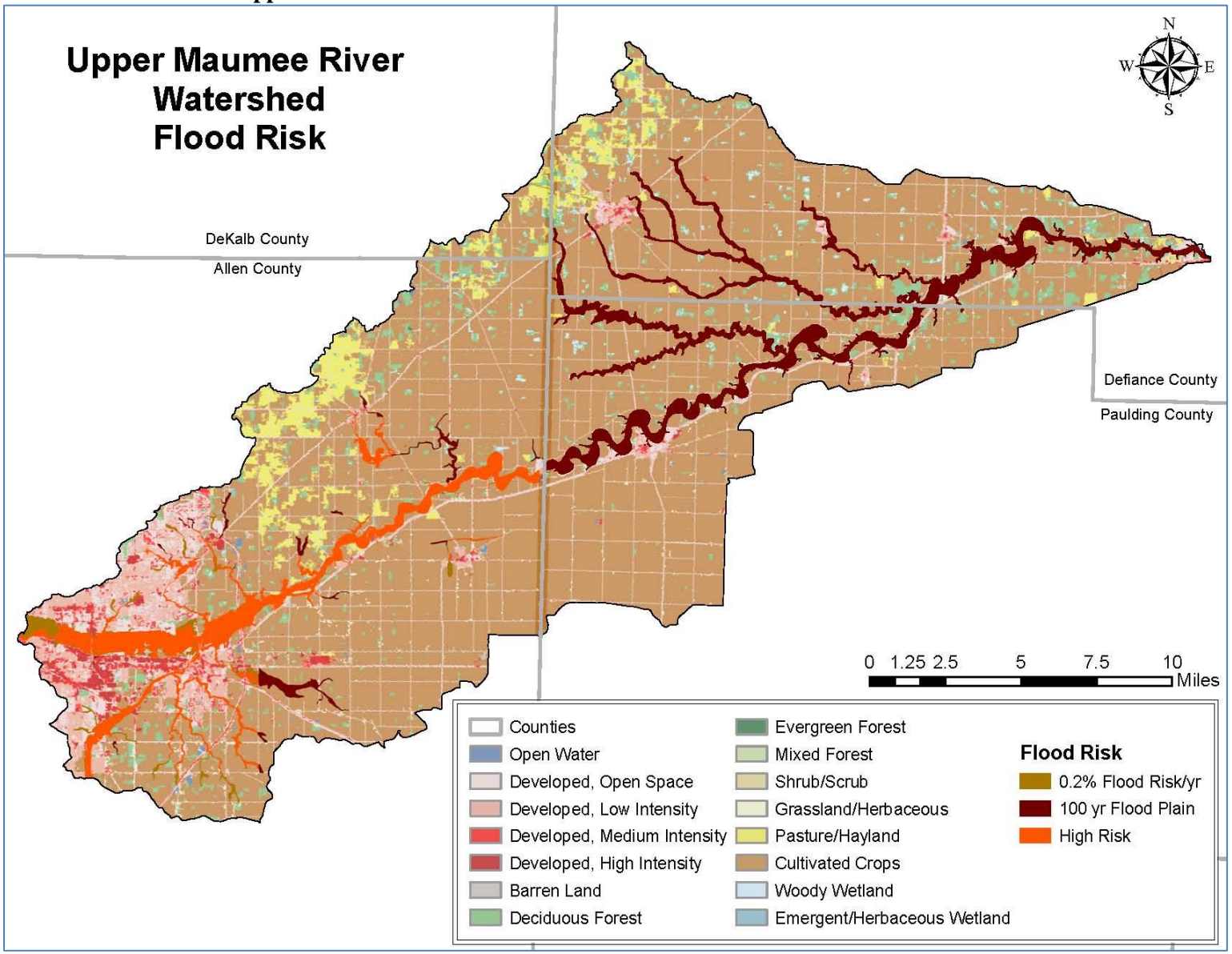
Stakeholders in the UMRW expressed concern over flooding issues within the watershed which can be linked to economic hardship, water impairment, and destruction of key wildlife habitat. Since 2003, the UMRW has experienced several small scale floods, as well as larger, "100 year flood events" in 2003, 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.

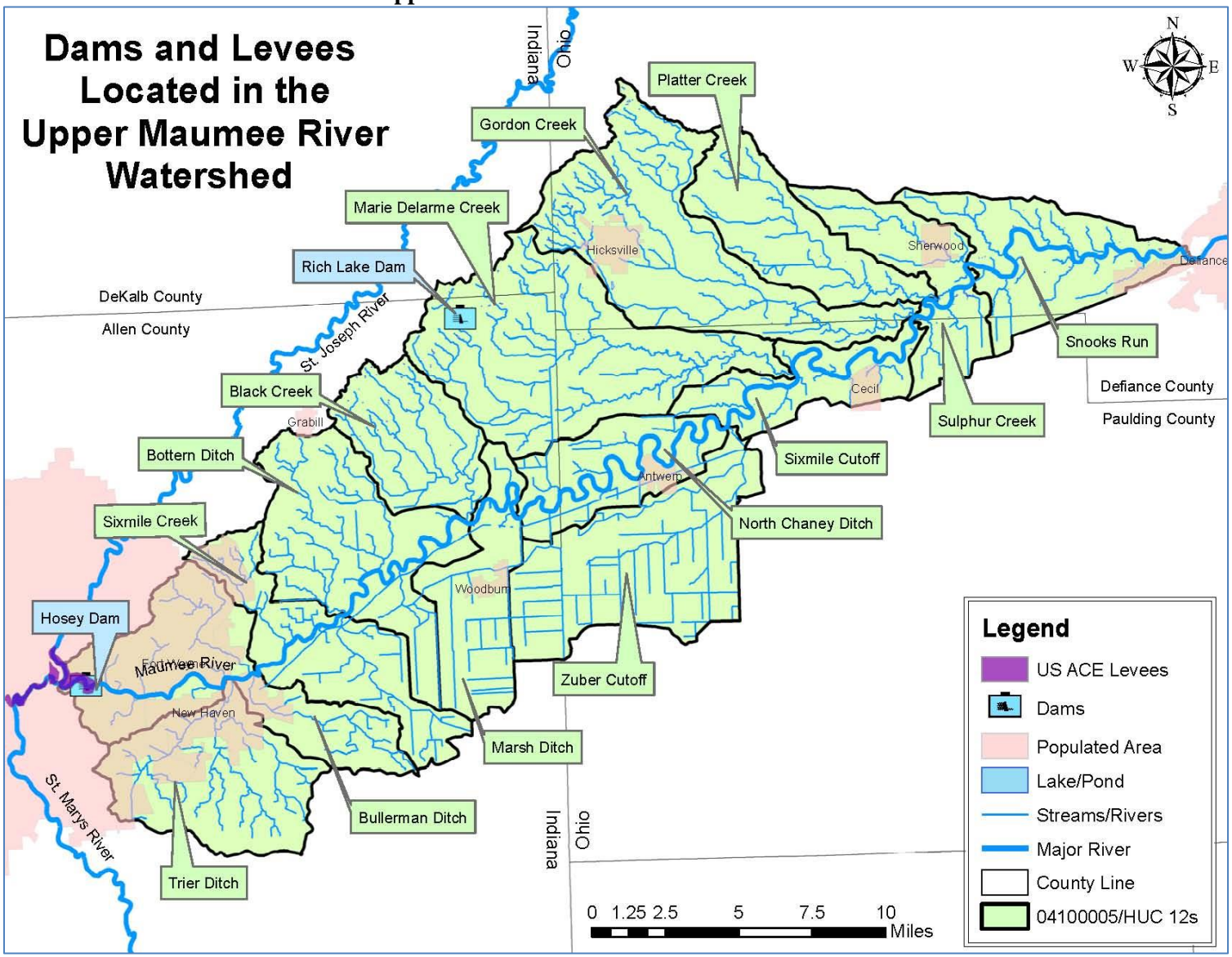
Figure 2.12: Flood Risks in the Upper Maumee River Watershed



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.

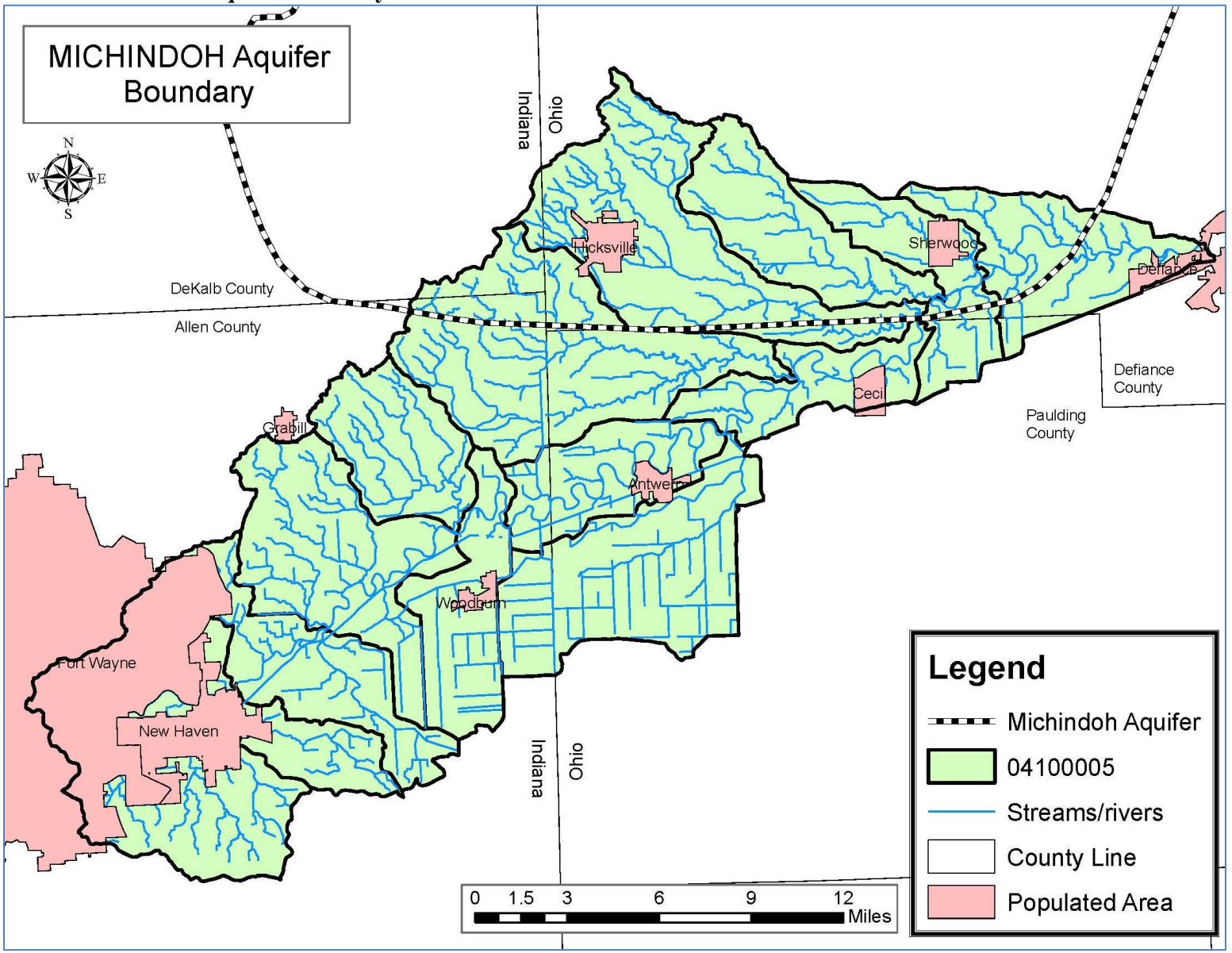
A survey of water withdrawals done by the USGS in 2005 showed that Indiana and Ohio withdraw 844 million gallons of water per day from ground water resources. Table 2.4 shows the total water withdrawals for Indiana and Ohio.

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

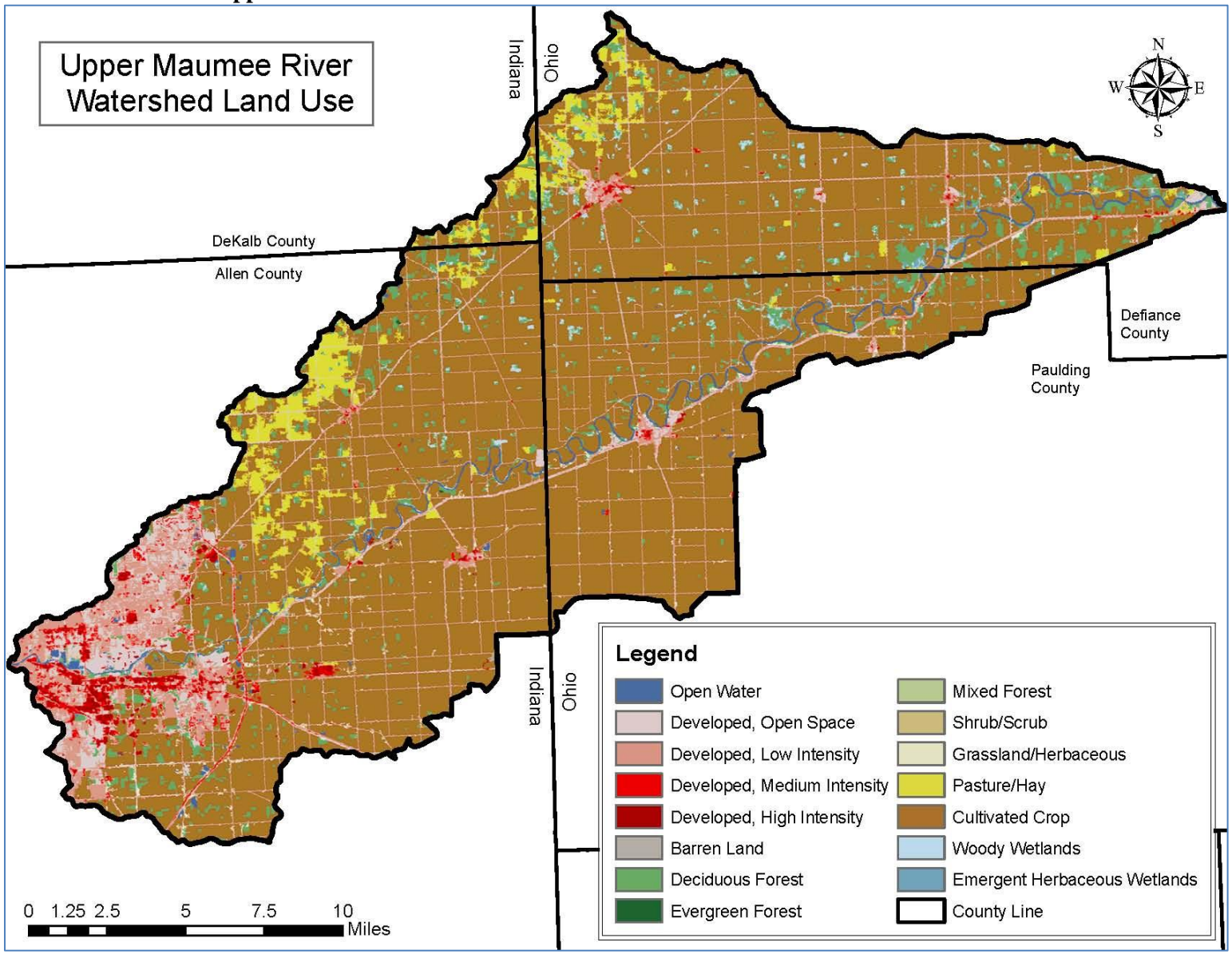
Land use in the project area greatly influences the quality of the water resources. Land in agricultural production has the potential to erode, especially if over worked or if it is conventionally tilled annually. Thus soil particles carrying high levels of nutrients and pesticides have the potential 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.

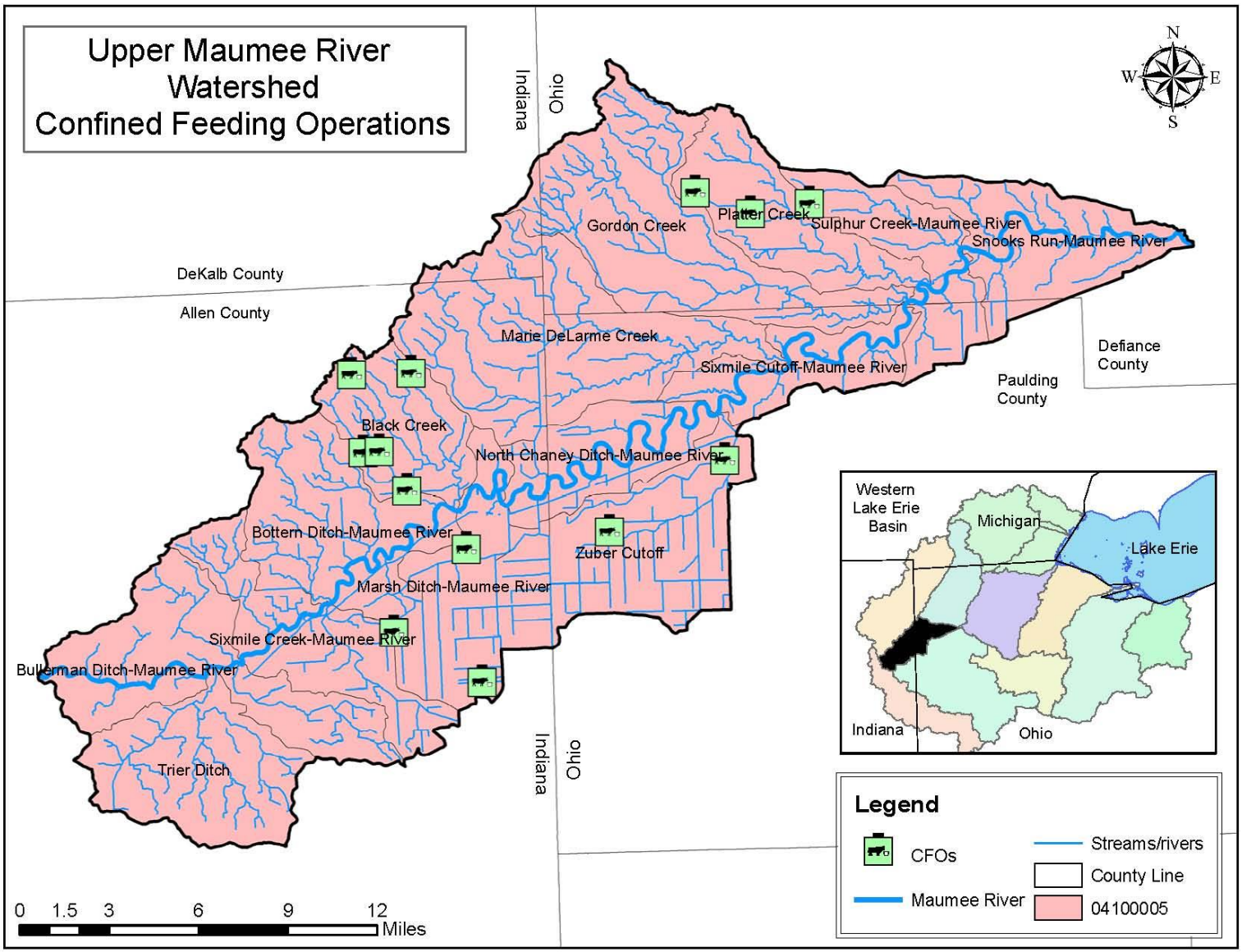
2.5.4: Confined Feeding Operations

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

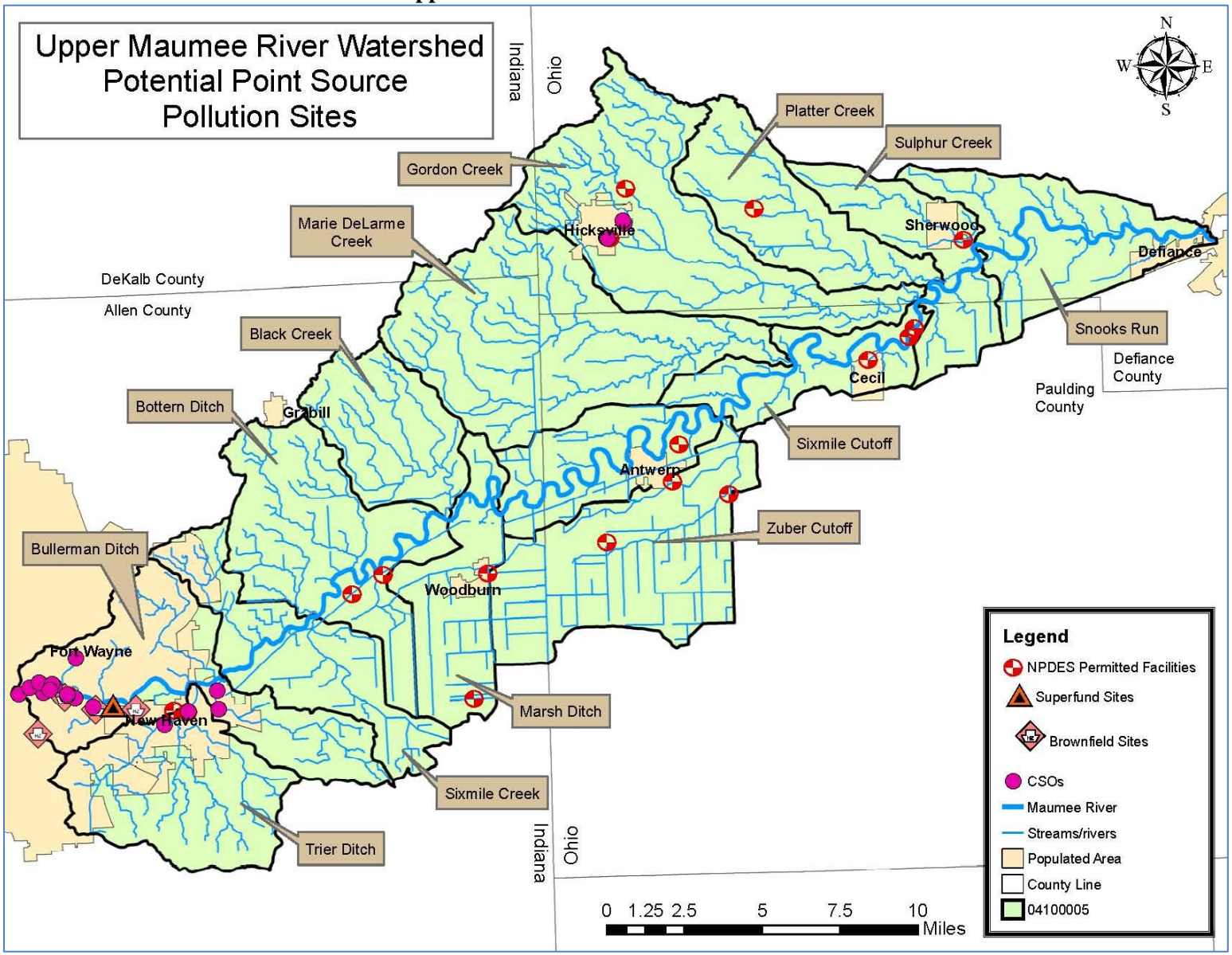
requirements are properly closed or upgraded. There are currently 131 LUSTs located in the project area. LUSTs will be discussed in Section 3 under the respective sub-watershed where they will also be mapped.

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

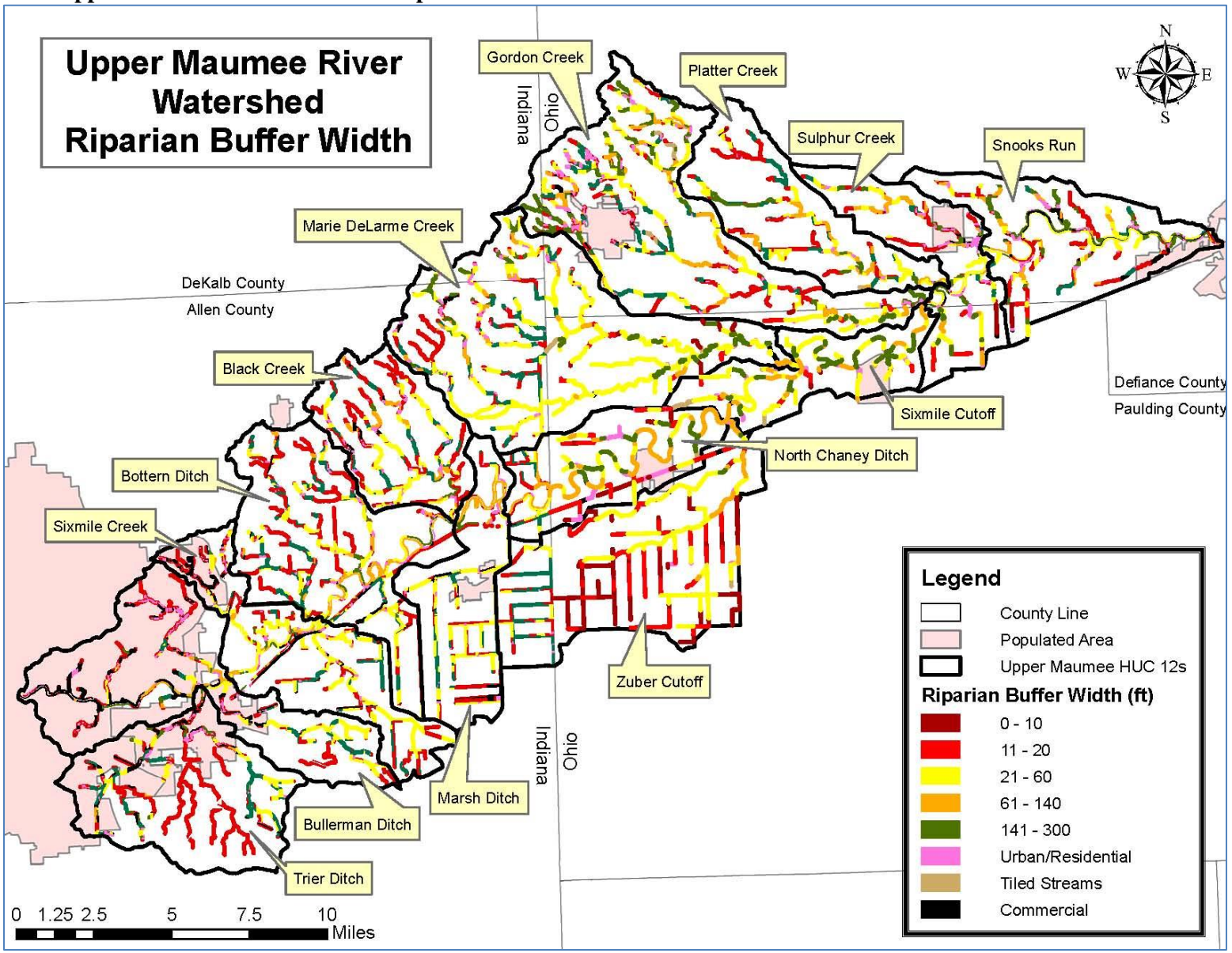
2.5.12 Riparian Buffer Inventory

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 Ditverted 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.

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