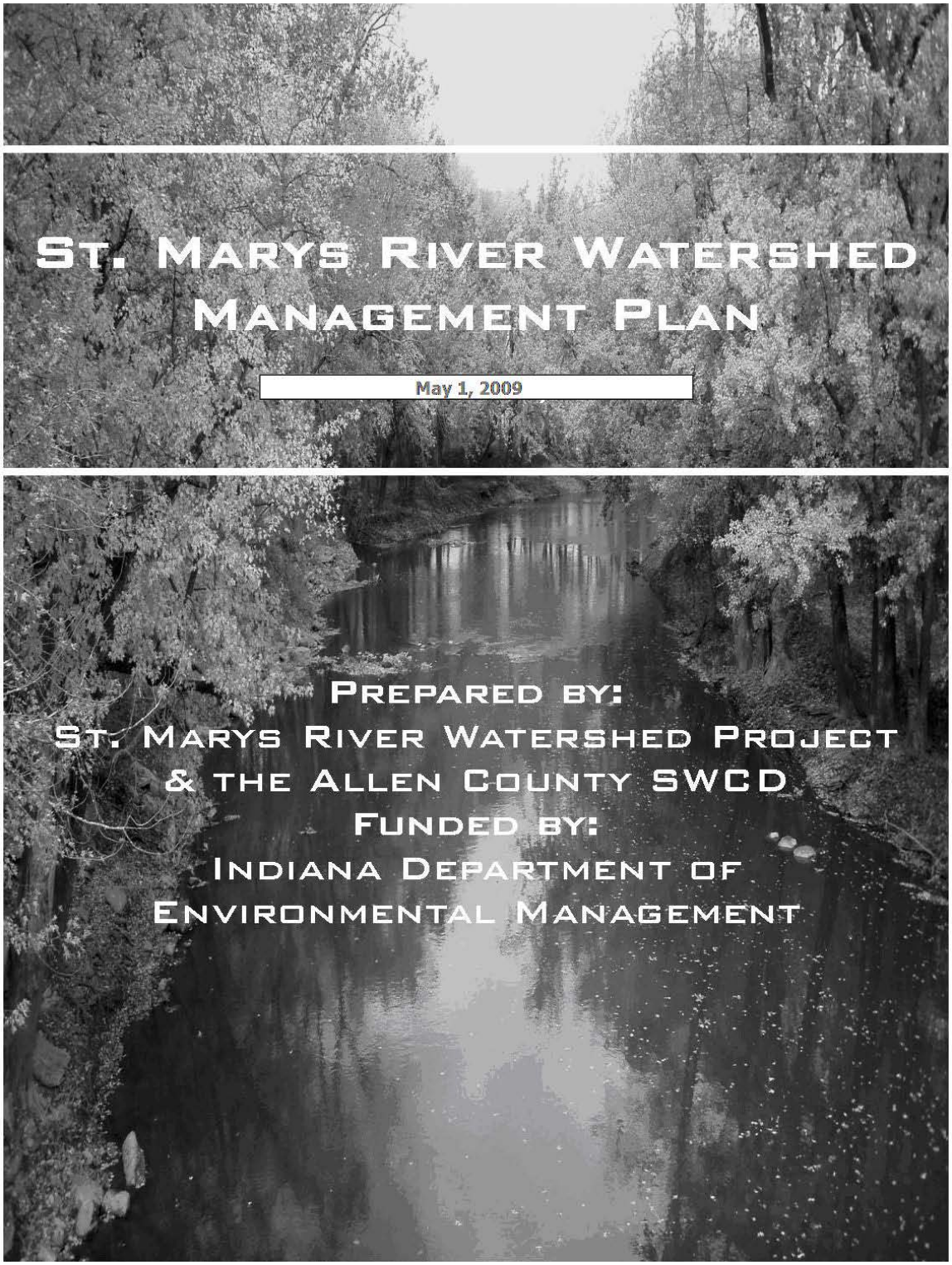
St. Marys River Watershed
Management Plan
May 1, 2009
Prepared by:
St. Marys River Watershed Project
& the Allen County SWCD
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Environmental Management

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ACRONYMS

BMP	Best Management Practice
BOD	Biochemical Oxygen Demand
C	Celsius
CAFO	Confined Animal Feeding Operation
CBOD	Carbonaceous Biochemical Oxygen Demand
CCA	Certified Crop Advisor
CCC	Criterion Continuous Concentration
CFR	Code Federal Regulation
CFS	Cubic Feet per Second
CFU	Colony Forming Units
COD	Chemical Oxygen Demand
CR	County Road
CSO	Combined Sewer Overflow
DO	Dissolved Oxygen
DSC	Division of Soil Conservation
E	East
E. coli	*Escherichia coli*
FCA	Fish Consumption Advisory
FEMA	Federal Emergency Management Agency
GAP	Gap Analysis Program
GLC	Great Lakes Commission
GPS	Global Positioning System
H+	Hydrogen
HAL	Health Advisory Level
HEL	Highly Erodible Land
HUC	Hydrologic Unit Code
HWY	Highway
IAC	Indiana Administrative Code
IBC	Impaired Biotic Communities
IDEM	Indiana Department of Environmental Management
IN	Indiana
INAFSM	Indiana Association for Floodplain and Stormwater Management
INDOT	Indiana Department of Transportation
ISCO	Indiana State Chemist Office
ISDA	Indiana State Department of Agriculture
ISDH	Indiana State Department of Health
K	Susceptibility to Soil and Water Erosion Factor
LA	Load Allocation
LID	Low Impact Development
LS	Slope Length and Steepness Factor
LTCP	Long Term Control Plan
MCL	Maximum Contaminant Level
MI	Michigan
MOS	Margin of Safety
MRBC	Maumee River Basin Commission
MRBPLG	Maumee River Basin Partnership of Local Governments
MS4	Municipal Separate Storm Sewer System

N	North
NAI	No Adverse Impact
NGO	Non Government Organization
NH3-N	Ammonia Nitrogen
NPDES	National Pollutant Discharge Elimination System
NO_3-NO_2	Nitrate + Nitrite Nitrogen
NRCS	Natural Resources Conservation Service
NTU	Nephelometric Turbidity Unit
NWI	National Wetland Inventory
O_2	Oxygen
ODNR	Ohio Department of Natural Resources
OEPA	Ohio Environmental Protection Agency
OH	Ohio
ORC	Ohio Revised Code
P	Phosphorus
PCB	Polychlorinated Biphenyl
PPM	Parts Per Million
R	Rainfall and Runoff Factor
RTK	Real Time Kinematic
RUP	Restricted Use Pesticide
RUSLE	Revised Universal Soil Loss Equation
S	South
SMRWP	St. Marys River Watershed Project
SSO	Sanitary Sewer Overflow
SWCD	Soil and Water Conservation District
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
US	United States
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
USLE	Universal Soil Loss Equation
UWA	Unified Watershed Assessment
W	West
WLA	Waste Load Allocation
WLEB	Western Lake Erie Basin
WMP	Watershed Management Plan
WRAS	Watershed Restoration Action Strategy
WWTP	Waste Water Treatment Plant

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1.0 INTRODUCTION

1.1 Watershed Planning

A watershed, also referred to as a drainage area, catchment, or basin, is defined by the United States Environmental Protection Agency (USEPA), as the area of land where all of the water that is under it or that drains off of it goes into the same place (www.epa.gov/owow/watershed). A basin-like landform, the watershed boundaries are defined geographically by highpoints and ridgelines that descend into lower elevations. After rain falls and snow melts, drop by drop, water is channeled into soils, groundwaters, creeks, and streams, making its way to larger water systems and eventually the sea. The Scientist Geographer, John Wesley Powell, put it best when he said that a watershed is: "that area of land, a bounded hydrologic system, within which all living things are inextricably linked by their common water course and where, as humans settled, simple logic demanded that they become part of a community." (www.epa.gov/owow/watershed) Watersheds come in all shapes and sizes, from a large scale watershed which encompasses the drainage area of the Great Lakes, to small sub-watersheds, such as Blue Creek located in the St. Marys River Watershed. Watersheds can cross county, state, and national boundaries. The following Figure 1 is an illustration of a generalized watershed. (www.depweb.state.pa.us)

Figure 1. Watershed Illustration.

In the late 1980s, water resource planners began focusing on a watershed approach as a means of watershed planning. This approach crossed political boundaries and was quickly adopted as the standard method for watershed planning and managing water quality. Today, the standard is widely used by organizations, and federal and state agencies. The watershed approach is a flexible framework for managing water resource quality and quantity within specified drainage areas, or watersheds. This approach includes stakeholder involvement and management actions supported by sound science and appropriate technology. The watershed planning process works within this framework by using a series of cooperative, iterative steps to characterize existing conditions, identify and prioritize problems, define management objectives, develop protection or remediation strategies, and implement and adapt selected actions as necessary. The outcome of this process is documented or referenced in a watershed management plan. A watershed management plan (WMP) outlines a strategy that provides assessment and management information for a geographically defined watershed, including the analyses, actions, participants, and resources related to developing and implementing the plan. The development of a watershed plan requires a certain level of technical expertise and the participation of a variety of people with diverse skills and knowledge.

Using a watershed approach to restore impaired water bodies is beneficial because it addresses water quality and quantity problems in a holistic manner. A watershed approach also involves watershed stakeholders in selecting the management strategies

that will be implemented to solve water quality problems. Nonpoint source pollution poses the greatest threat to water quality and is the most significant source of water quality impairment in the St. Marys River watershed, as well as in the nation.

St. Marys River Watershed Management Plan

The St. Marys River Watershed Management Plan (WMP) intends to provide a comprehensive, useful, flexible tool to address resource concerns in the watershed and to protect and enhance natural resources within the boundaries of the Indiana portion of the St. Marys River Watershed. Once completed, the WMP will provide improved living conditions, recreational opportunities, and environmental health benefits to residents who live and work within the watershed. Consequently, it will provide benefits to residents and communities throughout the Western Lake Erie drainage basin. This management plan was developed through a collaborative effort between the Adams, Allen, and Wells County Soil and Water Conservation Districts, with the assistance of local government entities and stakeholders in the watershed. A steering committee of landowners, public officials and local producers was developed following a series of public meetings. Further, the involvement of stakeholders within the Ohio portion of the St. Marys River Watershed was essential for the development of a successful management plan. An array of data, reports, and information was submitted by Ohio stakeholders and incorporated into the WMP. The input obtained from a wide variety of constituencies and citizens was an invaluable resource. The watershed management plan has been developed following the requirements set forth in Indiana Department of Environmental Management's (IDEM) 2003 Watershed Management Plan Checklist.

The need for the development of a WMP for the Indiana portion of the St. Marys River Watershed was brought to light upon the completion of the Total Maximum Daily Load (TMDL) reports completed for the St. Marys River Watershed (HUC 04100000), as well as the Blue Creek/Habegger Ditch and Yellow Creek Watersheds. The TMDL addressed 18.08 river miles in the Blue Creek / Habegger Ditch (HUC 04100004040020, 04100004040030, 04100004040040, and 04100004040050) watershed in Adams County, IN and 32.79 river miles in the Yellow Creek Watershed (HUC 04100004040070) in Adams County. Completed by IDEM in 2005, the reports identified impaired water bodies and the necessary load reductions to meet IDEM water quality standards. TMDL reports were completed for *E. coli* in the St. Marys River Watershed, and for nutrients (nitrogen and phosphorus) and Impaired Biotic Communities (IBC) in the Blue Creek/Habegger Ditch and Yellow Creek Watershed.

To address the impairments addressed in the TMDL reports, as well as concerns identified by St. Marys River Watershed stakeholders and Steering Committee members, the following list of goals has been developed:

Goal: Reduce sediment in all monitored streams to meet a level of 30 mg/l by 2028

Goal: Reduce amount of trash/debris in the watershed by 50% by 2028.

Goal: Reduce Atrazine levels to meet a level of 3.00 µg/l (ppb) in all monitored streams by 2028.

Goal: Reduce levels of *E. coli* to meet IDEM water quality standards (235 cfu/100ml) by 2028.

Goal: Reduce levels of nutrients to meet levels set forth by the TMDL:Nitrogen (10 mg/l), Phosphorus (0.30 mg/l) by 2028. Reduce Ammonia levels so as not to exceed Criterion Continuous Concentration by 2028.

Goal: Significantly reduce stormwater runoff and activity in the Regulatory Flood Hazard Area in order to reduce severity and impacts of flooding by 2028.

Goal: Increase Public Awareness and Participation by 50% by 2028.

The St. Marys WMP identifies management measures, short and long term milestones, approximate cost estimates, and contributing partners necessary to meet these goals. The WMP will also be used as a tool for implementation as well as for securing future funding for implementation projects and management measures in the watershed.

1.2 Partnerships

To develop a successful and comprehensive watershed management plan, a number of partnerships have been developed. These partnerships have played a vital role in identifying resource needs in the watershed.

The following groups and organizations have been essential partners in the development of the St. Marys River Watershed Management Plan.

Adams, Allen, and Wells County Soil and Water Conservation Districts (SWCD)

The three SWCDs teamed together to develop the resources necessary to begin the process of developing the WMP. Additionally, the SWCDs, with their local knowledge of the land have been an essential resource for identifying resource needs in the watershed. Upon completion of the St. Marys River Watershed Management Plan, SWCDs will play a vital role in the implementation phase by working directly with landowners to implement conservation projects.

Adams County Planning Commission

The Adams County Planning Commission has been essential in identifying livestock operations in Adams County. They have an ordinance in place that requires producers to apply for a county livestock permit. Many of the regulations of the ordinance are more stringent than those of the State of Indiana. The ordinance also requires producers to identify locations where waste will be land applied.

Maumee River Basin Commission

Maumee River Basin Commission (MRBC) emerged in 1985 as an alliance between Adams, Allen, DeKalb, Noble, and Steuben Counties, which comprise the Maumee River Basin. The Commission is designed to assist communities in northeast Indiana to curb the threat of flooding. The MRBC is a state agency formed by Indiana Code 13-7-6.1. The MRBC provides regional leadership in planning, promoting, coordinating, and implementing flood control, conservation, and the control and development of resources

such as land, water, and man-made improvements (MRBC 1993). The MRBC has authority over several areas of concern that have impacted the watershed. The MRBC has played an essential role in the development of the WMP by helping to identify concerns associated with flooding and erosion in the St. Marys River Watershed.

United States Department of Agriculture - Natural Resources Conservation Service (USDA-NRCS)

NRCS has provided valuable technical assistance and information to the project. This partnership has been key to identifying the best management practices that are suitable to addressing resource concerns in the watershed. NRCS will also play a vital role in the implementation phase of the project by providing technical assistance and engineering design work, as well as information on current and upcoming farm bill programs.

Western Lake Erie Basin Partnership (WLEB)

The WLEB Charter was agreed to on March 29, 2006, and the signatories agreed to develop a consensus-based Partnership to pursue the following principles:

- The Partnership is committed to collaboration and consensus building - sharing resources and knowledge to link land use to water quality, support ongoing efforts and identify new opportunities to enhance and improve the watershed.
- The Partnership will apply watershed-based solutions to local problems and apply local solutions to watershed problems -inclusively empowering and building the capacity of local watershed groups and supporting ongoing efforts.
- The Partnership is results oriented - it will define the baseline status of the basin, identify and prioritize science based solutions, responsibly support the implementation of innovative and cooperative projects, monitor and evaluate its actions, and support an adaptive management approach.
- The Partnership will speak with one voice, promote transparency, encourage participation, be responsive, create awareness, educate, and inform.
- The Partnership will provide the structure necessary to coordinate public and private resources across political boundaries to accelerate achievement of environmental goals and support for local conservation initiatives.

The Leadership Committee for the WLEB Partnership is comprised of senior members of their respective organizations. Figure 2 outlines the organizational structure of the WLEB partnership.

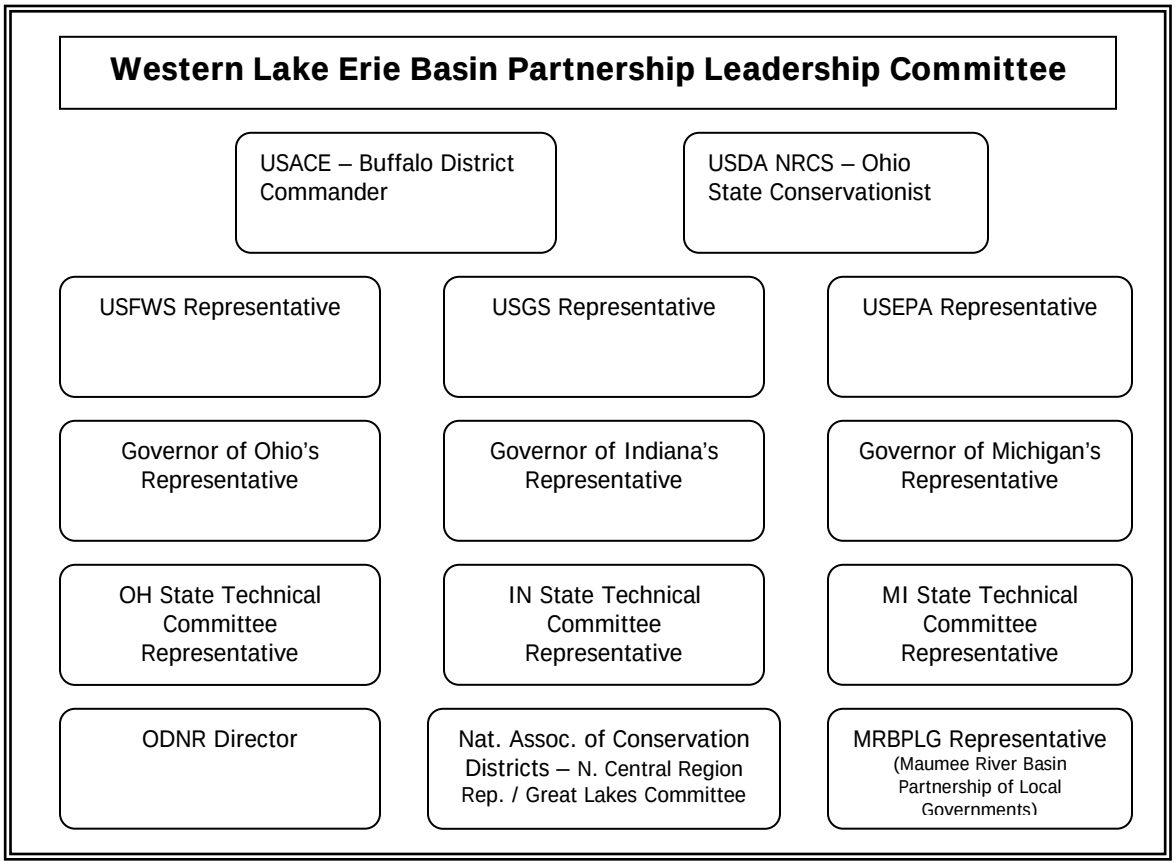

Figure 2. WLEB Partnership Leadership Committee Members.

This group oversees the efforts of an Operational Committee and four Coordination Teams: Project Coordination Team, Outreach/Public Education Coordination Team, Resource Coordination Team, and Research & Data Coordination Team. (www.wleb.org)

The WLEB has provided information about the St. Marys River Watershed. In particular, the WLEB, in association the the US Army Corps of Engineers completed a watershed assessment for the St. Marys River Watershed. The assessment covers both the Ohio and Indiana portion of the watershed, providing background watershed information, flood damage reduction, water quality, natural resource-based recreation, fish and wildlife enhancement, and commercial and recreational navigation. The watershed assessment can be found in Appendix I of this report.

Maumee River Basin Partnership of Local Governments (MRBPLG)

The Maumee River Basin Partnership of Local Governments (MRBPLG) is a consortium of cities, towns, villages, townships, counties, watershed management groups, and the regional community, which was founded in March 2001 by the City of Fort Wayne, Indiana and the City of Toledo, Ohio. This Partnership stretches across the Indiana, Ohio, and Michigan state boundaries and focuses on a watershed-based approach to water quality management in the Maumee River Basin.

The MRBPLG exists to improve and protect water quality on a regional and local watershed basis by acting as an advocate for its members with state and federal

agencies, consolidating data, integrating planning and priorities, and encouraging the development of smaller watershed partnerships. (www.mrbplg.org)

The MRBPLG has been an essential partner to the St. Marys River Watershed Project by advising on Combined Sewer Overflow (CSO) and MS4 stormwater issues in the watershed.

Indiana State Department of Agriculture – Division of Soil Conservation (ISDA-DSC)

The Division of Soil Conservation's (DSC) primary focus is soil erosion and its effects on land productivity and water quality. DSC employees work to control off-site sedimentation from agriculture to reduce non-point source pollution in Indiana's lakes, rivers and streams. DSC also provides administrative support and training to Indiana's 92 soil and water conservation districts. (www.in.gov/isda)

ISDA employs District Support Specialists who work cooperatively with soil and water conservation districts (SWCD) and other conservation partners in the design of programs that reach landusers, the general public, government officials, and primary and secondary educational institutions on the husbandry and management of soil and water resources.

Resource specialists are also employed to directly assist land users. The resource specialists work through regional Conservation Implementation Teams to help land users assess specific soil and water resource problems, as well as develop and apply appropriate solutions. Services available to agricultural land users include:

- Provide up-to-date information to create or revise conservation management plans
- Evaluate on-site erosion and nutrient problems
- Help landowners identify specific conservation practices
- Supervise installation and maintenance of selected conservation practices
- Help landowners identify nutrient control cost-share programs and applications.

ISDA also employs two Resource Specialists to promote conservation programs strictly within the greater Maumee River Basin. These WLEB specialists promote conservation programs by speaking with landowners one on one, planning and promoting field days, and providing technical assistance to landowners.

ISDA staff has assisted with the St. Marys WMP by providing information regarding resource concerns in the watershed, especially with soil erosion concerns. ISDA staff in Adams county have also been very helpful by serving as a contact with the Amish community in the area. Upon completion of the WMP, ISDA staff will serve an essential role by working one-on-one with landowners and providing technical assistance on BMP's and conservation programs.

St. Marys River Watershed Steering Committee

The St. Marys Steering Committee is composed of representatives from local city and county governments, Soil and Water Conservation Districts, and private landowners in the watershed. The input obtained from the Steering Committee has proved to be

invaluable. Through the local knowledge that these individuals possess, the information contained and presented within the WMP will serve as a valuable planning tool.

The vision of the St. Marys Watershed Project is improved water quality for the inhabitants of the St. Marys River Watershed, with appropriate economic growth and financial security for present and future generations.

The St. Marys River Watershed Project's mission is to continue to improve the health of the St. Marys River through the implementation of best management practices, water quality monitoring, public education, community outreach, and ecosystem restoration activities throughout the St. Marys River Watershed.

2.0 OVERVIEW OF THE ST. MARYS RIVER WATERSHED

2.1 Watershed Location

The St. Marys River watershed is located in the Great Lakes Basin, in the Western Lake Erie Basin, and defined by the 8-digit hydrologic unit code (HUC) 04100004 (Fig. 3, 4). The St. Marys River Watershed is located in northeastern Indiana and northwestern Ohio and covers an area of over 707,000 acres. In Indiana, the watershed spans 240,366 acres across Adams, Allen, and Wells counties. There are approximately 343 miles of perennial streams in Indiana.

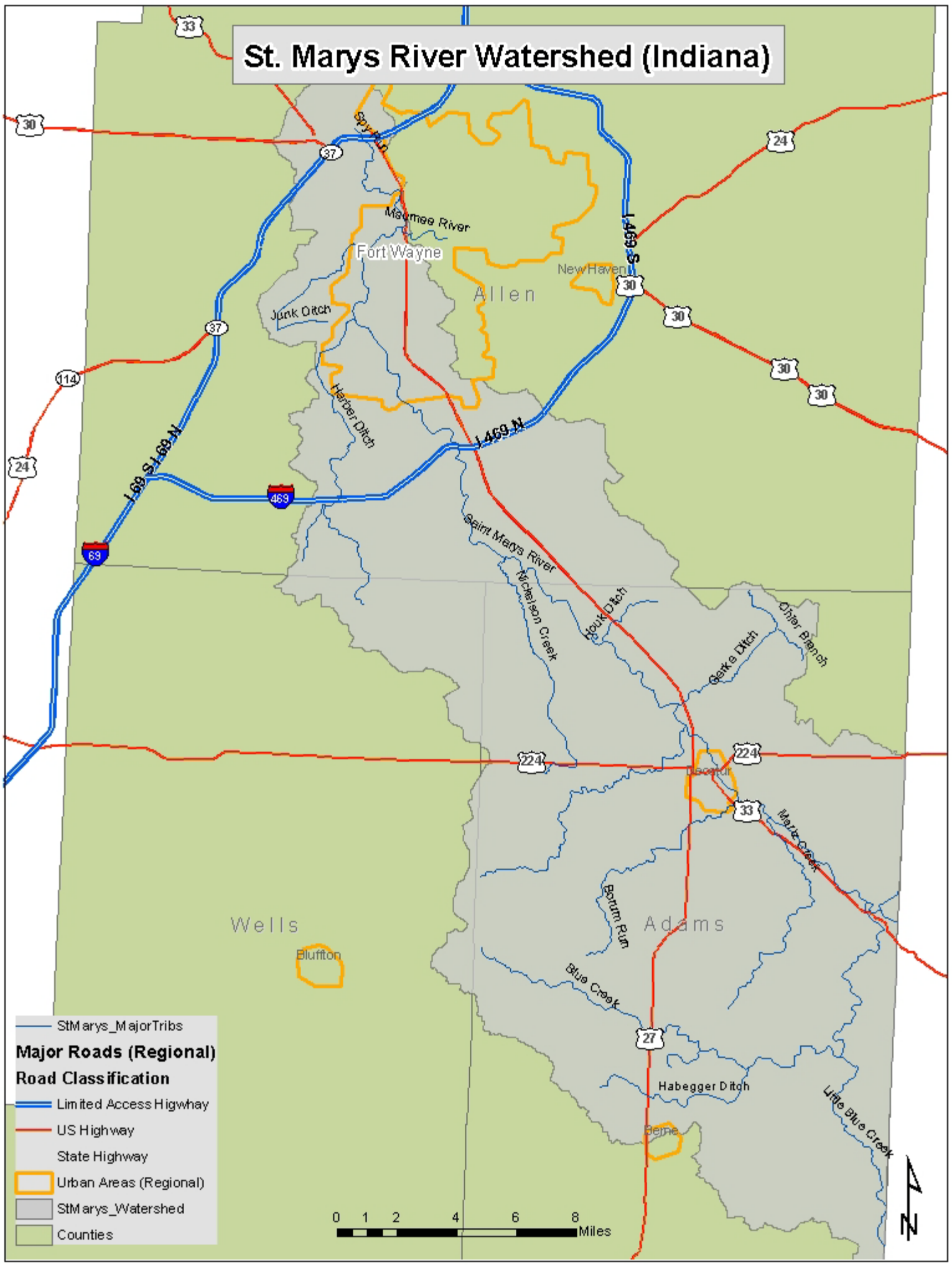

Figure 3. St Marys River Watershed

The St. Marys River originates in New Bremen, Ohio flowing to the Northwest through Auglaize, Mercer, Shelby and Van Wert counties in Ohio. The St. Marys River then flows into Indiana through Adams County southwest of Pleasant Mills, near the Indiana State Line and Highway 33. The St. Marys River continues to the northwest flowing through Wells County into Allen County where it joins the St. Joseph River in Fort Wayne to form the Maumee River, which flows northeast and empties into Lake Erie.

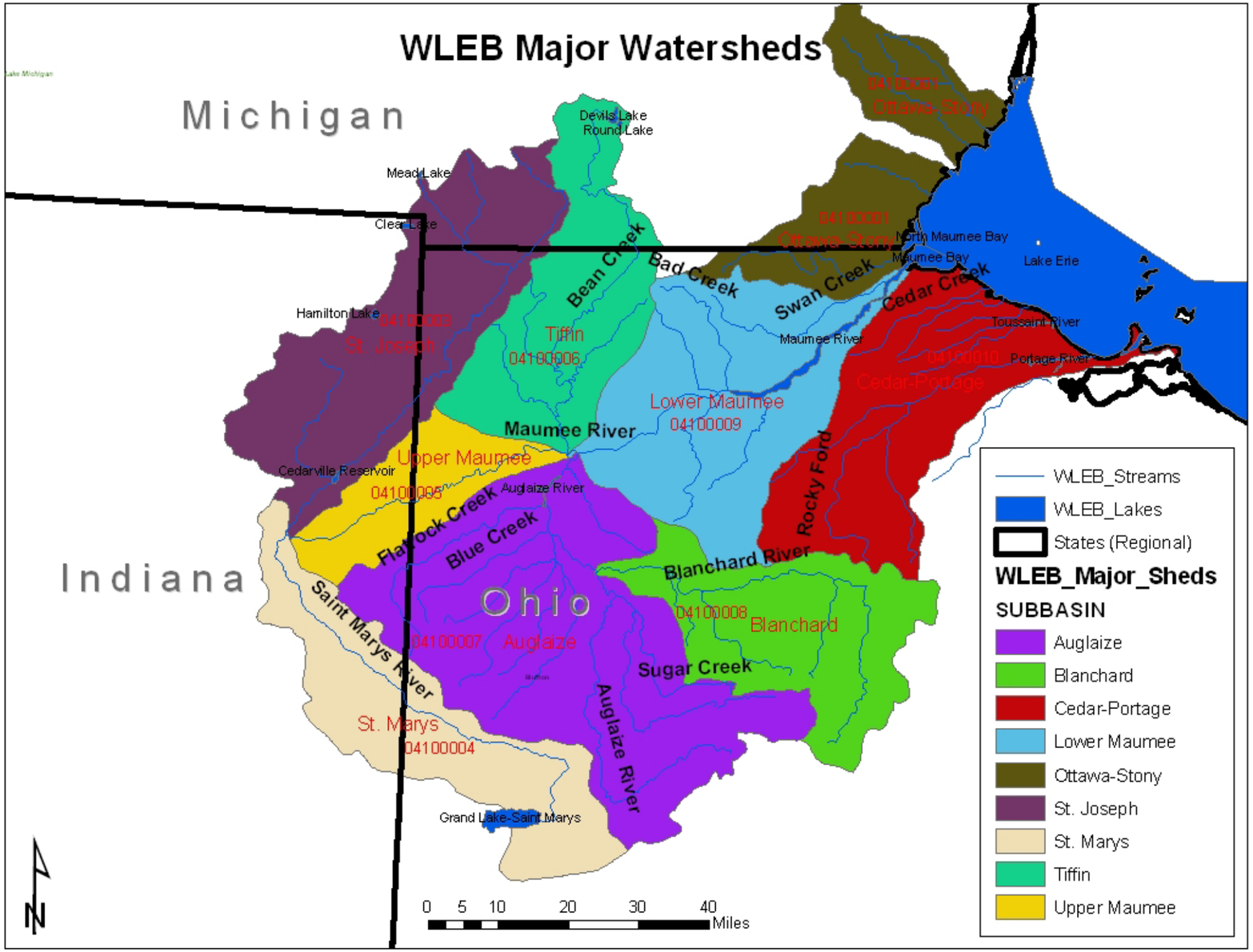

Figure 4. 8-digit watersheds in the Western Lake Erie Basin

The Indiana portion of the St. Marys River watershed can be divided into twenty-two 14-digit sub-watersheds according to the major tributaries of the river (Fig. 5).

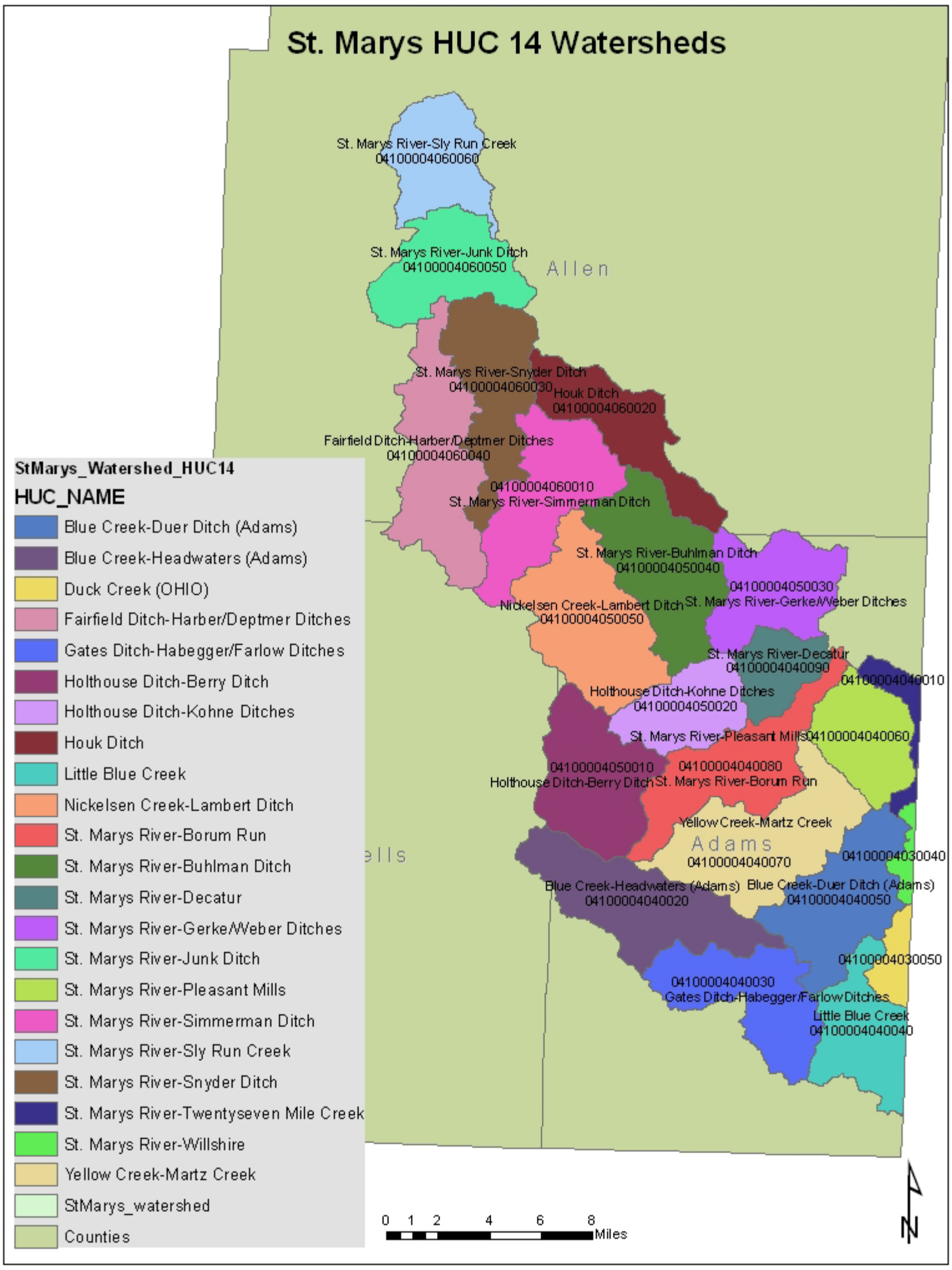

Figure 5. 14-digit sub-watersheds of the St. Marys River Watershed

2.2 Geology/Soils

The St. Marys River Watershed has had extensive glaciation. The area is comprised mainly of a Till Plain, which consists of gently rolling to flat landscapes. The elevations range from 780 to 840 feet above mean sea level. Except where stream valleys dissect the till plain, there is little internal relief.

The entire St. Marys River Watershed is located in the Eastern Corn Belt Plain ecoregion, which is characterized by rolling plains with local end moraines. Glacial deposits of the Wisconsin age are extensive in the region. In comparison to the Central Corn Belt Plains located to the west, it had more natural tree cover and has lighter soils. Prior to settlement, beech/maple hardwood forests were common on Wisconsin soils while beech forests and elm-ash swamp forests dominated the wetter pre-Wisconsin soils. Today, extensive corn, soybean, and livestock production occurs and has affected stream chemistry and turbidity. (www.epa.gov/wed/pages/ecoregions/level_iii.htm) The following Figure 6 shows the geographic location of the St. Marys River Watershed in the Eastern Corn Belt Ecoregion.

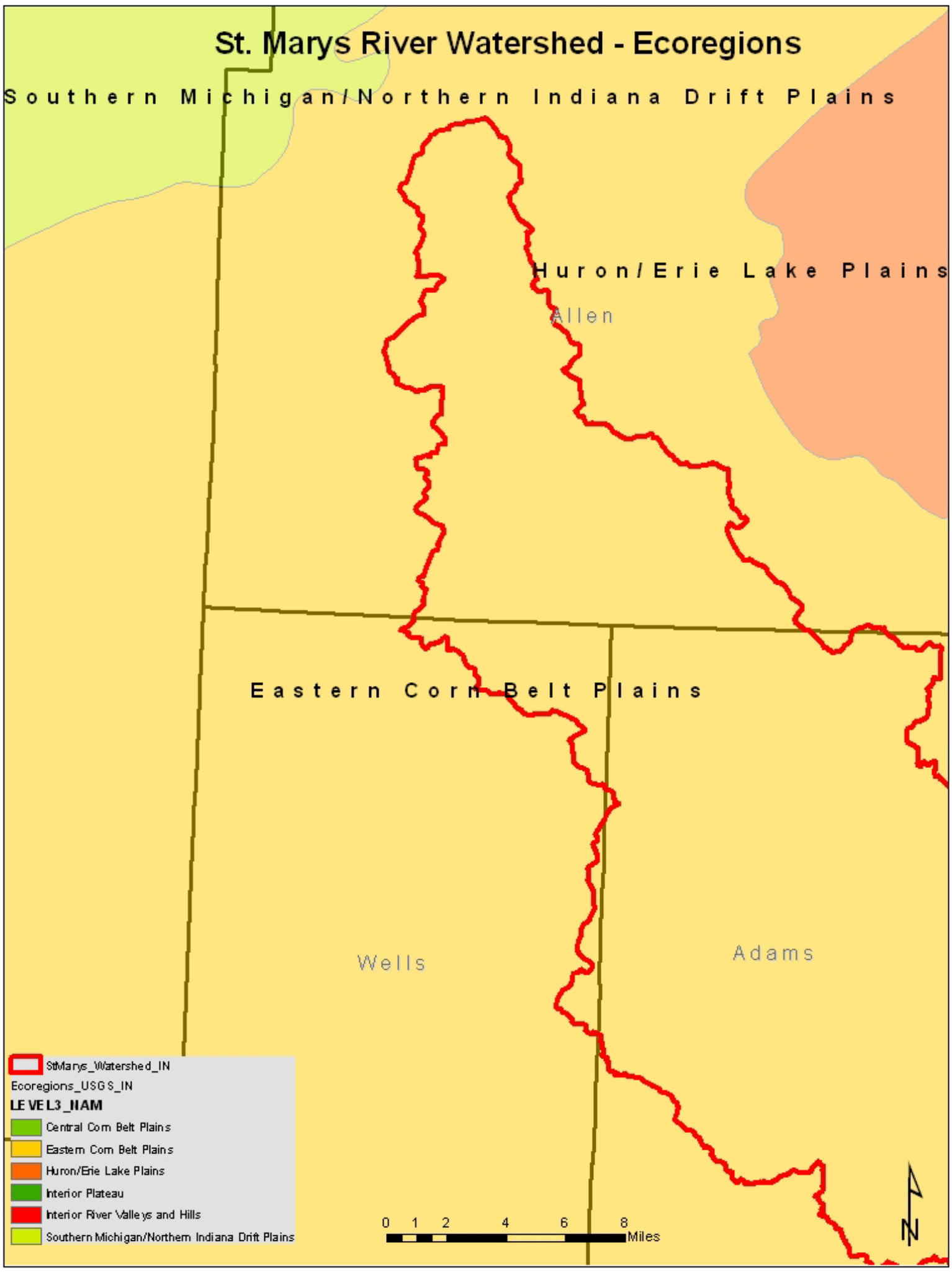

Figure 6. St. Marys River Watershed Ecoregion

The area is very poorly drained and drainage ditches are commonly used to carry runoff and lower the characteristically shallow water table within the slow draining till. The St. Marys River itself is comprised of alluvial and outwash deposits. The alluvium does not extend significantly beyond the channel. The surrounding clayey or silty soils have high runoff coefficients. These factors contribute to surface runoff and ultimately the flooding of the St. Marys River.

Indiana, particularly in the central region, has some of the most productive soils in the United States. The soils, good management, and temperate climate contribute to consistently increasing crop yields. Soil types in the St. Marys River Watershed are derived from two general groups: Saranac-Eel-Tice and the Blount-Pewamo-Glynwood. The clayey Saranac soils occur in depressional areas that are subject to frequent flooding and are poorly drained. Loamy Tice soils, which appear in slightly higher areas than Saranac soils, are somewhat poorly drained. The silty, clayey, and loamy soils of the Blount-Pewamo-Glynwood association, characterized by very gradual swale and swell topography and occasional areas that have frequent changes of slope, occur on till plains and moraines. In depressional areas, the nearly level, very poorly drained Pewamo soils occur. On relatively higher lying broad flats and slight rises, the nearly level somewhat poorly drained Blount soils appear. Glynwood soils, which are gently sloping, moderately well drained soils, are located on yet higher convex side slopes. (Maumee Comm. 1996)

The USDA classifies lands with high potential for erosion as Highly Erodible Lands (HEL). The basis for identifying highly erodible land is the erodibility index of a soil map unit. The erodibility index of soil is determined by dividing the potential erodibility for each soil by the soil loss tolerance (T) value established for the soil. The T value represents the maximum annual rate of soil erosion that could take place without causing a decline in long-term productivity. A soil mapping unit with an erodibility index of 8 or more is a highly erodible soil mapping unit.

Potential erodibility for sheet and rill erosion is estimated by multiplying the following factors of the Universal Soil Loss Equation (USLE):

1. Rainfall and runoff factor (R)
2. Susceptibility of the soil to water erosion (K)
3. Combined effects of slope length and steepness (LS)

The erodibility index for sheet and rill erosion is represented by the formula RKLS/T. A soil map unit is highly erodible if the LS factor for the shortest length and minimum percent of slope is used and the RKLS/T value equals or exceeds 8.

A soil mapping unit is potentially highly erodible if: (1) the RKLS/T value using the minimum LS factor is less than 8 and (2) the RKLS/T value using the maximum LS factor is equal to or greater than 8. Figure 7 below shows areas in the watershed that are subject to erosion.

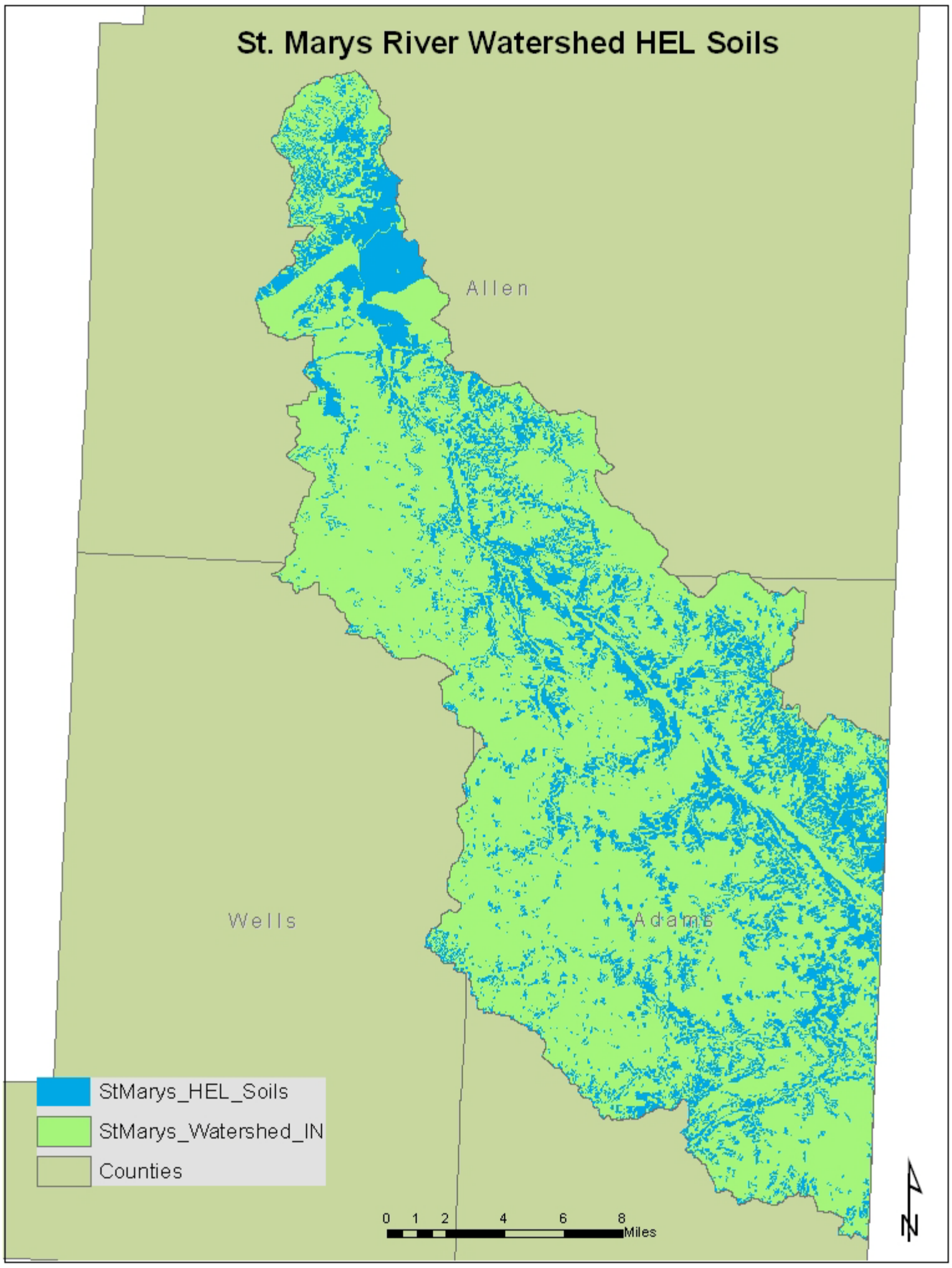

Figure 7. HEL Soil in the St. Marys River Watershed

Septic systems need well-drained soils to function properly. The majority of the soils in the St. Marys River Watershed have severe limitations for the suitability of septic systems due to slow permeability, ponding and seasonal wetness. Figure 8 shows soil limitations for septic systems in the watershed based off of USDA Soil Surveys. Limitations are considered severe if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required (USDA, 1986). However, it should be noted, that after direct conversation with local health departments who conduct investigations for the placement of septic systems, in most cases a suitable area can be found on most land tracts to install a system.

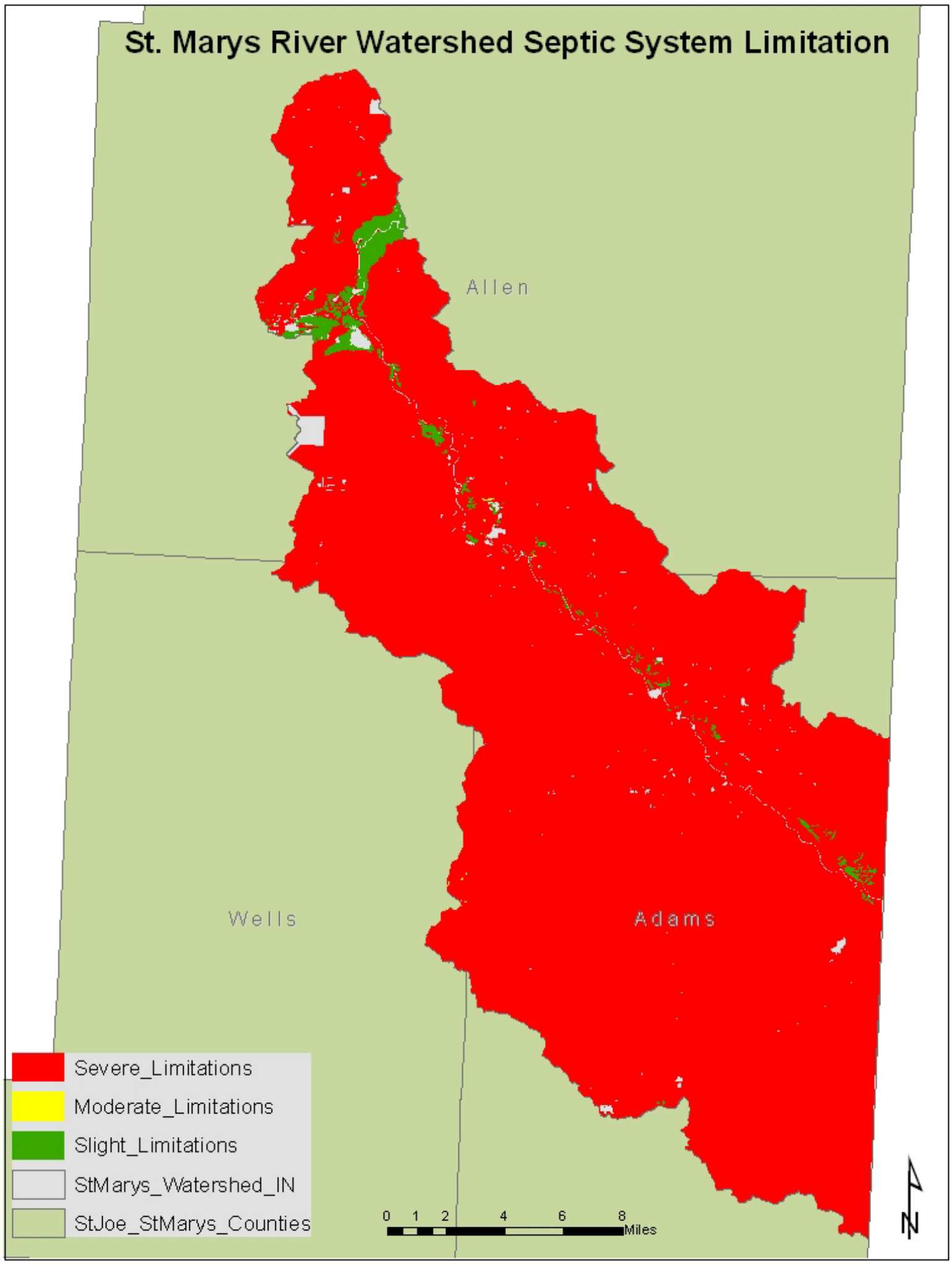

Figure 8. Soil Limitations in the St. Marys River Watershed for septic systems.

2.3 Hydrology

There are approximately 1303.9 miles of waterways in the St. Marys River Watershed. Table 1 provides a break down of stream miles by order and county.

Stream Miles by Order							
Description	**Acres of Standing Water (Lakes/Ponds)**	**Total Miles of Streams**	**Total Miles of 1st Order Streams**	**Total Miles of 2nd Order Streams**	**Total Miles of 3rd Order Streams**	**Total Miles of 4th Order Streams**	**Total Miles of 5th Order Streams**
St. Marys Watershed	1006.1	1303.9	713.0	285.9	140.5	75.7	88.8
Adams Co., IN portion	360.4	371.1	196.7	90.4	40.1	22.9	21.0
Allen Co., IN portion	294.8	161.7	80.3	35.8	23.3	2.8	19.6
Auglaize Co., OH portion	250.9	304.5	157.0	73.1	32.6	29.2	12.6
Mercer Co., OH portion	51.6	322.7	180.3	60.4	36.7	18.1	27.2
Shelby Co., OH portion	27.6	43.9	31.5	10.0	2.4	N/A	N/A
Van Wert Co., OH portion	20.8	90.2	58.5	15.2	5.4	2.7	8.4

Table 1. Stream Miles by Order (NRCS, 2008).

In Allen County the St. Marys is one of four major rivers, draining the south central portion of the county. The northern part of Adams County is drained by the St. Marys River while the southern portion is drained by the Wabash River. Northern Wells County is drained by Eight-Mile Creek and the Wabash River. A small area in the northeastern part of the county is drained by the St. Marys River. The central and southern parts are drained by the Wabash River, while the southwestern part is drained by the Salamonie River. Approximately 0.32% of the watershed is designated as open water. Prior to clearing and heavy agricultural use, swamps, marshes and wetlands were common in the St. Marys River Watershed. However, once settlements arose, many of these water resources disappeared as subsurface drainage systems were installed to increase agricultural productivity. Furthermore, to increase agricultural productivity in the watershed, many small ditches and streams have been cleared, straightened, and deepened to augment drainage of agricultural fields. Today, legal drains in the watershed are maintained by County Drainage Boards. Many streams in the watershed now lack a riparian corridor or buffer. An inventory of stream buffer widths was completed by the St. Marys River Watershed Project using aerial photos. The following Table 2 shows the results from this inventory.

St. Marys River Watershed Stream Buffers			
	Buffer Width	# Parcels	% Parcels
	0 – 10 feet	978	41%
	11 – 20 feet	221	9%
	21 – 60 feet	450	19%
	61 – 140 feet	396	17%
	141 - >300 feet	344	14%

Table 2. St. Marys River Watershed Stream Buffers.

Figures 9 and 10 represent approximate stream buffer widths in the St. Marys River Watershed.

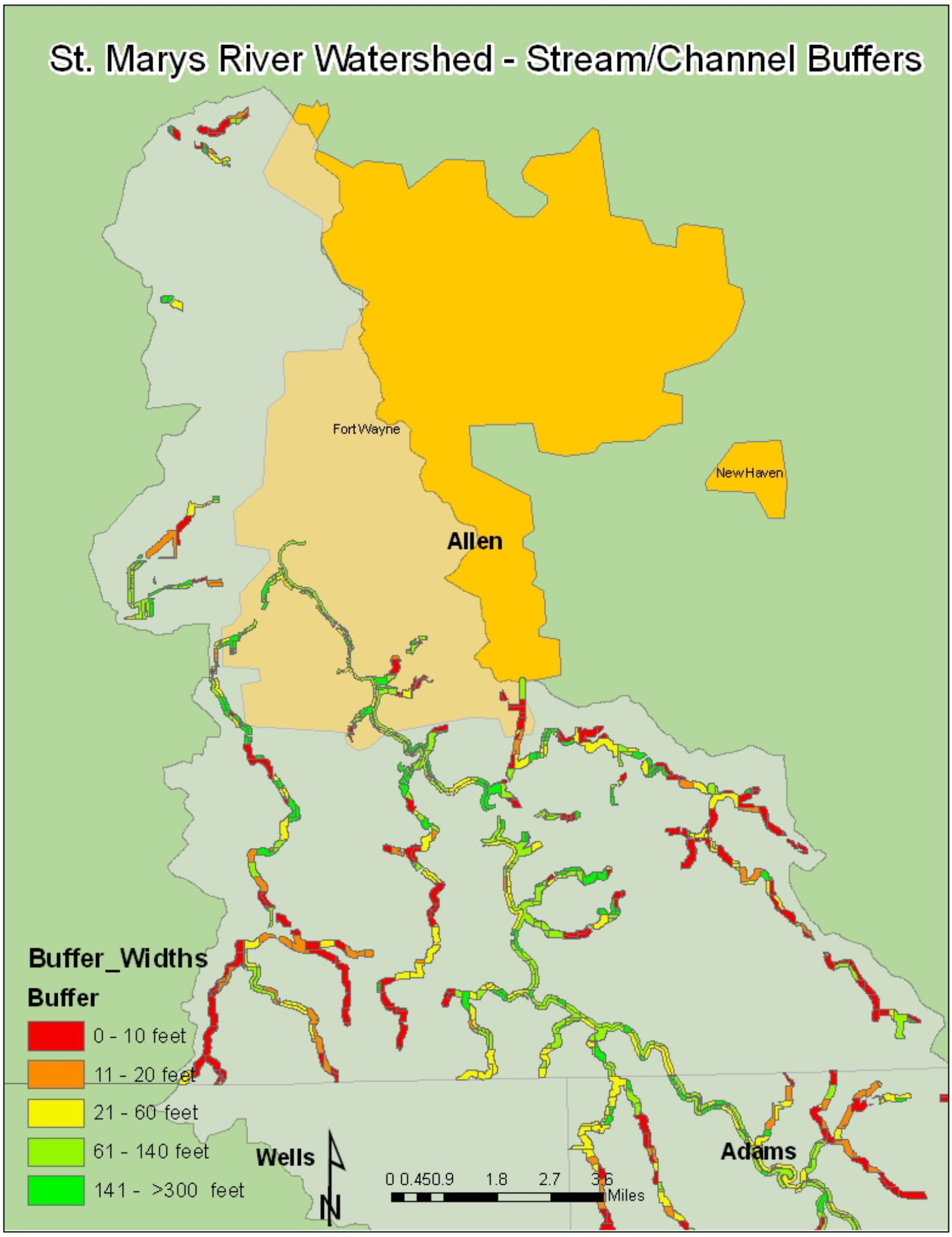

Figure 9. Stream buffer widths in the St. Marys River Watershed – Allen County.

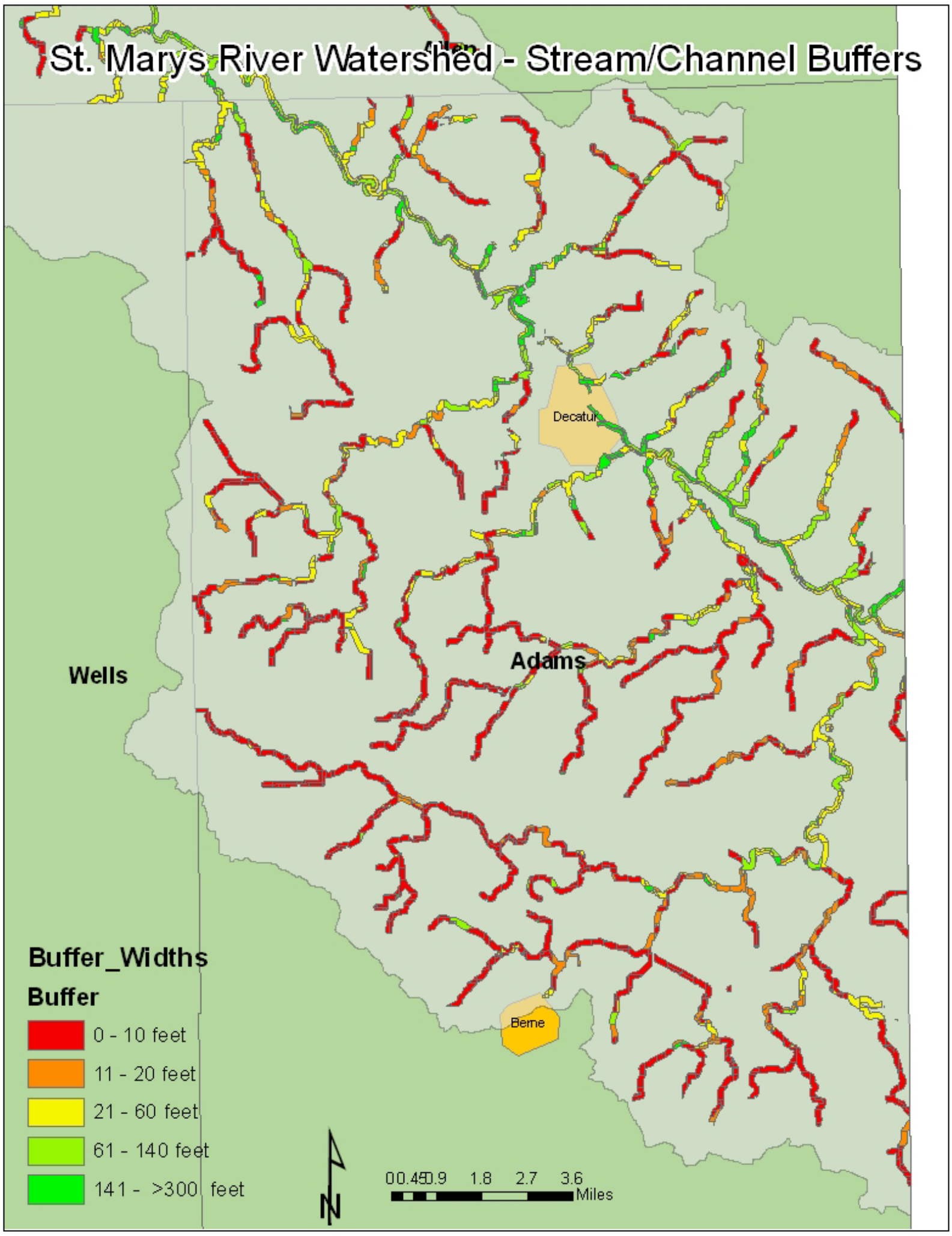

Figure 10. Stream buffer widths in the St. Marys River Watershed – Adams County.

2.4 Climate

The climate of the St. Marys River basin is classified as temperate continental, which describes areas having warm summers, cool winters, and the absence of a pronounced dry season. Precipitation and temperature throughout the basin vary considerably on a daily, seasonal and yearly basis. An average winter temperature of 28ºF and a summer average temperature of 72ºF characterize the climate in the St. Marys River Watershed region. Rainfall averages 36 inches per year with 60% of this falling between April and September during the crop season. Snowfall annually averages 29 inches, which provides a vital source for soil moisture. The average relative humidity is 60% and the predominant wind is from the southwest. (USDA County Soil Surveys, Adams County)

2.5 Landuse

The native vegetation of the St. Marys River Watershed consists of beech-maple hardwood forest. Today this vegetation has been replaced with an intensive agricultural base. The land cover in the watershed is predominantly agriculture, representing approximately 84% of the total land cover. The U.S. Geological Survey - Biological Resources Division and the U.S. Fish and Wildlife Service are overseeing the National GAP Analysis Program. The mission of the Gap Analysis Program (GAP) is to provide regional assessments of the conservation status of native vertebrate species and natural land cover types and to facilitate the application of this information to land management activities (http://gapanalysis.nbii.gov). Figure 11 is a summary of vegetative cover in the watershed determined from the GAP image and Figures 12 and 13, geographically show the land use type within the St. Marys Watershed. Data from the 2006 National Ag Statistics indicates there are approximately 150,921 acres of crop land in the watershed.

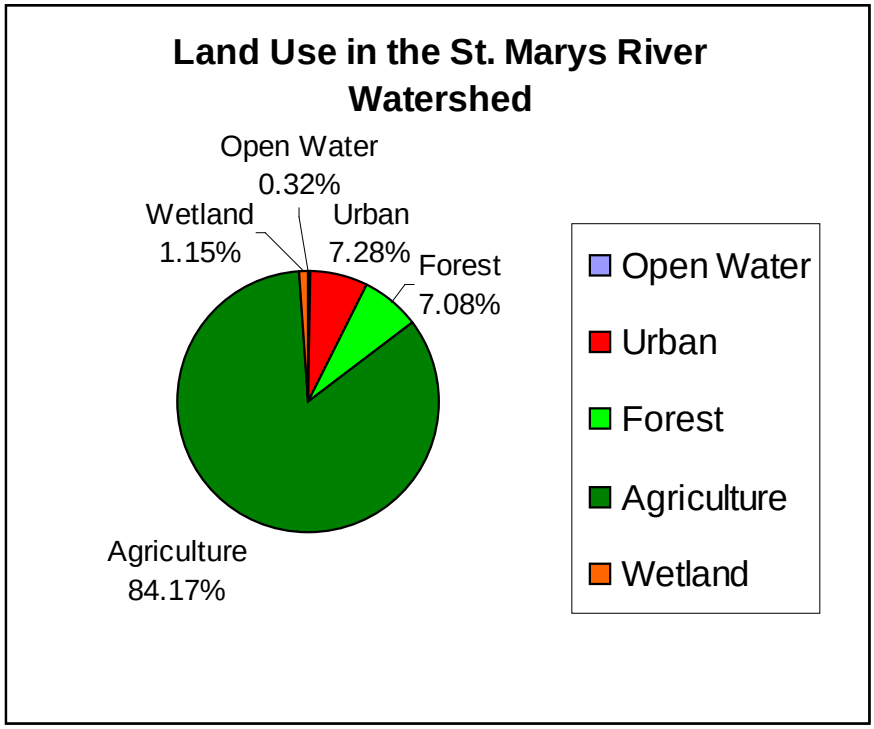

Figure 11. Land Use in the St. Marys River Watershed via Gap Analysis

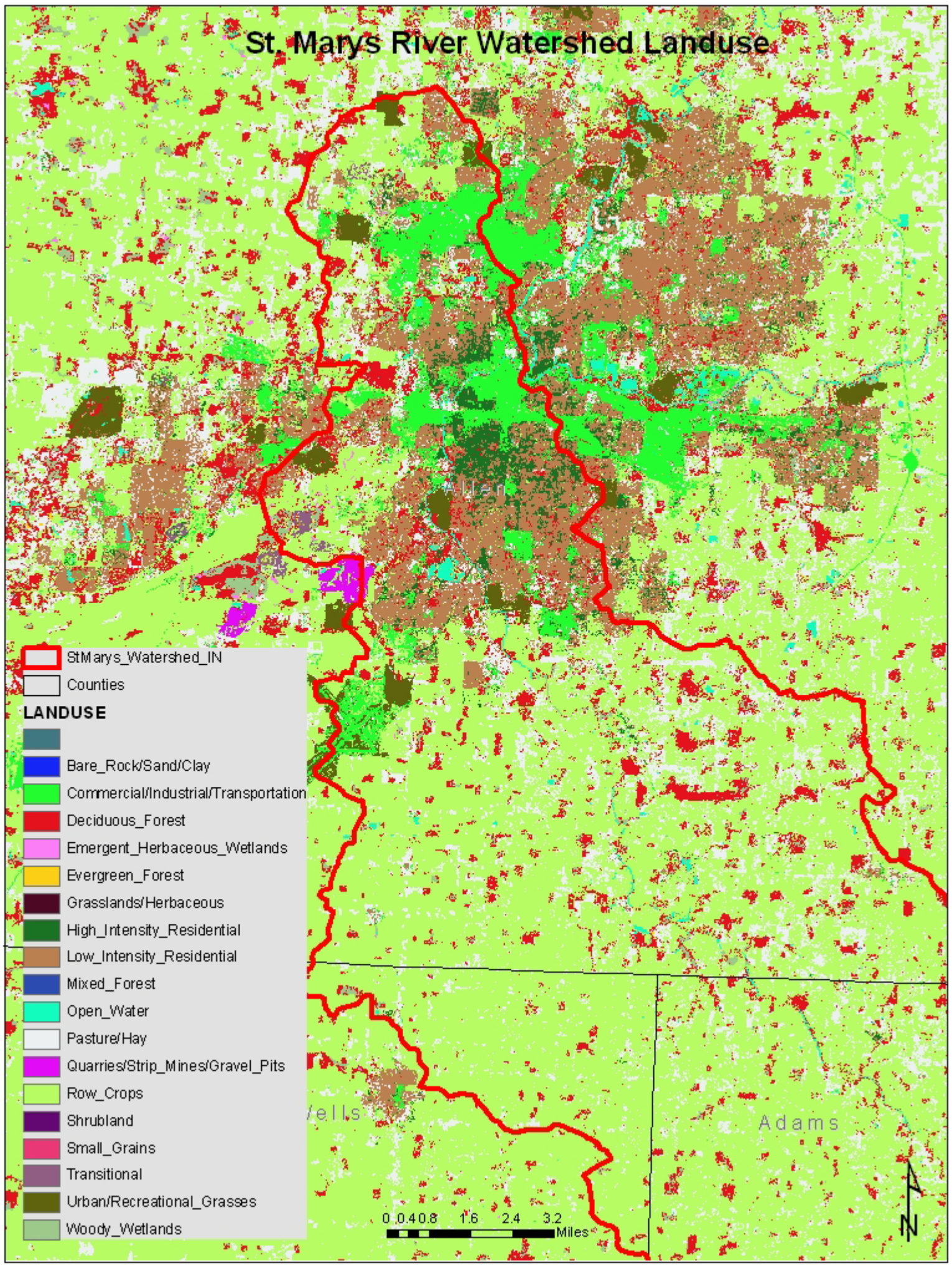

Figure 12. Land use in the St. Marys River Watershed (Allen County)

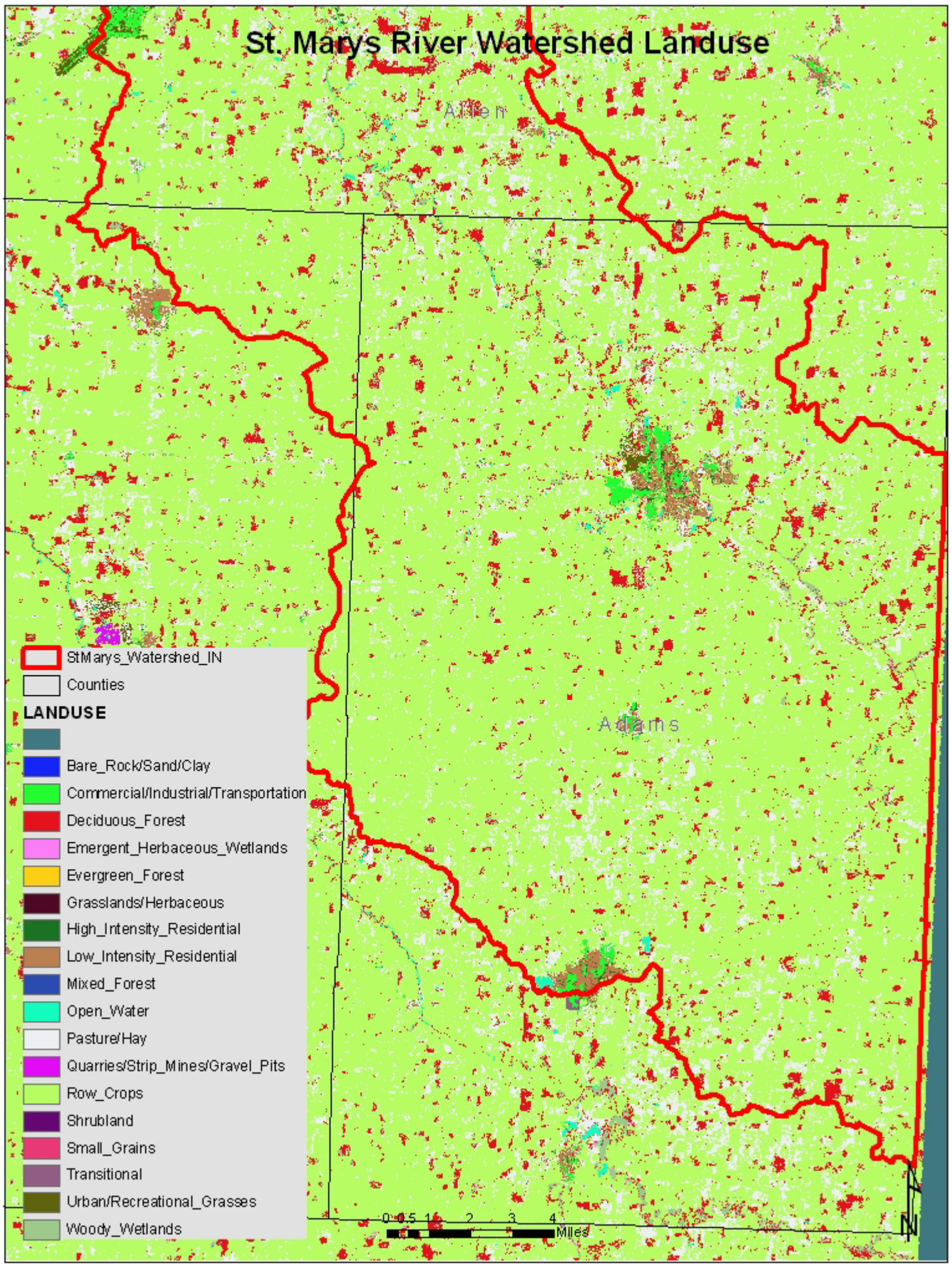

Figure 13. Land use in the St. Marys River Watershed (Adams County)

Corn and soybeans comprise the majority of crops produced in the St. Marys River Watershed. Additional land uses include urban areas, wetlands, and wooded areas. The wetland communities that were present in the watershed include floodplain forest, till plains flat woods, wet prairies, marshes, seeps, and fens. These communities are nearly gone due to the impact of agriculture and urbanization (U.S. Geological Survey, 1994). Decatur, Berne, Monroe and Fort Wayne are the four major urban areas within the watershed. Decatur and Monroe are located wholly within the watershed while Berne and Fort Wayne are located within multiple watersheds. Land use within the city limits of the aforementioned metropolitan areas is by and large urban, consisting mainly of impervious surfaces. These surfaces include roads, parking lots, and rooftops, which direct stormwater into small headwater streams and ditches and ultimately into the main stem of the St. Marys River. In the City of Fort Wayne, sanitary sewers are directed to the waste water treatment plant (WWTP) and discharged to the Maumee River. However, numerous combined sewer overflows (CSO's) and stormwater outlets exist along the St. Marys River. The City of Decatur's sewage treatment plant discharges to the St. Marys River near the north edge of Decatur. Sanitary systems in Berne and Monroe are discharged to the Wabash River. It should be noted that untreated stormwater from these towns also discharges to the St. Marys River Watershed.

Urban sprawl is evident in the outskirts of Fort Wayne and Decatur. In these areas, land once used for agriculture is rapidly being converted to residential housing and commercial businesses. Land use in the majority of the watershed is expected to remain in agricultural production or rural area.

2.6 Land Ownership

The large majority of land in the St. Marys River watershed is privately owned . In the watershed, a total of 518 acres of the 240,366 acres comprising the watershed is designated public lands. The southern portion of the City of Fort Wayne is located in the watershed, with a population of approximately 252,000 people. Decatur, the Adams County seat, is located in the watershed with a population 9,500. Other small towns located within the watershed boundaries include Monroe (population 734) and the northern edge of Berne (population 4150).

2.7 Threatened and Endangered Species

The St. Marys River Watershed is home to numerous threatened and endangered species. Appendix II shows the endangered, threatened and rare species that have been identified in Adams, Allen, and Wells counties. The following Table 3 identifies unique habitat areas in the St. Marys River Watershed.

Unique Habitat Areas				
Ac. Within Range of Known T&E Species	**% of Watershed Within Range of Known T&E Species**	**Natural Communities**	**Permanent Easement (Ac.)**	**% of Watershed in Permanent Easement**
8,431	3.51	122	1,043	0.43
Data Source (Threatened and Endangered Species) = IDNR, Div. of Nature Preserves; Analysis by NRCS, 2007, data source is not public. Habitat ranges indicate the likely life-history range surrounding known locations of T&E species (state & federal listed) that have the potential to be used by the species (ranges for plants = point – 0 miles; amphibians/reptiles/insects/aquatic species = ¼-½ mile; mammals/birds = 1 mile.				
Data Source (Natural Communities) = Areas identified and classified by the IDNR as unique/rare (data include the Natural Community acreage + ¼ mile buffer), unpublished data.				
Data Source (Permanent Easements) = Indiana NRCS (Wetlands Reserve Programs), 2007, unpublished data.				

Table 3. Unique habitat areas in the St. Marys River Watershed.

2.8 Wetlands

Prior to European settlement, 24.1% of Indiana's surface was covered by wetlands (State of Indiana, 2007). Approximately 85% of Indiana's wetlands have been lost, which ranks Indiana fourth in the nation for wetland loss. The following Figure 14, identifies hydric soils in the watershed. Hydric soils have typical characteristics of wetland soils.

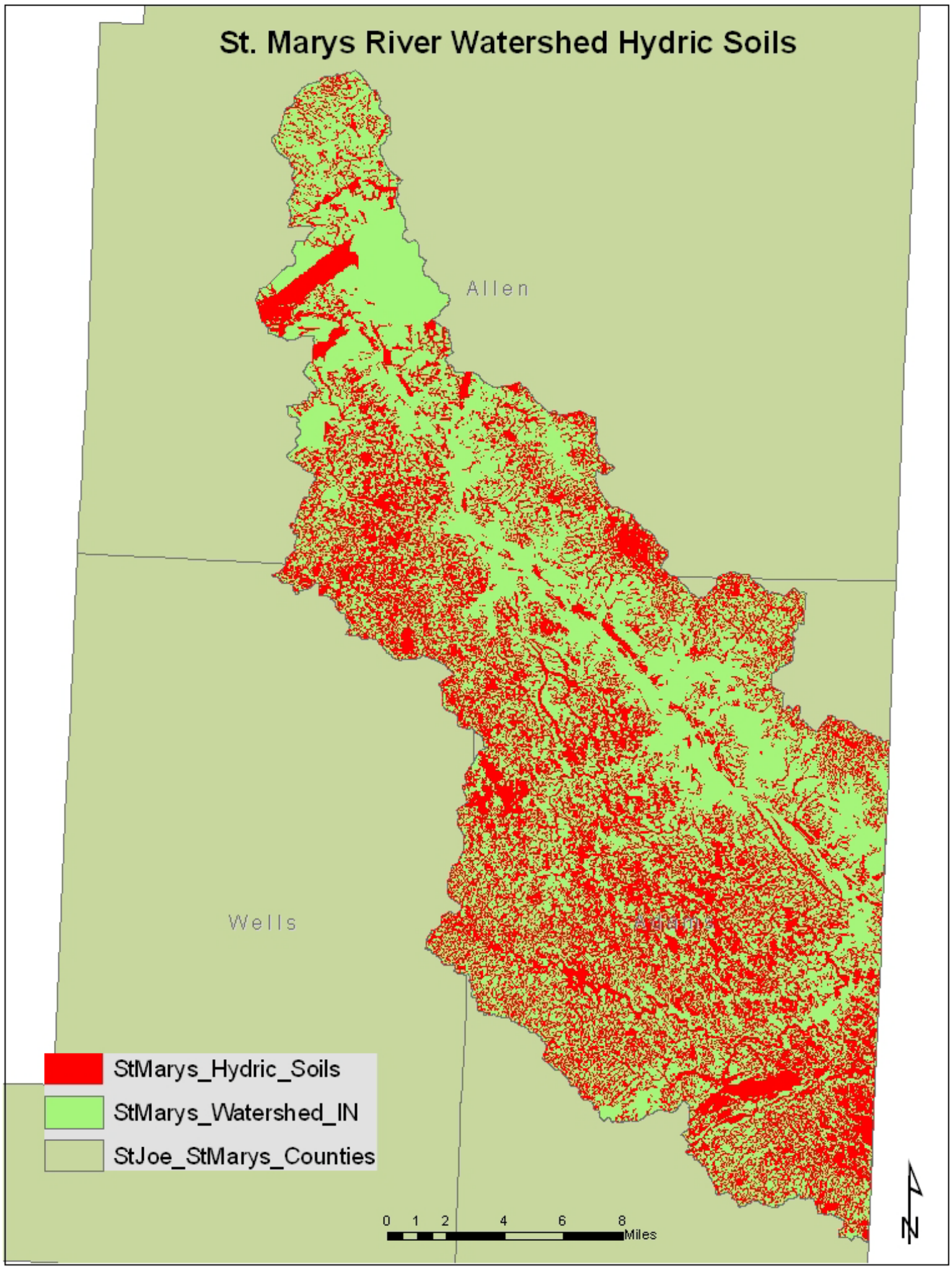

Figure 14. Hydric Soils in the St. Marys River Watershed.

Currently, the St. Marys River Watershed contains approximately 1.15% or 3,322 acres of wetlands. The National Wetland Inventory (NWI) compiled by the United States Geological Society uses aerial photography to catalog wetlands. Figure 15 shows wetlands in the St. Marys River Watershed as compiled by the NWI.

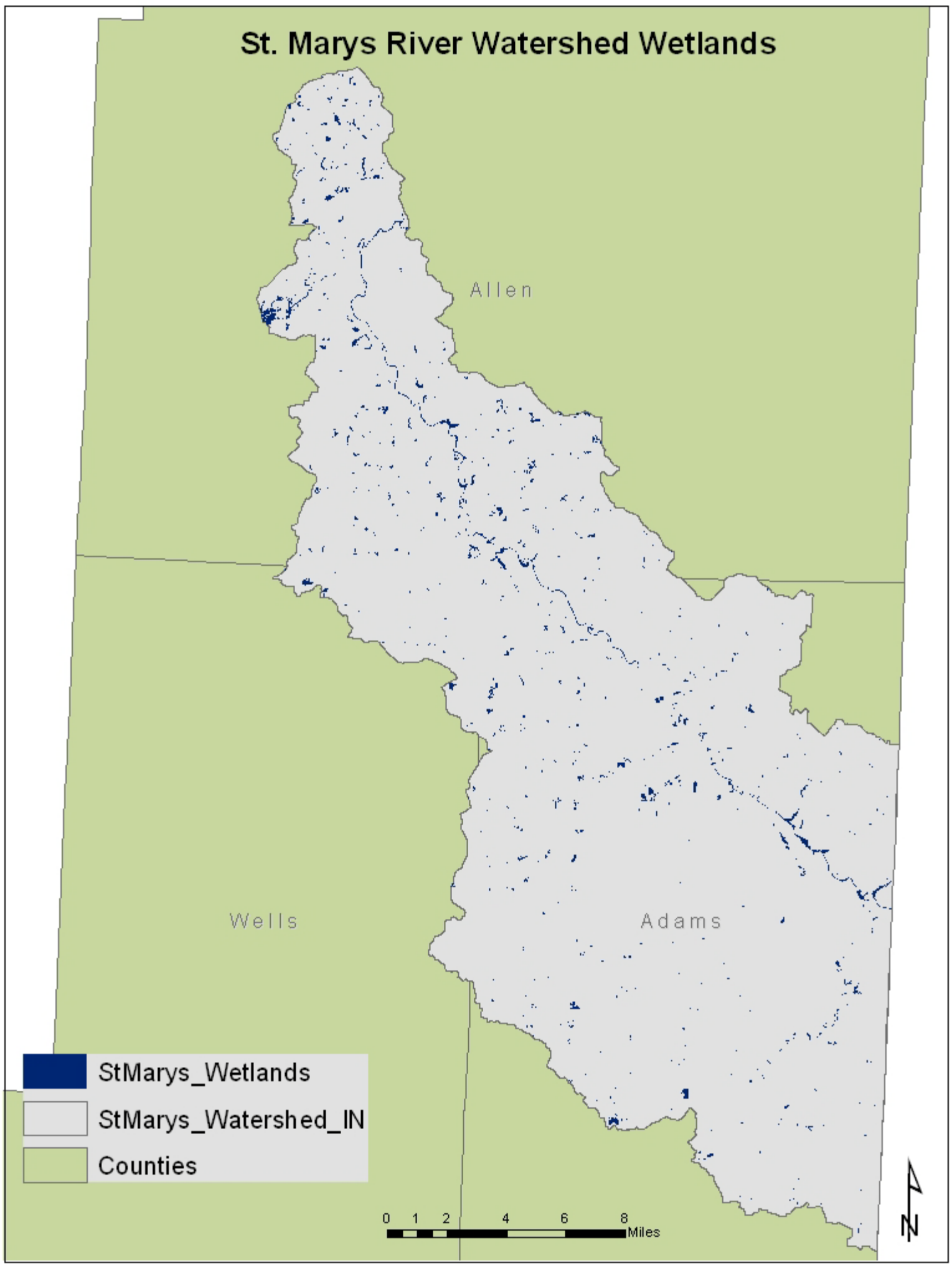

Figure 15. Wetlands in the St. Marys River Watershed.

3.0 WATER QUALITY

A critical step in the watershed planning process is to research and assess the current status of the watershed as well as existing water quality studies that have documented historic conditions in the watershed. IDEM has been the principal party involved in collecting data in the St. Marys River Watershed. IDEM studies have included numerous long term monitoring locations, dating back to 1990; 303(d) list assessments, TMDL studies, a Watershed Restoration Action Strategy survey, as well as biotic community surveys. Furthermore, a number of other agencies and organizations have completed research and collected data in the watershed. The following sections will detail previous and current assessments of the St. Marys River Watershed.

3.1 Indiana 303(d) List

The St. Marys River and its tributaries are designated by IDEM for full body contact recreation and warm water aquatic communities. The USEPA designated the St. Marys for human health and wildlife. The St. Marys River and many of its tributaries do not currently meet IDEM standards for the aforementioned use designations. Section 303(d) of the Clean Water Act requires states to identify waters, through their Section 305(b) water quality assessments, that do not or are not expected to meet applicable water quality standards with federal technology based standards alone. States are also required to develop a priority ranking for these waters, taking into account the severity of the pollution and the designated uses of the waters. Once this listing and ranking of impaired waters is completed, the states are required to develop Total Maximum Daily Loads (TMDLs) for these waters in order to achieve compliance with the water quality standards.

The 303(d) list commonly recognizes waters in the St. Marys watershed as being impaired. Stream segments in the St. Marys River watershed are listed on the 2002 303(d) List for *E. coli*, impaired biotic communities (IBC), ammonia, nutrients, algae, and total dissolved solids. On the 2004 303(d) List, segments from the St. Marys River watershed are listed for *E. coli*, impaired biotic communities (IBC), ammonia, and nutrients. On the 2006 303(d) List, the St. Marys River watershed is listed for *E. coli*, impaired biotic communities (IBC), nutrients, and fish consumption advisory (FCA) for PCB's and Mercury. The following Table 4 identifies impaired water body segments listed on the 2008 303(d) list as well as the cause of impairment. Figure 16 represents the geographic locations of the 2008 303(d) listed waters.

St. Marys River Watershed (Indiana) 2008 303(d) List of Impaired Waters				
County	Waterbody Segment ID	Waterbody Segment Name	Cause of Impairment	Category
ADAMS CO	INA0442_T1001A	FUCH DITCH - UNNAMED TRIBUTARY (CR 17)	IMPAIRED BIOTIC COMMUNTIES	5A
ADAMS CO	INA0442_T1001A	FUCH DITCH - UNNAMED TRIBUTARY (CR 17)	NUTRIENTS	5A
ADAMS CO	INA0443_T1014	GATES DITCH	NUTRIENTS	5A
ADAMS CO	INA0445_00	DUER DITCH (ADAMS) AND OTHER TRIBS	*E. COLI*	5A
ADAMS CO	INA0446_T1015	ST. MARYS RIVER	NUTRIENTS	5A
ADAMS CO	INA0447_T1002	MARTZ CREEK-RUPPERT DITCH AND UNNAMED TRIBUTARY	NUTRIENTS	5A
ADAMS CO	INA0448_00	BORUM RUN AND TRIBS	IMPAIRED BIOTIC COMMUNTIES	5A
ALLEN CO	INA0454_T1005	ST. MARYS RIVER	*E. COLI*	5A
ALLEN CO	INA0454_T1021	ST. MARYS RIVER	IMPAIRED BIOTIC COMMUNTIES	5A
ALLEN CO	INA0454_T1021	ST. MARYS RIVER	NUTRIENTS	5A
ALLEN CO	INA0463_T1003	St. Marys River	NUTRIENTS	5A
ALLEN CO	INA0465_00	JUNK DITCH AND OTHER TRIBS	Mercury in Fish Tissue	5B
ALLEN CO	INA0465_00	JUNK DITCH AND OTHER TRIBS	PCBs in Fish Tissue	5B
ALLEN CO	INA0465_T1002	St. Marys River	NUTRIENTS	5A
ALLEN CO	INA0465_T1002	ST MARYS RIVER	Mercury in Fish Tissue	5B
ALLEN CO	INA0465_T1002	ST MARYS RIVER	PCBs in Fish Tissue	5B
ALLEN CO	INA0466_T1022	St. Marys River	NUTRIENTS	5A
ALLEN CO	INA0466_T1022	ST MARYS RIVER	Mercury in Fish Tissue	5B
ALLEN CO	INA0466_T1022	ST MARYS RIVER	PCBs in Fish Tissue	5B
ADAMS CO	INA0434_00	ST. MARYS RIVER-WILLSHIRE	*E. COLI*	4A
ADAMS CO	INA0441_00	ST. MARYS RIVER	*E. COLI*	4A
ADAMS CO	INA0442_00	BLUE CREEK HEADWATERS (ADAMS)	*E. COLI*	4A
ADAMS CO	INA0442_T1007	BLUE CREEK	*E. COLI*	4A
ADAMS CO	INA0443_T1008	HABEGGER DITCH	*E. COLI*	4A
ADAMS CO	INA0443_T1014	GATES DITCH	*E. COLI*	4A
ADAMS CO	INA0443_T1019	FARLOW DITCH AND TRIBS	*E. COLI*	4A
ADAMS CO	INA0443_T1020	WITTMER NO 1 DITCH	*E. COLI*	4A
ADAMS CO	INA0444_00	LITTLE BLUE CREEK	*E. COLI*	4A
ADAMS CO	INA0445_T1006	BLUE CREEK	*E. COLI*	4A
ADAMS CO	INA0446_00	PLEASANT MILLS AND	*E. COLI*	4A

		TRIBS		
ADAMS CO	INA0446_T1015	ST. MARYS RIVER	*E. COLI*	4A
ADAMS CO	INA0447_00	YELLOW CREEK	*E. COLI*	4A
ADAMS CO	INA0447_T1002	MARTZ CREEK-RUPPERT DITCH AND UNNAMED TRIBUTARY	*E. COLI*	4A
ADAMS CO	INA0448_00	BORUM RUN AND TRIBS	*E. COLI*	4A
ADAMS CO	INA0448_T1016	ST. MARYS RIVER	*E. COLI*	4A
ADAMS CO	INA0449_00	DECATUR TRIBS	*E. COLI*	4A
ADAMS CO	INA0449_T1017	ST. MARYS RIVER	*E. COLI*	4A
ADAMS CO	INA0452_00	HOLTHOUSE DITCH-KOHNE DITCH	*E. COLI*	4A
ADAMS CO	INA0453_00	GERKE/WEBER DITCH AND TRIBS	*E. COLI*	4A
ADAMS CO	INA0453_T1018	ST. MARYS RIVER	*E. COLI*	4A
ALLEN CO	INA0454_T1012	ST. MARYS RIVER TRIB	*E. COLI*	4A
ALLEN CO	INA0454_T1021	ST. MARYS RIVER	*E. COLI*	4A
ALLEN CO	INA0461_T1004	ST. MARYS RIVER	*E. COLI*	4A
ALLEN CO	INA0463_00	SNYDER DITCH AND OTHER TRIBS	*E. COLI*	4A
ALLEN CO	INA0463_T1003	ST. MARYS RIVER	*E. COLI*	4A
ALLEN CO	INA0465_00	JUNK DITCH AND OTHER TRIBS	*E. COLI*	4A
ALLEN CO	INA0465_T1002	ST. MARYS RIVER	*E. COLI*	4A
ALLEN CO	INA0466_T1011	SPY RUN CREEK	*E. COLI*	4A
ALLEN CO	INA0466_T1012	SPY RUN CREEK-UNNAMED TRIBUTARIES	*E. COLI*	4A
ALLEN CO	INA0466_T1022	ST. MARYS RIVER	*E. COLI*	4A
ADAMS CO	INA0443_T1008	HABEGGER DITCH	IMPAIRED BIOTIC COMMUNITIES	4A
ADAMS CO	INA0445_T1006	BLUE CREEK	IMPAIRED BIOTIC COMMUNITIES	4A
ADAMS CO	INA0447_00	YELLOW CREEK	NUTRIENTS	4A
ADAMS CO	INA0447_00	YELLOW CREEK	IMPAIRED BIOTIC COMMUNITIES	4A
ALLEN CO	INA0454_T1012	ST. MARYS RIVER TRIB	IMPAIRED BIOTIC COMMUNITIES	4A

Table 4. 2008 303(d) Listings for St. Marys River watershed

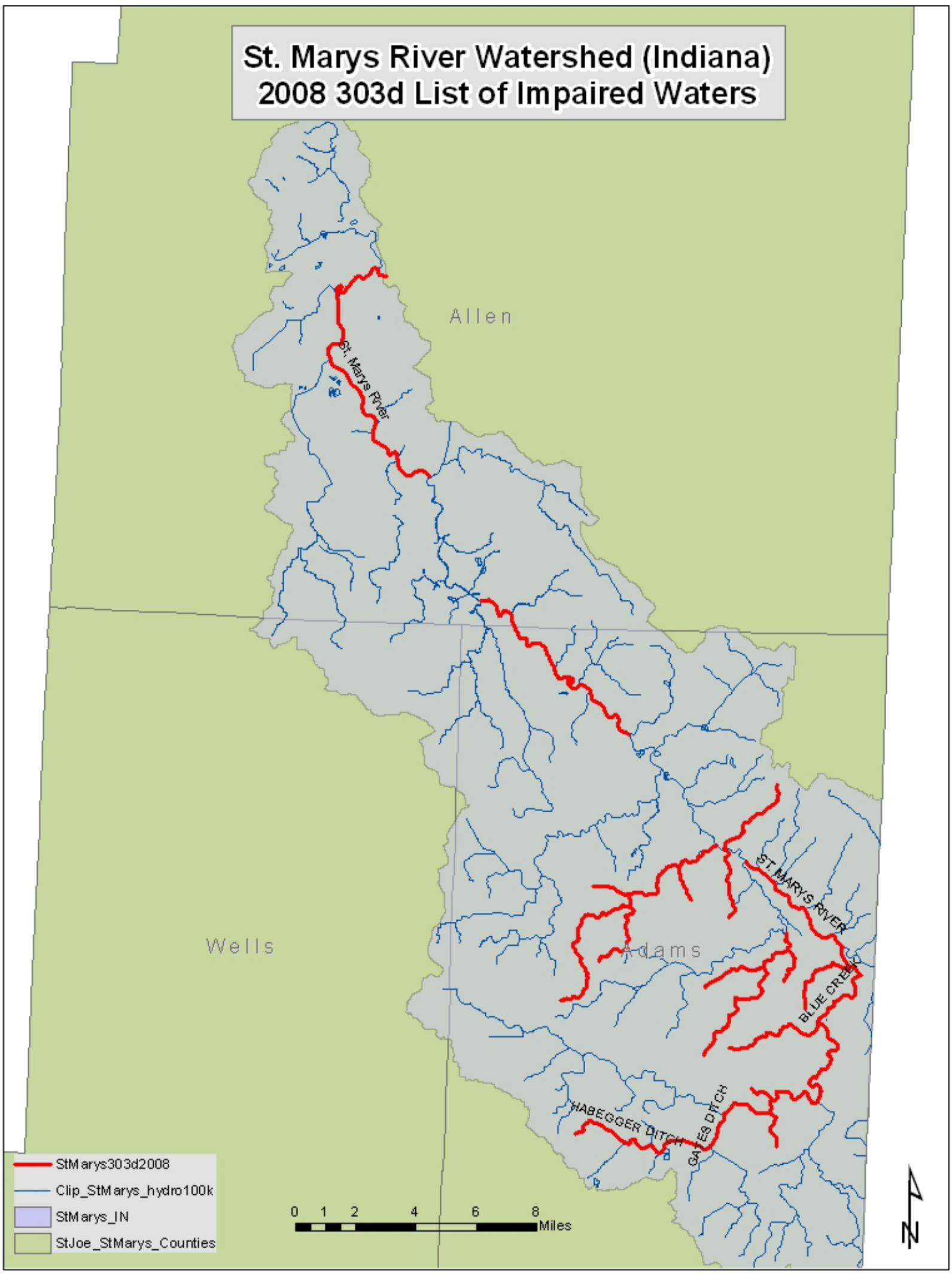

Figure 16. 2008 303(d) list waters.

3.2 St. Marys River TMDL for *E. coli* Impairment / TMDL for Impaired Biotic Communities and Nutrients for the Blue Creek/Habegger Ditch and Yellow Creek Watersheds

In accordance with section 303(d) of the Federal Clean Water Act and the United States Environmental Protection Agency's (USEPA's) Water Quality Planning and Management Regulations (Title 40 of the Code of Federal Regulations (CFR), Part 130) it is required that States develop a Total Maximum Daily Load (TMDL) for water bodies that are not meeting State Water Quality Standards (WQS). A TMDL is a calculation of the maximum amount of a pollutant that a water body can receive and still safely meet water quality standards (www.epa.gov). The TMDL for a given water body and pollutant is the sum of individual waste load allocations (WLA's) for point sources and load allocations (LA's) for nonpoint sources and natural background levels (USEPA, 2001). The sum of the allocations must not result in the exceedence of the water quality standard. In addition, a margin of safety (MOS) must be included in the analysis, either implicitly or explicitly. The MOS accounts for any uncertainty in the relationship between loads and conditions in the receiving water and helps to ensure that the water quality standard is met. These concepts can be expressed conceptually by the equation:

$$TMDL = \sum WLA's + \sum LA's + MOS$$

In 2005, the Indiana Department of Environmental Management (IDEM) completed a TMDL for the St. Marys River Watershed in Allen and Adams Counties to identify the sources of the impairment and determine the allowable levels of *E. coli*, nutrients, and total suspended solids (TSS). The following Table 5 outlines impaired water body segments addressed in the St. Marys River Watershed TMDL.

Waterbody Name	303(d) List ID	Segment ID Number	Length (Miles)	Impairment
St. Marys – Willshire	40	INA0434_00	2.84	*E. coli*
St. Marys River	40	INA0441_00	0.86	*E. coli*
Blue Creek	40	INA0442_T1007	11.94	*E. coli*
Blue Creek	40	INA0445_T1006	12.28	*E. coli*, IBC, Ammonia, Nutrients
Duer Ditch (Adams) and Other Tribs	*to be determined	INA0445_00	9.33	*E. coli*
Blue Creek Headwaters (Adams)	*to be determined	INA0442_00	8.46	*E. coli*
Habegger Ditch	43	INA0443_T1008	5.8	*E. coli*, IBC, Nutrients
Wittmer Ditch, No. 1	*to be determined	INA0443_T1020	2.98	*E. coli*
Farlow Ditch and Tribs	*to be determined	INA0443_T1019	11.01	*E. coli*
Gates Ditch	273	INA0443_T1014	1.17	*E. coli*
Little Blue Creek	272	INA0444_00	22.12	*E. coli*
Borum Run and Tribs	*to be	INA0448_00	21.65	*E. coli*

	determined			
Yellow Creek	274	INA0447_00	32.79	*E. coli*, IBC, Nutrients
Martz Creek – Ruppert Ditch and Unnamed Tributaries	274	INA0447_T1002	9.82	*E. coli*
Holthouse Ditch – Kohne Ditch	275	INA0452_00	10.16	IBC, *E. coli*
St. Marys River	47	INA0448_T1016, INA0449_T1017, INA0453_T1018, INA0454_T1021	21.27	*E. coli*
St. Marys River	47	INA0461_T1004, INA0463_T1003, INA0465_T1002	16.43	*E. coli*, FCA for PCD & Hg
St. Marys River	*to be determined	INA0446_T1015	4.79	*E. coli*
Unnamed Trib. Of St. Marys River	276	INA0454_T1012	2.84	*E. coli*, IBC
Pleasant Mills and Tribs.	*to be determined	INA0446_T1015	4.79	*E. coli*
Decatur Tribs.	*to be determined	INA0449_00	7.12	*E. coli*
Gerke/Weber Ditch and Tribs.	*to be determined	INA0453_00	17.53	*E. coli*
Snyder Ditch and Other Tribs.	*to be determined	INA0463_00	10.61	*E. coli*
Junk Ditch	*to be determined	INA0465_00	6.55	*E. coli*
Spy Run Creek	278	INA0465_T1011	8.75	*E. coli*
Unnamed Tributaries to Spy Run Creek	Evaluated Assessment – will not be listed	INA0466_T1012	5.08	*E. coli*
St. Marys River	47	INA0466_T1022	0.5	*E. coli*

Table 5. Impaired water body segments addressed in the St. Marys River Watershed TMDL.

IDEM has also completed a TMDL for Impaired Biotic Communities and Nutrients for the Blue Creek/Habegger Ditch and Yellow Creek Sub-watersheds located within the larger St. Marys. The following Table 6 outlines impaired water body segments addressed in the Blue Creek/Habegger Ditch and Yellow Creek Watershed TMDL.

Waterbody Name	303(d) List ID	Segment ID Number	Length (Miles)	Impairment
Blue Creek	40	INA0445_T1006	12.28	*E. coli*, IBC, Nutrients
Habegger Ditch	43	INA0443_T1008	5.8	*E. coli*, IBC, Nutrients
Yellow Creek – Martz Ditch	274	INA0447_00	32.79	IBC, Nutrients
Unnamed Trib. Of St. Marys River	276	INA0454_T1012	2.84	*E. coli*, IBC

Table 6. Impaired water body segments addressed in the Blue Creek/Habegger Ditch and Yellow Creek Watershed TMDL.

Ohio also has the St. Marys River listed on their 303(d) List for impaired aquatic life use. Unfortunately, Ohio's portion of the St. Marys River TMDL is not scheduled for completion until 2017. Ohio's TMDL Program has provided support in the completion of Indiana's St. Marys River watershed TMDL. The Indiana TMDLs were developed on the basis that Ohio's water quality standards would be met at the Indiana – Ohio state line. The following Table 7 identifies the target loads set by the St. Marys and Blue Creek/Habegger Ditch and Yellow Creek Watersheds TMDL's.

Indiana TMDL Targets	
TMDL	Target
E. coli	125 cfu/100 ml / 235 cfu/100 ml**
Nitrogen* (nitrate+nitrite)	10 mg/l
Phosphorus*	0.30 mg/l
Total Suspended Solids (TSS)*	30 mg/l
Dissolved Oxygen*	Values ≤4.0 mg/l or ≥12.0 mg/l
pH*	Values <9.0
Algae*	"Excessive" observations by trained staff
* TMDL completed for Blue Creek/Habeggar Ditch and Yellow Creek Watersheds ** Single Sample Maximum Standard = 235 cfu/100 ml; Geometric Mean Standard= 125 cfu/100ml	

Table 7. TMDL target loads.

On average, in the Blue Creek sub watershed, nitrogen data exceeded the IDEM numeric target 14% of the time. Phosphorus criteria was exceeded 44% of the time, and TSS data was exceeded 28% of the time. In the Yellow Creek sub watershed, nitrogen targets were exceeded 5% of the time, phosphorus 39% of the time, and TSS 21% of the time. (Blue Creek/Habegger Ditch & Yellow Creek TMDL) The following table, Table 8, details *E. coli* target exceedances in the St. Marys River watershed.

E. coli Exceedences in the St. Marys River Watershed		
Watershed	**% Violation of IDEM Single Sample Maximum Standard (235 cfu/100ml)**	**% Violation of IDEM Geometric Mean Standard (125 cfu/100ml)**
Blue Creek	86%	100%
Yellow Creek	84%	100%
Martz Ditch	68%	N/A
Borum Run	59%	N/A
Holthouse Ditch	62%	72%
Nickelson Creek	72%	91%
St. Marys River Mainstem	85%	N/A
St. Marys River Mainstem	74%	N/A
St. Marys River Mainstem	71%	100%
St. Marys River Mainstem	60%	100%
St. Marys River Mainstem	75%	N/A
Source: St. Marys TMDL		

Table 8. *E. coli* exceedences in the St. Marys River Watershed

The purpose of the St. Marys River watershed TMDL is to identify pollutant sources and determine the allowable levels of *E. coli* bacteria, ammonia, nutrients, algae, and total dissolved solids from point and nonpoint sources, as well as impaired biotic communities (IBC). For the water bodies listed as impaired, the goal of the TMDL was to identify the pollutants causing the impairment and then set the appropriate allocations or assimilative capacity of the water body based on the pollutants that have been identified. Implementation of the TMDL will help in the attainment of the applicable WQS in the St. Marys River watershed in Adams, Allen and Wells Counties, Indiana. The complete TMDLs are included in Appendix III.

3.3 Water Quality Monitoring by the St. Marys River Watershed Project

The primary objective of the water quality monitoring project was to characterize the water quality in the St. Marys River Watershed. Samples were collected in order to evaluate the current chemical and physical characteristics of surface water, as well supplement previous data collected by IDEM, the Allen County Health Department, and the Adams County Soil and Water Conservation District. Furthermore, nutrient and TSS sampling were conducted throughout the winter months. Collection of these data will allow for levels to be observed during the non-recreational season, complementing data collected by outside sources during the recreational season.

In order to retrieve further baseline water quality conditions, additional water quality data were gathered from approximately twenty (20) sites in the watershed for *E. coli*, ammonia nitrogen, phosphorus, total suspended solids and pesticides. Sampling was conducted weekly in October and November 2007 and April through June 2008. Sampling was completed on a bi-weekly basis December 2007 though March 2008.

Complete sampling results can be found in Appendix IV of this report. The following Figure 17 identifies the water quality monitoring locations used and their associated subwatershed. Table 9 provides descriptions of water quality monitoring locations.

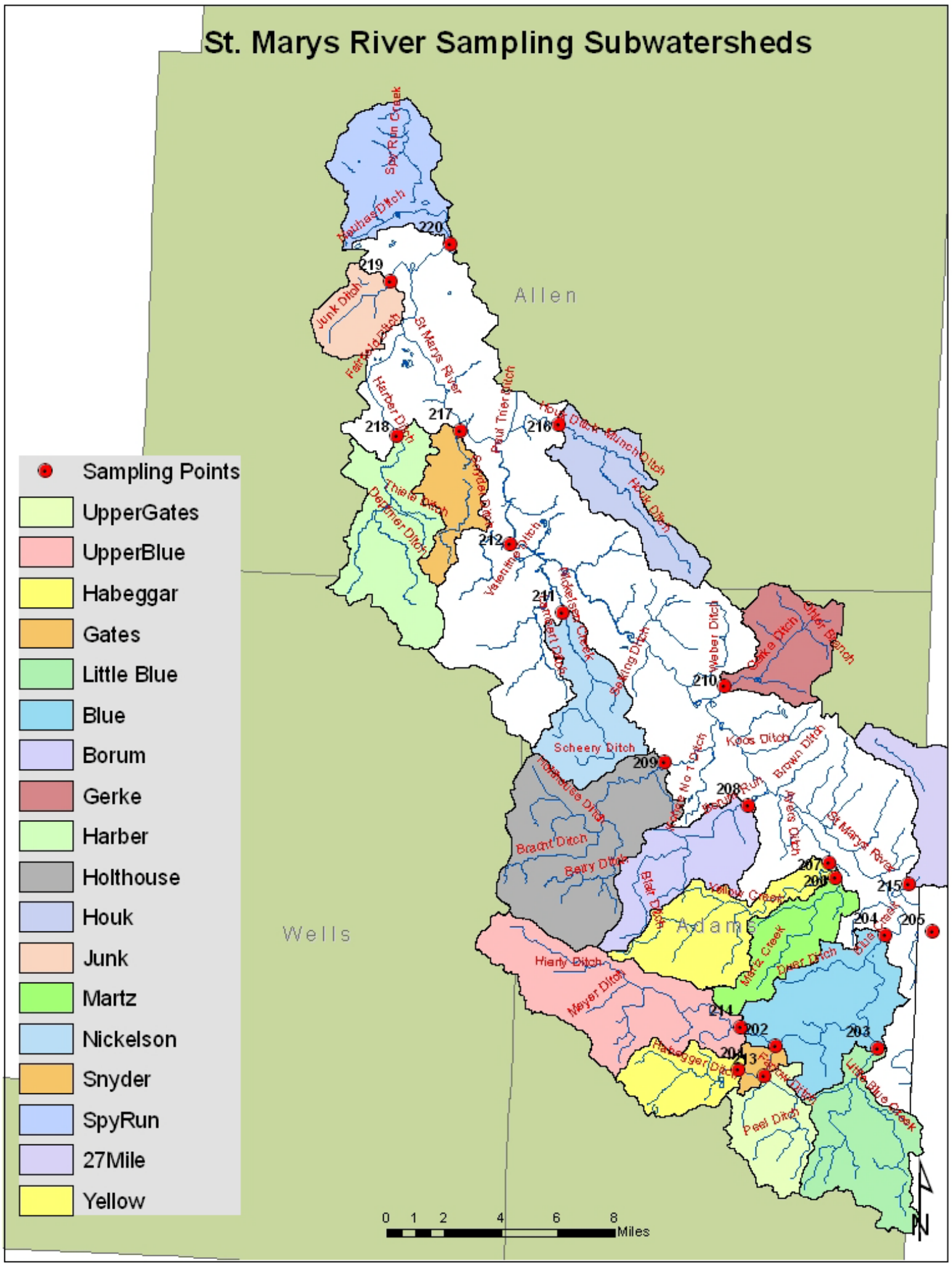

Figure 17. St. Marys River Sampling Subwatersheds.

SAMPLING LOCATION DESCRIPTIONS					
SITE NUMBER	STREAM NAME	NORTH (METERS)	EAST (METERS)	ROAD NAME	IDEM SITE NAME
201	Habegger Ditch	4510003.66	168902.49	CR S 100 W	LES040-0099
202	Gates Ditch	4511345.77	170976.66	CR E 400 S	LES040-0023
203	Little Blue Ck	4511193.26	176772.14	CR E 400 S	LES040-0010
204	Blue Creek	4517629.29	177183.92	S.R. 124	LES040-0009
205	St. Marys-OH Ln.	4517827.55	179913.89	S.R. 81	UNK000-0007
206	Martz Ditch	4520893.06	174362.44	CR E 200 N	LES040-0040
207	Yellow Creek	4521747.13	174057.41	CR E 250 N	LES040-0038
208	Borum Run	4524949.89	169482.04	High St.	N/A
209	Holthouse Ditch	4527435.84	164754.15	CR N 200 W	LES050-0008
210	Gerke Ditch	4531706.19	168109.42	CR N 000	N/A
211	Nickelsen Creek	4535915.54	158989.18	CR W 1100 W	LES050-0015
212	St. Marys-Poe	4539758.86	156030.43	Hoagland Rd.	LES060-0006
213	Upper Gates Ditch	4509705.65	170355.32	CR S 200 W	N/A
214	Upper Blue Creek	4512448.44	169027.86	CR S 100 W	N/A
215	Twentyseven Mile Creek	4520549.90	178554.40	Piqua Road	N/A
216	Houk Ditch	4546991.91	157158.72	Trentman Road	N/A
217	Snyder Ditch	4546211.05	153166.55	Muldoon Road	N/A
218	Harber Ditch	4545898.70	149555.06	Ferguson Road	N/A
219	Junk Ditch	4554673.66	149242.71	Taylor Road	N/A
220	Spy Run Creek	4556723.43	152629.71	4th Street	N/A

Table 9. Sampling location descriptions.

3.3.1 Water Quality by Parameter

The following section will briefly describe the parameters that were analyzed during sampling activities conducted by the St. Marys River Watershed Project.

Temperature

In addition to having its own toxic effect, temperature affects the solubility and, in turn, the toxicity of many other parameters. Generally the solubility of solids increases with increasing temperature, while gases tend to be more soluble in cold water. Temperature is a factor in determining allowable limits for other parameters such as ammonia (www.kywater.org). The Federal Water Pollution Control Administration (1967) referred to temperature as "a catalyst, a depressant, an activator, a restrictor, a stimulator, a controller, a killer, one of the most important and most influential water quality characteristics to life in water." An important physical relationship exists between the amount of dissolved oxygen in a body of water and its temperature. Simply put, "the warmer the water, the less dissolved oxygen, and vice versa." Figure 18 shows the relationship.

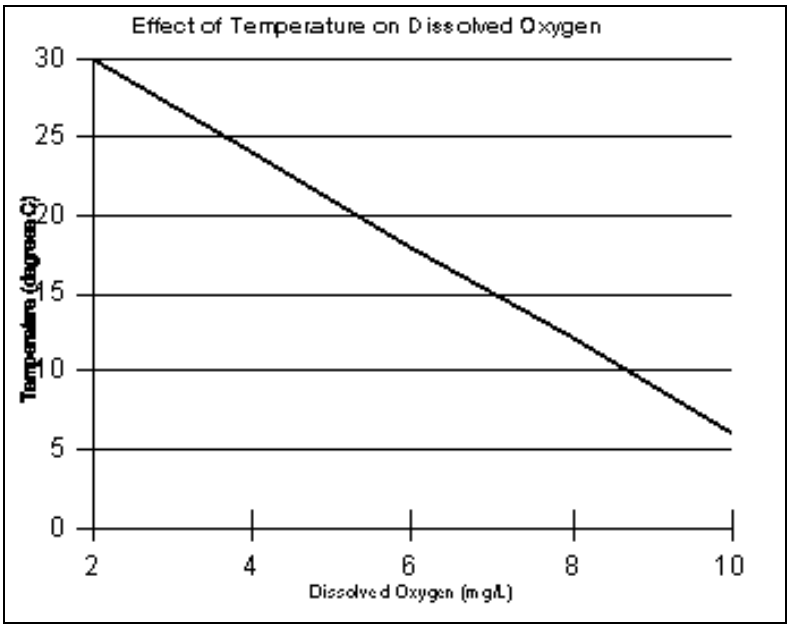

Figure 18. Effects of temperature on dissolved oxygen.

For this reason, heat or "thermal pollution" may be a problem, especially in shallow slow-moving streams, embayments, or pools which can get very warm in mid-summer. Most fish and aquatic organisms simply can't stand warm water and/or low levels of dissolved oxygen. The IAC (327 IAC 2-1.5-8) sets maximum temperatures for Indiana streams in the Great Lakes watershed that are variable by the time of the year, temperatures in May should not exceed 80ºF (26.7ºC) and temperatures from June through September should not surpass 90ºF (32.2ºC).

The following Figure 19 shows maximum temperature levels observed during sampling conducted by the St. Marys River Watershed Project. None of the samples collected exceeded the maximum temperatures set forth by the IAC (327 IAC2-1.5-8).

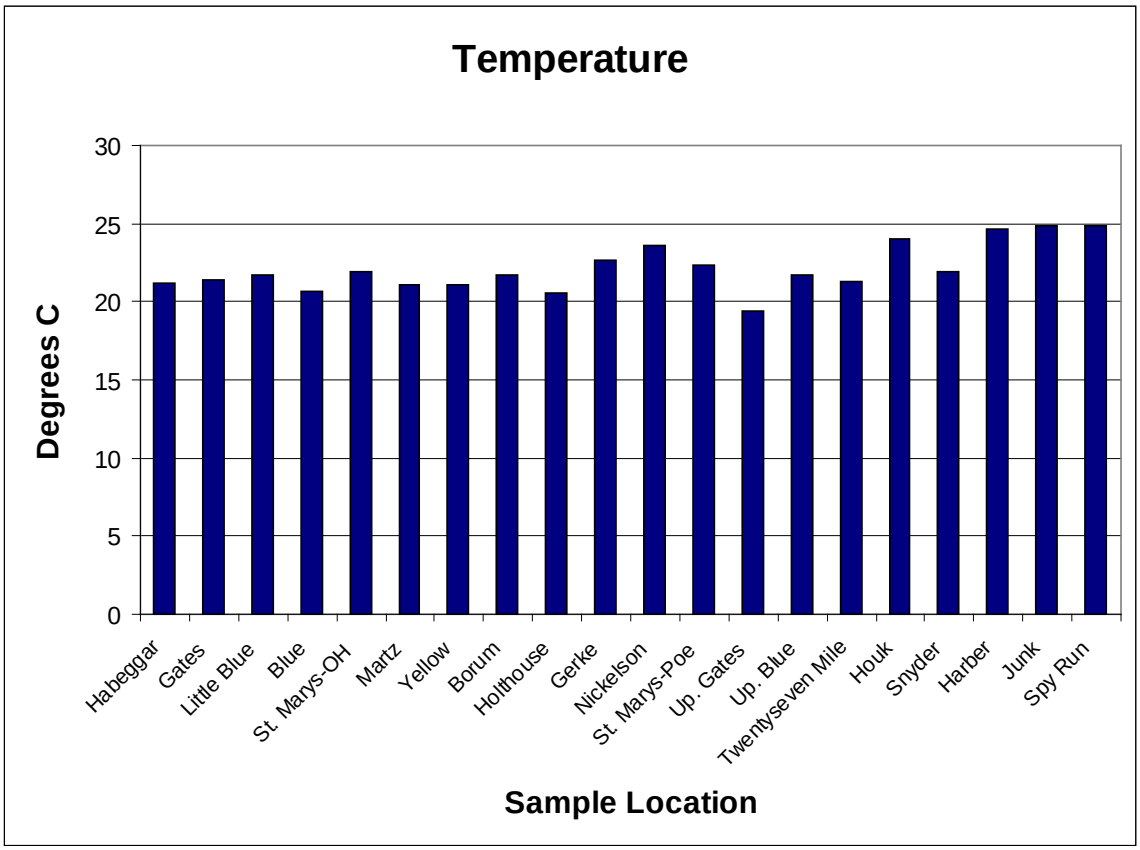

Figure 19. Maximum Temperature levels in the St. Marys River Watershed.

pH

The acidity or basic nature of a solution is expressed as the pH. The concentration of the hydrogen ion [H+] in a solution determines the pH. The more acidic the solution, the lower the pH; the more basic, the higher the pH.

A pH range of 6.0 to 9.0 was established by the IAC (327 IAC 2-1.5-8) and appears to provide protection for the life of freshwater fish and bottom dwelling invertebrates.
The following Table 10 gives some special effects of pH on fish and aquatic life.

Limiting pH Values		
Minimum	**Maximum**	**Effects**
3.8	10.0	Fish eggs could be hatched, but deformed young were often produced
4.0	10.1	Limits for the most resistant fish species
4.1	9.5	Range tolerated by trout
4.3	---	Carp died in five days
4.5	9.0	Trout eggs and larvae develop normally
4.6	9.5	Limits for perch
5.0	---	Limits for stickleback fish
5.0	9.0	Tolerable range for most fish
---	8.7	Upper limit for good fishing waters
5.4	11.4	Fish avoided waters beyond these limits
6.0	7.2	Optimum (best) range for fish eggs
1.0	---	Mosquito larvae were destroyed at this pH value
3.3	4.7	Mosquito larvae lived within this range
7.5	8.4	Best range for the growth of algae

Table 10. Limiting pH values.

One of the most significant environmental impacts of pH is the affect that it has on the solubility and thus the bioavailability of other substances. This process is important in surface waters. Runoff from agricultural, domestic, and industrial areas may contain iron, lead, chromium, ammonia, mercury or other elements. The pH of the water affects the toxicity of these substances. As the pH falls (solution becomes more acidic) many insoluble substances become more soluble and thus available for absorption.

The following Figure 20 shows average pH levels observed during sampling conducted by the St. Marys River Watershed Project. One sample, collected on 10/31/2007/ at the monitoring station located on the St. Marys River at Willshire, OH exceeded the 9.0 maximum value set by the IAC (327 IAC 2-1.5-8) with a value of 9.09. All other values were within the acceptable range.

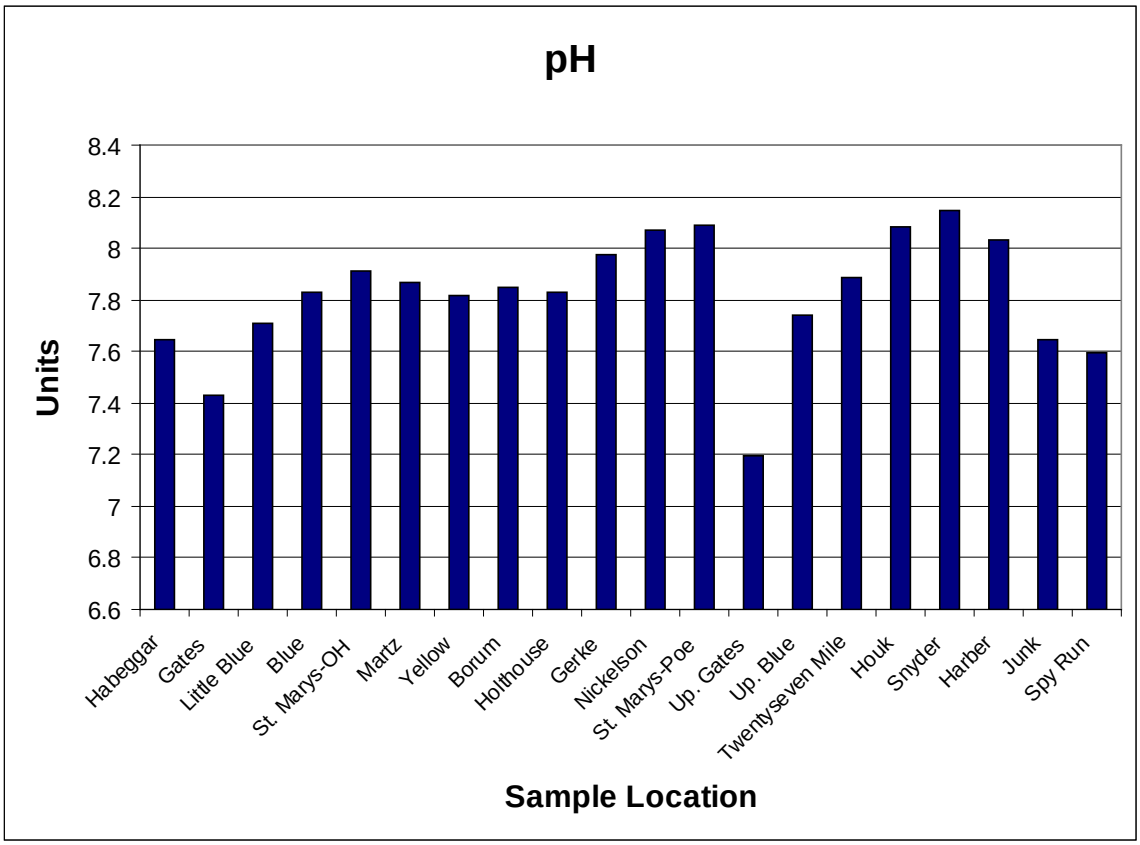

Figure 20. Average pH levels in the St. Marys River Watershed.

Conductivity

Conductivity is a measurement of the ability of an aqueous solution to carry an electrical current. An ion is an atom of an element that has gained or lost an electron(s) which will create a negative or positive state (www.kywater.org). Effects of excess dissolved solids can include the elimination of desirable food plants and habitat-forming plant species. Agricultural uses of water for livestock watering are limited by excessive dissolved solids and high dissolved solids can be a problem in water used for irrigation.

The IAC does not directly set a conductivity standard, it instead sets a standard for dissolved solids (750 mg/L). Multiplying a dissolved solids concentration by a conversion factor of 0.55 to 0.75 µS/cm per mg/L of dissolved solids provides an estimated conversion between dissolved solids concentration and specific conductance (Allan, 1995). This conversion of the IAC standard of 750 mg/L to specific conductance produces a range from 1,000 to 1,360 µS/cm.

Figure 21 displays average conductivity levels observed in the watershed during sampling conducted by the St. Marys River Watershed Project. Average conductivity values across the watershed similar in the range of 500 to 800 µS/cm. The exception to this is at the Harber Ditch monitoring station, this station has an average conductivity level of approximately 1,150 µS/cm.

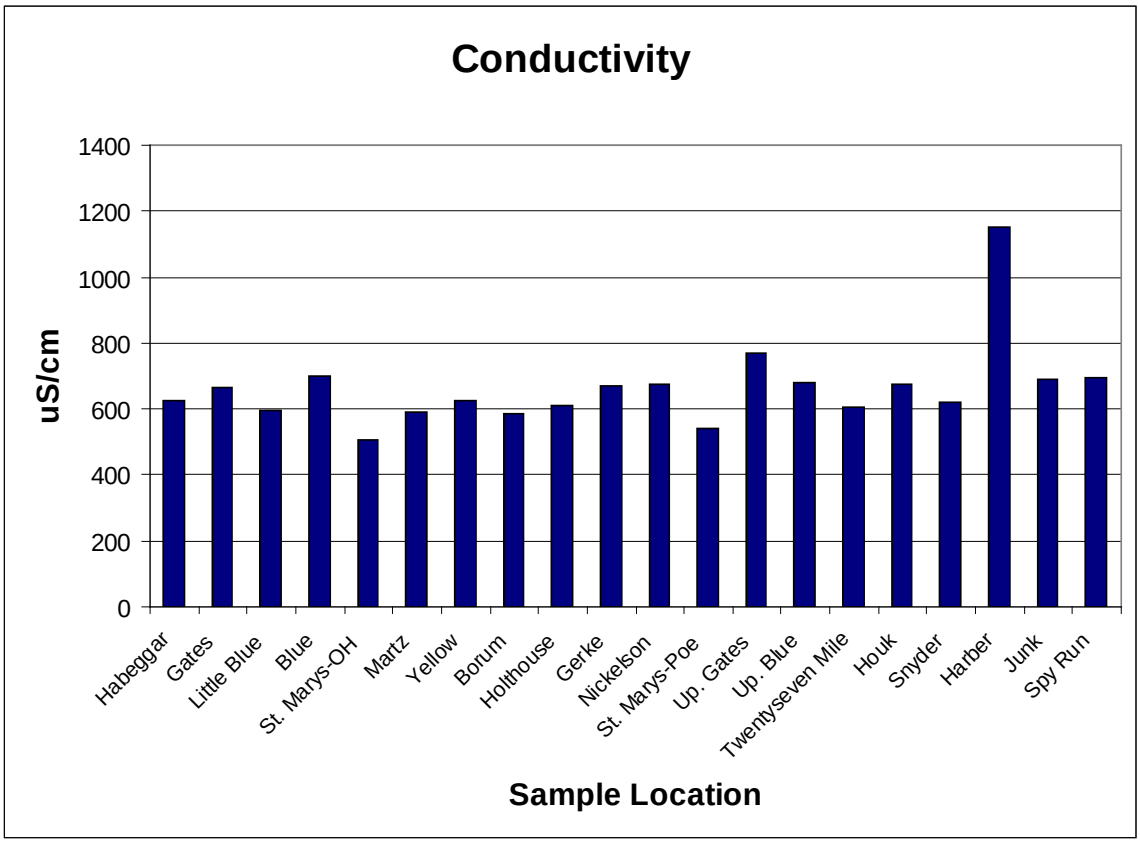

Figure 21. Average Conductivity levels in the St. Marys River Watershed.

Turbidity

Turbidity refers to the clarity of water. The greater the amount of TSS in the water, the murkier it appears and the higher the measured turbidity. Turbidity in the St. Marys River Watershed is most commonly the result of suspended clay and silt that is deposited from erosion. Other factors increasing turbidity include channelization, increased flow rates, and floods (http://waterontheweb.org).

High concentrations of particulate matter can modify light penetration, cause shallow lakes and bays to fill in faster, and smother benthic habitats - impacting both organisms and eggs. As particles of silt, clay, and other organic materials settle to the bottom, they can suffocate newly hatched larvae and fill in spaces between rocks which could have been used by aquatic organisms as habitat. Fine particulate material also can clog or damage sensitive gill structures, decrease their resistance to disease, prevent proper egg and larval development, and potentially interfere with particle feeding activities (http://waterontheweb.org).

Very high levels of turbidity for a short period of time may not be significant and may even be less of a problem than a lower level that persists longer. Figure 22 shows how aquatic organisms are generally affected.

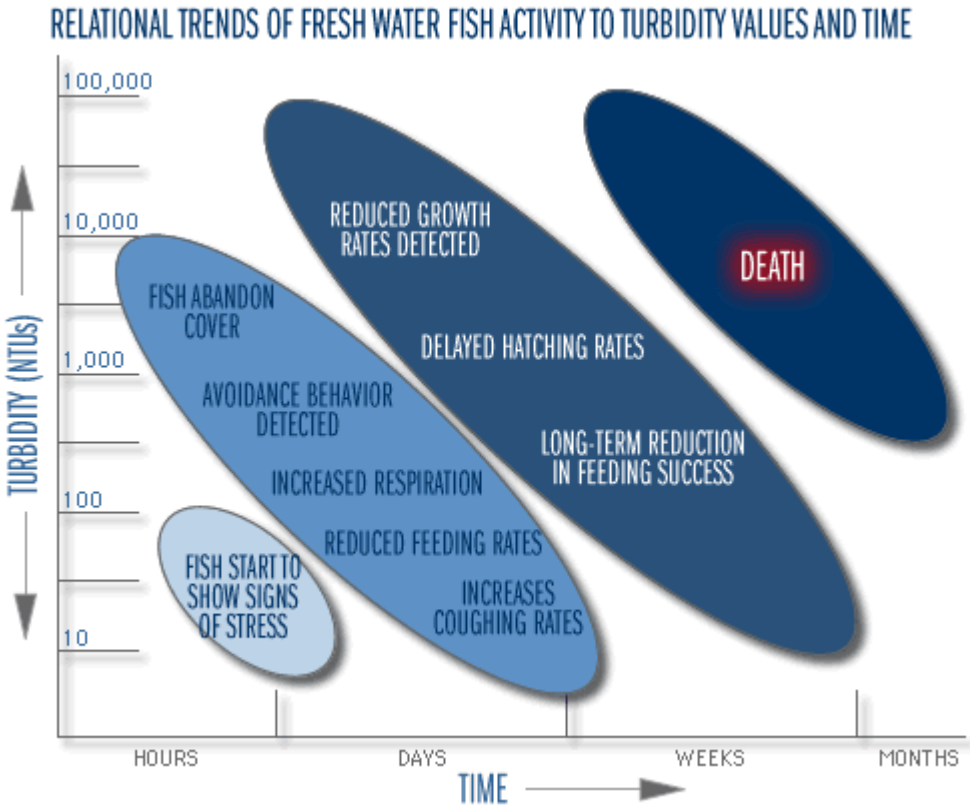

Figure 22. Turbidity effects on fresh water fish. (http://dnr.wi.gov)

Turbidity levels were monitored in the St. Marys River Watershed and averaged. These results are shown in the following Figure 23. Turbidity levels were observed to be the highest in the Blue Creek watershed, which incorporates monitoring stations on Habegger Ditch, Gates Ditch, Little Blue Creek and the Blue Creek. Turbidity levels were especially high at the Gates Ditch stations, with an average of 217 NTU's on the upper reach and 133 NTU's in the lower reach. The Field Manual for Water Quality Monitoring by Mitchell and Stapp indicate levels above 150 NTU's as being "poor" water quality.

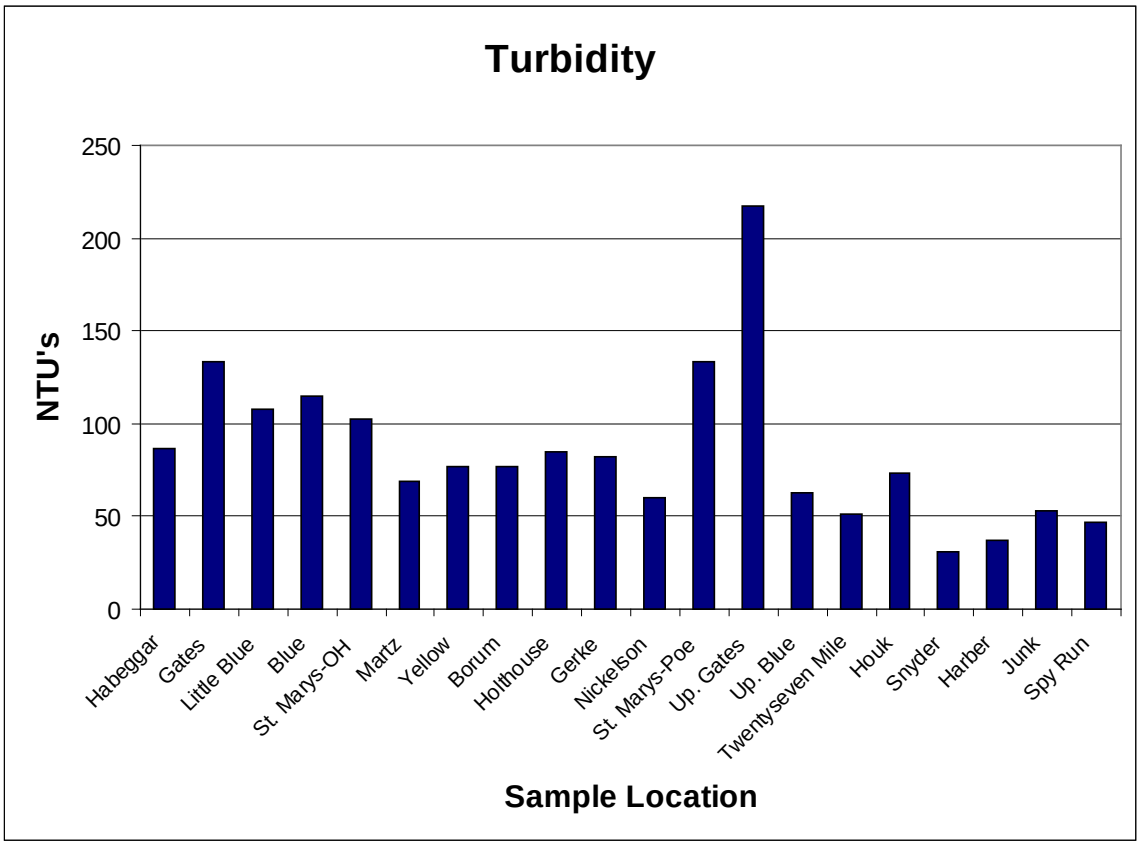

Figure 23. Average Turbidity levels in the St. Marys River Watershed

Dissolved Oxygen

Dissolved oxygen analysis measures the amount of gaseous oxygen (O_2) dissolved in an aqueous solution. Dissolved oxygen is one of the most important parameters in aquatic systems. This gas is an absolute requirement for the metabolism of aerobic organisms and also influences inorganic chemical reactions. Oxygen gets into water by diffusion from the surrounding air, by aeration (rapid movement) and as a waste product of photosynthesis. The amount of dissolved oxygen gas is highly dependent on temperature. The warmer the water, the less dissolved oxygen. This relationship is shown in Figure 18 in the discussion of temperature.

In a nutrient-rich water body the dissolved oxygen is quite high in the surface water due to increased photosynthesis by the large quantities of algae. However, dissolved oxygen tends to be depleted in deeper waters because photosynthesis is reduced due to poor light penetration and due to the fact that dead phytoplankton (algae) falls toward the bottom using up the oxygen as it decomposes. Adequate dissolved oxygen is needed and necessary for good water quality. Oxygen is a necessary element to all forms of life. Adequate oxygen levels are necessary to provide for aerobic life forms which carry on natural stream purification processes. The IAC (327 IAC 2-1.5-8) sets a minimum daily average DO concentration of 5.0 mg/l and a minimum concentration of 4.0 mg/l at any point.

The following Figure 24 shows average dissolved oxygen levels in the St. Marys River Watershed. During sampling, a total of eight sites recorded levels below the minimum

concentration of 4.0 mg/l. These sites included: Habegger Ditch (2.34 mg/l), Gates Ditch (1.02 mg/l), St. Marys River at Willshire (1.67 mg/l), Martz Ditch (2.23 (mg/l), Yellow Creek (1.67 mg/l), Borum Run (1.04 mg/l), Holthouse Ditch (0.15 mg/l) and Upper Gates Ditch (2.35 mg/l).

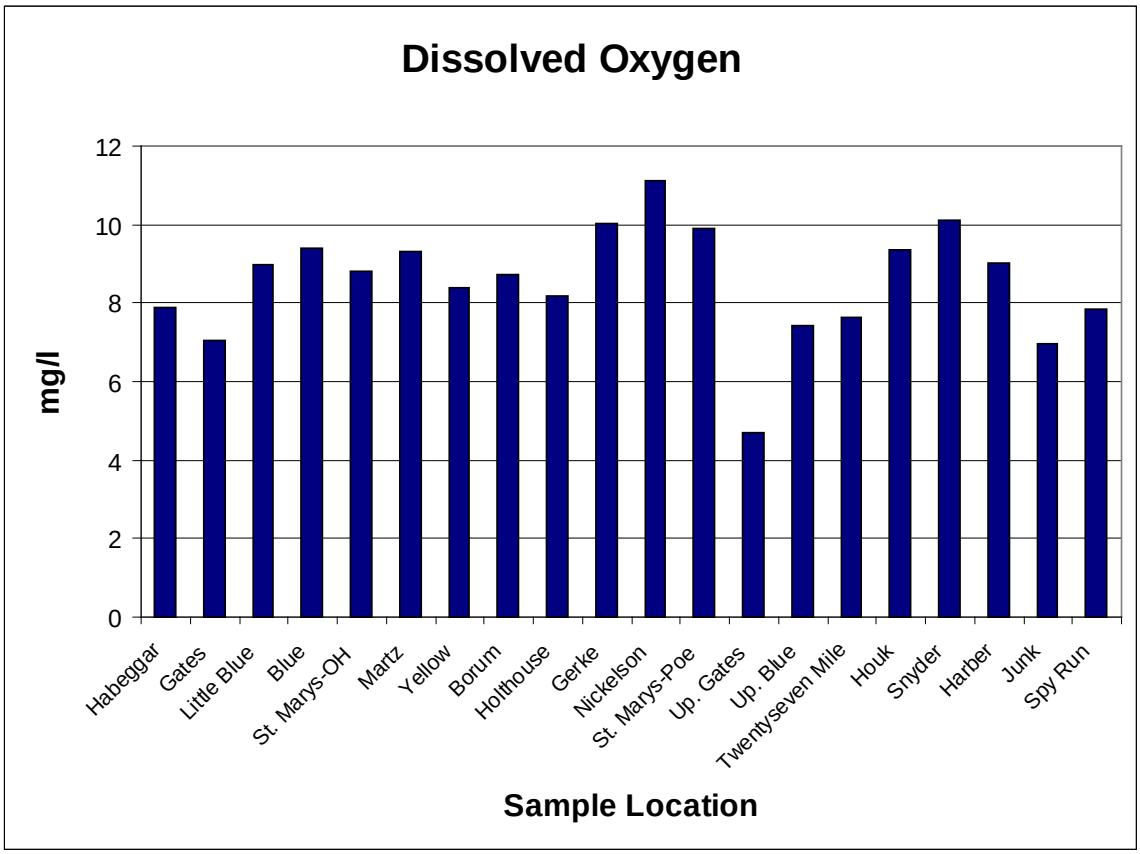

Figure 24. Average Dissolved Oxygen levels in the St. Marys River Watershed

Biological Oxygen Demand

Biological Oxygen Demand (BOD) is a measure of the oxygen used by microorganisms to decompose organic matter. When large quantities of organic wastes are in the water supply, there will also be a lot of bacteria present working to decompose these wastes. In response, the demand for oxygen will be high so the BOD level will also be high. As the waste is consumed or dispersed through the water, BOD levels will begin to decline.

Nutrients can contribute to high BOD levels. Nitrates and phosphates can cause plant life and algae to grow quickly. When plants grow quickly, they also die quickly. This contributes to the organic waste in the water, which is then decomposed by bacteria. This results in a high BOD level. Temperature can also contribute to high BOD levels. For example, warmer water usually will have a higher BOD level than colder water. As water temperature increases, the rate of photosynthesis by algae and other plant life in the water also increases. When this happens, plants grow faster and also die faster. When the plants die, they fall to the bottom where they are decomposed by bacteria. The bacteria require oxygen for this process so the BOD is high at this location. Therefore,

increased water temperatures will speed up bacterial decomposition and result in higher BOD levels (www.ciese.org).

When BOD levels are high, dissolved oxygen (DO) levels decrease because the oxygen that is available in the water is being consumed by the bacteria. Since less dissolved oxygen is available in the water, fish and other aquatic organisms may not survive. The following Table 11 provides BOD ranges for water quality.

BOD Level (mg/L)	Water Quality
0.0 – 2.0	Excellent
2.1 – 4.0	Good
4.1 – 10.0	Fair
>10.0	Poor

Table 11. BOD ranges for water quality (Field Manual for Water Quality Monitoring, Mitchell and Stapp)

Figure 25 shows average BOD levels observed during sampling collected by the St. Marys River Watershed Project. Average BOD levels range from 2.34 mg/l at Borum Run to 4.95 mg/l at Upper Gates Ditch with put them into the "good" to "fair" range for water quality. Three monitoring stations had single sample values in the "poor" water quality range; Gates Ditch at 11.73 mg/l, Holthouse Ditch at 11.70 mg/l, and the St. Marys River at Poe, IN at 11.64 mg/l.

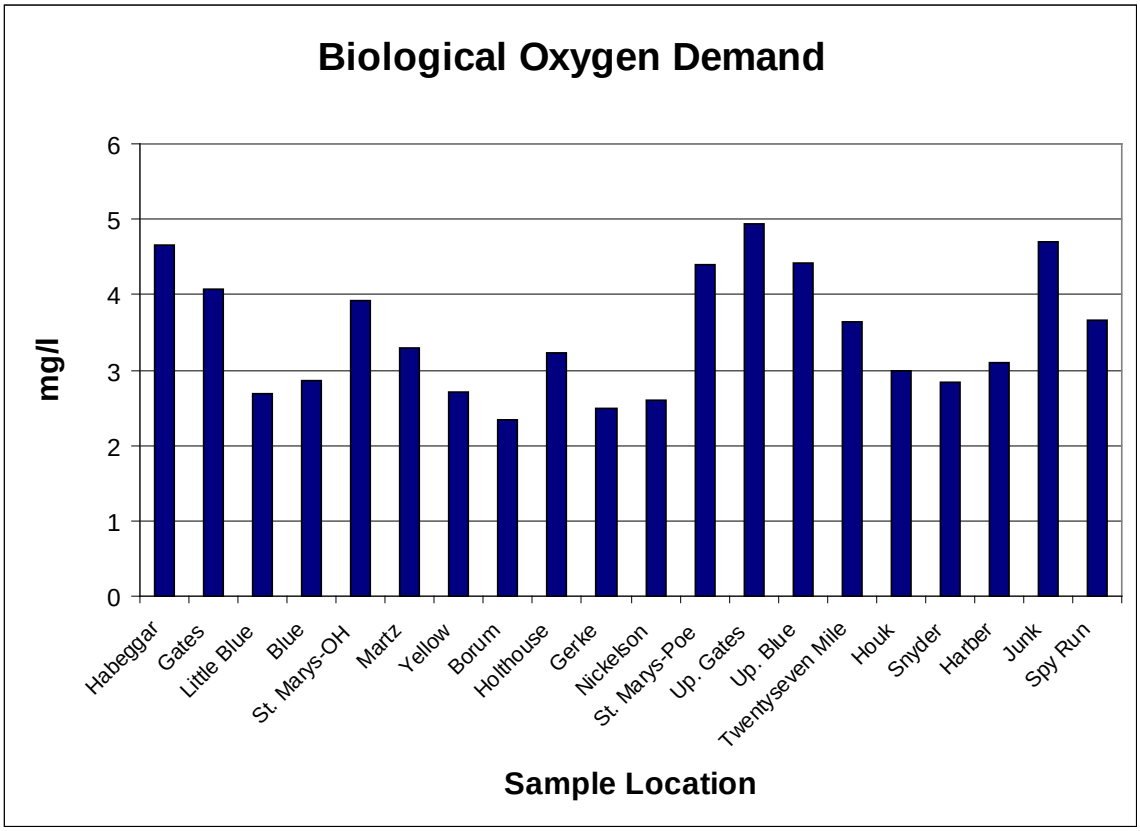

Figure 25. Average BOD levels in the St. Marys River Watershed

Nutrients

The term nutrient refers to two major plant nutrients, phosphorus and nitrogen. Nutrients are measured to predict the amount of algal and plant growth that will occur in a stream, in most cases to predict the potential for nuisance growth. It should be noted that some algal and plant growth is a natural and necessary part of a functioning ecosystem. In fact, nutrients are beneficial to aquatic life in small amounts. However, in over-abundance and under favorable conditions, they can stimulate the occurrence of algal blooms and excessive plant growth in quiet waters or low flow conditions. The algal blooms and excessive plant growth often reduce the dissolved oxygen content of surface waters through plant respiration and decomposition of dead algae and other plants. This is accentuated in hot weather and low flow conditions because of the reduced capacity of the water to retain dissolved oxygen. Nutrients are common components of fertilizers, animal and human waste, vegetation, and some industrial processes. Nutrients in surface waters come from both point and nonpoint sources.

The USEPA has established some nutrient standards for drinking water, to date it has not established standards for protecting the biological integrity of a stream. Conversations with IDEM staff indicate that nutrient standards are in the process of being developed for Indiana surface waters. USEPA has issued recommendations for numeric nutrient criteria for streams (USEPA, 2000a). While these are not part of the IAC, they serve as potential target conditions for which watershed managers might aim. The Ohio EPA (OEPA) has also made recommendations for numeric nutrient criteria in streams based on research on Ohio streams (OEPA, 1999). These recommendations also serve as potential target conditions for Indiana surface waters.

Phosphorus

Phosphorus, commonly a result of nonpoint source pollution, can be present as organic matter and dissolved or suspended in the water column. Phosphorus can also be in the form of inorganic compounds originating from soil minerals, fertilizers and household detergents. Phosphorus is the primary target nutrient associated with algae production.

The USEPA recommended targets for nutrient levels in streams are fairly low. The USEPA recommends a target total phosphorus concentration of 0.076 mg/L in streams (USEPA, 2000a). The OEPA recommends a total phosphorus concentration of 0.08 mg/L in Warm water Habitat (WWH) headwater streams to protect the streams' aquatic biotic integrity (OEPA, 1999). WWH refers to a stream that is capable of supporting a healthy, diverse warm water fauna. Streams that cannot support a healthy, diverse community of warm water biota due to irretrievable modifications of the physical habitat are classified as Modified Warmwater Habitat (MWH) streams and have a different criterion (ORC 3745-1-07). Figure 26 shows the State of Ohio's Aquatic Life Use Designations.

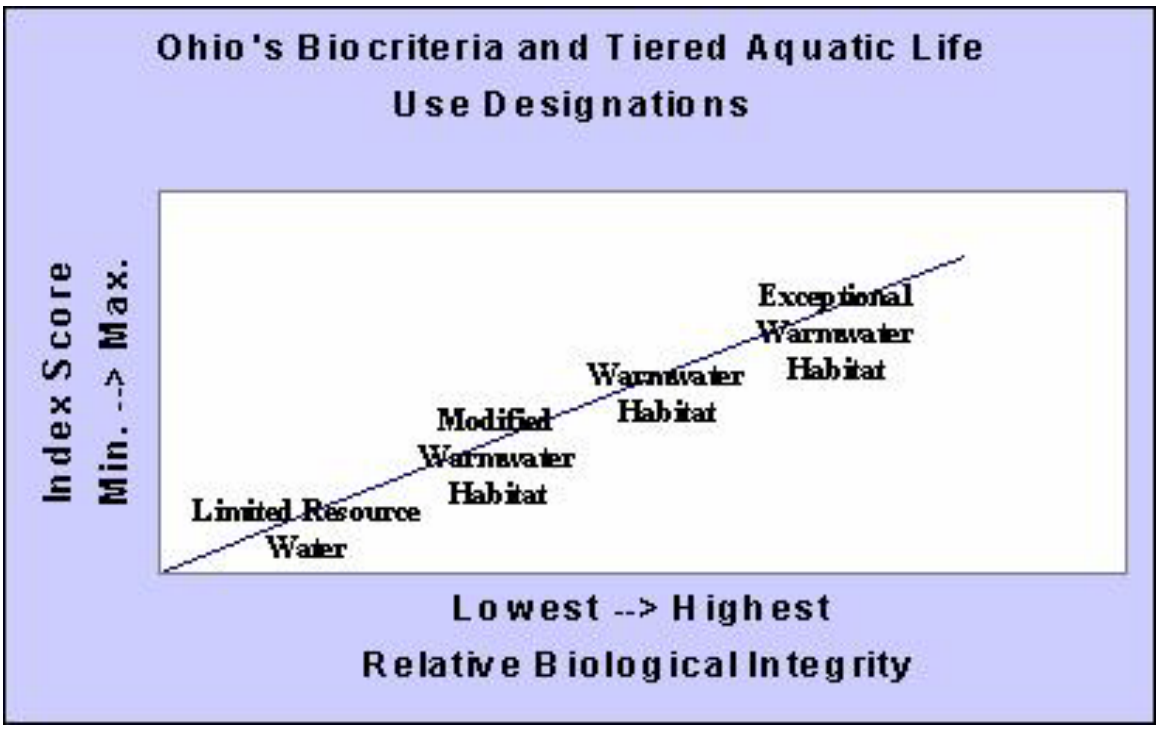

Figure 26. Ohio Aquatic Life Use Designations
(http://www.epa.gov/waterscience/biocriteria/casestudies/aquaticlifeohio.html)

The IDEM TMDL for the Blue Creek/Habegger Ditch and Yellow Creek Watershed set a phosphorus target at 0.30 mg/l in order to meet applicable water quality standards. This standard is also being utilized by the St. Marys River Watershed Project.

Figure 27 shows average Total Phosphorus levels in the St. Marys River Watershed. The data shows that on average, half of the stations were exceeding the 0.30 mg/l phosphorus standard set by the TMDL. All monitoring stations have single sample concentrations that exceed the 0.30 mg/l standard.

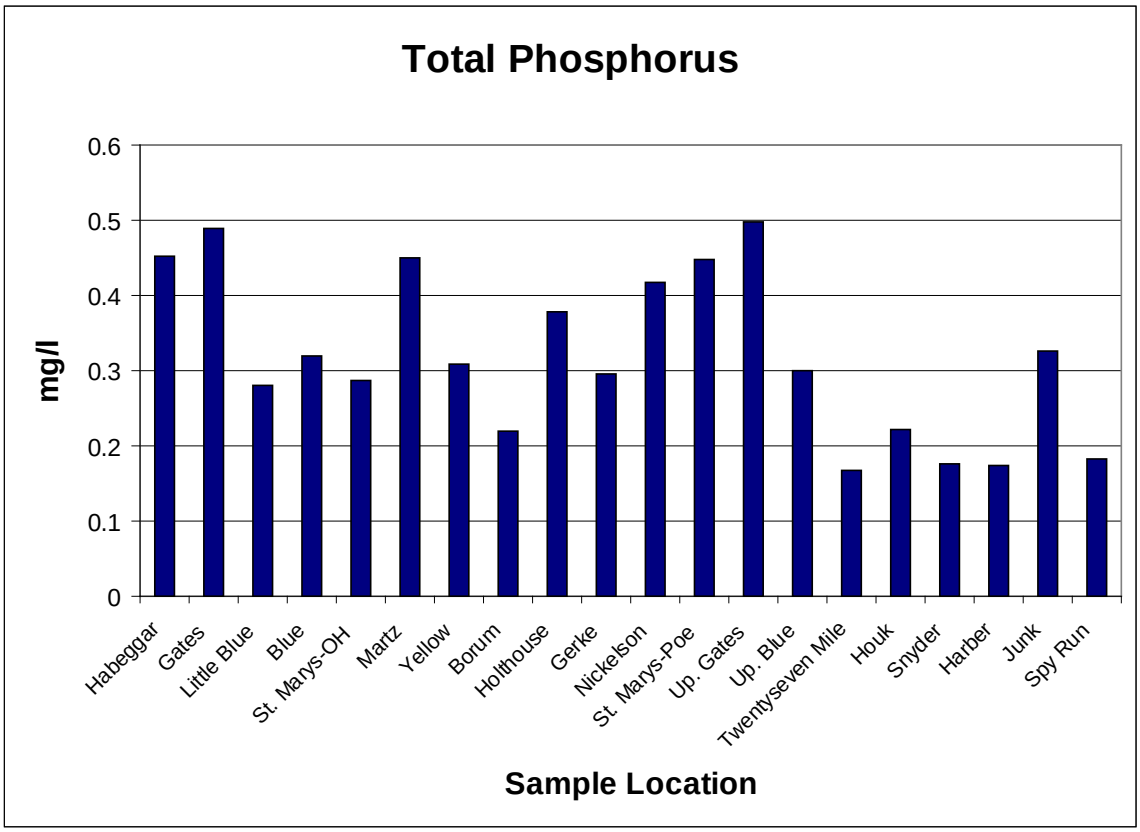

Figure 27. Average Total Phosphorus levels in the St. Marys River Watershed.

Nitrogen – Ammonia

Ammonia is the most reduced form of nitrogen and is introduced into rivers and streams through both urban and rural routes. Urban exposure to ammonia generally comes from the discharge of sewer treatment plants and from industrial processes such as fertilizer manufacture and oil refining. In rural and agricultural areas, ammonia is often present due to fertilizer application and failing septic systems. About three-fourths of the ammonia produced in the United States is used in fertilizers either as the compound itself or as ammonium salts such as sulfate and nitrate. (www.kywater.org)

The USEPA sets aggressive nitrogen criteria recommendations for streams compared to the OEPA. The USEPA's recommended criteria for nitrate-nitrogen concentrations for streams in Aggregate Nutrient Ecoregion VI are 0.633 mg/L (USEPA, 2000a). In contrast, the OEPA suggests using nitrate-nitrogen criteria of 1.0 mg/L in WWH wadeable and headwater streams and MWH headwater streams to protect aquatic life.

It should be made clear that the aforementioned concentrations are not used by the State of Indiana as water quality standards, these are simply listed to use comparatively with nutrient concentrations in the St. Marys River Watershed. The IAC sets only nitrate-nitrogen and ammonia-nitrogen standards for water bodies in Indiana. The IAC requires that drinking waters of the state have a nitrate-nitrogen concentration of less than 10 mg/L. The IAC standard for ammonia-nitrogen depends upon the water's pH and temperature, since both can affect ammonia-nitrogen's toxicity. At a pH >8.0, ammonia is converted to a highly toxic (unionized) form that is fatal to aquatic life at

very low levels. At a high pH, ammonia levels as low as 0.02 mg/l can begin to damage fish, and levels of 0.20 mg/l will begin to kill sensitive fish species. As a general rule, streams with an ammonia level of 0.10 mg/l or greater should be considered to be impaired by the pollutant. The IAC requires that ammonia concentrations in fresh waters should range between 0.00 and 0.21 mg/l, depending on water temperature and pH.

The following Figure 28 represents average Ammonia Nitrogen levels observed in the St. Marys River Watershed. Observed values were compared with the maximum ammonia concentrations set by the IAC. Ammonia levels in Habegger Ditch, Gates Ditch, Martz Ditch, and Upper Gates Ditch commonly exceeded IAC concentrations.

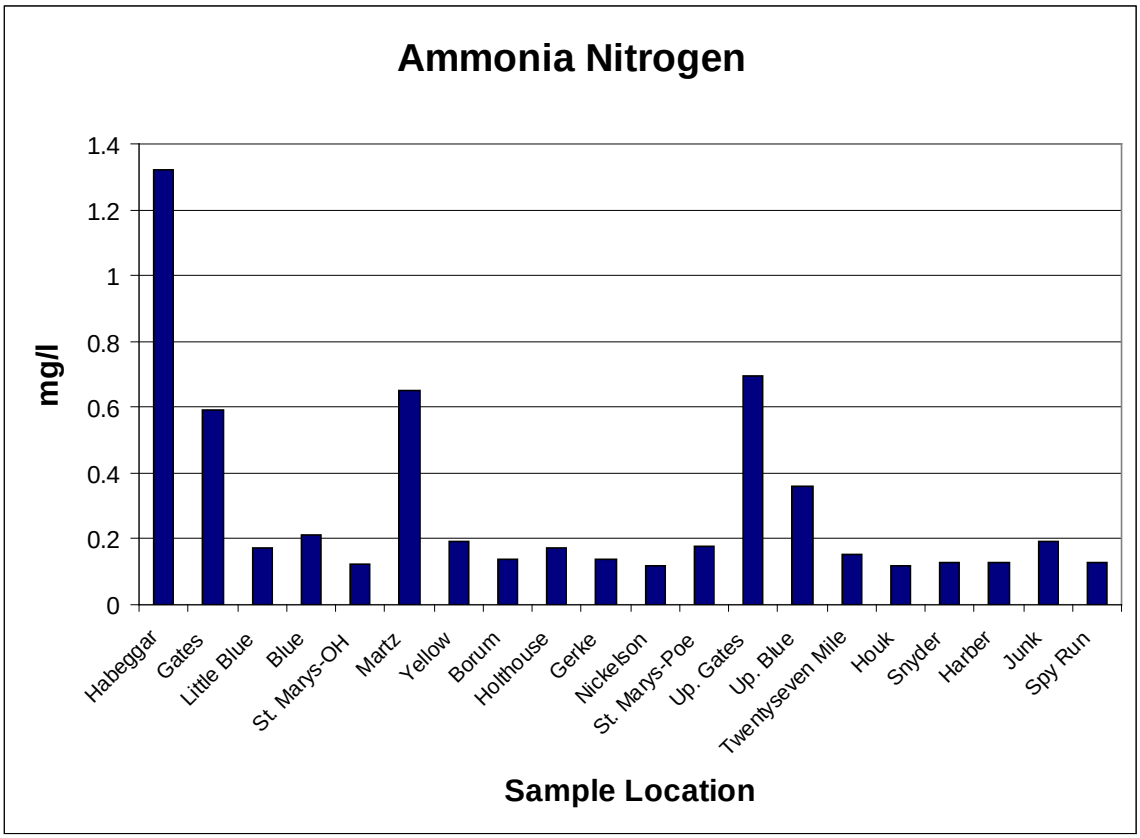

Figure 28. Average Ammonia Nitrogen levels in the St. Marys River Watershed

The Criterion Continuous Concentration (CCC) is a chronic criterion, meaning it is an estimate of the highest concentration of a substance in the water column to which an aquatic community can be exposed to indefinitely without adverse effects. Ammonia is considered a toxic substance for the purposes of determining aquatic life use support. According to IDEM's Consolidated Assessment and Listing Methodology (CALM), a stream is considered impaired if there is more than one exceedance of the CCC in a three year period. Calculation of the CCC on the data collected by the St. Marys River Watershed Project showed CCC exceedences on Habegger Ditch, Gates Ditch, Upper Gates Ditch and Martz Ditch.

E. coli Bacteria

E. coli bacteria are associated with the intestinal tract of warm-blooded animals and are widely used as an indicator of the potential presence of fecal pollution. *E. coli* can enter surface water bodies from nonpoint sources such as runoff from malfunctioning septic systems, straight pipe discharges from septic tanks, livestock, domestic pets, and wildlife. In addition, *E. coli* can come from improperly treated or untreated discharges of domestic wastewater common in urban areas with CSOs. Combined Sewer Overflow locations are shown geographically in Figure 51.

Detection of *E. coli* in water bodies may indicate the presence of other microbes harmful to humans. Certain *E. coli* bacteria themselves also may cause disease in humans and animals.

E. coli is also used as an indicator because it is easier and less costly to monitor and detect than the actual pathogenic organisms such as *Giardia, Cryptosporidium,* and *Shigella*, which require special sampling protocols and sophisticated laboratory techniques in order to evaluate. The presence of waterborne disease-causing organisms can induce outbreaks of typhoid fever, dysentery, cholera, and cryptosporidosis.

E. coli water quality standards have been established in order to ensure safe use of waters for municipal water supplies and recreation. Indiana water quality standards set the maximum *E. coli* levels at 125 cfu/100 ml as a geometric mean based on not less than five samples equally spaced over a 30 day period nor exceed 235 cfu/100ml in any one sample in a 30 day period. These standards are applicable for all surface waters in the state of Indiana.

Figure 29 shows average *E. coli* levels observed during grab sampling conducted by the St. Marys River Watershed Project. Average levels drastically exceed IAC water quality standards at all sites. The monitoring station located on the St. Marys River at Willshire, OH had the lowest average at 687 cfu/100ml. Gates Ditch was on the high end with an average of over 11,000 cfu/100ml.

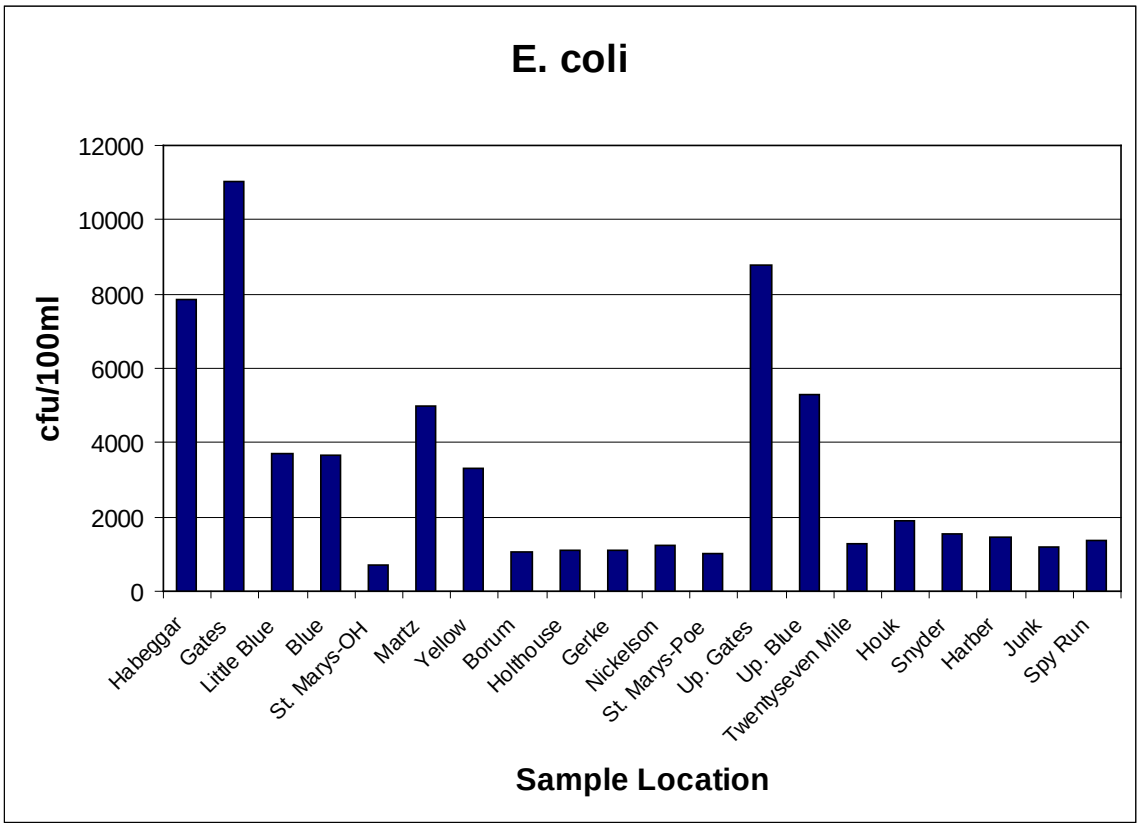

Figure 29. Average *E. coli* levels in the St. Marys River Watershed

Total Suspended Solids

TSS is comprised of organic (algae, zooplankton, bacteria, and detritus) and inorganic (silts, clays, etc.) particles that are transported in the water column. The inorganic portion is usually considerably higher than the organic. Both contribute to turbidity, or cloudiness of the water. Waters with high sediment loads are very obvious because of their "muddy" appearance. This is especially evident in rivers, where the force of moving water keeps the sediment particles suspended. TSS is closely linked to land erosion and erosion of river channels and banks. Moreover, sediment is often linked to the transport of *E. coli*, nutrients (specifically phosphorus), metals, and other chemicals related to agricultural production.

Excessive levels of TSS can smother bottom dwelling (benthic) organisms and eggs, and also impair fish and organismal habitats. Increased levels of TSS can also alter fish populations, causing death in some cases.

Indirectly, suspended solids affect other parameters such as temperature and dissolved oxygen. Because of the greater heat absorbency of the particulate matter, the surface water becomes warmer and this tends to stabilize the stratification (layering) in stream pools, embayments, and reservoirs. This, in turn, interferes with mixing, decreasing the dispersion of oxygen and nutrients to deeper layers.

The 2005 IDEM TMDL set a numeric target of 30 mg/l for TSS in the Blue Creek/Habegger Ditch and Yellow Creek sub watersheds.

Total suspended solids data collected by the St. Marys River Watershed Project was averaged and the results are shown below in Figure 30. Average TSS levels on the Houk, Snyder, Harber, and Junk Ditches, as well as Spy Run Creek are at or under the 30 mg/l TSS target set by the IDEM TMDL. However it should be noted that these locations were not sampled during the winter of 2008, a period when other monitoring stations were reporting very high TSS levels. Of particular concern is Gates Ditch, where the monitoring station on Upper Gates Dates averages over 130 mg/l.

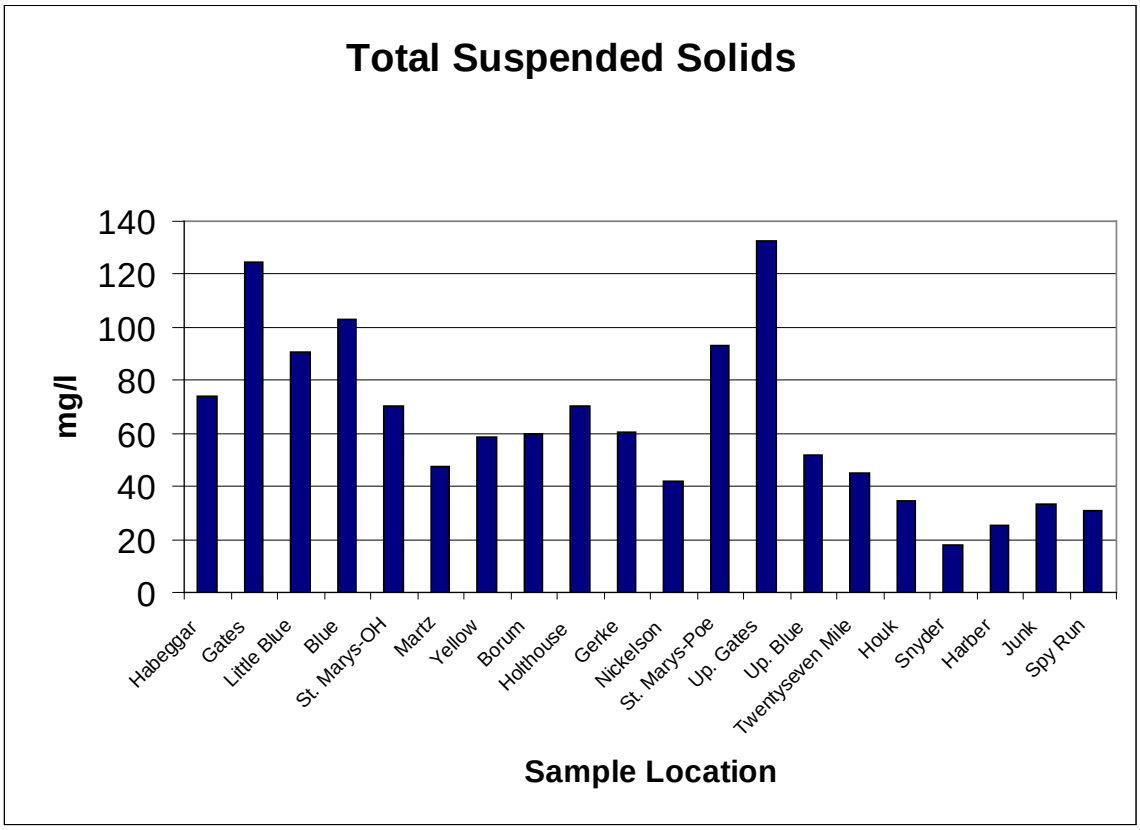

Figure 30. Average Total Suspended Solids levels in the St. Marys River Watershed

Atrazine

Atrazine is an herbicide that is widely used throughout the United States to control weeds in agricultural fields. Atrazine controls a broad spectrum of annual broadleaf weeds and certain annual grasses. Atrazine can be highly mobile in surface runoff and is often carried into nearby water bodies or leaches into ground water. USGS studies have shown that Atrazine commonly uses agricultural drainage tiles as a conduit to nearby surface waters. (Baker, N.T., Stone, W.W., Wilson, J.T., and Meyer, M.T., 2006, Occurrence and Transport of Agricultural Chemicals in Leary Weber Ditch Basin, Hancock County, Indiana, 2003-04: U.S. Geological Survey Scientific Investigations Report 2006-5251, 44p.) USEPA reports indicate that people exposed to atrazine for short periods of time can be subject to the following health effects: congestion of heart, lungs and kidneys; low blood pressure; muscle spasms; weight loss; and damage to adrenal glands. Long term exposure can result in the following health effects: weight loss; cardiovascular damage; retinal and some muscle degeneration; and cancer. USEPA

has set a drinking water standard of 3 ppb (3 micrograms/L), which has been adopted in Indiana's drinking water standards (327 IAC 8-2-5).

Atrazine data collected by the St. Marys River Watershed Project was averaged and the results are shown in Figure 31. It should be noted that sampling at sites: Upper Gates Ditch, Upper Blue Creek, Twentyseven Mile Creek, Houk, Snyder, Harber, and Junk Ditches and Spy Run Creek was only completed April – July 2008. (This is a period during which atrazine is being readily applied to agricultural fields.) However, the Blue Creek headwaters and Twentyseven Mile Creek are seeing atrazine levels that exceed the IAC drinking water standard.

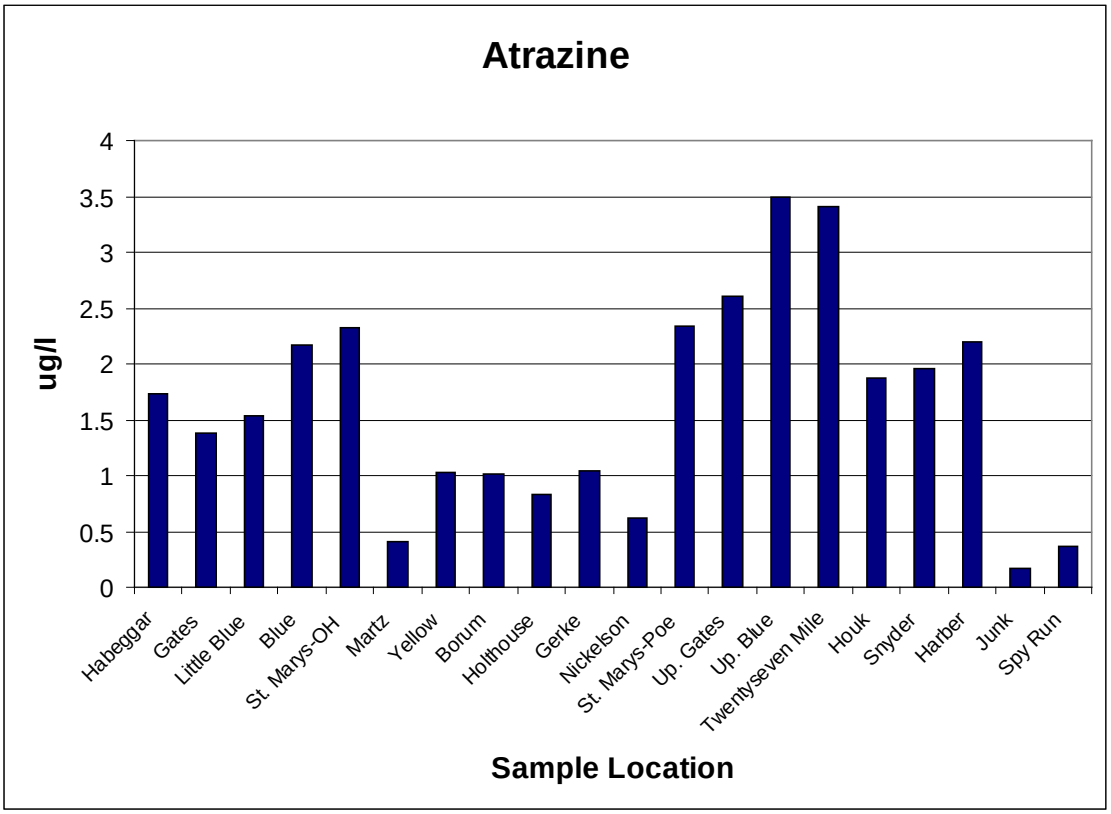

Figure 31. Average Atrazine levels in the St. Marys River Watershed.

Alachlor

Alachlor is an herbicide used to control grasses and broadleaf weeds in corn and soybeans. Alachlor is easily mixed with other chemicals and is often used in conjunction with Atrazine. USEPA has set the maximum contaminant level (MCL) at 2.0 ppb (2 micrograms/l). Exposure at the MCL may result in slight skin and eye irritation. Lifetime exposure above the MCL may result in damage to the liver, kidneys, sleep, lining of the nose and the eyelids; and cancer.

Alachlor data collected by the St. Marys River Watershed Project was averaged and the results are shown in Figure 32. It should be noted that sampling at sites: Upper Gates Ditch, Upper Blue Creek, Twentyseven Mile Creek, Houk, Snyder, Harber, and Junk Ditches and Spy Run Creek was only completed April – July 2008. The alachlor MCL (2

micrograms/l) was exceeded in only one sample, located on the Blue Creek (2.04 micrograms/l).

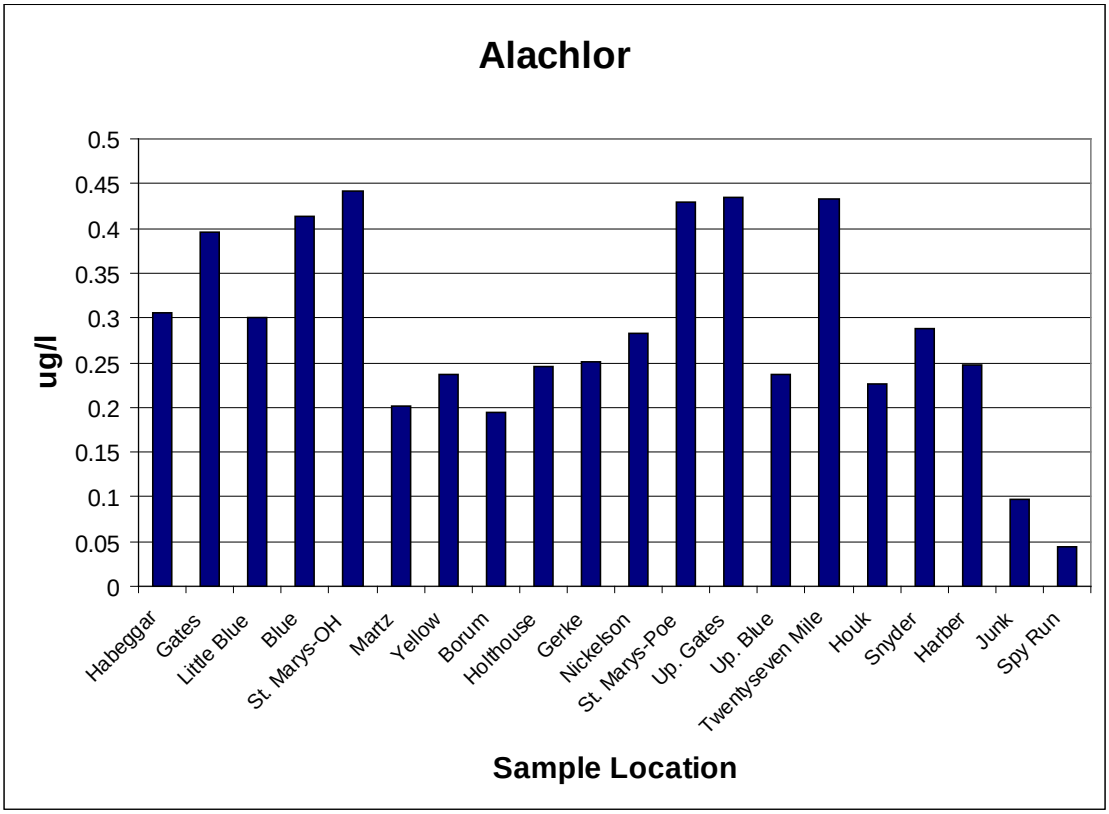

Figure 32. Average Alachlor levels in the St. Marys River Watershed

Cyanazine

Cyanazine is used to control grasses and broadleaf weeds. In the U.S., over 90% of its use in agriculture is to control weeds in corn fields. Its highest use is in corn-growing states of the Midwest. It is used primarily as a pre-emergent herbicide on corn. It is usually applied once during the growing season to control weeds before the corn-seedlings emerge from the soil (www.cornell.edu). Cyanazine may be used in conjunction with other herbicides. Cyanazine is classified by the EPA as a Restricted Use Pesticide (RUP) because of its teratogenicity and because it has been found in groundwater. USEPA has set the maximum contaminant level (MCL) at no more than 1.0 ppb (1 micrograms/L).

Cyanazine data collected by the St. Marys River Watershed was averaged, with results shown in Figure 33. Samples for Upper Gates Ditch, Upper Blue Creek, Twentyseven Mile Creek, Houk, Snyder, Harber, and Junk Ditches and Spy Run Creek were not analyzed for cyanazine due to a shortage of laboratory testing kits. Cyanazine concentrations in the St. Marys River Watershed fall well below USEPA's MCL.

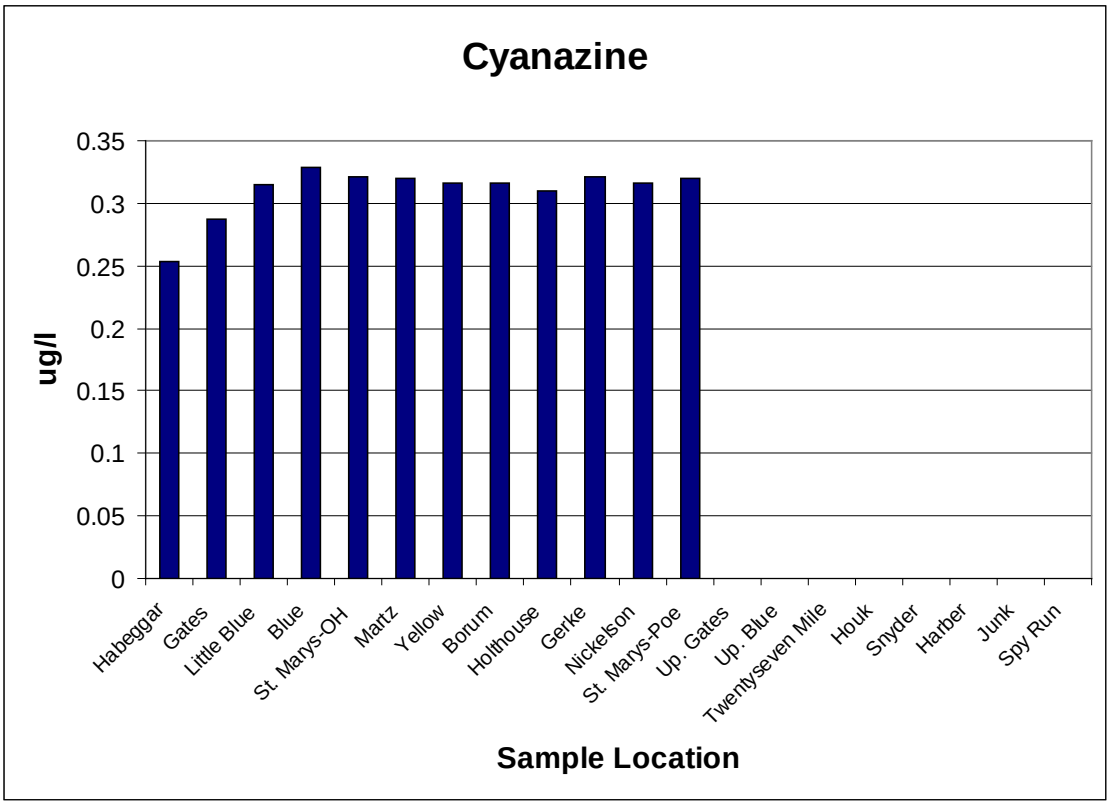

Figure 33. Average Cyanazine levels in the St. Marys River Watershed

Metolachlor

Metolachlor is usually applied to crops before plants emerge from the soil, and is used to control certain broadleaf and annual grassy weeds in field corn, soybeans, peanuts, grain sorghum, potatoes, pod crops, cotton, safflower, stone fruits, nut trees, highway rights-of-way and woody ornamentals (www.cornell.edu). While there is no set MCL for metolachlor that is allowed in drinking water, the USEPA does have a health advisory level (HAL) of 0.525 mg/L for this chemical.

Metolachlor data collected by the St. Marys River Watershed Project was averaged and the results are shown in Figure 34. It should be noted that sampling at sites: Upper Gates Ditch, Upper Blue Creek, Twentyseven Mile Creek, Houk, Snyder, Harber, and Junk Ditches and Spy Run Creek was only completed April – July 2008. All twenty monitoring locations have average concentrations well under USEPA's 0.525 mg/l health advisory level.

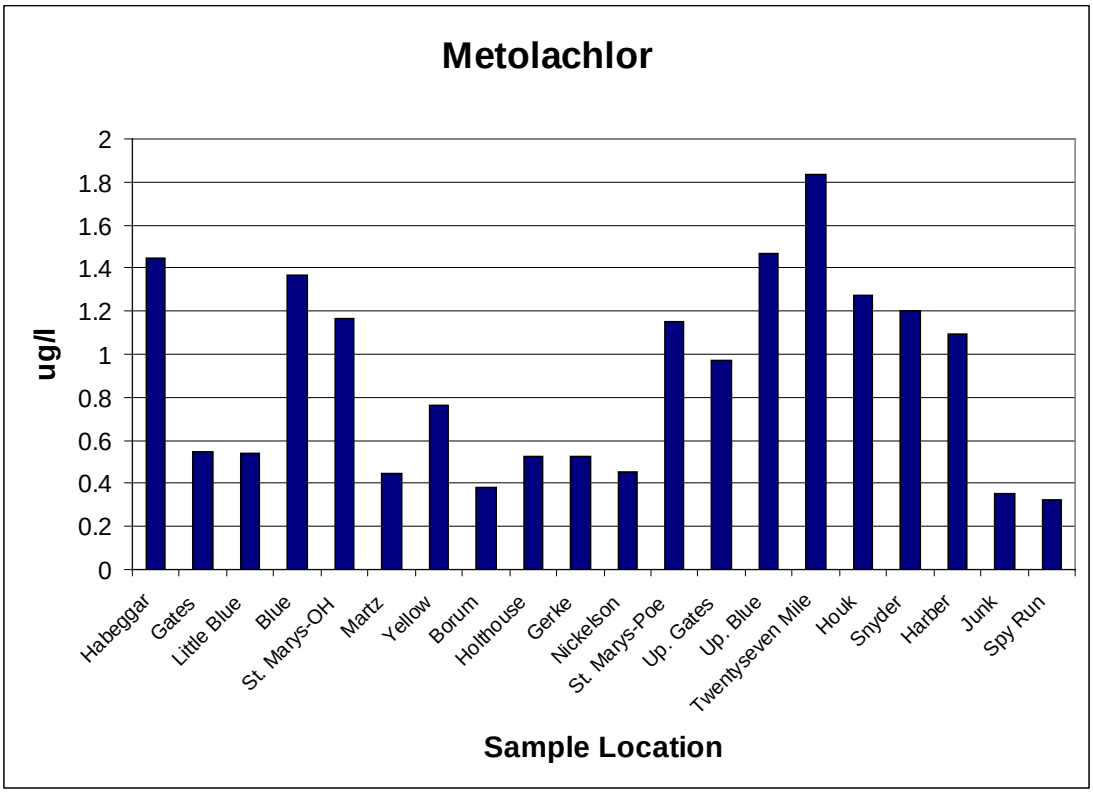

Figure 34. Average Metolachlor levels in the St. Marys River Watershed.

3.4 St. Marys River Watershed Social Indicator Survey

In association with Purdue University, a survey of social indicators was completed in the St. Marys River Watershed. The purpose of this study was to collect social indicators data from both agricultural producers and "urban" residents in the St. Mary's watershed to inform the watershed planning and implementation activities. The results of this survey also provide baseline social indicator information that will be used for comparison with a follow up survey in order to examine changes that occurred in the watershed over time.

The questions in the survey were developed by a regional team of researchers for utilization in nonpoint source pollution (NPS) projects. More information about this regional project can be found at: http://www.uwex.edu/ces/regionalwaterquality/Flagships/Indicators.htm. Social indicators data collected include awareness of water quality issues, sources, and practices for improvement; general water quality attitudes and attitudes toward implementation of practices; and behavior. In Winter, 2008, a five-wave mail survey was utilized to collect the data (Dillman, 2000). An advance notice letter was sent to potential respondents to inform them of the survey's purpose and to notify them that they would be receiving a survey in the next week. The survey was sent the following week, accompanied by a cover letter, similar to the advance notice letter, which informed them of the survey's purpose. A postcard reminder was sent two weeks later, and a replacement survey was sent the following week. After two more weeks, a third replacement survey was sent by priority mail to non-respondents. A 12-page survey was sent to 1000 residents in the watershed; 500 agricultural producers in Allen and Adams counties, and 500 residents of Allen County. After accounting for

undeliverable surveys, the overall response rate was 45%. A complete analysis of the results can be found in Appendix V.

3.5 Indiana Fish Consumption Advisory

The Indiana Fish Consumption Advisory (FCA) is an annual report compiled through a collaborative effort between the Indiana Department of Natural Resources (IDNR), the Indiana Department of Environmental Management (IDEM), the Indiana State Department of Health (ISDH) and Purdue University. The FCA reports on the presence of Mercury, heavy metals, and PCBs found in fish tissue. If samples were found to have levels that could be harmful to humans, a fish consumption advisory is issued for that water body.

The 2008 Fish Consumption Advisory lists advisories for a number of species in the Allen County portion of the St. Marys River. The FCA also points out that there is a statewide advisory for carp consumption due to bioaccumulation of PCB's. Appendix VI provides more information regarding specific species and locations.

3.6 St. Marys River Watershed Restoration Action Strategy

The Watershed Restoration Action Strategy (WRAS) was developed by IDEM to be a living document to assist restoration and protection efforts of stakeholders in the St. Marys River Watershed. Released in 2001, the overall goal and purpose of Part I of the Watershed Restoration Action Strategy (WRAS) was to provide a reference point and map to assist with improving water quality. The major water quality concerns and recommended management strategies are addressed in Part II of the WRAS.

This Strategy broadly covers the entire watershed; therefore, it is intended to be an overall strategy and does not dictate management and activities at the stream site or segment level. Water quality management decisions and activities for individual portions of the watershed are most effective and efficient when managed through sub watershed plans. However, these sub watershed plans must also consider the impact on the watershed as a whole.

Finally, this Strategy is intended to be a fluid, living document in order to respond to the temporally dynamic quality of our environment. Therefore, this Strategy will require revision when new or different information becomes available. The WRAS for the St. Marys River Watershed that follows describes the Indiana portion of the watershed. Where available, information for the entire watershed is being included.

Part II of the WRAS identifies priority issues as well as recommended management strategies. Table 12 identifies priority issues as well as recommended management strategies as identified in the WRAS.

WRAS Priority Issues and Recommended Management Strategies	
Issue	Management Strategy
Data / Information & Targeting: A need for more water quality data and information to prioritize and target specific areas.	**Strategy 1:** Volunteer water quality monitoring programs. **Strategy 2:** TMDL development. **Strategy 3:** Coordination between groups completing water quality monitoring activities.
Streambank Erosion & Stabilization: Streambank cutting and erosion increases sediment load and impacts scenic and recreational values. A result of stream energy and velocity, flooding, and land management.	**Strategy:** Structural stabilizqation may be a temporary solution. However, a full understanding of drainage, stream hydraulics, and land management practices is required to solve this problem. Local programs such as those through MRBC may have some influence on reducing sediment, nutrient and pesticide loading.
Failing Septic Systems & Straight Pipe Discharges: Local health departments have identified and verified that this is a problem in the watershed. However, these practices continue at the present.	**Strategy:** The impacts resulting from effluent discharges needs to be illustrated to communities. Elimination will be a cooperative effort between homeowners and government stakeholders.
Water Quality – General: Segments of waterbodies are commonly listed as impaired on the State's 303(d) list.	**Strategy:** Development of St. Marys TMDL as well as a WMP for the St. Marys.
Fish Consumption Advisory: Fish consumption advisories are commonly issued for the St. Marys River Watershed.	**Strategy:** Continued monitoring of PCB's and mercury. Development of TMDL and WMP for the St. Marys River Watershed.
Nonpoint Source Pollution – General: Characterization of water quality impairments resulting from nonpoint source pollution.	**Strategy 1:** Development of TMDL to quantify pollutant loadings. **Strategy 2:** Promotion of Local, State, and Federal programs to reduce nonpoint source pollution. **Strategy 3:** Utilize local SWCD's to work with the Ag community in terms of livestock and waste management and crop production management.
Point Sources – General: Illegal and permitted point source dischargers exist in the watershed.	**Strategy:** Improve compliance of NPDES permit holders. Identify and eliminate illegal dischargers.

Table 12. WRAS Priority Issues and Recommended Strategies.

3.7 Estimating Pollutant Loadings

In order to determine the overall extent of nonpoint source pollution in the watershed, it is important to have an understanding of existing pollutant loads in the watershed.

Flow data for the St. Marys River was available for several United States Geological Survey (USGS) gaging stations in the watershed. Data for the main stem of the St. Marys was available from the USGS gage 04181500 located at Decatur, IN and USGS gage 04182000 located near Fort Wayne, IN. The USGS gage located on Harber Ditch, a tributary to the St. Marys, was retired in 1991. Therefore, to stay consistent with the TMDL, the USGS gage 03324000 on the Little River was used for tributary flow data. Through a regression analysis, the gage on the Little River was found to be a good comparison to the Harber Ditch gage and was used to develop load duration curves for the TMDLs.

Drainage areas were calculated for the twenty (20) sampling locations monitored by the St. Marys River Watershed. From the aforementioned USGS gages and calculated drainage areas, average flows were calculated for each sample date.

The estimated average flows were then multiplied by the sample concentrations for TSS, ammonia, phosphorus, *E. coli*, and atrazine to provide estimated pollutant loads. This process was completed for all twenty (20) sampling locations. Loading results can be found in Appendix IV.

In order to make loading comparisons across subwatersheds, average loading calculations were divided by the subwatershed drainage area, resulting in an average load per square mile. The results are shown in Figures 35-39.

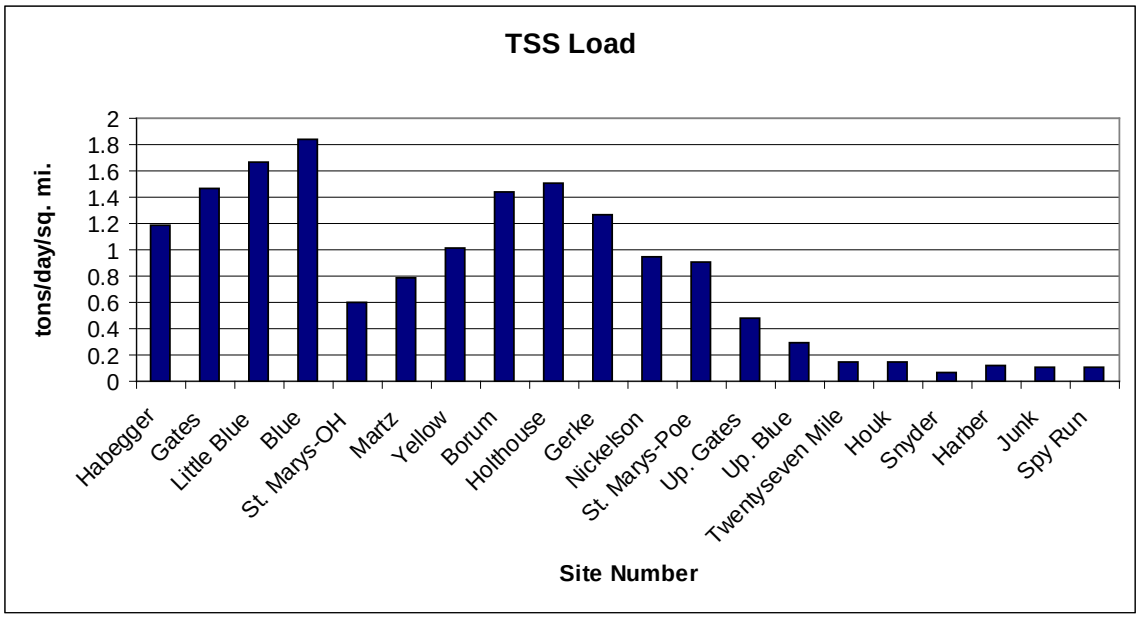

Figure 35. TSS Load: tons/day/sq. mi.

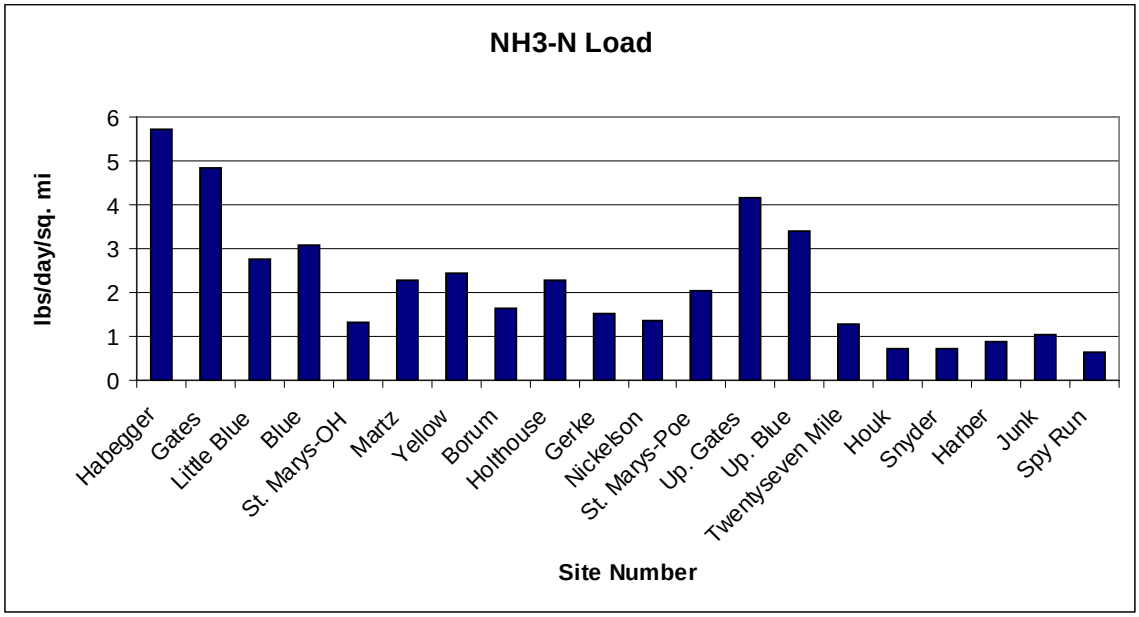

Figure 36. NH3-N Load: lbs./day/sq. mi.

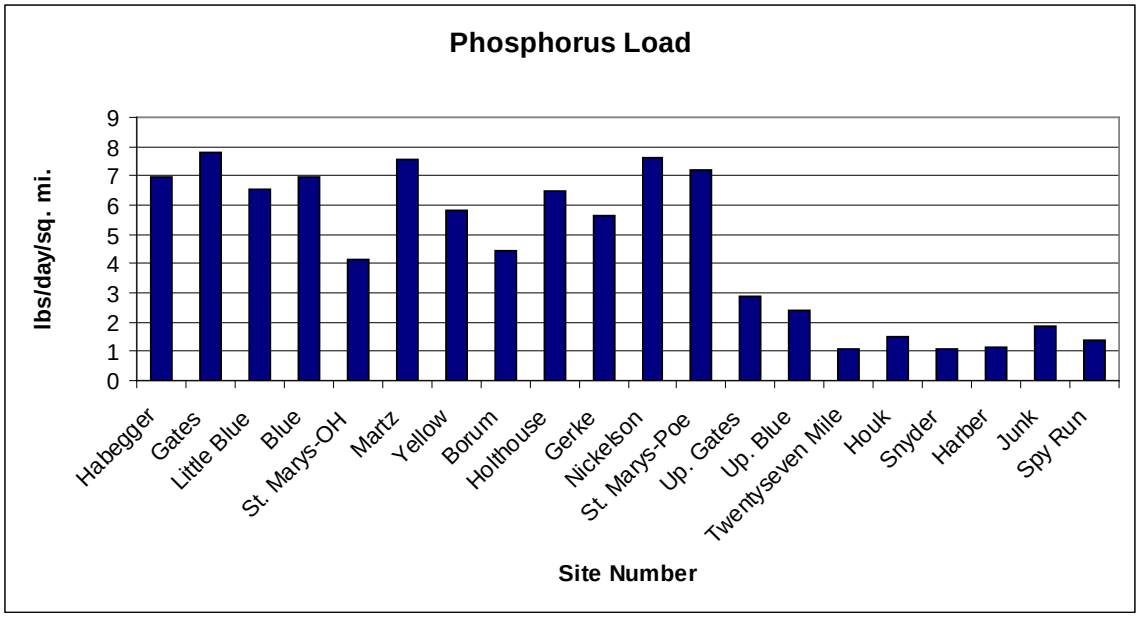

Figure 37. Phosphorus Load: lbs./day/sq. mi.

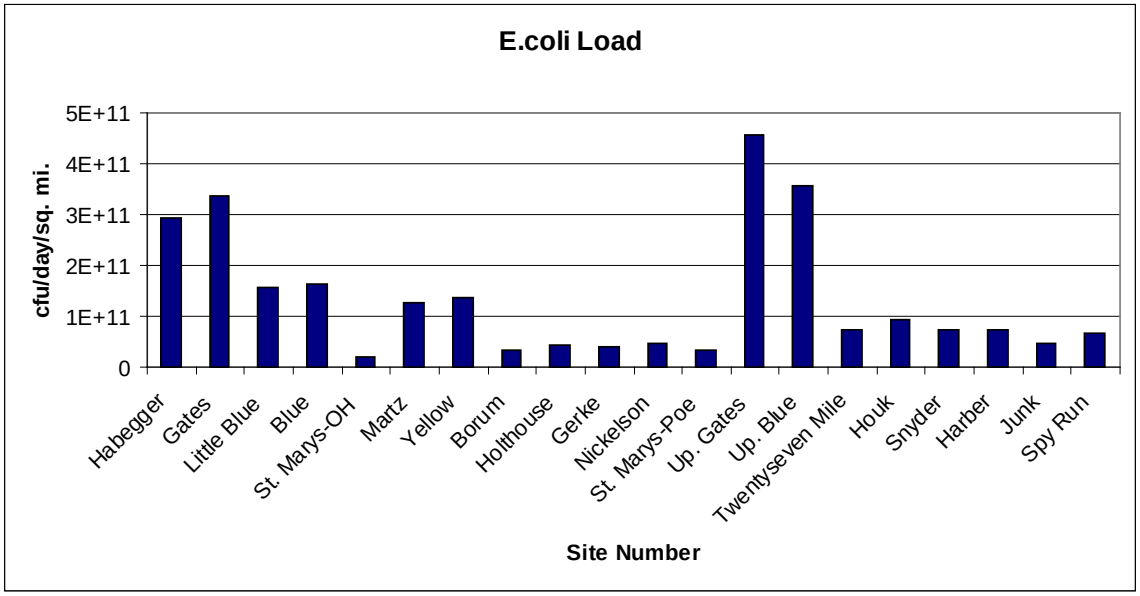

Figure 38. *E. coli* Load: cfu/day/sq. mi.

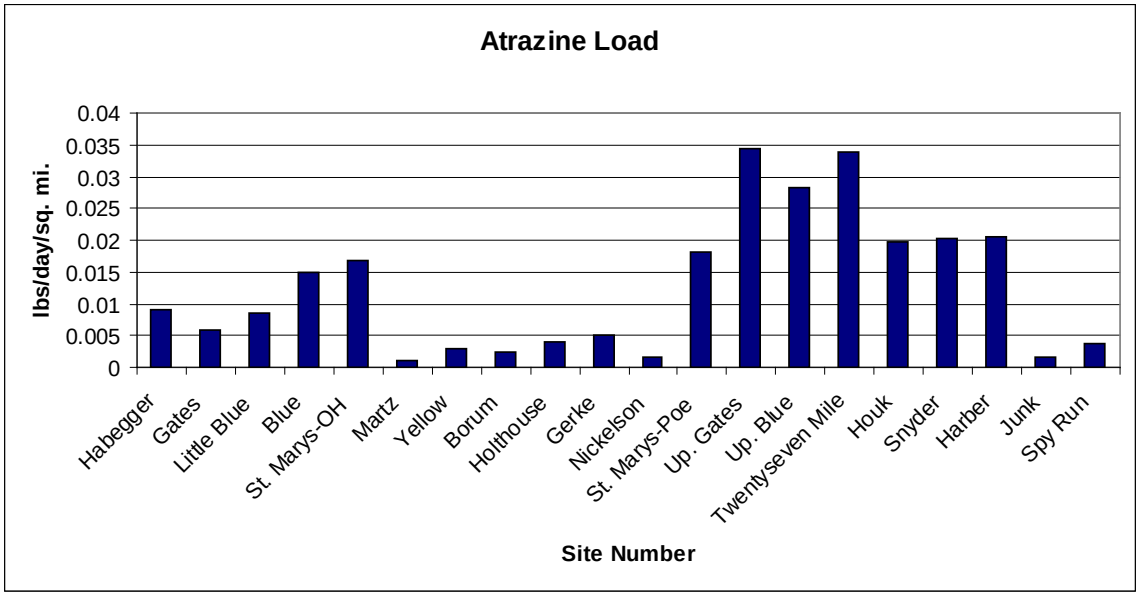

Figure 39. Atrazine Load: lbs./day/sq. mi.

3.8 Indiana's Unified Watershed Assessment (UWA)

The UWA workgroup gathered a wide range of water quality data that could be used to characterize Indiana's water resources. The data were used in layers in order to sort the 8 digit HUC watersheds according to the present condition of the water in lakes, rivers, and streams. The workgroup used only those data that concerned the water column, organisms living in the water, or the suitability of the water supporting aquatic ecosystems. Each layer of information was partitioned by percentiles into scores. The scores ranged between 1 and 5, with a score of 1 being indicative of good water quality or minimum impairment, and a score of 5 indicating heavily impacted or degraded water quality. The scoring derived through the UWA process is derived in the following Table 13.

The data layers listed in Table 13 can be defined as:

- Lake Fishery: Large mouth bass community information for lakes.
- Stream Fishery: Small mouth bass community information for streams.
- Aquatic Life Use Support: The livability of the water column for aquatic life, determined from evaluation of chemical and physical water data, and assessment of aquatic life.
- Fish Consumption Advisories: Site specific advisories based on current data.
- Fish Index of Biotic Integrity: Based on fish community diversity and fish health
- Qualitative Habitat Evaluation Index: Measure of whether the aquatic habitat is suitable for diverse communities, based on visual observations.
- Lake Trophic Scores: Indicator for the rate at which the lake is aging due to inputs of nutrients and other factors.
- Sediment Potential: Indicator of potential sediment input to water bodies in the watershed.

The sources and additional information for these layers include:

- Lake Fishery: From IDNR fish surveys of lakes and reservoirs from 1972 to 1994. Raw scores were averaged for all lakes in the watershed.
- Stream Fishery: From IDNR fish surveys of streams from 1972 to 1994. Raw scores were averaged for all lakes in the watershed.
- Aquatic Life Use Support: IDEM, Office of Water Quality, Assessment Branch
- Fish Consumption Advisories: ISDH and IDEM, Office of Water Quality, Assessment Branch
- Fish Index of Biotic Integrity: IDEM, Office of Water Quality, Assessment Branch
- Qualitative Habitat Evaluation Index: IDEM, Office of Water Quality, Assessment Branch
- Lake Trophic Scores: Indiana Clean Lakes Program through IDEM, Office of Water Quality, Assessment Branch. This score was based on information gathered from sampling conducted in the 1970's and 1980's.
- Sediment Potential: U.S. Geological Survey scored the population rate of change and the 1996 Conservation Tillage Transect data. The scores were then added and normalized to produce a sediment yield indicator for each watershed.

From this scoring, it is evident that stream fishery, aquatic life use support, and qualitative habitat evaluation index are the key concerns. However all categories are of concern based on the ranking for the St. Marys River Watershed.

Results of the Unified Watershed Assessment for the St. Marys River	
Data / Information Layer	**St. Marys River (04100004) Score**
Lake Fishery	*
Stream Fishery	5
Aquatic Life Use Support	5
Fish Consumption Advisories	3
Fish Index of Biotic Integrity	*
Qualitative Habitat Evaluation Index	5
Lake Trophic Scores	*
Sediment Potential	3
Note: The UWA scores range from 1 to 5, with a score of 1 indicating good water quality and a score of 5 indicating severe impairment.	
* No score determined.	

Table 13. Results of the Unified Watershed Assessment for the St. Marys River

During the summer of 1999 the UWA workgroup used additional layers of information to identify the resource concerns and stressors for each of the 361 11-digit watersheds in Indiana. Examination of the human activities that have the potential to impact the ecosystem will help planners focus on those areas where restoration may be most critical. Organizations can identify opportunities to use their programs and resources to address those areas.

This focusing process will illuminate areas where interests of two or more partner agencies may converge. It is intended that this will lead to more effective allocation of resources for restoration and protection activities. At the local level, this information can assist groups to prioritize watershed activities and provide some discussion points for planning.

This amended assessment has the following benefits:

- Provides a logical process for targeting funds, which may be expanded or updated without changing the basic framework.
- Provides information at a finer resolution (11-digit HUC) to agencies and local watershed groups.
- Identifies data gaps.
- Can be used as a compliment to other assessments, such as the 305(b) Report and the 303(d) List.

Table 14 shows the results of the 2000-2001 UWA for the St. Marys River Watershed.

HUC Scores for Each Parameter Used in the Unified Watershed Assessment (2000-2001)																
	11 Digit HUC	Mussel Diversity & Occurrence	Aquatic Life Use Support	Recreational Use Attainment	Stream Fishery	Lake Fishery	Eurasion Milfoil Infestation Status	Lake Trophic Status	Critical Biodiversity Resource	Aquifer Vulnerability	Population Using Surface Water for Drinking Water	Residential Septic System Density	Degree of Urbanization	Density of Livestock	% Cropland	Mineral Extraction Activities
St. Marys	04100004030	nd	nd	nd	nd	nd	nd	nd	1	5	4	1	1	5	5	3
	04100004040	nd	nd	nd	nd	nd	nd	nd	2	5	4	2	2	5	5	3
	04100004050	nd	nd	nd	nd	nd	nd	nd	2	5	4	3	2	5	5	3
	04100004060	nd	nd	nd	5	nd	nd	nd	3	4	4	4	3	4	3	2

Table 14. Scores from the 2000-2001 Unified Watershed Assessment

3.9 St. Marys Watershed Nutrient Management Program

The Adams County SWCD was granted a 319 grant in 2000 to develop a nutrient management program in the St. Marys River Watershed. Phase I of the project involved the hiring of a nutrient management specialist to develop an education and outreach program to assist producers with the development of Nutrient Management Plans, including storage, handling, and application procedures for manure and fertilizer. The specialist was also responsible for collecting bimonthly water quality samples at 12 sites focusing on nitrates and phosphates.

Phase II of the project established a cost share program for livestock producers. The goal of the cost share program was to improve the environmental quality of natural resources in Adams County by establishing a long term nutrient management program. Phase II of the project also continued water quality monitoring across the watershed.

The following Figures 40-42 represent the observed nutrient levels during water quality monitoring during the St. Marys Watershed Nutrient Management Program.

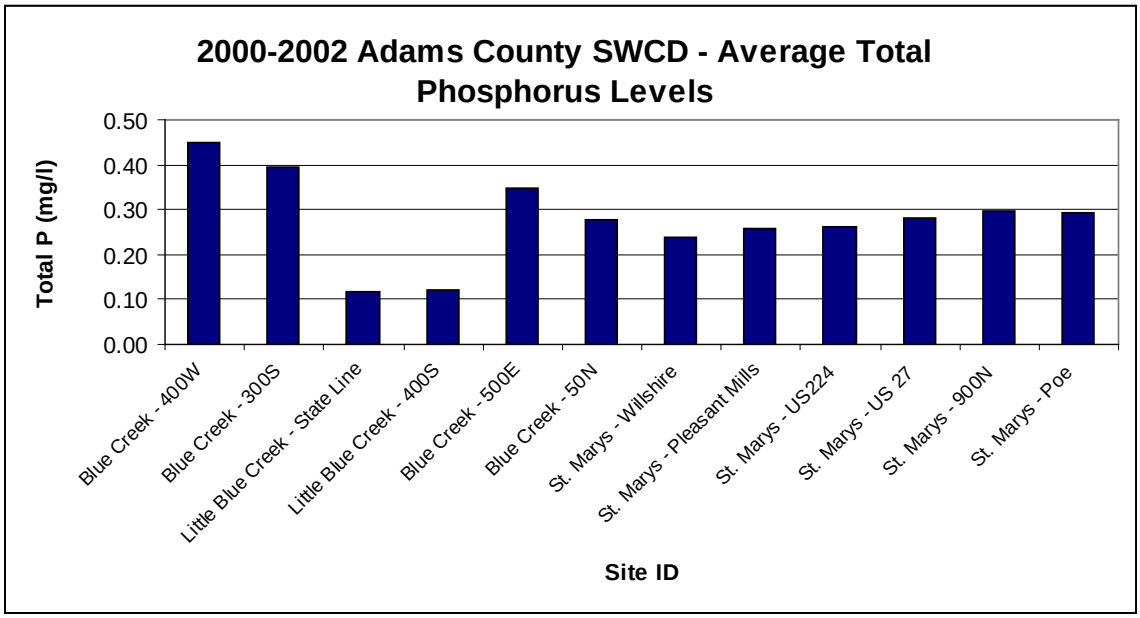

Figure 40. Average Total Phosphorus levels in the St. Marys River Watershed.

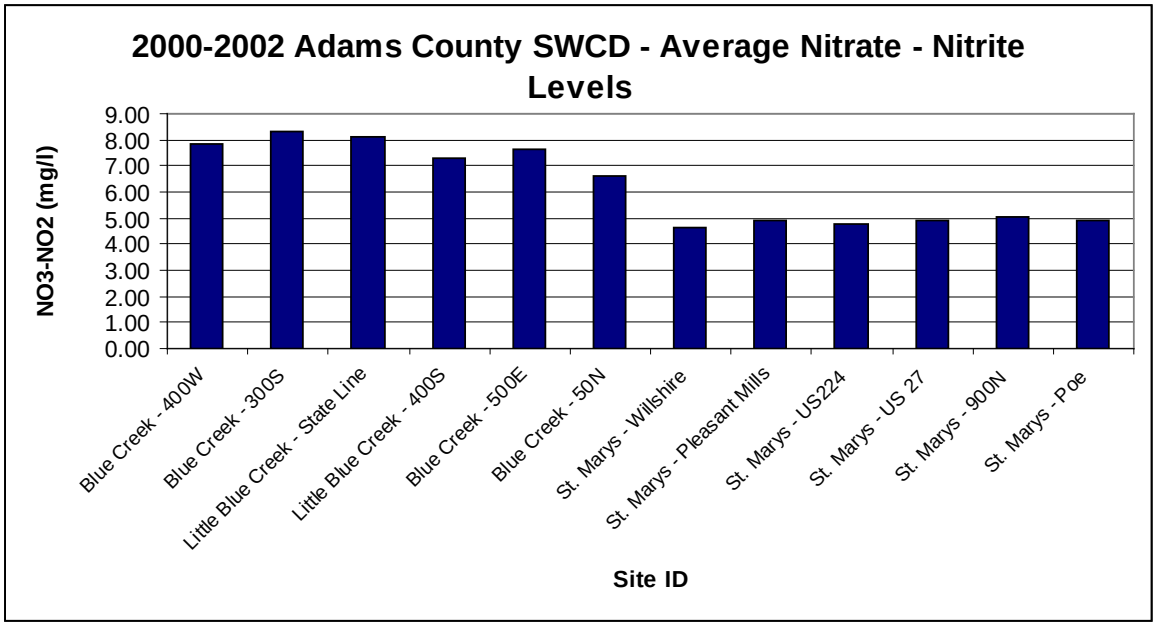

Figure 41. Average Nitrate – Nitrite Levels in the St. Marys River Watershed.

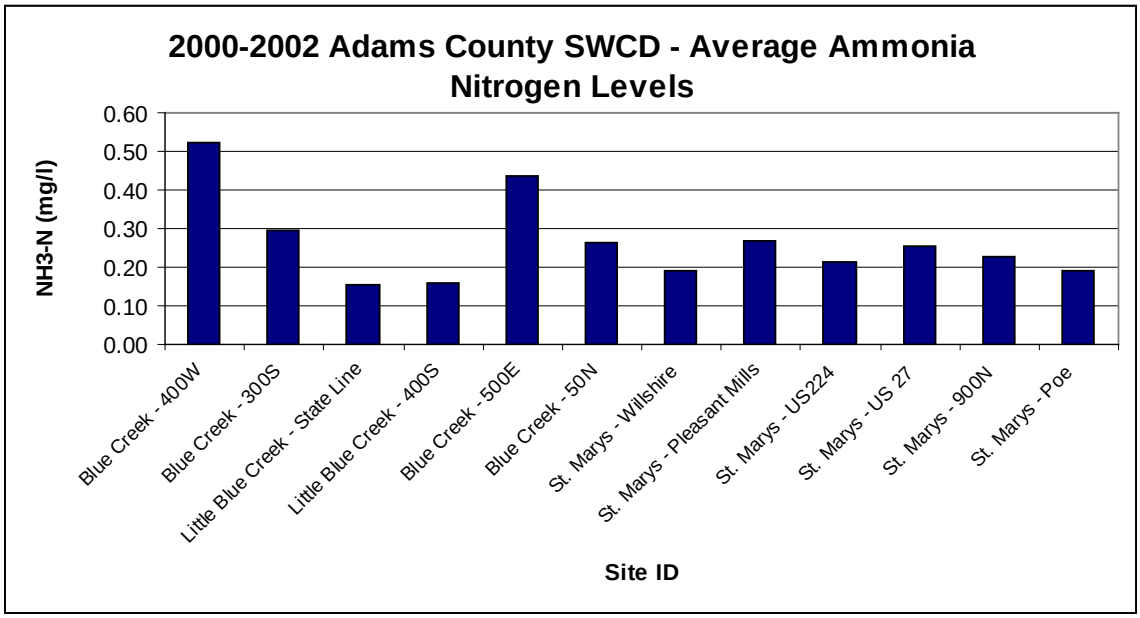

Figure 42. Average Ammonia Nitrogen Levels in the St. Marys River Watershed.

3.10 Water Quality Summary

Habegger Ditch

Habegger Ditch is a tributary to the Gates Creek located in the southern portion of the watershed, with its headwaters located near Berne, IN. Wittmer Ditch and Sprunger Ditch feed into Habegger Ditch. Habegger Ditch was sampled by IDEM in 2004 during the TMDL development as well as the St. Marys River Watershed Project in 2007-2008.

Physical parameter measurements were measured in Habegger Ditch by the St. Marys River Watershed Project. Dissolved oxygen measurements violated Indiana water quality standards for a four week period in late September and early October 2007, with a low value of 2.34 mg/l. Temperature, pH and conductivity measurements were within Indiana water quality standards.

Habegger Ditch commonly exceeds the Indiana state standard of 235 cfu/100ml. Loading data shows that a 75% reduction in *E. coli* loads will be necessary to meet IAC *E. coli* standards.

IDEM Nitrate data shows that on average, the IAC drinking water standard (10 mg/l) is met. However, occasional slugs during high flows were observed with levels reaching more than 20 mg/l. Ammonia data collected by the St. Marys River Watershed Project revealed extremely high ammonia levels in the watershed. Concentrations as high as 15.00 mg/l were observed, with an average of 1.32 mg/l. Ammonia concentrations in this range for a prolonged period can be extremely toxic to aquatic organisms. Calculation of the Criterion Continuous Concentration (CCC) resulted in five exceedences of the CCC.

Phosphorus data collected by both IDEM and the St. Marys River Watershed Project exceeded the TMDL and St. Marys Watershed Project standard of 0.30 mg/l with averages of 0.38 mg/l and 0.45 mg/l.

TSS data collected by IDEM was quite different than that collected by the St. Marys River Watershed Project. IDEM data on average met the TMDL goal of 30 mg/l by averaging 23.95 mg/l. However, during high flows, levels as high as 94.50 mg/l were observed. Data collected by the St. Marys River Watershed Project saw an average of almost 74 mg/l with the maximum concentration reaching 696 mg/l. This inconsistency may be due to sampling time, IDEM data was collected March through October. The St. Marys River Watershed Project data was collected during the months of September through July, which included the winter months. It was during the winter months of February and early March that the highest TSS levels were recorded.

Pesticide data was collected by the St. Marys River Watershed Project in 2007-2008. Samples were analyzed for Atrazine, Alachlor, Cyanazine, and Metolachlor. Six Atrazine samples were found to be in violation of the USEPA drinking water standard of 3.00 µg/l. All violations occurred in the months of April-July, a period when Atrazine is being readily applied. Concentrations of Alachlor, Cyanazine, were below MCL levels and Metolachlor concentrations were not in excess of health advisory levels.

The following Table 15 summarizes water quality data in Habegger Ditch.

Habegger Ditch							
IDEM LES040-0099, CR 150E at CR 500S							
		Concentration			Loading		
Parameter	Data Source	Min.	Max.	Avg.	Min.	Max.	Avg.
E. coli	2004 IDEM	84.7	17329	3594.5			
E. coli	SMRWP	200	48,392	7846	9.61E+09	2.49E+13	2.31E+12
Nitrogen, NO3+NO2	2004 IDEM	0.06	20.10	4.11			
Phosphorus	2004 IDEM	0.07	1.17	0.38			
Phosphorus	SMRWP	0.03	1.44	0.45	0.2	558.7	55.1
TSS	2004 IDEM	6.7	94.50	23.95			
TSS	SMRWP	9	696	73.99	0.0	151.5	13.0
Temperature	SMRWP	0.04	21.17	11.00			
pH	SMRWP	7.23	8.11	7.64			
DO	SMRWP	2.34	13.15	7.88			
Conductivity	SMRWP	128	1069	624			
Turbidity	SMRWP	11.20	700.90	87.00			
BOD	SMRWP	1.35	9.86	4.66			
NH3-N	SMRWP	0.10	15.00	1.32	0.5	288.7	45.0
Atrazine	SMRWP	0.03	8.17	1.73	0.001	0.527	0.071
Alachlor	SMRWP	0.04	0.71	0.31			
Cyanazine	SMRWP	0.00	0.41	0.25			
Metolachlor	SMRWP	0.06	7.74	1.45			

Table 15. Water quality in Habegger Ditch

Gates Ditch

Gates Ditch, fed by Habegger Ditch, is a tributary to the Blue Creek located in the southern portion of the watershed. Farlow Ditch and Habegger Ditch combine to form Gates Ditch. There are two monitoring stations located on Gates Ditch, one on Lower Gates Ditch near the confluence with Blue Creek, and another in the headwaters, upstream of Habegger Ditch. Lower Gates Ditch was sampled in 2004 by IDEM and again in 2007-2008 by the St. Marys River Watershed Project. Upper Gates Ditch was sampled by the St. Marys River Watershed Project in 2007-2008.

Physical parameter measurements in Lower Gates Ditch again revealed dissolved oxygen violations during a two week period in mid-October 2007. Measurements of 1.02 mg/l and 2.43 mg/l were recorded during this time. Upper Gates Ditch also experienced low dissolved oxygen levels, 2 of 9 measurements violated the Indiana water quality standard for minimum dissolved oxygen concentration (4.0 mg/l). Temperature, pH and conductivity measurements were within Indiana water quality standards for both monitoring stations on Gates Ditch.

Similar to Habegger Ditch, Lower Gates Ditch *E. coli* data shows extremely high *E. coli* levels, averaging 4,440.4 cfu/100ml in 2004 and 11,041.15 cfu/100ml most recently. Loading data shows that an 86% reduction is necessary to meet Indiana state standards (235 cfu/100ml). The headwaters site also showed elevated bacteria levels, with 100% of the samples exceeding the IAC standard (235 cfu/100ml). Loading results show that an 85% reduction is necessary to meet the standard. On a per square mile analysis, Upper Gates Ditch ranked first for *E. coli* loading.

Nitrogen data collected by IDEM at the lower site exceeded the Nitrate drinking water standard (10 mg/l) in only 2 of 16 samples. Ammonia data for Lower Gates Ditch collected by the St. Marys River Watershed Project ranged from the lab detection level of 0.10 mg/l on several occasions to a maximum of 3.59 mg/l on June 4, 2008. Ammonia levels in the headwaters averaged 0.69 mg/l, with a maximum concentration of 3.70 mg/l. 1 violation of the CCC was reported at the upper reach and 2 exceedences occurred at the lower reach of Gates Ditch.

Phosphorus data collected by IDEM in the lower reach averaged 0.41 mg/l. However, it was interesting that all samples collected in July through October exceeded the 0.30 mg/l TMDL standard. Phosphorus data collected by the St. Marys River Watershed Project averaged 0.49 mg/l with a maximum of 1.51 mg/l. Upper Gates Ditch had the highest Phosphorus concentration with an average of 0.50 mg/l.

In Lower Gates Ditch, only 25% of IDEM TSS samples exceeded the TMDL standard of 30 mg/l, whereas 64% of samples collected by the St. Marys River Watershed Project exceeded the standard. At the upper sampling site TSS levels were in violation of the TMDL standard (30 mg/l) 100% of the time.

Pesticide data was collected in Lower Gates Ditch by the St. Marys River Watershed Project in 2007-2008. Pesticide data in Upper Gates was collected in 2008. Samples were analyzed for Atrazine, Alachlor, Cyanazine, and Metolachlor. In Lower Gates Ditch, three Atrazine samples were found to be in violation of the USEPA drinking water

standard of 3.00 µg/l. A maximum concentration of 10.04 µg/l was reported in June 2008. In the upper reach of Gates Ditch, one sample was in violation of the drinking water standard (9.45 µg/l).All violations occurred in the months of April-July, a period when Atrazine is being readily applied. Concentrations of Alachlor, Cyanazine, were below MCL levels and Metolachlor concentrations were not in excess of health advisory levels.

The following Tables 16 & 17 summarize water quality in Gates Ditch.

Gates Ditch							
IDEM LES040-0023, CR 400S, East of CR 200E							
		Concentration			Loading		
Parameter	Data Source	Min.	Max.	Avg.	Min.	Max.	Avg.
E. coli	2004 IDEM	204.6	24,200	4,440.4			
E. coli	SMRWP	435	104,620	11,041.15	2.94E+10	6.01E+13	6.36E+12
Nitrogen, NO3+NO2	2004 IDEM	0.28	22.60	4.53			
Phosphorus	2004 IDEM	0.07	1.08	0.41			
Phosphorus	SMRWP	0.11	1.51	0.49	1.4	1925.6	149.0
TSS	2004 IDEM	6.30	157.0	33.51			
TSS	SMRWP	2	1004	124.61	0.1	424.4	38.4
Temperature	SMRWP	0.06	21.36	11.04			
pH	SMRWP	1.02	12.05	7.05			
DO	SMRWP	1.02	12.05	7.05			
Conductivity	SMRWP	128	932	663			
Turbidity	SMRWP	13.40	841	133.83			
BOD	SMRWP	1	11.73	4.07			
NH3-N	SMRWP	0.10	3.59	0.59	0.0	616.5	92.7
Atrazine	SMRWP	0.02	10.04	1.38	0.001	1.565	0.111
Alachlor	SMRWP	0.05	1.47	0.40			
Cyanazine	SMRWP	0.00	0.42	0.29			
Metolachlor	SMRWP	0.00	1.53	0.55			

Table 16. Water quality in Gates Ditch.

Upper Gates Ditch							
CR 500S, Upstream of confluence with Habegger Ditch							
		Concentration			Loading		
Parameter	Data Source	Min.	Max.	Avg.	Min.	Max.	Avg.
Temperature	SMRWP	10.22	19.40	15.12			
pH	SMRWP	6.92	7.47	7.19			
DO	SMRWP	2.35	6.29	4.71			
Conductivity	SMRWP	536	905	770.11			
Turbidity	SMRWP	54.90	1,040	217.11			
BOD	SMRWP	3.34	7.30	4.95			
TSS	SMRWP	46	586	132.50	0.3	22.1	5.1
NH3-N	SMRWP	0.13	3.70	0.69	2.0	278.6	34.3
Phosphorus	SMRWP	0.04	1.66	0.50	0.5	125.3	23.7
E. coli	SMRWP	613	48,392	8,795	2.76E+10	2.81E+13	3.75E+12
Atrazine	SMRWP	0.08	9.45	2.61			
Alachlor	SMRWP	0.21	0.68	0.43			
Cyanazine	SMRWP						
Metolachlor	SMRWP	0.12	2.82	0.97			

Table 17. Water quality in Upper Gates Ditch

Little Blue Creek

Little Blue Creek is a tributary to Blue Creek located in the southern portion of the watershed near the Indiana – Ohio state line. The first monitoring station is located on Little Blue Creek upstream of the confluence with Blue Creek. This site was sampled by the Adams County SWCD in 2000 and 2001, by IDEM in 2004, and by the St. Marys River Watershed Project in 2007-2008. The second monitoring station is located in the Little Blue Creek headwaters. This site was sampled by the Adams County SWCD in 2000 and 2001.

Conductivity measurements in Little Blue Creek yielded three violations of the Indiana dissolved solids standard, measurements of 1,067 µS/cm, 1,464 µS/cm, and 1,776 µS/cm were recorded in October 2007. Measurements for pH, temperature, and dissolved oxygen were with Indiana water quality standards.

In the lower reach, *E. coli* levels exceeded IDEM standards 100% of the time when sampled by the Adams County SWCD, 75% of the time when sampled by IDEM, and 90% of the time when sampled by the St. Marys River Watershed Project. A 56% reduction in *E. coli* loading levels will be necessary to meet IDEM water quality standards for *E. coli* (235 cfu/100ml). In the headwaters of Little Blue Creek, all *E. coli* samples collected by the Adams County SWCD surpassed the IDEM standard. The headwaters had an average value of 2,940 cfu/100ml.

Nitrogen data collected for the downstream reach by the Adams County SWCD and IDEM showed averages of 7.28 and 4.26 mg/l, with maximum values of 22.50 and 15.10 mg/l. Ammonia data collected at this site ranged from 0.05 mg/l to 1.02 mg/l when sampled by the Adams County SWCD, and from 0.10 mg/l to 0.44 mg/l when sampled by the St. Marys River Watershed Project. No violations of the CCC were reported on

Little Blue Creek. In the Little Blue Creek headwaters, Nitrogen had a slightly higher average concentration than the downstream site, at 8.09 mg/l. Similar averages were observed between ammonia levels at the upstream and downstream monitoring stations.

Phosphorus data was collected at the downstream monitoring location by all three organizations. In 2000-2001 the Adams County SWCD recorded an average concentration of 0.12 mg/l. In 2004 IDEM saw an average of 0.19 mg/l and in 2007-2008 the St. Marys River Watershed Project observed an average of 0.28 mg/l. In the most recent round of sampling, 70% of samples were under the 0.30 mg/l phosphorus standard set by the TMDL. During the 2000-2001 Adams County SWCD sampling in the Little Blue Creek headwaters, concentrations ranged from the laboratory detection limit up to 0.26 mg/l.

TSS data collected near the confluence showed that in 2004 24% of samples collected by IDEM exceeded the standard of 30 mg/l set by the TMDL. In 2007-2008 sampling conducted by the St. Marys River Watershed project, this number rose to 56% of samples being in exceedence.

Pesticide data was collected by the St. Marys River Watershed Project in 2007-2008. Samples were analyzed for Atrazine, Alachlor, Cyanazine, and Metolachlor. Two Atrazine samples were found to be in violation of the USEPA drinking water standard of 3.00 µg/l. A maximum concentration of 16.4 µg/l was reported. All violations occurred in the months of April-July, a period when Atrazine is being readily applied. Concentrations of Alachlor, Cyanazine, were below MCL levels and Metolachlor concentrations were not in excess of health advisory levels.

Tables 18 and 19 summarize water quality in Little Blue Creek.

Little Blue Creek							
IDEM LES040-0010, CR 400S, West of CR 600E							
		Concentration			Loading		
Parameter	Data Source	Min.	Max.	Avg.	Min.	Max.	Avg.
E. coli	2004 IDEM	70.3	24192	4706			
E. coli	2000-2001 Adams SWCD	400	11,000	2743.8			
E. coli	SMRWP	100	30,760	3,694	4.22E+09	4.18E+13	2.47E+12
Nitrogen, NO3+NO2	2004 IDEM	0.08	15.10	4.26			
Nitrogen, NO3+NO2	2000-2001 Adams SWCD	0.02	22.50	7.28			
Phosphorus	2004 IDEM	ND	1.05	0.19			
Phosphorus	2000-2001 Adams SWCD	0.01	0.42	0.12			
Phosphorus	SMRWP	0.02	1.43	0.28	0.3	1234.3	103.4
TSS	2004 IDEM	8.10	183.0	34.29			
TSS	SMRWP	9.50	920.00	90.61	0.1	452.4	37.4
Temperature	SMRWP	0.04	21.76	11.04			
pH	SMRWP	7.23	8.31	7.71			
DO	SMRWP	4.76	13.54	9.00			
Conductivity	SMRWP	67.30	1776	595.24			
Turbidity	SMRWP	8.80	840.60	107.55			
BOD	SMRWP	1.17	6.00	2.68			
NH3-N	SMRWP	0.10	0.44	0.17	0.9	479.3	43.2
NH3-N	2000-2001 Adams SWCD	0.05	1.02	0.16			
Atrazine	SMRWP	0.01	16.40	1.53	0.001	2.315	0.132
Alachlor	SMRWP	0.03	1.43	0.30			
Cyanazine	SMRWP	0.01	0.46	0.31			
Metolachlor	SMRWP	0.00	2.58	0.54			

Table 18. Water quality in Little Blue Creek

Little Blue Creek							
Adams SWCD: State Line (700E) N of 900S (Headwaters)							
		Concentration			Loading		
Parameter	Data Source	Min.	Max.	Avg.	Min.	Max.	Avg.
E. coli	2000-2001 Adams SWCD	400	12,200	2,940			
Phosphorus	2000-2001 Adams SWCD	0.01	0.26	0.12			
Nitrogen, NO3-NO2	2000-2001 Adams SWCD	0.02	21.20	8.09			
NH3-N	2000-2001 Adams SWCD	0.05	0.43	0.16			

Table 19. Water quality in Little Blue Creek (Headwaters)

Blue Creek

Blue Creek is the largest tributary to the St. Marys River. The Blue Creek watershed encompasses the aforementioned tributaries of Habegger Ditch, Gates Ditch and Little Blue Creek. A total of four monitoring stations have been sampled on Blue Creek. The uppermost site was sampled by the Adams County SWCD in 2000 and 2001. Moving downstream, the next monitoring station is located upstream of the Gates Ditch confluence. This site has been sampled by the Adams SWCD in 2000-2001, by IDEM in 2004, and by the St. Marys River Watershed Project in 2007-2008. The next site is located on Blue Creek between the confluences of Gates Ditch and Little Blue Creek. This site was monitored in 2000-2001 by the Adams County SWCD and again in 2004 by IDEM. The final site on Blue Creek is located just upstream of the confluence with the St. Marys River, this site was sampled by all three entities.

Physical parameter measurements were taken by the St. Marys River Watershed Project from 2007-2008 upstream of the confluence with the St. Marys River. Conductivity measurements in Blue Creek saw a period with high conductivity levels leading to violations of the Indiana dissolved solids standard, measurements of 1,281 µS/cm, 1,435 µS/cm, 1,379 µS/cm 1,282 µS/cm and 1,137 µS/cm were recorded in September and October 2007. Measurements for pH, temperature, and dissolved oxygen were with Indiana water quality standards.

In the uppermost reach of Blue Creek, 75% of samples collected by the Adams County SWCD exceeded the 235 cfu/100ml IDEM standard. Concentrations ranged from a low of 100 cfu/100ml to a high of 11,200 cfu/100ml. The next sampling location, also

considered as a headwater reach, was sampled by the Adams County SWCD in 2000-2001, by IDEM in 2004, and most recently the St. Marys River Watershed Project in 2007-2008. Average *E. coli* concentrations were recorded as 4,612.5 cfu/100ml in 2000-2001, 2,739.8 cfu/100ml in 2004, and 5,300.5 cfu/100ml in 2007-2008. Loading estimates for this site illustrate that approximately a 50% reduction in *E. coli* loading will be necessary to meet IDEM water quality standards. Moving further downstream, the next monitoring station was sampled in 2000-2001 by the Adams County SWCD and in 2004 by IDEM. Adams County SWCD data shows that 86% of collected samples exceeded the IDEM standard, while 88% of the samples collected by IDEM exceeded the standard. Samples collected by Adams County ranged from 150 cfu/100ml to 58,400 cfu/100ml, whereas those collected by IDEM ranged from 178.8 cfu/100ml to 24,200 cfu/100ml. The furthest downstream site was sampled by all three organizations. Adams County SWCD recorded average *E. coli* levels of 4,693.8 cfu/100ml, IDEM 6,817.9 cfu/100ml, and the St. Marys River Watershed Project 3,644.9 cfu/100ml. Loading calculations for this site estimate that a 52% loading reduction is necessary to meet IDEM water quality standards.

Nitrogen data was collected in the headwater reaches by the Adams County SWCD in 2001, by IDEM in 2004, and by the St. Marys River Watershed Project in 2007-2008. In the uppermost reach, NO3-NO2 data collected by the Adams County SWCD averaged 7.85 mg/l with a maximum level of 27.10 mg/l. Ammonia data collected at this site ranged from a low of the laboratory detection limit to a high of 3.40 mg/l. Downstream of this site, Adams County NO3-NO2 data averaged 8.35 mg/l, while IDEM data averaged 5.49 mg/l. Ammonia concentration collected by the Adams County SWCD and the St. Marys River Watershed Project were similar with averages of 0.30 mg/l and 0.36 mg/l. Maximum ammonia concentrations were recorded at 1.64 mg/l and 2.00 mg/l. No exceedences of the CCC were found in Blue Creek. Downstream of the Gates Ditch confluence, Adams County SWCD NO3-NO2 concentrations ranged from 0.20 mg/l to 29.80 mg/l, IDEM concentrations ranged from 0.53 mg/l to 28.70 mg/l. 21% of the Adams County SWCD samples violated the Indiana drinking water standard of 10 mg/l. 18% of IDEM samples exceeded the standard. Ammonia data collected by Adams County in 2001 at this site ranged from the laboratory detection level of 0.05 mg/l to 3.06 mg/l. The average ammonia concentration at this site was 0.44 mg/l. At the most downstream site on Blue Creek, NO3-NO2 concentrations averaged 6.64 mg/l and 4.80 mg/l. A value of 30.90 mg/l was recorded by the Adams County SWCD in May, 2000. Average ammonia levels of 0.26 mg/l were recorded by the Adams County SWCD in 2000-2001, while an average concentration of 0.21 mg/l was observed in the most recent round of monitoring by the St. Marys River Watershed Project. Tables 20 – 23 summarize water quality in Blue Creek.

Phosphorus data collected by the Adams County SWCD in 2000-2001 had an average concentration of 0.45 mg/l, 48% of these samples exceeded the 0.30 mg/l standard set by the IDEM TMDL. Moving downstream to the next location, phosphorus was sampled by Adams County SWCD in 2000-2001, IDEM in 2004, and by the St. Marys River Watershed Project in 2007-2008. Levels have seen a slight decrease over the period, with an average concentration of 0.39 mg/l in 2000-2001, 0,34 mg/l in 2004, and 0.30 mg/l in 2007-2008. This trend also held true at the monitoring station between Gates Ditch and Little Blue Creek. Adams County SWCD data collected in 2000-2001 averaged 0.35 mg/l, while 2004 IDEM data averaged 0.31 mg/l. At the furthest downstream site,

2000-2001 average values were reported at 0.28 mg/l, 0.25 mg/l in 2004, and 0.32 mg/l in 2007-2008. 35% of samples exceeded the TMDL phosphorus standard (0.30mg/l) in 2000-2001, 25% in 2004, and 39% in 2007-2008.

TSS data were not collected at the most upstream station on Blue Creek. At the monitoring station upstream of Gates Ditch, TSS data were collected by IDEM in 2004 and by the St. Marys River Watershed Project in 2007-2008. IDEM reported TSS levels from below the laboratory detection limit to as high as 139 mg/l. Only 25% of IDEM samples exceeded the TMDL standard of 30 mg/l. In 2007-2008 the St. Marys River Watershed Project recorded TSS levels ranging from 11.4 mg/l to 254 mg/l. 31% of these samples exceeded the TMDL standard. At the monitoring station downstream of Gates Ditch, IDEM reported levels ranging from 10.3 mg/l to 460 mg/l, with an average concentration of 52.61 mg/l. 25% of samples exceeded the TMDL standard.

Pesticide data were collected at two locations on Blue Creek by the St. Marys River Watershed Project in 2007-2008. In the Blue Creek headwaters, two of seven samples exceeded the USEPA drinking water standard of 3.00 µg/l. In Blue Creek near the confluence with the St. Marys River, data revealed a period from June 4, 2008 to July 2, 2008 where high Atrazine levels were reported. Five Atrazine samples exceeded the USEPA drinking water standard. A maximum concentration of 14.42 µg/l was reported on June 4, 2008. On this same day, Alachlor levels in Blue Creek exceeded the MCL level, with a concentration of 2.04 µg/l Concentrations of Cyanazine were below MCL levels and Metolachlor concentrations were not in excess of health advisory levels.

The following Tables 20-23 summarize water quality in Blue Creek.

Blue Creek							
400W just South of 100S							
		Concentration			Loading		
Parameter	Data Source	Min.	Max.	Avg.	Min.	Max.	Avg.
E. coli	2000-2001 Adams County SWCD	100	11,200	3850			
Phosphorus	2000-2001 Adams County SWCD	0.10	2.20	0.45			
Nitrogen, NO3-NO2	2000-2001 Adams County SWCD	0.20	27.10	7.85			
NH3-N	2000-2001 Adams County SWCD	0.05	3.40	0.52			

Table 20. Water Quality in Blue Creek (Headwaters)

Blue Creek							
IDEM LES040-0066, CR 300S, East of CR 000; SMRWP, CR 100E, Upstream of confluence with Gates Ditch							
		Concentration			Loading		
Parameter	Data Source	Min.	Max.	Avg.	Min.	Max.	Avg.
E. coli	2000-2001 Adams SWCD	250	27,200	4,612.5			
E. coli	2004 IDEM	34.5	24,200	2738.9			
E. coli	SMRWP	98	43,520	5,300.54	1.17E+10	8.69E+13	8.47E+12
Nitrogen, NO3+NO2	2004 IDEM	0.06	36.40	5.49			
Nitrogen, NO3+NO2	2000-2001 Adams SWCD	0.20	28.90	8.35			
Phosphorus	2004 IDEM	0.09	0.66	0.34			
Phosphorus	2000-2001 Adams SWCD	0.01	1.45	0.39			
Phosphorus	SMRWP	0.04	0.78	0.30	4.3	341.8	57.2
NH3-N	2000-2001 Adams SWCD	0.05	1.64	0.30			
NH3-N	SMRWP	0.10	2.00	0.36	3.0	703.3	81.3
TSS	2004 IDEM	ND	139.00	25.91			
TSS	SMRWP	11.4	254	51.77	0.2	55.8	6.6
Temperature	SMRWP	11.16	21.72	16.95			
pH	SMRWP	7.23	8.10	7.74			
DO	SMRWP	5.13	9.96	7.43			
Conductivity	SMRWP	574	820	680.89			
Turbidity	SMRWP	25.40	166.00	62.65			
BOD	SMRWP	2.32	7.61	4.42			
Atrazine	SMRWP	0.57	6.83	3.49	0.016	2.377	0.674
Alachlor	SMRWP	0.04	0.76	0.24			
Cyanazine	SMRWP						
Metolachlor	SMRWP	0.13	4.44	1.47			

Table 21. Water Quality in Blue Creek (Lower headwaters)

Blue Creek							
IDEM LES040-0011, Salem Rd., South of CR 300S; Adams County SWCD, CR 500 E							
		Concentration			Loading		
Parameter	Data Source	Min.	Max.	Avg.	Min.	Max.	Avg.
E. coli	2004 IDEM	178.8	24,200	2680.1			
E. coli	2000-2001 Adams SWCD	150	58,400	13,421.43			
Nitrogen, NO3+NO2	2004 IDEM	0.53	28.70	5.43			
Nitrogen, NO3+NO2	2000-2001 Adams SWCD	0.20	29.80	7.63			
Phosphorus	2004 IDEM	ND	1.03	0.31			
Phosphorus	2000-2001 Adams SWCD	0.01	1.31	0.35			
NH3-N	2000-2001 Adams SWCD	0.05	3.06	0.44			
TSS	2004 IDEM	10.3	460	52.61			

Table 22. Water quality in Blue Creek (Downstream Gates Ditch)

Blue Creek							
IDEM LES040-0009, SR 124, East of SR 101, Adams County SWCD @ CR 50N							
		Concentration			Loading		
Parameter	Data Source	Min.	Max.	Avg.	Min.	Max.	Avg.
E. coli	2004 IDEM	75.9	48,400	6817.9			
E. coli	2000-2001 Adams SWCD	150	28,000	4693.8			
Nitrogen, NO3+NO2	2004 IDEM	0.49	17.80	4.80			
Nitrogen, NO3+NO2	2000-2001 Adams SWCD	0.02	30.90	6.64			
Phosphorus	2004 IDEM	0.05	0.72	0.25			
Phosphorus	2000-2001 Adams SWCD	0.01	0.97	0.28			
Phosphorus	SMRWP	0.12	1.23	0.32	1.6	8893.0	529.5
TSS	2004 IDEM	ND	692	71.08			
Temperature	SMRWP	0.00	20.62	12.10			
pH	SMRWP	7.20	8.38	7.83			
DO	SMRWP	5.96	14.31	9.41			
Conductivity	SMRWP	134.00	1435.00	700.10			
Turbidity	SMRWP	0.90	840.00	115.12			
BOD	SMRWP	0.66	8.04	2.86			
TSS	SMRWP	3	792	102.99	0.1	2364.7	197.8
NH3-N	SMRWP	0.10	0.91	0.21	4.2	3800.9	234.3
NH3-N	2000-2001 Adams SWCD	0.05	3.03	0.26			
E. coli	SMRWP	96	30,760	3644.90	2.38E+10	2.02E+14	1.23E+13
Atrazine	SMRWP	0.04	14.42	2.17	0.013	9.858	1.132
Alachlor	SMRWP	0.01	2.04	0.41			
Cyanazine	SMRWP	0.02	0.54	0.34			
Metolachlor	SMRWP	0.00	7.35	1.37			

Table 23. Water quality in Blue Creek (Upstream confluence with St. Marys River)

Twentyseven Mile Creek

Twentyseven Mile Creek is a tributary to the St. Marys River. Twentyseven Mile Creek originates in Ohio, flows southwest across the Indiana-Ohio state line, and joins the St. Marys River north of Willshire, Ohio. Sampling was conducted on Twentyseven Mile Creek upstream of the confluence with the St. Marys River by the St. Marys River Watershed Project during April-July 2008.

Physical parameter measurements in Twentyseven Mile Creek saw no violations of the Indiana water quality standards.

E. coli levels ranged from 219 cfu/100ml to 8,130 cfu/100ml. 92% of samples exceeded the Indiana water quality standard (235 cfu/100ml). Loading calculations show that a 49% reduction in *E. coli* loading is necessary to meet the Indiana standard.

Ammonia data collected during the summer of 2008 reported average ammonia levels of 0.15 mg/l, with a maximum value of 0.71 mg/l.

Phosphorus levels ranged from the laboratory detection level of 0.05 mg/l to 0.42 mg/l. 92% of samples were under the TMDL standard of 0.30 mg/l.

54% of TSS samples violated the TMDL standard for TSS.

Pesticide data was collected by the St. Marys River Watershed Project in 2007-2008. Samples were analyzed for Atrazine, Alachlor, and Metolachlor. Two Atrazine samples were found to be in violation of the USEPA drinking water standard of 3.00 µg/l. A maximum concentration of 8.80 µg/l was reported on June 25, 2008. Concentrations of Alachlor were below MCL levels and Metolachlor concentrations were not in excess of health advisory levels.

The following Table 24 summarizes water quality in Twentyseven Mile Creek.

Twentyseven Mile Creek							
		Concentration			Loading		
Parameter	Data Source	Min.	Max.	Avg.	Min.	Max.	Avg.
Temperature	SMRWP	12.39	21.27	12.88			
pH	SMRWP	7.56	8.11	7.88			
DO	SMRWP	5.63	11.61	7.65			
Conductivity	SMRWP	508	647	604.25			
Turbidity	SMRWP	25.10	98.40	51.20			
BOD	SMRWP	1.51	6.04	3.64			
TSS	SMRWP	15.00	146.00	44.93	0.3	26.6	5.5
NH3-N	SMRWP	0.10	0.71	0.15	3.2	300.6	33.7
TP	SMRWP	0.05	0.42	0.17	2.1	123.0	28.2
E. coli	SMRWP	219	8,130	1,290.85	3.25E+10	1.94E+13	1.95E+12
Atrazine	SMRWP	0.26	8.80	3.41	0.014	3.272	0.849
Alachlor	SMRWP	0.03	1.06	0.43			
Cyanazine	SMRWP						
Metolachlor	SMRWP	0.57	4.32	1.83			

Table 24. Water quality in Twentyseven Mile Creek.

Martz Creek

Martz Creek is a tributary to Yellow Creek, located in Adams County, south of Decatur, Indiana. Ruppert Ditch is a major tributary to Martz Creek. Martz Creek was sampled by IDEM in 2004 and again by the St. Marys River Watershed Project in 2007-2008.

Physical parameter measurements were measured in 2007-2008 by the St. Marys River Watershed Project. One of twenty nine dissolved oxygen measurements violated the Indiana dissolved oxygen standard. A reading of 2.23 mg/l was recorded on 10/17/2007. Measurements on Martz Creek also recorded two violations of the Indiana dissolved solids standard. Conductivity reading of 1,037 µS/cm and 1,096 µS/cm were recorded on 9/26/2007 and 10/3/2007. Measurements for pH and temperature were within Indiana standards.

E. coli was first sampled by IDEM in 2004. IDEM recorded levels ranging from a low of 39.7 cfu/100ml to a high of 24,192 cfu/100ml. 67% of IDEM samples exceeded the 235 cfu/100ml Indiana standard. *E. coli* data collected in 2007-2008 by the St. Marys River Watershed Project reported average values over 5,000 cfu/100ml. 100% of the samples collected in Martz Creek exceeded the Indiana *E. coli* standard. An 81% reduction in loading is needed in order to meet Indiana water quality standards.

The St. Marys River Watershed Project reported average ammonia levels of 0.65 m/l. During a 4 week period from 9/26/2007 – 10/17/2007 abnormally high levels of ammonia were observed in Martz Creek. Concentrations of 6.92 mg/l, 5.36 mg/l, 3.74 mg/l and 2.25 mg/l were reported. Concentrations during this period were in violation of the CCC.

Phosphorus levels ranged from 0.03 mg/l to 4.08 mg/l. 42% of samples were in violation of the 0.30 mg/l standard set by the IDEM TMDL.

The St. Marys River Watershed Project recorded average TSS concentrations of 47.73 mg/l in 2007-2008. 28% of samples exceeded the TMDL standard of 30 mg/l.

Pesticide data were collected by the St. Marys River Watershed Project in 2007-2008. Samples were analyzed for Atrazine, Alachlor, Cyanazine, and Metolachlor. Concentrations of Atrazine were under the USEPA drinking water standard; Alachlor and Cyanazine were below MCL levels; and Metolachlor concentrations were not in excess of health advisory levels.

The following Table 25 summarizes water quality in Martz Creek.

Martz Creek							
IDEM LES040-0040, CR 200N, West of US 33							
		Concentration			Loading		
Parameter	Data Source	Min.	Max.	Avg.	Min.	Max.	Avg.
E. coli	2004 IDEM	37.9	24,192	2935			
Temperature	SMRWP	0.00	21.13	11.53			
pH	SMRWP	7.37	8.25	7.87			
DO	SMRWP	2.23	19.97	9.29			
Conductivity	SMRWP	89	1096	592.79			
Turbidity	SMRWP	11.10	488.20	69.25			
BOD	SMRWP	1.35	9.84	3.30			
TSS	SMRWP	7.5	416	47.73	0.00	122.9	10.5
NH3-N	SMRWP	0.10	6.92	0.65	0.6	229.5	21.5
TP	SMRWP	0.03	4.08	0.45	0.2	753.5	71.7
E. coli	SMRWP	345	48,840	5,000.52	3.50E+10	1.79E+13	1.21E+12
Atrazine	SMRWP	0.03	1.48	0.41	0.001	0.043	.009
Alachlor	SMRWP						
Cyanazine	SMRWP						
Metolachlor	SMRWP						

Table 25. Water quality in Martz Creek.

Yellow Creek

Yellow Creek is a tributary to the St. Marys River, located in central Adams County. Smith Ditch and Johnson Ditch combine to form Yellow Creek. Straight Branch and Hendricks Ditch join Yellow Creek downstream of the Smith Ditch and Johnson Ditch confluence. Martz Creek is a large tributary to Yellow Creek. Yellow Creek was sampled in 2004 by IDEM and the City of Ft. Wayne and again in 2007-2008 by the St. Marys River Watershed Project.

The St. Marys River Watershed Project measured physical parameters in 2007-2008. Dissolved oxygen measurements were found to be in violation of the Indiana dissolved

oxygen standard during a four week period from 9/26/2007 – 10/17/2007. A minimum reading of 1.67 mg/l was recorded on 10/10/2007. Measurements on Yellow Creek also recorded two violations of the Indiana dissolved solids standard. Conductivity measurements were in violation for the same four week period. A maximum measurement of 1,120 µS/cm was recorded on 10/17/2007. Measurements for pH and temperature were within Indiana standards.

E. coli data were collected by IDEM and Ft. Wayne in 2004. IDEM data averaged over 2,000 cfu/100ml, while data collected by the City of Ft. Wayne averaged over 13,000 cfu/100ml. Cumulatively, the 2004 data were in violation of the single sample maximum standard 84% of the time. *E. coli* levels were again analyzed in 2007-2008 by the St. Marys River Watershed Project. Concentrations ranged from 96 cfu/100ml to 30,760 cfu/100ml. Loading calculations project that a 52% reduction in loading is necessary to regularly meet the *E. coli* single sample maximum standard.

Nitrogen data were collected by IDEM in 2004. NO3-NO2 data averaged 2.89 mg/l. 94% of collected data was under the Indiana drinking water standard of 10.00 mg/l. Ammonia data was collected by the St. Marys River Watershed Project in 2007-2008. Concentrations averaged 0.10 mg/l to 0.79 mg/l. There were no exceedences of the CCC for Ammonia.

Phosphorus data were collected by IDEM in 2004 and by the St. Marys River Watershed Project in 2007-2008. IDEM saw levels range from under the laboratory detection level to 0.53 mg/l. In 2007-2008 concentrations ranged from a low of 0.03 mg/l to a high of 0.90 mg/l. 24% of IDEM samples exceeded the 0.30mg/l phosphorus standard, while 37% of St. Marys River Watershed Project samples were in violation.

In 2004 24% of IDEM TSS samples were found to be in violation of the standard set forth by the IDEM TMDL. 34% of the TSS samples collected by the St. Marys River Watershed Project were found to be in violation of the 30 mg/l standard.

Pesticide data were collected in Yellow Creek by the St. Marys River Watershed Project in 2007-2008. Samples were analyzed for Atrazine, Alachlor, and Metolachlor. Two Atrazine samples were found to be in violation of the USEPA drinking water standard of 3.00 µg/l. A maximum concentration of 10.42 µg/l was reported on July 2, 2008. Concentrations of Alachlor were below MCL levels and Metolachlor concentrations were not in excess of health advisory levels.

The following Table 26 details water quality in Yellow Creek.

Yellow Creek							
IDEM LES040-0038, CR 250N, East of Salem Road							
		Concentration			Loading		
Parameter	Data Source	Min.	Max.	Avg.	Min.	Max.	Avg.
E. coli	2004 IDEM	19.9	17,329	2007.4			
E. coli	2004 Fort Wayne	322	48,392	13014.9			
E. coli	SMRWP	96	30,760	3,310.83	6.33E+09	6.27E+13	3.21E+12
Nitrogen, NO3+NO2	2004 IDEM	ND	14.10	2.89			
Phosphorus	2004 IDEM	ND	0.53	0.23			
Phosphorus	SMRWP	0.03	0.90	0.31	0.4	1,522.7	137.3
TSS	2004 IDEM	ND	476.00	54.35			
TSS	SMRWP	5	460	58.49	0.1	404.3	34.1
Temperature	SMRWP	0.00	21.09	11.55			
pH	SMRWP	7.26	8.11	7.82			
DO	SMRWP	1.67	13.78	8.39			
Conductivity	SMRWP	107	1,120	623.83			
Turbidity	SMRWP	1.20	521.90	76.93			
BOD	SMRWP	1.11	5.99	2.70			
NH3-N	SMRWP	0.10	0.79	0.19	1.5	727.7	57.8
Atrazine	SMRWP	0.03	10.42	1.03	0.003	0.675	0.070
Alachlor	SMRWP	0.01	0.66	0.24			
Cyanazine	SMRWP	0.00	0.45	0.32			
Metolachlor	SMRWP	0.00	6.14	0.76			

Table 26. Water quality in Yellow Creek.

Borum Run

Borum Run is located in Adams County, near the southern edge of Decatur, Indiana. The headwater streams of Blair Ditch, Hessler Ditch, Bluhm Ditch, and Hahnert Ditch form Borum Run. Miller Ditch is a tributary to Borum Run. Borum Run was sampled by IDEM in 2004 and by the St. Marys River Watershed Project in 2007-2008.

Physical parameter measurements in Borum Run were found to be mostly in compliance with Indiana water quality standards. Three dissolved oxygen measurements were found to be in violation, while one conductivity measurement was in violation of the dissolved solids standard.

E. coli data collected by IDEM on Borum Run had an average value of 1,216.7 cfu/100ml, and was in violation of the IDEM single sample maximum standard 63% of the time. 2007-2008 data averaged 1,040.03 cfu/100ml, violating the standard 70% of the time.

Ammonia data collected in 2007-2008 by the St. Marys River Watershed Project reported values ranging from the laboratory detection level to 1.21 mg/l. The average concentration on Borum Run was 0.14 mg/l. There were no violations of the CCC on Borum Run.

Phosphorus data collected in 2007-2008 was in violation of the TMDL standard (0.30 mg/l) 25% of the time. A maximum concentration of 0.84 mg/l was reported in March 2008.

St. Marys River Watershed Project data showed that TSS data exceeded the 30 mg/l standard 19% of the time.

Pesticide data were collected in Borum Run in 2007-2008 by the St. Marys River Watershed Project. Samples were analyzed for Atrazine, Alachlor, and Metolachlor. Two Atrazine samples were found to be in violation of the USEPA drinking water standard of 3.00 µg/l, with measurements of 4.82 µg/l on June 18, 2008 and 8.59 µg/l on July 2, 2008. Concentrations of Alachlor were below MCL levels and Metolachlor concentrations were not in excess of health advisory levels.

Table 27 summarizes water quality in Borum Run.

Borum Run							
IDEM LES040-0097, Mercer Road in Decatur, Then Salem Road at Lift Station							
		Concentration			Loading		
Parameter	Data Source	Min.	Max.	Avg.	Min.	Max.	Avg.
E. coli	2004 IDEM	11	11,199	1,216.7			
E. coli	SMRWP	1	5,510	1,040.03	4.33E+07	4.13E+12	5.79E+11
Temperature	SMRWP	0.01	21.71	11.58			
pH	SMRWP	7.45	8.12	7.85			
DO	SMRWP	1.04	13.99	8.73			
Conductivity	SMRWP	82.40	1,056	586.26			
Turbidity	SMRWP	0.20	746.50	77.12			
BOD	SMRWP	1.05	4.89	2.34			
TSS	SMRWP	2	752	59.94	0.0	364.8	28.2
NH3-N	SMRWP	0.01	1.21	0.14	0.2	244.8	27.8
TP	SMRWP	0.01	0.84	0.22	0.2	704.3	75.9
Atrazine	SMRWP	0.03	8.59	1.01	0.002	0.214	0.039
Alachlor	SMRWP	0.00	0.50	0.19			
Cyanazine	SMRWP	0.00	0.46	0.32			
Metolachlor	SMRWP	0.00	1.16	0.38			

Table 27. Water quality in Borum Run.

Holthouse Ditch

Holthouse Ditch is located in central Adams County, flowing northeast to the St. Marys River. Bracht Ditch and Berry Ditch join to form Holthouse Ditch. In 2004 Holthouse Ditch was sampled by IDEM and the City of Fort Wayne. In 2007-2008 Holthouse Ditch was sampled by the St. Marys River Watershed Project.

Physical parameter measurements collected by the St. Marys River Watershed Project for temperature, pH and conductivity were found to be in compliance with Indiana standards. The exception was dissolved oxygen, where four measurements were in violation of the Indiana minimum dissolved oxygen concentration standard. Of specific concern were two readings in October, measurements of 0.66 mg/l and 0.15 mg/l.

IDEM and City of Fort Wayne data were found to be in violation the *E. coli* single sample maximum standard 63% of the time. A maximum value of 39,726 cfu/100ml was reported on 7/22/2004 and 8/19/2004. The St. Marys River Watershed Project reported values ranging from 22 cfu/100ml to 8,600 cfu/100ml. 66% of these samples violated the *E. coli* single sample maximum standard.

Ammonia concentrations were recorded by the St. Marys River Watershed Project from 2007-2008. Levels ranged from 0.10 mg/l to 1.65 mg/l. The average ammonia concentration in Holthouse Ditch was 0.17 mg/l. No violations of the CCC were recorded on Holthouse Ditch.

56% of phosphorus samples collected by the St. Marys River Watershed Project were in violation of the TMDL phosphorus target. A maximum value of 1.17 mg/l was reported in March 2008.

TSS concentrations were analyzed by the St. Marys River Watershed Project in 2007-2008. Values ranged from 6 mg/l to 720 mg/l. 31% of these samples were found to be in violation of the TMDL TSS target of 30 mg/l.

Atrazine levels in Holthouse Ditch were in violation of the USEPA drinking water standard (3.00 µg/l) in one of twenty samples. A concentration of 6.63 µg/l was reported on June 4, 2008. Concentrations of Alachlor were below MCL levels and Metolachlor concentrations were not in excess of health advisory levels.

Table 28 summarizes water quality in Holthouse Ditch.

Holthouse Ditch							
IDEM LES050-0008, CR 200W, South of US 224							
		Concentration			Loading		
Parameter	Data Source	Min.	Max.	Avg.	Min.	Max.	Avg.
E. coli	2004 IDEM	23.3	6,488	1077.1			
E. coli	Fort Wayne	40	39,726	12,723.5			
E. coli	SMRWP	22	8,600	1,087.90	1.92E+09	2.00E+13	1.20E+12
Temperature	SMRWP	0.00	20.52	11.63			
pH	SMRWP	7.39	8.17	7.83			
DO	SMRWP	0.15	13.59	8.17			
Conductivity	SMRWP	107	1,037	612.21			
Turbidity	SMRWP	0.40	688.30	84.74			
BOD	SMRWP	1.08	11.70	3.22			
TSS	SMRWP	6	720	70.13	0.1	797.7	60.5
NH3-N	SMRWP	0.10	1.65	0.17	1.5	673.8	61.0
Phosphorus	SMRWP	0.01	1.17	0.38	0.6	2,745.8	174.4
Atrazine	SMRWP	0.03	6.63	0.83	0.003	1.598	0.104
Alachlor	SMRWP	0.00	0.61	0.24			
Cyanazine	SMRWP	0.00	0.44	0.31			
Metolachlor	SMRWP	0.01	1.25	0.52			

Table 28. Water quality in Holthouse Ditch.

Gerke Creek

Gerke Ditch originates in northeastern Adams County near the Adams County – Allen County Line. Gerke Ditch flows southwest to its confluence with the St. Marys River. Wagner Ditch, Ohler Branch and Ohler Ditch are tributaries to Gerke Ditch. Gerke Ditch was sampled by the St. Marys River Watershed Project from 2007-2008.

No violations were found for temperature, pH or dissolved oxygen measurements made by the St. Marys River Watershed Project in 2007-2008. Conductivity measurements were found to be in violation of the Indiana dissolved solids standard for a four week period in late September and early October. A maximum reading of 1,459 µS/cm was recorded on 10/17/2007.

The *E. coli* data collected by the St. Marys River Watershed Project exceeded the Indiana single sample maximum standard in 83% of collected samples. A maximum value of 4,710 cfu/100ml was recorded in July 2008.

Ammonia concentrations were recorded by the St. Marys River Watershed Project from 2007-2008. Levels ranged from 0.01 mg/l to 0.68 mg/l. The average ammonia concentration in Holthouse Ditch was 0.14 mg/l. There were no CCC exceedences on Gerke Ditch.

Phosphorus samples collected by the St. Marys River Watershed Project were in violation of the TMDL phosphorus target 29% of the time. A maximum value of 1.06 mg/l was reported in March 2008.

TSS values averaged 60.31 mg/l in Gerke Ditch, with 26% of samples violating the TMDL target for TSS.

Gerke Ditch Atrazine levels were in violation of the USEPA drinking water standard (3.00 µg/l) in one of twenty samples. A concentration of 9.16 µg/l was reported on June 4, 2008. Concentrations of Alachlor and Cyanazine were below MCL levels and Metolachlor concentrations were not in excess of health advisory levels.

Table 29 summarizes water quality in Gerke Ditch.

Gerke Ditch							
CR 000, North of CR 850N							
		Concentration			Loading		
Parameter	Data Source	Min.	Max.	Avg.	Min.	Max.	Avg.
Temperature	SMRWP	0.04	22.65	12.63			
pH	SMRWP	7.42	8.57	7.97			
DO	SMRWP	4.42	15.38	10.04			
Conductivity	SMRWP	109	1,459	671.43			
Turbidity	SMRWP	0.30	671.40	82.33			
BOD	SMRWP	1.14	6.39	2.48			
TSS	SMRWP	3.90	620	60.31	0.0	242.3	19.8
NH3-N	SMRWP	0.01	0.68	0.14	0.2	148.4	16.2
Phosphorus	SMRWP	0.03	1.06	0.29	0.2	714.9	59.6
E. coli	SMRWP	100	4,710	1,080.90	2.84E+09	4.32E+12	4.06E+11
Atrazine	SMRWP	0.00	9.16	1.05	0.002	0.872	0.054
Alachlor	SMRWP	0.01	0.48	0.25			
Cyanazine	SMRWP	0.00	0.47	0.32			
Metolachlor	SMRWP	0.04	1.35	0.53			

Table 29. Water quality in Gerke Ditch.

Nickelson Creek

Nickelson Creek begins in northwest Adams County, and flows north into Allen County where it joins the St. Marys River. Lambert Ditch is a major tributary to Nickelson Creek. Nickelson Creek was sampled by IDEM and the City of Ft. Wayne in 2004 and again by the St. Marys River Watershed Project in 2007-2008.

Physical parameter measurements were measured in Nickelson Creek by the St. Marys River Watershed Project. Measurements were found to be in compliance for temperature, pH, and dissolved oxygen. Conductivity measurements were in violation for a four week period. A maximum value of 1,442 µS/cm was reported.

E. coli data collected jointly by IDEM and the City of Ft. Wayne in 2004 exceeded the Indiana *E. coli* single sample maximum approximately 72% of the time. A maximum concentration of 48,400 cfu/100ml was recorded in August 2004. More recently, *E. coli* data collected by the St. Marys River Watershed Project was found to be in violation 72% of the time, with a maximum concentration of 1,217.69 cfu/100ml.

Ammonia data collected by the St. Marys River Watershed Project had an average concentration of 0.12 mg/l. Concentrations ranged from 0.10 mg/l to 0.31 mg/l. No exceedences of the CCC were reported on Nickelson Creek.

Phosphorus data were found to be in violation of the TMDL target approximately 33% of the time. On 3/5/2008 a maximum concentration of 5.41 mg/l was recorded on Nickelson Creek.

TSS data collected in 2007-2008 recorded TSS levels ranging from 0.80 mg/l to 456 mg/l. 22% of collected samples violated the 30 mg/l target set by the TMDL.

Pesticide data were collected by the St. Marys River Watershed Project in 2007-2008. Samples were analyzed for Atrazine, Alachlor, Cyanazine, and Metolachlor Concentrations of Atrazine were under the USEPA drinking water standard, Alachlor and Cyanazine, were below MCL levels and Metolachlor concentrations were not in excess of health advisory levels.

The following Table 30 summarizes water quality in Nickelson Creek.

Nickelson Creek							
IDEM LES050-0015, CR 1100N, West of CR 550W							
		Concentration			Loading		
Parameter	Data Source	Min.	Max.	Avg.	Min.	Max.	Avg.
E. coli	2004 IDEM	18.7	4106	698.7			
E. coli	Fort Wayne	100	48,400	10,864.4			
E. coli	SMRWP	100	7,540	1,217.69	3.41E+09	4.16E+12	6.04E+11
Temperature	SMRWP	0.12	23.61	12.70			
pH	SMRWP	7.36	8.52	8.07			
DO	SMRWP	5.00	18.20	11.11			
Conductivity	SMRWP	105	1,442	676.62			
Turbidity	SMRWP	0.10	529.6	59.75			
BOD	SMRWP	1.21	6.18	2.61			
TSS	SMRWP	0.80	456	41.85	0.0	239.5	18.0
NH3-N	SMRWP	0.10	0.31	0.12	0.7	180.2	17.5
Phosphorus	SMRWP	0.03	5.41	0.42	0.7	180.2	17.5
Atrazine	SMRWP	0.00	2.34	0.63	0.002	0.137	0.021
Alachlor	SMRWP	0.00	1.53	0.28			
Cyanazine	SMRWP	0.01	0.45	0.32			
Metolachlor	SMRWP	0.00	1.23	0.45			

Table 30. Water quality in Nickelson Creek.

Unnamed Tributary (Barkley Road)

The Unnamed Tributary is located in southern Allen County near Barkley Road. The tributary flows southwest before discharging into the St. Marys River. The site was sampled for *E. coli* by IDEM and the City of Fort Wayne in 2004. Samples exceeded the Indiana *E. coli* single sample maximum standard 82% of the time. The City of Ft. Wayne reported a value of 48,400 cfu/100ml in August 2004. The following Table 31 summarizes water quality in the Unnamed Tributary.

Unnamed Tributary							
IDEM LES050-0020, Barkley Road, East of US 27/33							
		Concentration			Loading		
Parameter	Data Source	Min.	Max.	Avg.	Min.	Max.	Avg.
E. coli	2004 IDEM	9.6	24,200	2,728.2			
E. coli	2004 Fort Wayne	446	48,400	11,859			

Table 31. Water quality in Unnamed Tributary (Barkley Road)

Natural Drain to St. Marys River

The Natural Drain is located in Allen County, between Hoagland Road and Monroeville Road near US 27. The site was sampled from April 2001 through October 2004 by the Allen County Health Department. *E. coli* data collected at the site violated the Indiana single sample maximum standard 95% of the time. Concentration averaged 55,693.1 cfu/100ml, with a maximum concentration of 590,000 cfu/100ml. Table 32 summarizes data collected from the Natural Drain to the St. Marys River.

Natural Drain to the St. Marys River							
West side of US 27, South of Monroeville T intersection							
		Concentration			Loading		
Parameter	Data Source	Min.	Max.	Avg.	Min.	Max.	Avg.
E. coli	2001-2004 Allen County Health Dept.	10	590,000	55,693.1			

Table 32. Water quality in the Natural Drain to the St. Marys River.

Houk Ditch

Houk Ditch originates near the Allen County – Adams County Line and flows northwest where it discharges into the St. Marys River. Munch Ditch and Paul Trier Ditch are tributaries to Houk Ditch. Houk Ditch was sampled by the St. Marys River Watershed Project in 2007-2008.

Physical parameter measurements in Houk Ditch were found to be in compliance with Indiana water quality standards. No violations were reported for temperature, pH, dissolved oxygen or conductivity.

E. coli data collected by the St. Marys River Watershed Project on Houk Ditch had an average value of 1,892.08 cfu/100ml, a violation of the IDEM single sample maximum standard 77% of the time.

Ammonia data collected in 2007-2008 by the St. Marys River Watershed Project reported values ranging from 0.10mg/l to 0.25 mg/l. The average concentration on Borum Run was 0.12 mg/l. None of the observed levels were in violation of the CCC.

Phosphorus data collected in 2007-2008 were in violation of the TMDL standard (0.30 mg/l) 15% of the time. A maximum concentration of 0.90 mg/l was reported in May 2008.

St. Marys River Watershed Project data showed that TSS data exceeded the 30 mg/l standard 23% of the time.

Pesticide data was collected in Houk Ditch in 2008 by the St. Marys River Watershed Project. Samples were analyzed for Atrazine, Alachlor, and Metolachlor. Two Atrazine

samples were found to be in violation of the USEPA drinking water standard of 3.00 µg/l, with measurements of 3.69 µg/l on June 11, 2008 and 6.40 µg/l on May 14, 2008. Concentrations of Alachlor were below MCL levels and Metolachlor concentrations were not in excess of health advisory levels.

Table 33 summarizes water quality in Houk Ditch.

Houk Ditch							
		Concentration			Loading		
Parameter	Data Source	Min.	Max.	Avg.	Min.	Max.	Avg.
Temperature	SMRWP	13.14	23.97	18.59			
pH	SMRWP	7.57	8.37	8.08			
DO	SMRWP	7.06	13.64	9.38			
Conductivity	SMRWP	400	926	674.66			
Turbidity	SMRWP	14.1	228.3	73.58			
BOD	SMRWP	1.75	5.66	2.99			
TSS	SMRWP	7.50	168.00	34.45	0.1	11.0	2.4
NH3-N	SMRWP	0.10	0.25	0.12	1.5	32.6	9.0
Phosphorus	SMRWP	0.03	0.90	0.22	0.4	117.0	19.2
E. coli	SMRWP	75	6,896	1,892.08	7.44E+09	7.42E+12	1.17E+12
Atrazine	SMRWP	0.04	6.40	1.87	0.001	0.835	0.234
Alachlor	SMRWP	0.01	0.53	0.23			
Cyanazine	SMRWP						
Metolachlor	SMRWP	0.32	2.73	1.27			

Table 33. Water quality in Houk Ditch.

Snyder Ditch

Snyder Ditch starts near the Allen County – Wells County line before flowing north to the St. Marys River. Snyder Ditch was sampled by the St. Marys River Watershed Project in 2007-2008.

Physical parameter measurements in Snyder Ditch were found to be in compliance with Indiana water quality standards. No violations were reported for temperature, pH, dissolved oxygen or conductivity.

E. coli levels were analyzed in 2007-2008 by the St. Marys River Watershed Project. Concentrations ranged from 169 cfu/100ml to 7,980 cfu/100ml. Loading calculations project that a 58% reduction in loading is necessary to regularly meet the *E. coli* single sample maximum standard.

Ammonia data were collected by the St. Marys River Watershed Project in 2007-2008. Concentrations ranged from 0.10 mg/l to 0.44 mg/l. All concentrations were in compliance with the CCC.

Phosphorus concentrations ranged from a low of 0.01 mg/l to a high of 0.51 mg/l. One of thirteen samples exceeded the 0.30mg/l phosphorus standard.

In 2007-2008 23% of the TSS samples collected by the St. Marys River Watershed Project were found to be in violation of the 30 mg/l standard set forth by the IDEM TMDL.

Snyder Ditch Atrazine levels were in violation of the USEPA drinking water standard (3.00 µg/l) in two of seven samples. A concentration of 4.29 µg/l was reported on June 11, 2008 and a concentration of 5.38 µg/l was reported on May 14, 2008. Concentrations of Alachlor were below MCL levels and Metolachlor concentrations were not in excess of health advisory levels.

The following Table 34 details water quality in Snyder Ditch.

Snyder Ditch							
		Concentration			Loading		
Parameter	Data Source	Min.	Max.	Avg.	Min.	Max.	Avg.
Temperature	SMRWP	12.90	21.90	17.70			
pH	SMRWP	7.60	8.57	8.15			
DO	SMRWP	7.24	15.55	10.11			
Conductivity	SMRWP	6.81	685.00	543.42			
Turbidity	SMRWP	17.90	522.00	84.32			
BOD	SMRWP	1.48	41.40	8.38			
TSS	SMRWP	2.60	50.00	17.04	0.0	3.5	0.7
NH3-N	SMRWP	0.10	17.40	1.46	0.8	715.3	56.7
Phosphorus	SMRWP	0.01	0.51	0.17	0.1	37.2	7.9
E. coli	SMRWP	169	7,980	1,395.77	3.16E+07	5.14E+12	5.32E+11
Atrazine	SMRWP	0.08	5.38	1.96	0.001	0.486	0.136
Alachlor	SMRWP	0.01	0.59	0.29			
Cyanazine	SMRWP						
Metolachlor	SMRWP	0.45	2.62	1.20			

Table 34. Water quality in Snyder Ditch.

Harber Ditch

Harber Ditch starts in northern Wells County and flows north into Allen County where it meets the St. Marys River. Thiele Ditch, Deptmer Ditch and Hiser Ditch are tributaries to Harber Ditch. Harber Ditch was sampled by the Allen County Health Department from 2000-2004 and again by the St. Marys River Watershed Project in 2007-2008.

Physical parameter measurements were taken by the St. Marys River Watershed Project in 2008. No violations were reported for temperature, pH, and dissolved oxygen measurements. One conductivity reading was in violation of the Indiana dissolved solids standard, reading 5,500 µS/cm on 6/4/2008.

E. coli data collected by the Allen County Health Department ranged from a minimum concentration of 10 cfu/100ml to a maximum of 200,000 cfu/100ml. 84% of these sampled exceeded the Indiana standard (235 cfu/100ml). More recently, *E. coli* data

was collected by the St. Marys River Watershed Project. 85% of samples violated the standard.

Ammonia concentrations were recorded by the St. Marys River Watershed Project from 2007-2008. Levels ranged from 0.10 mg/l to 0.21 mg/l. The average ammonia concentration in Harber Ditch was 0.13 mg/l. No violations of the CCC were reported.

Phosphorus samples collected by the St. Marys River Watershed Project were in violation of the TMDL phosphorus target 15% of the time. A maximum value of 0.56 mg/l was reported in May 2008.

TSS values averaged 25.55 mg/l in Harber Ditch, with 23% of samples violating the TMDL target for TSS.

Atrazine levels in Harber Ditch were in violation of the USEPA drinking water standard (3.00 µg/l) in three of seven samples. A maximum concentration of 5.94 µg/l was observed on May 14, 2008. Concentrations of Alachlor were below MCL levels and Metolachlor concentrations were not in excess of health advisory levels.

Table 35 summarizes water quality in Harber Ditch.

Harber Ditch / Thiele Drain							
Bluffton Road, North of I-469, Ferguson Road							
		Concentration			Loading		
Parameter	Data Source	Min.	Max.	Avg.	Min.	Max.	Avg.
E. coli	2001-2004 Allen County Health Dept.	10	200,000	10,278.4			
E. coli	SMRWP	24	7,890	1,473.31	2.27E+09	1.24E+13	1.38E+12
Temperature	SMRWP	13.69	24.64	18.90			
pH	SMRWP	7.57	8.54	8.03			
DO	SMRWP	6.81	14.12	9.03			
Conductivity	SMRWP	513	5,500	1,150.89			
Turbidity	SMRWP	20.2	68.2	36.89			
BOD	SMRWP	2.06	4.54	3.10			
TSS	SMRWP	6.60	95.00	25.55	0.1	16.5	2.2
NH3-N	SMRWP	0.10	0.21	0.13	2.1	72.5	16.6
Phosphorus	SMRWP	0.06	0.56	0.17	1.4	101.0	21.7
Atrazine	SMRWP	0.09	5.94	2.20	0.003	1.071	0.385
Alachlor	SMRWP	0.07	0.57	0.25			
Cyanazine	SMRWP						
Metolachlor	SMRWP	0.4	2.87	1.09			

Table 35. Water quality in Harber Ditch.

Junk Ditch

Junk Ditch is a tributary to the St. Marys River located in Allen County, near Ft. Wayne, Indiana. Junk Ditch was sampled by the St. Marys River Watershed Project from April 2008-July 2008.

Physical parameter measurements in Junk Ditch were found to be in compliance with Indiana water quality standards. No violations were reported for temperature, pH, dissolved oxygen or conductivity.

The *E. coli* data collected by the St. Marys River Watershed Project exceeded the Indiana single sample maximum standard in 85% of collected samples. A maximum value of 4,350 cfu/100ml was recorded in July 2008. Loading data shows that on average a 50% *E. coli* loading reduction is necessary to meet Indiana standards.

Ammonia concentrations were recorded by the St. Marys River Watershed Project from 2007-2008. Levels ranged from 0.01 mg/l to 0.41 mg/l. The average ammonia concentration in Junk Ditch was 0.19 mg/l. All observed levels were in compliance with the CCC.

Phosphorus samples collected by the St. Marys River Watershed Project were in violation of the TMDL phosphorus target 54% of the time. A maximum value of 0.83 mg/l was reported in May 2008.

TSS values averaged 33.34 mg/l in Junk Ditch, with 69% of samples violating the TMDL target for TSS.

Pesticide data were collected in Junk Ditch by the St. Marys River Watershed Project in 2007-2008. Samples were analyzed for Atrazine, Alachlor, Cyanazine, and Metolachlor Concentrations of Atrazine were under the USEPA drinking water standard, Alachlor and Cyanazine, were below MCL levels and Metolachlor concentrations were not in excess of health advisory levels.

Table 36 summarizes water quality in Junk Ditch.

Junk Ditch							
Taylor Road at Omni Source							
		Concentration			Loading		
Parameter	Data Source	Min.	Max.	Avg.	Min.	Max.	Avg.
Temperature	SMRWP	14.83	24.88	19.92			
pH	SMRWP	7.32	8.04	7.65			
DO	SMRWP	4.38	11.23	6.96			
Conductivity	SMRWP	477	910	688			
Turbidity	SMRWP	19.20	91.00	52.86			
BOD	SMRWP	3.05	6.90	4.69			
TSS	SMRWP	6.60	56.00	33.34	0.0	2.2	0.7
NH3-N	SMRWP	0.1	0.41	0.19	0.8	28.2	7.2
Phosphorus	SMRWP	0.17	0.83	0.33	1.4	40.8	13.0
E. coli	SMRWP	194	4,350	1,175.23	6.88E+09	2.58E+12	3.39E+11
Atrazine	SMRWP	0.01	0.30	0.16			
Alachlor	SMRWP	0.00	0.26	0.10			
Cyanazine	SMRWP						
Metolachlor	SMRWP	0.12	0.94	0.35			

Table 36. Water quality in Junk Ditch.

Spy Run Creek

Spy Run Creek is a tributary to the St. Marys River, located in Allen County, near Ft. Wayne, Indiana. Neuhaus Ditch is a major tributary to Spy Run Creek. Neuhaus Ditch was sampled by IDEM in 2005. Spy Run Creek was sampled by the St. Marys River Watershed Project in 2007-2008.

Physical parameter measurements were taken by the St. Marys River Watershed Project in 2008. No violations were reported for temperature, pH, and dissolved oxygen measurements. One conductivity reading was in violation of the Indiana dissolved solids standard, reading 1,032 µS/cm on 5/28/2008.

E. coli was first sampled by IDEM in 2005. IDEM recoded levels ranging from a low of 125.9 cfu/100ml to a high of 4,352 cfu/100ml. 80% of IDEM samples exceeded the 235 cfu/100ml Indiana standard. *E. coli* data collected in 2007-2008 by the St. Marys River Watershed Project reported average values over 1,300 cfu/100ml. 77% of the samples collected in Spy Run Creek exceeded the Indiana *E. coli* standard. A 40% reduction in loading is needed in order to meet Indiana water quality standards.

The St. Marys River Watershed Project reported average ammonia levels of 0.13 mg/l. No exceedences of the CCC were reported on Spy Run Creek.

Phosphorus levels ranged from 0.05 mg/l to 0.72 mg/l. However, only one sample violated the 0.30 mg/l standard set by the IDEM TMDL.

The St. Marys River Watershed Project recorded average TSS concentrations of 30.72 mg/l in 2007-2008. 54% of samples exceeded the TMDL standard of 30 mg/l.

Pesticide data was collected in Spy Run Creek by the St. Marys River Watershed Project in 2007-2008. Samples were analyzed for Atrazine, Alachlor, Cyanazine, and Metolachlor Concentrations of Atrazine were under the USEPA drinking water standard, Alachlor and Cyanazine, were below MCL levels and Metolachlor concentrations were not in excess of health advisory levels.

The following Table 37 and Table 38 summarize water quality in Spy Run Creek and Neuhaus Ditch.

Spy Run Creek							
4th Street, Lawton Park							
		Concentration			Loading		
Parameter	Data Source	Min.	Max.	Avg.	Min.	Max.	Avg.
Temperature	SMRWP	14.26	24.91	19.46			
pH	SMRWP	6.89	7.82	7.59			
DO	SMRWP	5.72	9.79	7.83			
Conductivity	SMRWP	287	1,032	695			
Turbidity	SMRWP	22.80	87.40	46.81			
BOD	SMRWP	2.04	5.69	3.66			
TSS	SMRWP	9.90	62.00	30.72	0.1	6.8	1.8
NH3-N	SMRWP	0.10	0.28	0.13	1.7	27.8	10.4
Phosphorus	SMRWP	0.05	0.72	0.18	0.9	103.9	24.7
E. coli	SMRWP	76	6,310	1,364.08	1.05E+10	7.96E+12	1.42E+12
Atrazine	SMRWP	0.03	0.73	0.37	0.001	0.162	0.063
Alachlor	SMRWP	0.00	0.14	0.04			
Cyanazine	SMRWP						
Metolachlor	SMRWP	0.08	0.93	0.32			

Table 37. Water quality in Neuhaus Ditch.

Neuhaus Ditch							
IDEM LES060-0020, Goshen Road							
		Concentration			Loading		
Parameter	Data Source	Min.	Max.	Avg.	Min.	Max.	Avg.
E. coli	2005 IDEM	125.9	4,352	1,344.7			

Table 38. Water quality in Spy Run Creek.

St. Marys River

The St. Marys River has been the subject of numerous water quality studies. Between 2000 and 2008, nine locations have been monitored on the St. Marys. The most upstream monitoring station is located near Willshire, Ohio. This site was first monitored by the Adams County SWCD from 2000-2001. IDEM and the City of Ft. Wayne sampled the site again in 2004. Most recently, in 2007-2008 the site was sampled by the St. Marys River Watershed Project. The next site downstream is located near the town of Pleasant Mills. The Pleasant Mills site was sampled by the Adams County SWCD in 2000-

2001 and by IDEM in 2004. The next two sites were sampled by the Adams County SWCD in 2000-2001, the first located at US 224 in Decatur, IN as well as a location at US 33-27 located north of Decatur. Moving north of Decatur, the Adams County SWCD monitored the St. Marys River at CR 900. Moving approximately three miles downstream, the Adams County SWCD sampled at the Adams County – Allen County line. Moving downstream to the Village of Poe, the river was studied by IDEM in 2004 and the St. Marys River Watershed Project in 2007-2008. Further into Allen County, the City of Fort Wayne has collected water quality data at the Ferguson Road Bridge as well as at the Spy Run Bridge.

Physical parameter measurements for temperature, pH, dissolved oxygen, and conductivity were taken at two locations on the St. Marys River by the St. Marys River Watershed Project in 2007-2008. At the Willshire, Ohio monitoring station, physical parameter readings were found to be in compliance for all measurements with the exception of dissolved oxygen and conductivity measurements on 10/10/2007. Dissolved oxygen was recorded as a concentration of 1.67 mg/l while conductivity had a reading on 1,049 µS/cm. At the monitoring station near the Village of Poe, no violations were reported for temperature, pH, or dissolved oxygen. Conductivity readings were in violation for a three week period in October, with measurements of 1,068 µS/cm, 1,089 µS/cm, and 1,224 µS/cm.

E. coli data was collected at all nine monitoring stations on the St. Marys River. At the Willshire, OH site, 75% of collected *E. coli* data exceeded the Indiana single sample maximum standard. In 2004, 64% of IDEM and City of Ft. Wayne samples exceeded the standard, while 52% of samples collected in 2007-2008 by the St. Marys River Watershed Projects exceeded the standard. At the Pleasant Mills site, data collected in 2000-2001 by the Adams County SWCD violated the single sample maximum standard 75% of the time. 2004 IDEM data at this site violated the standard 79% of the time. In Decatur, *E. coli* data collected by the Adams County SWCD in 2000-2001 violated the standard 88% of the time at both the US 224 site and the US 33-27 site. At the CR 900N monitoring station, data reported by the Adams County SWCD also showed an 88% exceedence of the Indiana standard. A 75% exceedence rate was shown at the county line monitoring station. In 2004, data collected by IDEM and City of Ft. Wayne on the St. Marys River near the Village of Poe violated the maximum single sample standard 60% of the time. Data collected by the St. Marys River Watershed Project at this site violated the standard 52% of the time. City of Ft. Wayne data reported from the Ferguson Road site was in violation 53% of the time, while the Spy Run station was in violation 66% of the time.

Nitrogen data were collected at the Willshire, Ohio station by the Adams County SWCD in 2001, and by the St. Marys River Watershed Project in 2007-2008. In the uppermost reach, NO3-NO2 data collected by the Adams County SWCD averaged 4.63 mg/l with a maximum level of 17.50 mg/l. Ammonia data collected at this site ranged from a low of the laboratory detection limit 0.05 mg/l to a high of 0.81 mg/l in 2000-2001 and 0.01 mg/l to 0.26 mg/l in 2007-2008. Ammonia data collected at this site by the St. Marys River Watershed Project was in compliance with the CCC. At the Pleasant Mills monitoring station, Adams County NO3-NO2 data averaged 4.91 mg/l, with a maximum concentration of 19.30 mg/l. Ammonia data collected by the Adams County SWCD reported an average concentration of 0.27 mg/l. The maximum ammonia concentration

was recorded at 1.68 mg/l at the Pleasant Mills location. NO3-NO2 data collected by the Adams County SWCD ranged from 0.20 mg/l to 19.00 mg/l. 17% of the Adams County SWCD samples violated the Indiana drinking water standard of 10 mg/l. Ammonia data collected by Adams County in 2001 at this site ranged from the laboratory detection level of 0.05 mg/l to 1.11 mg/l. The average ammonia concentration at this site was 0.21 mg/l. The Adams County SWCD collected NO3-NO2 data at the US 33-27 site. 13% of samples violated the 10 mg/l drinking water standard. Ammonia data collected at this site averaged 0.23 mg/l with a maximum concentration of 1.10 mg/l. North of Decatur at the CR 900 N monitoring station, Adams County SWCD NO3-NO2 data ranged from 0.25 mg/l to 17.90 mg/l. Ammonia data at the CR 900 N site ranged from 0.05 mg/l to 1.10 mg/l. At the Allen County – Adams County line monitoring station, the Adams County SWCD reported a maximum NO3-NO2 concentration of 18.60 mg/l. 17% of NO3-NO2 samples at this site exceeded the Indiana drinking water standard. Ammonia data collected at the County line location ranged from 0.05 mg/l to 1.07 mg/l. In 2007-2008 the St. Marys River Watershed Project collected ammonia data on the St. Marys River near the Village of Poe. Ammonia data ranged from 0.01 mg/l to 0.95 mg/l with an average concentration of 0.18 mg/l. Ammonia concentrations at this site were in compliance with the CCC. At the Ferguson Road site, the City of Ft. Wayne collected ammonia from 2007-2008. Concentrations ranged from 0.10 mg/l to 0.21 mg/l.

Phosphorus data collected by the Adams County SWCD in 2000-2001 at the Willshire, Ohio site had an average concentration of 0.24 mg/l, 25% of these samples exceeded the 0.30 mg/l standard set by the IDEM TMDL. Data collected by the St. Marys River Watershed Project at this site had an average concentration of 0.29 mg/l. 41% of samples violated the 0.30 mg/l phosphorus target set by the TMDL. Moving downstream to the Pleasant Mills location, phosphorus was sampled by Adams County SWCD in 2000-2001, with an average concentration of 0.26 mg/l. At the US 224 site in Decatur Indiana, the Adams County SWCD reported phosphorus results ranging from 0.01 mg/l to 0.78 mg/l. Samples exceeded the TMDL phosphorus standard (0.30 mg/l) 33% of the time. North of Decatur at US 33-27, phosphorus levels were found to be in violation of the standard 21% of the time. At the CR 900 N sampling site, the Adams County SWCD reported phosphorus values ranging from 0.10 mg/l to 0.95 mg/l, while at the Allen County-Adams County line values ranged from 0.01 mg/l to 0.92 mg/l. Samples were in exceedence of the TMDL phosphorus target 46% of the time at the CR 900 N site and 42% of the time at the County line site. At the Poe monitoring station, sampling by the St. Marys River Watershed Project in 2007-2008 reported average phosphorus levels of 0.45 mg/l, with a maximum concentration of 4.47 mg/l. At the Ferguson Road site, the City of Ft. Wayne reported phosphorus levels of 0.10 mg/l to 0.84 mg/l. 33% of samples exceeded the TMDL phosphorus standard.

TSS data were collected at three monitoring stations on the main stem of the St. Marys River. The St. Marys River Watershed Project collected data from 2007-2008 at the Willshire, Ohio monitoring station as well as the monitoring station near the Village of Poe. Average TSS levels were reported at 70.53 mg/l at the Willshire site and 93.32 mg/l at the Poe location. 78% of samples exceeded the TMDL target for phosphorus (30 mg/l) at the Willshire site, while 76% were in violation at the Poe site.

Pesticide data were collected at two locations on the St. Marys River by the St. Marys River Watershed Project in 2007-2008. At the Willshire, Ohio monitoring station, samples

exceeded the USEPA drinking water standard of 3.00 µg/l 22% of the time. At the monitoring station near the Village of Poe, data revealed a period from May 7, 2008 to July 2,2008 where high Atrazine levels were reported. Six Atrazine samples exceeded the USEPA drinking water standard. A maximum concentration of 16.40 µg/l was reported on June 4, 2008. Concentrations of Alachlor and Cyanazine were below MCL levels and Metolachlor concentrations were not in excess of health advisory levels.

The following Tables 39-47 summarize water quality in the St. Marys River.

St. Marys River							
IDEM UNK000-0007, Ohio SR 81, Willshire, OH							
		Concentration			Loading		
Parameter	Data Source	Min.	Max.	Avg.	Min.	Max.	Avg.
E. coli	2004 IDEM	47.9	5794	739.2			
E. coli	Fort Wayne	144	12,260	3338.3			
E. coli	2000-2001 Adams SWCD	100	3200	993.6			
E. coli	SMRWP	33	9,080	687.48	1.30E+10	1.16E+14	8.02E+12
Temperature	SMRWP	0.10	21.97	12.74			
pH	SMRWP	7.33	9.09	7.91			
DO	SMRWP	1.67	13.18	8.82			
Conductivity	SMRWP	176	1049	504.67			
Turbidity	SMRWP	8.40	338.00	102.46			
BOD	SMRWP	1.35	7.64	3.92			
TSS	SMRWP	10	352	70.53	0.5	4066.9	324.3
Nitrogen, NO3-NO2	2000-2001 Adams SWCD	0.02	17.50	4.63			
NH3-N	SMRWP	0.01	0.26	0.12	8.0	5984.9	496.7
NH3-N	2000-2001 Adams SWCD	0.05	0.81	0.19			
Phosphorus	SMRWP	0.03	1.24	0.29	4.7	16,641.6	1,565.7
Phosphorus	2000-2001 Adams SWCD	0.01	0.87	0.24			
Atrazine	SMRWP	0.06	14.75	2.32	0.028	65.624	6.245
Alachlor	SMRWP	0.00	1.97	0.44			
Cyanazine	SMRWP	0.00	0.47	0.32			
Metolachlor	SMRWP	0.00	3.68	1.16			

Table 39. Water quality in the St. Marys River (Willshire, OH)

St. Marys River							
IDEM LES040-0007, SR 101, North of Pleasant Mill							
		Concentration			Loading		
Parameter	Data Source	Min.	Max.	Avg.	Min.	Max.	Avg.
E. coli	2004 IDEM	148.3	24,200	2,149.4			
E. coli	2000-2001 Adams SWCD	50	13,600	2,856.3			
Phosphorus	2000-2001 Adams SWCD	0.01	0.67	0.26			
Nitrogen, NO3-NO2	2000-2001 Adams SWCD	0.20	19.30	4.91			
NH3-N	2000-2001 Adams SWCD	0.05	1.68	0.27			

Table 40. Water quality in the St. Marys River (Pleasant Mills)

St. Marys River							
Decatur, US HWY 224							
		Concentration			Loading		
Parameter	Data Source	Min.	Max.	Avg.	Min.	Max.	Avg.
E. coli	2000-2001 Adams SWCD	100	4,000	1,406.3			
Phosphorus	2000-2001 Adams SWCD	0.01	0.78	0.26			
Nitrogen, NO3-NO2	2000-2001 Adams SWCD	0.20	19.00	4.81			
NH3-N	2000-2001 Adams SWCD	0.05	1.11	0.21			

Table 41. Water quality in the St. Marys River (US HWY 224)

St. Marys River							
Decatur, US HWY 33-27							
		Concentration			Loading		
Parameter	Data Source	Min.	Max.	Avg.	Min.	Max.	Avg.
E. coli	2000-2001 Adams SWCD	200	24,000	5,006.3			
Phosphorus	2000-2001 Adams SWCD	0.01	2.01	0.28			
Nitrogen, NO3-NO2	2000-2001 Adams SWCD	0.31	18.70	4.93			
NH3-N	2000-2001 Adams SWCD	0.05	0.95	0.25			

Table 42. Water quality in the St. Marys River (US HWY 33-27)

St. Marys River							
CR 900N, West of US 27 and US 33							
		Concentration			Loading		
Parameter	Data Source	Min.	Max.	Avg.	Min.	Max.	Avg.
E. coli	2000-2001 Adams SWCD	500	15,400	3,681.3			
Phosphorus	2000-2001 Adams SWCD	0.10	0.95	0.30			
Nitrogen, NO3-NO2	2000-2001 Adams SWCD	0.25	17.90	5.02			
NH3-N	2000-2001 Adams SWCD	0.05	1.10	0.23			

Table 43. Water quality in the St. Marys River (CR 900 N)

St. Marys River							
CR 1200N, Adams/Allen County Line							
		Concentration			Loading		
Parameter	**Data Source**	**Min.**	**Max.**	**Avg.**	**Min.**	**Max.**	**Avg.**
E. coli	2000-2001 Adams SWCD	100	5,000	1,512.5			
Phosphorus	2000-2001 Adams SWCD	0.01	0.92	0.29			
Nitrogen, NO3-NO2	2000-2001 Adams SWCD	0.20	18.60	4.88			
NH3-N	2000-2001 Adams SWCD	0.05	1.07	0.19			

Table 44. Water quality in the St. Marys River (Adams County-Allen County Line)

St. Marys River							
IDEM LES060-0006, Hoagland Road near Poe							
		Concentration			Loading		
Parameter	Data Source	Min.	Max.	Avg.	Min.	Max.	Avg.
E. coli	2004 IDEM	30.5	14,136	1,391.1			
E. coli	Fort Wayne	20	48,400	12,169.4			
E. coli	SMRWP	40	8,570	1,030.97	4.39E+10	2.29E+14	2.48E+13
Temperature	SMRWP	0.23	22.39	13.44			
pH	SMRWP	7.39	8.58	8.09			
DO	SMRWP	5.59	13.71	9.90			
Conductivity	SMRWP	157	1,224	540.8			
Turbidity	SMRWP	7.80	811	133.67			
BOD	SMRWP	1.35	11.64	4.41			
TSS	SMRWP	10	554	93.32	0.9	10,955.0	943.8
NH3-N	SMRWP	0.01	0.948	0.18	6.6	15,788.1	1,496.2
Phosphorus	SMRWP	0.03	4.47	0.45	12.1	92,794.1	5,242.8
Atrazine	SMRWP	0.00	16.40	2.34	0.055	130.18	13.27
Alachlor	SMRWP	0.01	1.70	0.43			
Cyanazine	SMRWP	0.00	0.46	0.32			
Metolachlor	SMRWP	0.02	4.24	1.15			

Table 45. Water quality in the St. Marys River (Village of Poe)

St. Marys River Ferguson Road							
		Concentration			Loading		
Parameter	Data Source	Min.	Max.	Avg.	Min.	Max.	Avg.
E. coli	2001-2004 City of Fort Wayne	4	48,400	1,615.5			
E. coli	2007-2008 City of Fort Wayne	27	2,420	468.5			
pH	2007-2008 City of Fort Wayne	6.94	8.56	7.79			
DO	2007-2008 City of Fort Wayne	5.50	13.93	9.35			
Temperature	2007-2008 City of Fort Wayne	0.28	25.4	15.66			
NH3-N	2007-2008 City of Fort Wayne	0.10	0.21	0.11			
Phosphorus	2007-2008 City of Fort Wayne	0.10	0.84	0.31			
TSS	2007-2008 City of Fort Wayne	7.00	408	75.78			

Table 46. Water quality in the St. Marys River (Ferguson Road)

St. Marys River							
Spy Run Bridge							
		Concentration			Loading		
Parameter	Data Source	Min.	Max.	Avg.	Min.	Max.	Avg.
E. coli	2001-2004 City of Fort Wayne	1	48,400	1,656.6			

Table 47. Water quality in the St. Marys River (Spy Run Bridge)

4.0 Potential Water Quality Concerns, Sources, & Causes

A variety of methods were used to identify concerns within the St. Marys River Watershed. A series of public meetings were held that allowed the public to express their individual concerns and contribute to the development of the Watershed Management Plan. The following concerns were identified during two watershed stakeholder meetings. The concerns were then ranked using the nominal ranking method. The scores indicated in Table 48 are the results from the nominal ranking method; those receiving the highest score were assumed to be priority concerns.

Ranking	Issues	Score	Voters
1	Sediment - Runoff	45	17
2	Flooding (Flash & Scouring)	36	9
3	Nutrients - Runoff, Septics & Excess Fertilizer	33	14
4	Bacteria	28	9
5	Stream Bank Stabilization	20	9
6	CAFO - Concentrated Animal Feeding Operation	17	6
7	Reduced Floodplain	15	6
8	Wetlands	11	7
9	Log Jams & snags	7	4
10	Small livestock operations	6	5
11	Trash/Debris	4	1
12	Pesticides - Runoff	4	3
13	Wildlife - Geese	4	2
14	Change in Hydrology	4	2
15	Low Dissolved Oxygen (Impaired Biotic comm)	0	0
16	Municipal Operations	0	0
17	Pet Waste	0	0
18	Silting of the river	0	0
19	Toxic Residue	0	0
20	Public Awareness	0	0
21	Metals	0	0

Table 48. Stakeholder concerns and ranking results

Upon review by the Steering Committee, the list of concerns was consolidated to 7 broad areas of concentration for the St. Marys River Watershed.

1. Sediment
2. Flooding
3. Nutrients
4. Bacteria
5. Trash/Debris
6. Toxic Residues
7. Public Awareness

The following Table 49 details how identified public concerns were categorized into the seven broad categories.

St. Marys River Watershed Areas of Concern						
Sediment	**Flooding**	**Nutrients**	**Bacteria**	**Trash / Debris**	**Toxic Residues**	**Public Awareness**
Sediment-Runoff	Flash Flooding & Scouring	Runoff, Septics, & Excess fertilizer	Bacteria	Trash/ Debris	Pesticides-Runoff	Public Awareness
Streambank Stabilization	Reduced Floodplain	CAFO's	CAFO's		Toxic Residues	
Wetlands	Wetlands	Wetlands	Municipal Operations		Municipal Operations	
Log Jams/Snags	Log Jams/Snags	Small Livestock Operations	Small Livestock Operations		Metals	
Silting of the River	Change in Hydrology	Wildlife/Geese	Wildlife/Geese			
	Silting of the River	Low Dissolved Oxygen (IBC)				
		Pet Waste	Pet Waste			

Table 49. St. Marys River Watershed Areas of Concern

Concerns in the watershed were also identified by driving the watershed, aka a windshield survey. Tillage transects were completed in the months of March and June, any points having ephemeral erosion were documented. Also, a livestock inventory was completed. This inventory documented livestock species and number, as well as the access to streams and potential for waste runoff. Water quality was then used to validate the aforementioned concerns and to help prioritize concerns. The following Tables 50-56 list the potential problems, causes or sources, and the evidence to validate the concern.

Concern: Excessive Sediment Levels	
Potential Source / Cause	**Basis / Evidence**
Erosion and Sedimentation from cropland	High sediment levels could be originating from agricultural practices. Concern of excessive siltation was voiced at numerous public meetings by multiple stakeholders. Excessive sediment was ranked as the number one concern in the watershed by stakeholders. Results from tillage transects show that high amounts of conventional tillage are present throughout the watershed. Soils with a high erosion potential are common throughout the watershed (Figure 7). Evidence of erosion has been seen during windshield surveys. Water quality data has shown excessive TSS levels in the Gates, Little Blue Creek and Blue Creek sub-watersheds.
Channel and streambank erosion and sedimentation. Increased volume and flow due to altered hydrology, i.e subsurface tiling, filled wetlands and impervious surfaces.	High sediment levels could be originating from streambank erosion and destabilization. Concern over streambank erosion was documented as a concern at public meetings. Concerns over log jams resulting from streambank erosion was also voiced as a concern. County surveyors and the MRBC have verified that bank erosion and log jams are continual problems in the watershed.
Erosion from construction and development.	Concern was voiced by stakeholders regarding construction and development sites around the areas South of the City of Fort Wayne, the outlying areas of the City of Decatur, and the areas North of Berne. Development sites without proper stormwater BMP's have been observed during travel across the watershed.
Lack of Public Awareness	The steering committee voiced concern that lack of public awareness could be contributing to high sediment levels, e.g. poor erosion control practices on construction sites as well as poor farming practices. Results from the Social Indicator survey indicated that many ag producers are using conventional farming practices. However, many stated that they would be willing to try no-till or high residue methods.

Table 50. Sediment Concerns, Sources, Evidence.

Problem Statement: Stakeholders expressed great concern in regards to excessive sediment levels at a series of public meetings. Water quality data from current and past monitoring confirm these concerns. Evidence of erosion has been documented through windshield surveys as well as visits to sites with severe streambank erosion. Stakeholders feel that erosion is contributing to silting of

the river, impaired biotic communities, nutrient and pesticide loss, poor downstream drinking water, a loss of soil productivity, as well as being a visual impairment.

Concern: Flooding	
Potential Source / Cause	**Basis / Evidence**
Changes in hydrology and hydraulics. Increased volume and flow due to altered hydrology, i.e subsurface tiling, filled wetlands and impervious surfaces.	Flooding was listed as a major concern by watershed stakeholders. With the majority of landuse being agricultural, a high percentage of land has been cleared, tiled, and drained for agricultural practices. Development in the watershed leads to increased impervious surfaces, therefore creating the opportunity for flash flood situations. The National Wetlands Inventory indicates that approximately 85% of Indiana's wetlands have been lost since European settlement.
Developments without proper stormwater detention/retention measures.	The steering committee expressed the concern that developments currently exist and in some cases are being constructed without having the necessary stormwater detention/retention capacity to accommodate the development.
Poor agricultural practices (sediment reducing river carrying capacity)	Concern was expressed by the stakeholders at public meetings. Several lifelong residents of the area feel that the river no longer has the same capacity as it once had, therefore it often widens into the floodplain.
Log Jams/Snags	Log Jams and Snags are common on the St. Marys main stem and on larger tributaries. This was verified by both the Adams and Allen County Surveyors. Log Jams/Snags impede water flow, resulting in upstream flooding and streambank erosion. Voiced as a concern at public meetings.
Floodplain encroachment	The steering committee listed floodplain encroachment as a concern in the St. Marys River Watershed. Urban encroachment into the floodplain could lead to possible upstream flooding.
Natural Causes	It should be noted that flooding is a natural disaster that cannot be avoided. However the impacts that flooding has can be mitigated.

Table 51. Flooding Concerns, Sources, Evidence.

Problem Statement: Stakeholders expressed great concern over the issue of flooding. Historically, flooding has been a problem for the St. Marys, causing structural and agricultural damage for decades. Flooding has been exacerbated by erosion, changes in river hydrology and hydraulics, development without proper stormwater measures, wetland loss, poor agricultural practices, and floodplain encroachment.

Concern: Excessive Nutrient Levels	
Potential Source / Cause	**Basis / Evidence**
Nutrient loading from agricultural sources.	Increased nutrient levels could be coming from agricultural practices. Concern over nutrient runoff was listed as a major concern at stakeholder meetings. With the combination of highly erodible soils and the St. Marys watershed being predominately agricultural land, the potential for nutrient loading is very high. Water quality data has shown that nutrient levels are high in several sub-watersheds, especially following rain events.
Nutrient loading from livestock.	Increased nutrient levels could be resulting from runoff from livestock operations, including CAFO's, CFO's and small animal operations. Results from a livestock inventory have verified that there are very high livestock numbers within the St. Marys River Watershed; over 1000 locations were found to have livestock. 13 locations were identified where livestock had direct access to streams.
Nutrient loading from urban runoff.	Increased nutrient levels could be coming from urban runoff. This concern was voiced by stakeholders at public meetings. Results from the Social Indicator survey show that more than 30% of landowners are unsure of the effect that lawn fertilizers can have on water quality. However 68% viewed urban stormwater as a problem. A mere 16% of respondents are using phosphate free fertilizers.
Nutrient loading from septic systems and improperly operated treatment systems.	Increased nutrient levels could be coming from malfunctioning septic systems and improperly operated treatment plants. Soils throughout the watershed are not suitable for septic systems. In Adams County, the Health Department has verified 10 areas known for malfunctioning septic systems or improperly operated treatment systems. This concern was voiced at public meetings and also was reiterated by the steering committee. All NPDES permitted facilities are regularly in compliance.
Lack of Public Awareness	The steering committee voiced concern that lack of public awareness could be contributing to high nutrient levels, i.e. not following recommendations for agricultural or lawn fertilizer, livestock with stream access, illegal dumping, and placing yard waste into streams or storm sewers. Results from the social indicator survey indicate that there is a lack of environmental awareness in the watershed.

Table 52. Nutrient Concerns, Sources, Evidence.

Problem Statement: Stakeholders expressed concern over nutrient levels during public meetings. Water quality data confirms these concerns. With a large part of the watershed being classified as agricultural, fertilizers and livestock waste are potential sources of nutrients. In populated areas around Fort Wayne, Decatur, and Berne, fertilizers used for residential applications as well as runoff from urban areas could be potential sources of nutrients. Another potential source of nutrients is malfunctioning septic systems and improperly operated treatment systems. The majority of soils in the watershed are not suitable for septic systems.

Concern: Elevated Bacteria Levels	
Potential Source / Cause	**Basis / Evidence**
Wastewater Disposal: Human sources such as individual septic systems, combined sewer overflows & sanitary sewer overflows, and effluent from wastewater treatment plants.	Suspected failing septic systems indicated by high *E. coli* levels indentified in TMDL. CSO's and SSO's are present in the City of Fort Wayne (25/2), Decatur (4), and Berne (2/1). Concern has been voiced at public meetings and through discussions with watershed residents. Soils throughout the watershed are not suitable for septic systems. Water quality data from the St. Marys TMDL has shown that *E. coli* levels are typically above IDEM standards. This was also shown in water quality samples collected by the St. Marys River Watershed Project.
Agriculture: Animal waste runoff from livestock.	Suspected runoff from agricultural sites indicated by high *E. coli* levels indentified in TMDL. Water quality data from the St. Marys TMDL has shown that *E. coli* levels are typically above IDEM standards. This was also shown in water quality samples collected by the St. Marys River Watershed Project. Concern was voiced at stakeholder meetings. Results from a livestock inventory have identified very high numbers of livestock in the St. Marys River Watershed; over 1000 locations were found to have livestock. 13 locations were identified where livestock had direct access to streams.
Natural Sources: Wild animal waste in runoff.	Concern was voiced during public meetings. Wild animal waste could be a source of elevated *E. coli* levels identified by the TMDL. Visual evidence of geese and deer waste can be seen across the watershed.

Urban runoff: Domestic pet waste runoff.	Concern was voiced during public meetings. Pet waste could be a source of elevated *E. coli* levels identified by the TMDL. The Spy Run, Junk Ditch, Harber Ditch, Snyder Ditch, and Houk Ditch subwatersheds are heavily populated and the *E. coli* levels could be a result of domestic pet waste. Visual evidence of domestic pet waste can be seen across the watershed.
Lack of Public Awareness	The steering committee voiced concern that lack of public awareness could be contributing to high *E. coli* levels, e.g. improper septic system maintenance, livestock with stream access.

Table 53. Bacteria Concerns, Sources, Evidence.

Problem Statement: Elevated bacteria levels are seen as a severe issue in the watershed. Stakeholders discussed they were concerned with health risks associated with bacteria in the watershed. All streams sampled in the watershed typically exceeded IDEM *E. coli* water quality standards for full body contact recreation, this result mirrors that found by the TMDL. Suspected sources include failing or malfunctioning septic systems, combined sewer overflows, sanitary sewer overflows, effluent from improperly operated treatment plants, runoff from livestock waste, wild animal waste and pet waste.

Concern:Excessive levels of toxic residues: Pesticides/Herbicides, Industrial Wastes	
Potential Source / Cause	**Basis / Evidence**
Agriculture: Pesticides/Herbicides in runoff	Concern was voiced during public meetings. Water quality data has shown high atrazine levels in the Gates Ditch, Habegger Ditch, Little Blue Creek and Blue Creek sub-watersheds during the 2008 planting season.
Improper Pesticide/Herbicide application	This concern was brought up by the steering committee on the premise that pesticide/herbicide levels could be originating from improper application, i.e. not following setback guidelines and improper volumes being applied in both agricultural and residential settings. 63.9% of survey respondents see excessive pesticide/herbicide application as a problem.
NPDES Permit Holders (IDEM Rule 6)	The steering committee voiced concern that there are IDEM Rule

	6 permit holders who are commonly out of compliance with their permits. Rule 6 requires permit holders to obtain a general NPDES permit to monitor storm water on their site and implement BMP's. This was verified by the City of Decatur Stormwater Coordinator.
Lack of Public Awareness	The steering committee voiced concern that lack of public awareness could be contributing to high levels of toxic residue, e.g. illegal dumping, dumping of household wastes, permit violation, improper pesticide/herbicide application. Social Indicator survey results show that 40% of respondents were unsure of how pesticides/herbicides were affecting water quality.

Table 54. Toxic Residue Concerns, Sources, Evidence.

Problem Statement: Stakeholders expressed concern regarding excessive levels of toxic residues, specifically pesticides and herbicides as well as industrial wastes. IDEM Rule 6 requires analysis of the following parameters:

1. Oil and grease
2. Carbonaceous biochemical oxygen demand (CBOD)
3. Chemical oxygen demand (COD)
4. Total suspended solids (TSS)
5. Total Kjeldahl nitrogen (TKN)
6. Total phosphorous
7. pH
8. Nitrate plus nitrite nitrogen
9. Any pollutant attributable to a facility's industrial activity which is reasonably expected to be present in the discharge
10. Any pollutant that has the potential to be present in a stormwater discharge as requested by IDEM

Concerns were verified with water quality data showing high levels of atrazine. Concern was also voiced with regard to IDEM Rule 6 permit holders who are not meeting the criteria of their general NPDES permits. The steering committee agreed that a large cause of excessive toxic chemicals stems from lack of public awareness.

Concern: Excessive levels of trash/debris	
Potential Source / Cause	**Basis / Evidence**
Illegal dumping and littering	Concern was voiced at public meetings by stakeholders. The Decatur WWTP operator commented on the amount of bottles/cans/debris that are removed at the treatment plant. Visual evidence was observed along streambanks and ditches while completing windshield surveys.
Lack of Public Awareness	The steering committee voiced concern that lack of public awareness could be contributing to excessive levels of trash and debris, i.e. illegal dumping, and littering.

Table 55. Trash/debris Concerns, Sources, Evidence.

Problem Statement: Stakeholders voiced concern over trash and debris along water ways. Trash and debris resulting from illegal dumping and littering are a visual impairment and pose potential health risks.

Concern: Lack of Public Awareness	
Potential Source / Cause	**Basis / Evidence**
Runoff containing fertilizer, pet and livestock waste, and pesticides/herbicides.	Stakeholders identified this as a concern. Water quality data for nutrients, sediment, *E. coli*, and pesticides/herbicides verifies these concerns.
Improper septic system maintenance and operation.	Suspected failing septic systems indicated by high *E. coli* levels indentified in TMDL. Concern has been voiced at public meetings and through discussions with watershed residents. Soils throughout the watershed are not suitable for septic systems. Water quality data from the St. Marys TMDL has shown that *E. coli* levels are typically above IDEM standards. This was also shown in water quality samples collected by the St. Marys River Watershed Project. 55.7% of Social Indicator respondents believe septic systems may be a water quality problem.
Improper chemical disposal.	Concern voiced at public meetings. Social Indicator results show that 62.9% agree that improper chemical disposal is a contributor to poor water quality.
Inadequate stormwater BMP's.	Concern voiced at public meetings. Development sites without proper stormwater BMP's have been observed during travel across the watershed.

Table 56. Public Awareness Concerns, Sources, Evidence.

Problem Statement: Stakeholders identified that water quality issues could be amplified by a lack of individual knowledge of the impacts that people have on water quality. It was verified by Social Indicator survey results, that the majority of residents are unaware of their impacts on water quality.

4.1 Sediment

Erosion occurs when wind or water runoff carries soil particles from one area to another. Sedimentation occurs when these soil particles are deposited into a receiving water body, such as a stream or a lake. These mobilized soil particles may become suspended within the water column, clouding the water and reducing the amount of sunlight reaching aquatic vegetation, and obstructing the gills of aquatic organisms. Particles of silt and sand may eventually precipitate out of the water column, settling on the streambed effectively covering fish spawning areas and macroinverteberate habitat, and smothering food supplies. Land clearing and conventional tillage make soils more susceptible to erosion, which can then cause stream and ditch sedimentation.

Furthermore, pollutants such as phosphorus, pathogens, and heavy metals move through the landscape attached to microscopic soil and organic particles. These same microscopic particles may be easily transported via overland flow and are stored in and carried by streams throughout the watershed.

4.1.1 Agriculture

The land in the St. Marys River Watershed is primarily used for agricultural production. With the necessity of the use of field tiles due to soil conditions in the watershed, sediment from runoff has the potential to leach into field tiles and discharge into nearby streams. The Blue Creek / Habegger Ditch and Yellow Creek Watersheds TMDL indicated that TSS values during mid and high range flow conditions were due to TSS transportation via field tiles.

Agricultural practices inducing erosion is a potential source of sediment pollution in the St. Marys River Watershed. Areas with highly erodible soils, if not managed properly, can erode at an accelerated rate and may lead to excessive soil deposition within streams and ditches. Highly Erodible Land (HEL) determinations are made based on a mathematical equation, the Universal Soil Loss Equation (USLE). This equation, and subsequent versions, consider the average rainfall, erodibility of the soil type, allowable loss for that soil type, and the length and the slope of the area. According to the USDA, an entire farm tract is considered HEL if at least one third of the tract has highly erodible soils present.

HEL erosion has been identified by the NRCS as a water quality problem throughout the watershed. Activities involving land disturbance such as conventional tillage methods, intensive livestock grazing with stream accessibility and removal of wooded areas are likely to increase sediment loadings to the watershed. Figure 7 shows HEL soils in the watershed.

The NRCS has conducted a Rapid Watershed Assessment for the St. Marys River Watershed. Table 57 was developed with data from the NRCS Soil Data Mart and lists Soils Based Resource Concerns for the watershed.

Soils Based Resource Concerns									
County	**Hydric (Ac.)**	**Leaching Index ≥10 (Ac.)**	**Subsurface Drainage = H/VH (Ac.)**	**Soil Erosion (Wind) >500 (Ac.)**	**Potential for Frequent Flooding (Ac.)**	**Surface Runoff Class = H/VH (Ac.)**	**Soil Erosion (Water) >37 (Ac.)**	**Sheet/Rill Erosion Potential b/w 1T & 2T (Ac.)**	**Sheet/Rill Erosion Potential > 2T (Ac.)**
Adams	66,532	3,623	143,206	64,949	6,256	41,814	6,907	0	0
Allen	23,082	954	7,762	1,660	2,440	15,357	1,719	190	20
Wells	7,098	132	6,876	0	11	150	10	0	0
Totals	**96,712**	**4,709**	**157,844**	**66,609**	**8,707**	**57,321**	**8,636**	**190**	**20**

Source: NRCS Soil Data Mart, 2007

Hydric soils = Characterized by, relating to, or requiring an abundance of water, hydric soils are indicators of wetlands, which represent unique management considerations including groundwater impacts, crop production limitations, wildlife considerations, etc.

Leach Index = soils with a relatively high risk of water percolating below the crop root zone; developed using annual precipitation, rainfall distribution data and hydrologic soil groups.

Subsurface Drainage = soils with a relatively high risk of having subsurface drainage; determined from a matrix based on soil drainage class and depth to seasonal high water, and the presence of artificial subsurface drainage and surface tile inlets.

Soil Erosion (Wind) = soils with a relatively high risk of eroding by wind; determined from a location's C (Climate) Factor and a soil's Soil Erodibility Index (I).

Flooding Potential = soils with a relatively frequent risk of being covered by flowing water from any source; determined from the NRCS soil survey.

Surface Runoff Class = soils with a relatively high relative risk of soil solution movement from the surface of a management unit; determined using soil permeability and percent slope.

Soil Erosion (Water) = soils with a relatively high risk of eroding by water; determined from a location's R (Rainfall-Runoff Erosivity) Factor, and a soil's K (Soil Erodibility) and LS (Length-Slope) factors.

Sheet/Rill Erosion Potential = Erosion potential is based on the RUSLE2 calculation for the soil with a "C" Factor equal to that of a typical cropland management system used in Indiana (no-till soybeans, followed by chisel-plowed corn with an injected anhydrous application). Soils under this management system between 1 and 2 times of tolerable limits are eroding above sustainable levels; soils under this management system greater than 2 times of tolerable limits may be ineligible for certain USDA benefits. Management systems that leave more residue on the surface, those with less soil disturbance, crop rotations with higher-residue crops, etc. will decrease soil erosion compared to those under the typical cropland system. Management systems that leave less residue, disturb the soil more, and those with crop rotation with lower-residue crops may increase soil erosion above the typical cropland system.

Leach Index, Wind Erosion, Water Erosion, Flood Potential, and Surface and Subsurface Drainage = Because climatic and other data elements may be county-based, threshold values may differ among adjacent counties and result in abrupt data thresholds.

Table 57. Soil Based Resource Concerns.

Associated with sediment reduction, the Steering Committee feels it is necessary to look at tillage methods in the watershed as a possible source of excess sediment in the St. Marys River Watershed. County tillage data was obtained from the Indiana State Department of Agriculture (ISDA), Division of Soil Conservations and analyzed to show trends of conservation tillage practices in the St. Marys River Watershed (Fig. 43). While this information is provided on a county-wide basis, it is representative of the tillage types and percentages within the boundaries of the St. Marys River watershed. No-till refers to any direct seeding system including strip preparation with minimal soil disturbance.

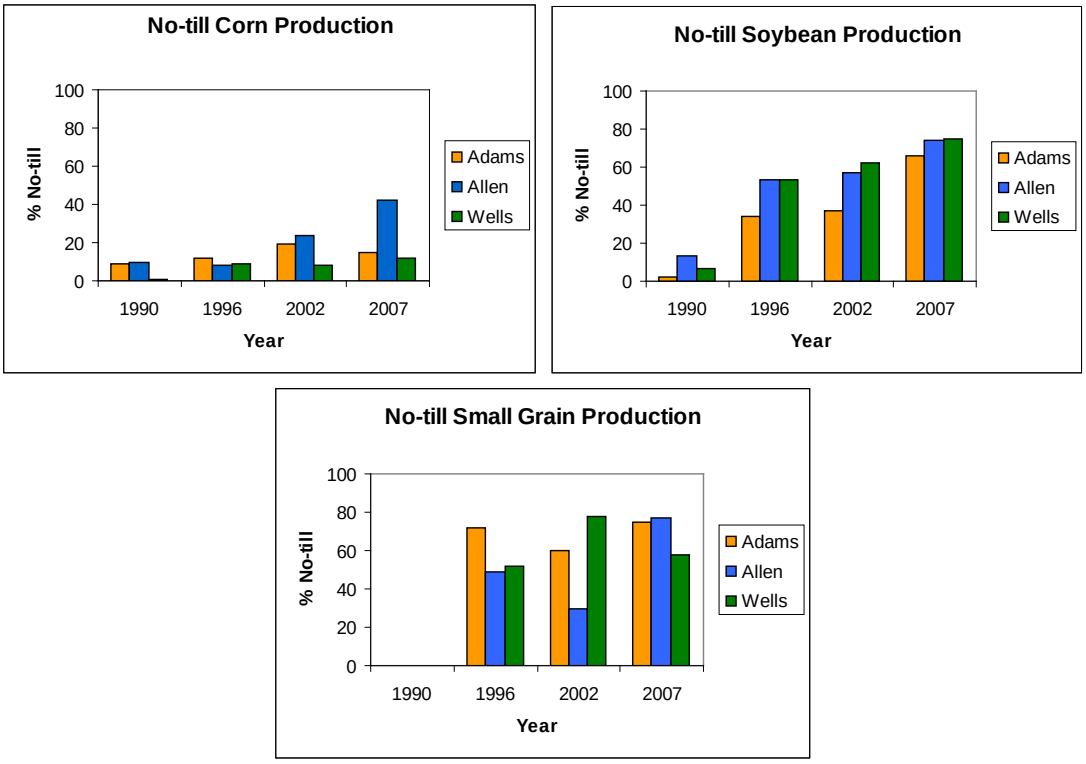

Figure 43. Trends of no-till adoption over a 17-year period, 1990-2007.

It is clear that while no-till soybeans seem to be an accepted practice throughout the tri-county area, no-till corn has not been widely established, especially in Adams and Wells Counties. Resistance to utilize conservation tillage in corn production can be attributed to several rationales including the needed acreage for manure application and associated incorporation methods, increased moisture attributed to the combination of poorly drained soils and excess fodder, the concern of inconsistent plant populations, and possible yield reductions. Alternatively, a continuation of conventional tillage methods may be due to producers continuing to use the “tried and true” methods that were used by generations before them. A change in farming practices may be seen as disrespectful to the elder generations. Small grain production, mainly hay and wheat crops, commonly use no-till practices. Further adoption of conservation tillage methods has the opportunity to open avenues for increased water quality, increased soil health and tilth, and also serves as a means for sediment and nutrient reduction in the St. Marys River Watershed.

Other contributing factors to sediment pollution include cropland being farmed to the stream edges, therefore intensifying erosion and limiting the potential for filtration in the riparian zone. Another source is allowing livestock direct access to streams. This access may destabilize stream banks and also removes vegetation from stream banks. Over grazing by livestock can also induce erosion through exposing the soil and through compaction, which reduces the potential for water infiltration into the soil.

4.1.2 Urban

Construction activities that involve excavation, grading or filling can produce significant sedimentation if not properly controlled. Sedimentation from developing urban areas can be a major source of pollution due to the cumulative number of acres disturbed in a watershed. Construction of single family homes in rural areas can also be a source of sedimentation when homes are placed in or near stream corridors.

As a pollution source, construction activities are typically temporary, but the impacts on water quality can be severe and long lasting. Construction activities tend to be concentrated in the more rapidly developing areas of the watershed, which include the outskirts of Fort Wayne, Decatur and Berne. However, road construction is widespread and often involves stream crossings in remote or undeveloped areas of the basin.

Soil erosion from construction activities contributes to the filling of nearby streams and ditches, affecting water quality, aquatic habitats, drainage, and recreational opportunities. There are a number of Best Management Practices (BMPs) including phased construction, silt fencing, and turf seeding, that when installed and maintained properly, can successfully limit sediment from leaving the site.

Land use planning and development practices are effective methods to control not only where development occurs but also the means by which it occurs, and the overall impact the development will have on water quality. Comprehensive Plans, Zoning Ordinances, MS4 permits and Subdivision Control Ordinances are documents that almost every community uses to guide growth and development within their jurisdictions. Comprehensive Plans were developed for Adams, Allen, and Wells Counties in the early 1990's and include brief descriptions regarding the preservation of natural resources and the environment. These plans should be updated to include land use changes that have occurred within the last 10 years, proposed management measures for protecting the St. Marys River and tributary streams where applicable, MS4 permit requirements and current long range planning measures.

Runoff from urbanized areas, as a rule, is more localized and can often be more severe in magnitude than agricultural runoff. The rate and volume of runoff in urban areas is much greater due both to the high concentration of impervious surface areas and storm drainage systems that rapidly transport stormwater to nearby surface waters. This increase in volume and rate of runoff can result in stream bank erosion and sedimentation in surface waters. Managing nonpoint source pollution in urban environments often includes measures of managing water quantity in addition to water quality. Urban drainage systems, including curb and guttered roadways, also allow urban pollutants to reach surface waters quickly and with little or no filtering.

Replacement of natural vegetation with pavement and removal of buffers reduces the ability of the watershed to filter pollutants before they enter surface waters. The chronic introduction of these pollutants and increased flow and velocity into a stream results in degraded waters.

Stormwater within the Allen County Portion of the St. Marys River Watershed will be managed by the City of Fort Wayne and the Allen County Storm Water Quality Management Plans. These plans will require the following minimum control measures:

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

The specific BMPs that the City of Fort Wayne and Allen County are attached in Appendix VII.

4.1.3 Channel Sources

Stream bank erosion and channel scouring are potential sources of sediment pollution in the St. Marys River Watershed. Sediment can enter surface waters when unstable stream banks collapse do to sloughing and undercutting. Additional sources include drainage ditch maintenance and concentrated flow from construction sites, agricultural land and urban areas. These areas have the potential to send large quantities of water to small streams and ditches at a high velocity, resulting in stream bank erosion and channel scouring. In addition to high sediment loads, this alters the physical and biological properties of the stream ecosystem. Implementing Low Impact Development (LID) and other BMP's can lessen the impacts resulting from increased flow volumes and velocities.

4.2 Flooding

Flooding and associated flood damage commonly occurs during the spring due to the mix of heavy rains combined with melting snow. However, provided with the right saturation conditions, intense rainfall of short duration during summer rain storms are capable of producing damaging flash flood conditions.

Historical climate and disaster data does indicate a strong prevalence of high water events, carrying with them the ability to result in significant property damages, wash out valuable in-stream habitat, destruct streambanks, increase pollutant loadings to receiving water bodies, and facilitate the associated destruction of aquatic communities. (www.crh.noaa.gov). Debris from infrastructure and buildings damaged by flood events, oils, grease, and toxins from submerged vehicles and septic systems, and common chemicals and solvents that are present in nearly every home, all have the ability to become mobile when flooding occurs. Table 58 illustrates major flooding events on the St. Marys River.

Major Flooding Events on the St. Marys River			
St. Marys River @ Decatur (USGS #04181500)		**St. Marys River near Ft. Wayne (USGS #04182000)**	
(1) 26.94 ft on 07/09/2003	Major Flood Stage: 24 ft.	(1) 21.20 ft on 07/09/2003	Major Flood Stage: 19 ft.
(2) 26.50 ft on 03/26/1913	Moderate Flood Stage: 20 ft.	(2) 19.66 ft on 03/14/1982	Moderate Flood Stage: 17 ft.
(3) 24.40 ft on 03/14/1982	Flood Stage: 17 ft.	(3) 19.06 ft on 01/14/2005	Flood Stage: 14 ft.
(4) 24.31 ft on 02/25/1985	Action Stage: 13 ft.	(4) 18.33 ft on 02/26/1985	Action Stage: 12 ft.
(5) 24.24 ft on 01/14/2005		(5) 17.92 ft on 01/01/1991	
(6) 24.22 ft on 02/10/1959		(6) 17.67 ft on 02/09/2008	
(7) 24.13 ft on 07/17/1992		(7) 17.07 ft on 07/18/1992	
(8) 23.90 ft on 07/16/1992		(8) 17.03 ft on 01/26/1999	
(9) 23.81 ft on 12/31/1990		(9) 15.81 ft on 05/12/2003	
(10) 23.62 ft on 02/08/2008		(10) 15.48 ft on 06/14/2004	

Table 58. Major Flooding Events on the St. Marys River.

Adams and Allen County have experienced many flood disasters that resulted in both Presidential Major Disaster and Governor's Disaster Declarations. The greatest known flood occurred in 1913. This event was approximately equivalent to a 500-year event on the St. Mary's and St Joseph Rivers and was equivalent to a 50-year event on the Maumee River. The greatest flood since the 500-year storm event of 1913 occurred in 1982 along the St. Mary's, St. Joseph, and Maumee Rivers on March 15-17, 1982. The National Weather Service reported that the snow accumulation in Northern Indiana at the time of this flood event had a snowmelt water equivalent of 3 to nearly 7 inches of rain. The St. Mary's water monitoring gage near Fort Wayne reached a peak of 19.64 feet and a discharge of 13,000 cubic feet per second (cfs). The St. Joseph River also crested at 13,000 cfs, and the Maumee River gage reached 25.05 feet and a discharge of 26,500 cfs. A record flood event, known as the "Firecracker Flood" was recorded in July 2003 and resulted in the St. Mary's River cresting at 21.20 feet with a discharge of 15,000 cfs. The flood resulted in approximately $66.6 million in personal and property damage combined. Damage in Adams County was $16.5 million. The previous discharge peak of record was February 10, 1959 for the St. Mary's river. Figure 44 shows downtown Decatur, IN following the 2003 flood. (MRBC, 2005) Figures 45 and 46 show flood zones in Allen and Adams Counties.

Figure 44. 2003 Flood, Decatur, IN

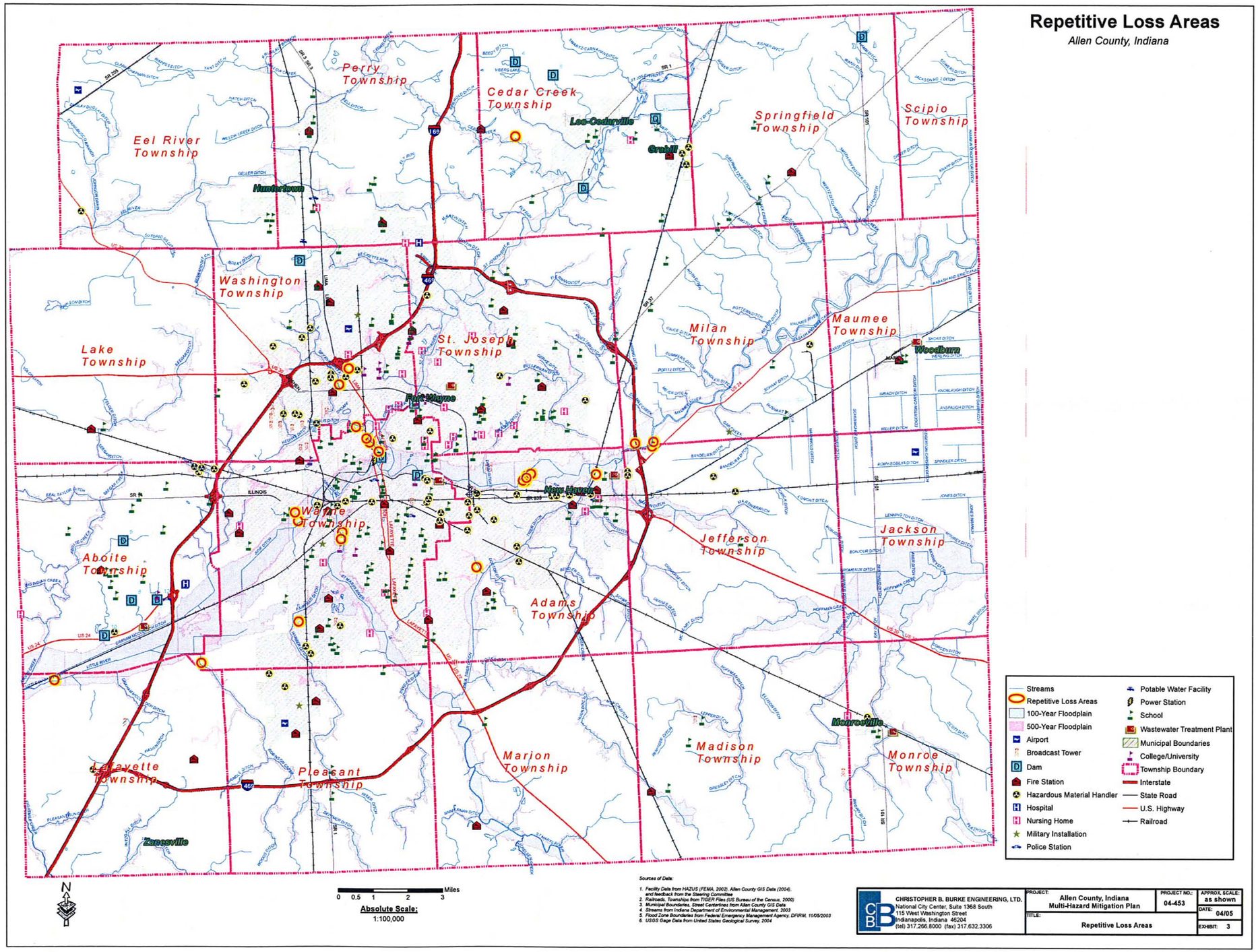

Figure 45. Allen County Flood Zones (MRBC, 2005)

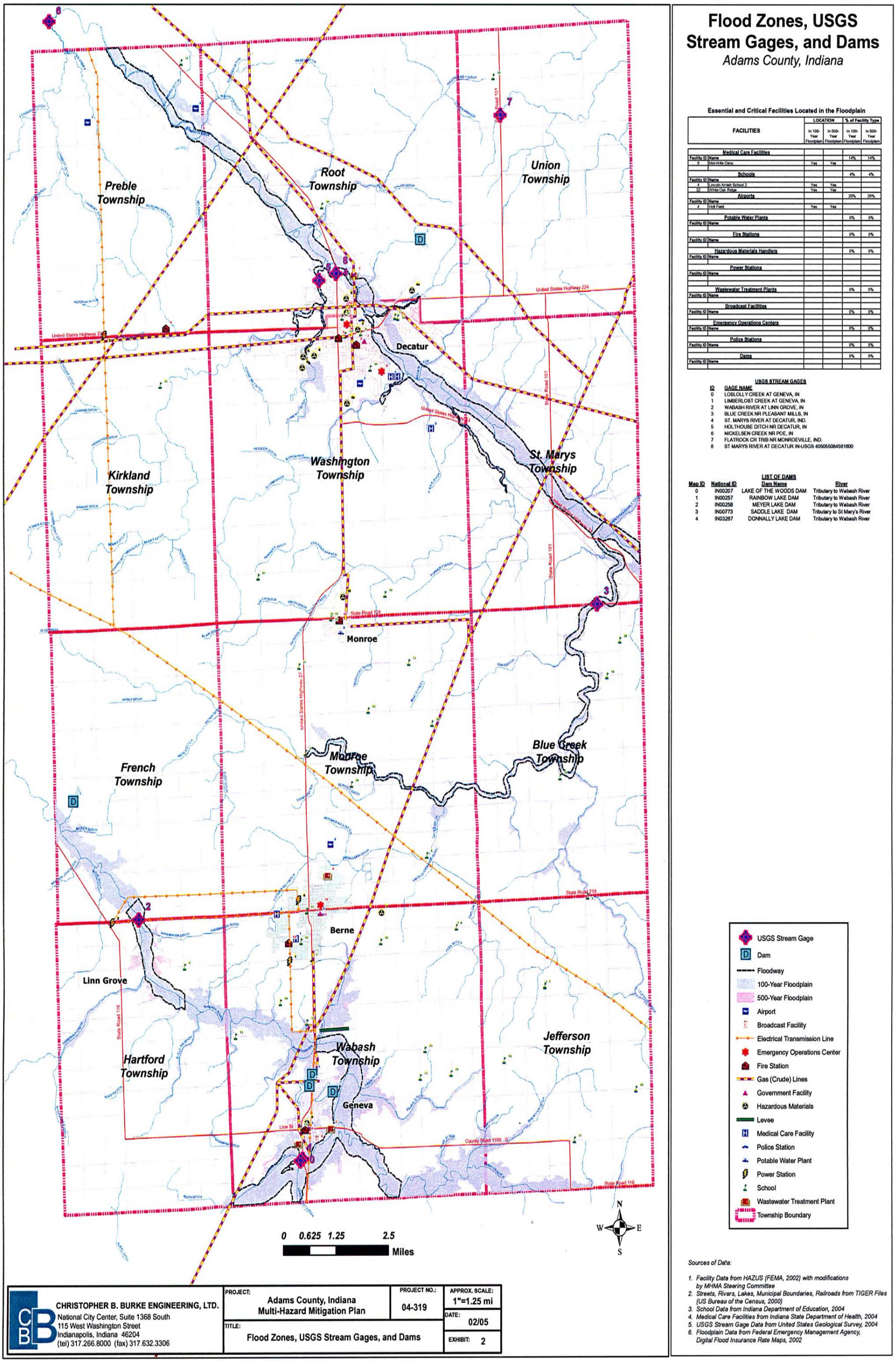

Figure 46. Adams County Flood Zones. (MRBC, 2005)

These events are not only damaging to homes, but also to the agricultural community. Producers may need to replant crops that have been damaged by flooding, or the entire field could become inundated, zeroing out the productivity for that cropping season. Furthermore, livestock facilities that are located in the floodway or the 100-year floodplain are at a higher risk for loss of animals. Table 59 provides a breakdown of the number of buildings in Decatur expected to sustain some level of damage as a result of a 100-year and 500-year flood. Table 59 numbers do not include structures outside of Decatur, IN. Within the rural portions of Adams County, an additional 52 buildings are susceptible to damage resulting from a 100-year flood, and 58 buildings are susceptible during a 500-year flood. MRBC estimates a $16.68 million total economic loss resulting from a 100-year flood, and a loss of $18.06 million resulting from a 500-year flood. (MRBC, 1995).

Number of Buildings Subject to Flood Damage in Decatur						
Stream	100-Year Flood			500-Year Flood[1]		
	Residential	Non-Residential	Total	Residential	Non-Residential	Total
St. Marys River	129	21	150	130	23	153
1. Numbers represent the number of structures that, based on the USACE 1992 study, sustain some damage regardless of their first floor elevations						

Table 59. Number of Buildings Subject to Flood Damage in Decatur. (MRBC, 1995)

Tables 60 provides a breakdown of the number of buildings in Fort Wayne and vicinity expected to sustain some level of damage as a result of a 100-year and 500-year flood. In the remaining portion of Allen County, an additional 1,483 buildings are subject to damage in 100-year flood, resulting in a $32 million total economic loss. During a 500-year flood event, 143 buildings are subject to damage, a total economic loss of $37 million.

Number of Buildings Subject to Flood Damage in Fort Wayne and Vicinity						
Stream	100-Year Flood			500-Year Flood[1]		
	Residential	Non-Residential	Total	Residential	Non-Residential	Total
St. Marys River	479[2]	65[2]	544[2]	3,207	280	3,487
Spy Run Creek	114[2]	6[2]	120[2]	177	27	204
Junk Ditch	48	42	90	117	52	169
Fairfield Ditch	487	2	489	622	12	634
Trier Ditch	17	10	27	419	23	442
1. Numbers represent the number of structures that, based on the USACE 1993 study, sustain some damage regardless of their first floor elevations						
2. Numbers shown exclude the buildings protected by the USACE Diking Project.						

Table 60. Number of Buildings Subject to Flood Damage in Fort Wayne and Vicinity. (MRBC, 1995)

The 100-year flood is referred to as the "regulatory" or "base" flood and used as a benchmark by the Federal Emergency Management Agency (FEMA). The term 100-year flood is often incorrectly used and can be misleading. It does not mean that only one flood of that size will occur every 100 years. What it actually means is that there is a 1% chance of a flood of that intensity and elevation happening in any given year. In other

words, the regulatory flood elevation has a 1% chance of being equaled, or exceeded, in any given year and it could occur more than once in a relatively short period.

As part of the Maumee River Basin, the Indiana portion of the St. Marys Watershed falls under the jurisdiction of the Maumee River Basin Commission (MRBC). The MRBC emerged in 1986 as an alliance between Adams, Allen, DeKalb, Noble, and Steuben Counties, which comprises the Maumee River Basin. Each County is represented by the 3 County Commissioners (or their official designee), the County Surveyor, and a member of the Soil and Water Conservation District Board of Supervisors (SWCD) (or their official designee). These members play a critical role in the formulation of policy and program recommendations and work closely with individual communities by providing assistance and guidance on a number of flood mitigation projects. The Commission is designed to assist communities in northeast Indiana to curb the threat of flooding. The MRBC is a state agency formed by Indiana Code 13-7-6.1. The MRBC provides regional leadership in planning, promoting, coordinating, and implementing flood control, conservation, and the control and development of resources such as land, water, and man-made improvements. This is further stated in the MRBC mission statement: *To provide regional leadership and promotion of flood control, soil and water conservation, and related resource management through a coordinated and comprehensive planning and implementing approach* (MRBC, 1993).

The MRBC is able to provide assistance in the areas of flood control project planning and administration, flood mitigation assistance grant writing, 319 water quality improvement grant writing, erosion and sediment control, flood insurance, floodplain ordinances, inventories of flood prone properties, stormwater and erosion control ordinances, soil and water conservation, and public information programs.

County Commissioners in the St. Marys River Watershed have elected to adopt the Maumee River Basin Commission's (MRBC) more restrictive floodplain ordinance requirements above and beyond the Indiana State requirements. This additional language requires No Adverse Impact (NAI) due to construction within floodplains. When any portion of the Special Flood Hazard Area (SFHA) is filled for the purpose of construction, this needs to be balanced by an equivalent volume of excavation within the same immediate watershed. This results in no net loss of floodplain storage post construction.

As flood events occur in the St. Marys River Watershed, the possibility for pollutants to enter the waterways is increased exponentially. Debris from infrastructure and buildings damaged by flood events, oils, grease, and toxins from submerged vehicles and septic systems, and common chemicals and solvents that are present in nearly every home can all become mobile when flooding occurs. These substances can be severely harmful to aquatic life, other wildlife, and humans that come into contact with the contaminated water, and can pose long term problems for saturated soils in the flood area.

Another common problem associated with flooding is that of streambank erosion. Bank erosion is often the result of increased stream flows associated with heavy rainfall events. When stream flow rates exceed the resistance ability of nearby soils and vegetation, bank erosion occurs. Streambank erosion can have numerous negative impacts ranging from increased turbidity, loss of in-stream habitat, loss of conveyance

volume, and damage to public infrastructure such as roads and bridges. Localized streambank problems, primarily in association with in-stream obstructions, have been identified as a water quality issue in the St. Marys River Watershed that needs to be addressed in more detail. To assist in removing obstructions, in 1996 the MRBC developed a Stream Obstruction Removal Assistance Program, providing funding for in-stream obstruction removal. In 1999 MRBC partnered with the Adams County Drainage Board and Surveyor on the first of a 2-phase Stream Obstruction Removal Project. Phase 1 began at the Indiana-Ohio State Line and continued to the CR 900 N Bridge. In Allen County, the City of Fort Wayne Flood Control Manager annually coordinates with the Indiana Department of Transportation (INDOT) to remove debris around bridge piers. In Adams County, the County Engineer and the Mayors Office coordinate with INDOT to remove obstructions.

Areas along the main stem of the St. Marys River and its major tributaries are sensitive to in-stream obstructions following high water events. These obstructions lead to destabilization of stream banks, increased sediment (TSS) loadings to the river, and increased damages and pollutant loadings associated with flooding in sensitive areas.
Sedimentation of river systems depletes the integral pool-riffle-run pattern of stream flow; decreases habitat, spawning, and feeding areas for aquatic organisms; and increases turbidity of the water column. An increased rate of stream bank erosion initiates the cyclical actions of bank destabilization, increased sedimentation in-stream, obstruction development, and increased stream bank erosion, (Figure 47).

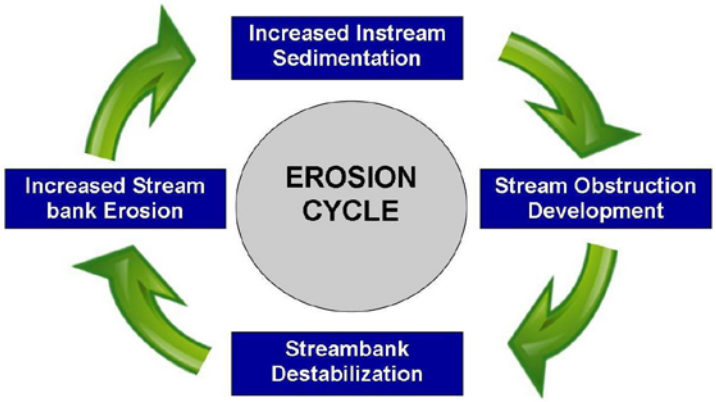

Figure 47. Erosion Cycle

General debris, either from the destruction of buildings or from general washing away of materials on the ground can also have an effect on the severity of the event. When materials are trapped in the stream, water is impeded and can potentially cause an enlarged area to become affected adding to the potential for pollutants to enter the water course and surrounding lands.

4.3 Nutrients

Nutrients, phosphorus (P) and nitrogen (N), are commonly applied in the watershed for agricultural, commercial, and residential practices. In small amounts, N and P are beneficial and necessary to aquatic life. However, in excessive amounts, they can stimulate the occurrence of algal blooms and aquatic plant growth.

Algal blooms and excessive plant growth often reduce the dissolved oxygen content of surface waters through plant respiration and the decomposition of dead algae and other aquatic plants. This situation is accelerated by high temperatures and low flow conditions due to the reduced capacity of the water system to retain dissolved oxygen. When the dissolved oxygen levels reach severely low limits, fish kills occur and the aquatic ecosystem is disrupted. The IAC (327 IAC 2-1.5-8) sets a minimum daily average DO concentration of 5.0 mg/l and a minimum concentration of 4.0 mg/l at any point.

Nutrient loading in the surface waters of the St. Marys River Watershed has been identified as a water quality problem and is addressed in this WMP. High nutrient concentrations were observed during water quality monitoring. Nutrient impairments were also reported in the Blue Creek/Habegger Ditch and Yellow Creek Watershed TMDL. Every home, regardless of size or age, has potential pollution sources that can impact ground and surface water and contribute to water quality impairments. Common chemicals applied to flowerbeds and small gardens can have a major impact to local streams and tributaries.

Urban activities may create conditions that result in higher-than-normal concentrations of ammonia and phosphorus in water bodies downstream. While professional lawn and garden chemical applicators receive training and are required to maintain application records, the average homeowner does not. This often results in over-application of lawn and garden chemicals and contributes significant nutrient loads to adjacent water bodies. It is advisable to have residential lawns sampled for available nutrient levels prior to application of additional fertilizers and/or nutrients. These samples will outline the specific needs of the lawn and will reduce the potential for over-application and contaminated runoff entering the local water courses.

Yard waste such as grass clippings, leaves, and dead plants are high in organic matter and if piled or dumped on nearby stream banks can result in the smothering of the vegetation that is naturally stabilizing the bank and preventing soil erosion. Depleted dissolved oxygen levels of nearby waterways as the vegetation decomposes can also be an outcome of improper disposal of lawn and brush clippings.

4.3.1 Agriculture

Nutrients in the form of commercial fertilizers, manure, land-applied sludge, legumes, and crop residue are utilized to enhance crop production. Nutrients can enter streams via surface runoff, nutrients bind with soil particles and are transported along with sediment to rivers and streams. Highly Erodible Land (HEL) in the watershed is shown in Figure 7. Nutrients can also leach into surface drainage tiles, which are common across the watershed, and are carried to surface waters. The Blue Creek / Habegger Ditch and Yellow Creek Watersheds TMDL indicated that nutrient values during mid and high range flow conditions were due to nutrient transportation via field tiles. Livestock manure can also be a contributing factor to nutrient loading in the watershed. Manure can be washed from pastures, washed from crop fields after manure is land applied, or directly placed when livestock are given direct access to streams. The St. Marys River Watershed Project livestock inventory identified 13 locations where livestock have direct access to streams. In reality, this number is likely to be higher due to the fact that pastures away from the road were not visible during the survey. The TMDL also indicated that nutrient

levels during and following mid range to high flow conditions are a result of runoff from small animal operations.

4.3.2 Urban

Nutrient applications to residential and commercial lawns, parks, and golf courses can be transported to streams and ditches by storm water. Furthermore, nutrient loading contributions can come from failing septic systems, NPDES dischargers, and Combined Sewer Overflows. These locations are shown geographically in Figures 49-51. The Blue Creek / Habegger Ditch and Yellow Creek Watersheds TMDL indicated that high nutrient values could be contributed during high flow conditions from failing septic systems as well as CSO's and SSO's.

Stormwater within the Allen County Portion of the St. Marys River Watershed will be managed by the City of Fort Wayne and the Allen County Storm Water Quality Management Plans. These plans will require the following minimum control measures:

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

The specific BMPs that the City of Fort Wayne and Allen County are attached in Appendix VII.

4.4 *E. coli*

The findings of the St. Marys River TMDL reported that there are numerous contributors to elevated *E. coli* levels in the St. Marys River Watershed. *E. coli* is present in the intestinal tracts of warm blooded animals and is used as an indicator to identify pathogenic organisms in surface waters. The presence of pathogenic organisms presents a human health risk to stakeholders in the St. Marys River Watershed. The St. Marys River Watershed Project WMP will address the following sources:

4.4.1 Livestock Manure

In the St. Marys River Watershed, livestock manure is a potential source of *E. coli*. Adams, Allen, and Wells Counties combine to create a significant concentration of livestock production within the state of Indiana. Adams County ranks 4th in the state for hog production with nearly 153,000 head. Adams County is 5th in the state for ducks with approximately 78,814 head. Adams County also ranks 5th in layer production, 10th in pullet production and 7th in Broiler production. Allen County ranks 3rd in horses with 3,249 head and 8th in broiler production. Wells County ranks 10th for laying hens and 16th for pullet production in Indiana. (USDA, 2007) Livestock manure can typically enter surface water through three methods; when livestock is allowed direct access to streams and ditches, through run off from livestock pastures, and through run off following land application of manure. With the necessity of the use of field tiles due to soil conditions in the watershed, applied livestock manure and manure runoff has the potential to leach into field tiles and discharge into nearby streams. The St. Marys TMDL indicated that *E.*

coli values during mid and high range flow conditions were due to *E. coli* transportation via field tiles.

Many landowners in the watershed utilize nearby streams and ditches for watering sources for their livestock. In turn, livestock have the opportunity to deposit fecal matter directly in-stream and on stream banks. As stated earlier, windshield surveys have identified approximately 13 locations in the watershed where livestock have direct access to a stream or ditch. The St. Marys TMDL confirms that since there is a continuous source of *E. coli* during dry conditions, animals with direct access to the stream are considered a source of *E. coli* in addition to other factors.

Manure deposited into upland pastures can also be an *E. coli* source when storm water runoff transports it to nearby streams or ditches. Specifically in the southern portion of the St. Marys River Watershed, grazing livestock in pasture lands or livestock in feedlots have the potential to provide a significant contribution of bacteria. Run off potential from pastures and feedlots can be exacerbated when pastures are overgrazed. Overgrazing reduces the buffering capability of the pasture, allowing surface runoff to drain to nearby streams or ditches unfiltered.

Land application of manure is often beneficial to the health of the soil and crop, and also serves as a useful method of disposal. However it can have the potential to contribute to *E. coli* levels in the St. Marys River Watershed. Guidelines are provided by the NRCS in Standard 633 to assist landowners in reducing the potential for manure-laden water to leave the field where it has been applied (USDA, 2009). Setbacks from streams and open waters, application rates, seasonal timing of the application and various other techniques are outlined in this Standard. While this information cannot be considered a law or regulation, it does encourage landowners to demonstrate their stewardship for the watershed in which they operate. Furthermore, the Adams County Planning Commission has an adopted ordinance, inflicting more stringent regulations for the operator than those set forth in state and federal guidance.

Manure can be land applied by a variety of methods; surface application followed by disking or chiseling to incorporate it into the soil, surface application without incorporation, injection into the soil, and irrigation. In the St. Marys River Watershed, surface application followed by incorporation or direct injection are viewed as the most favorable methods to reduce run off potential.

The number of livestock in the watershed was estimated by a windshield survey conducted during the summer of 2008. During the survey, livestock were recorded with a GPS as every road in the watershed was driven. In addition to major livestock types being observed and recorded, an estimated number of animals, facility age, if the animals were confined or pastured, and if livestock had stream access was also recorded. Table 61 identifies livestock numbers in the watershed.

St. Marys River Watershed Livestock Inventory		
Livestock Type	**No. Operations Identified**	**Estimated No. Animals**
Alpaca	1	12
Beef	257	3,033
Buffalo	1	10
Camel	1	2
Chickens	28	475,260
Dairy	21	3,565
Ducks	13	40,406
Goats	17	189
Horses	710	3,105
Pigs	98	94,799
Rabbits	1	200
Rats	1	500
Sheep	17	517

Table 61. Results of the St. Marys River Watershed Livestock Inventory

The following Figure 48 geographically shows locations where livestock were observed in the watershed as well as livestock type.

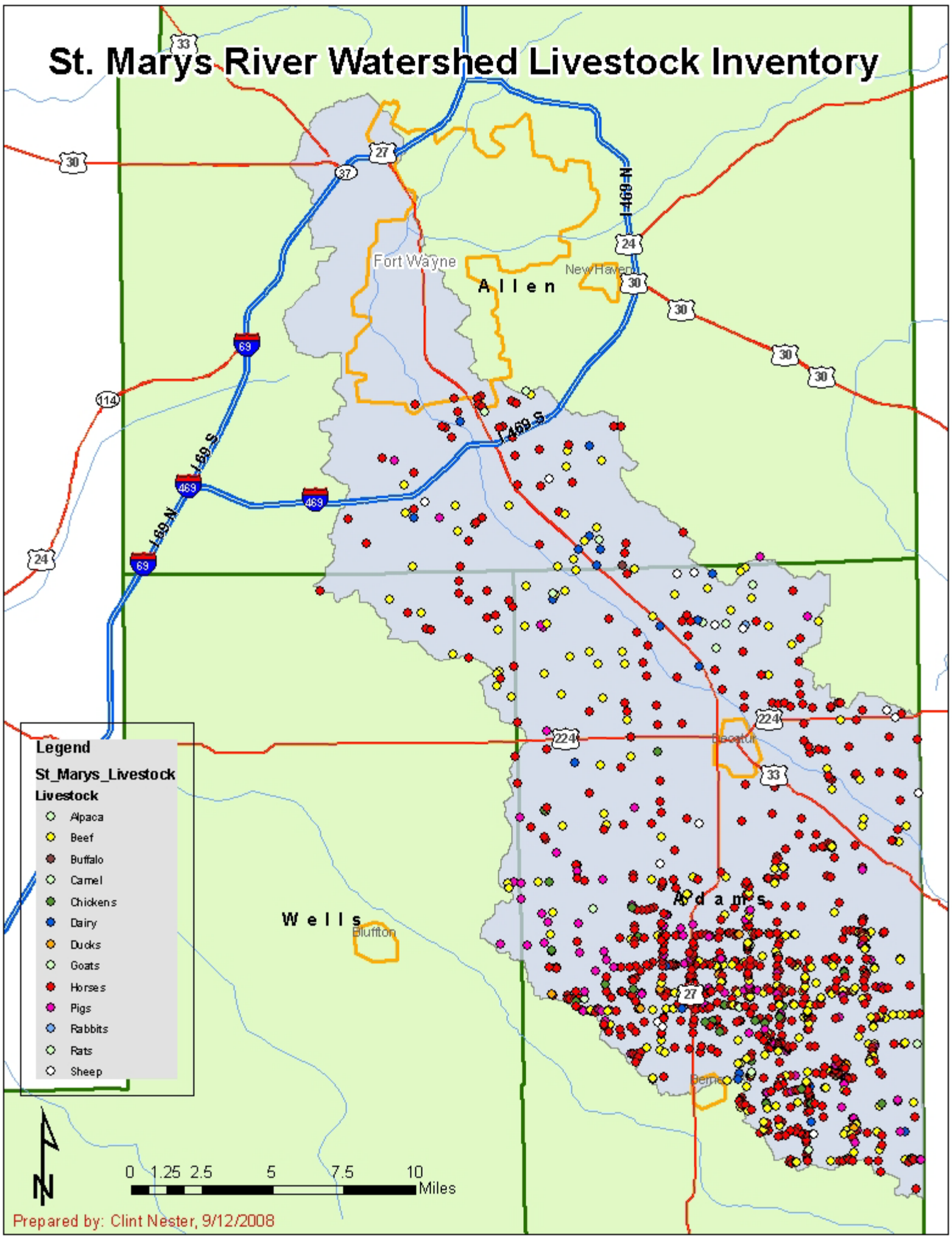

Figure 48. Livestock Operations in the St. Marys River Watershed.

4.4.2 Septic Systems

Septic systems contain all of the wastewater from a household or business that is not connected to a municipal sewer system. A complete septic system consists of a septic tank and an absorption field to receive effluent from the septic tank. The septic tank retains the solid waste, but the soil absorption field provides further absorption and treatment of the liquid waste. Septic systems can be a safe and effective method for treating wastewater if they are sized, sited, and maintained properly. Systems must be properly engineered and installed, located in suitable soils, and receive routine maintenance. If the tank or absorption field malfunctions or are improperly placed, constructed or maintained, nearby wells and surface waters may become contaminated.

Some of the potential problems from malfunctioning septic systems include:

- Polluted groundwater: Pollutants in septic effluent include bacteria, nutrients, toxic substances, and oxygen-consuming wastes. Nearby wells can become contaminated by failing septic systems.
- Polluted surface water: Groundwater often carries the pollutants mentioned above into surface waters, where they can cause serious harm to aquatic ecosystems. Leaking septic tanks can also leak into surface waters through or over the soil. In addition, some septic tanks may directly discharge to surface waters.
- Risks to human health: Septic system malfunctions can endanger human health when they contaminate nearby wells, drinking water supplies, and fishing and swimming areas.

Pollutants associated with onsite wastewater disposal may also be discharged directly to surface waters through direct pipe connections between the septic system and surface waters (straight pipe discharge). It is likely that some straight pipe discharges do occur in rural areas of Adams, Allen, and Wells Counties.

In rural portions of Adams, Allen, and Wells Counties, septic systems are the normal mechanism used for residential wastewater treatment. However, it is important to mention that the majority of soils, especially those in Adams County, are classified as having severe limitations for conventional septic systems. This classification is mainly due to the high clay content of the soils, which inhibits proper percolation of the waste effluent into the soil. This may cause wastewater to remain in the upper levels of the soil profile and in some cases rise to the surface or drain laterally, often to a drainage tile or nearby stream. Figure 8 identifies areas in the watershed with septic limitations due to soil conditions. Figure 49 highlights known septic areas in the watershed. In Allen County, the yellow dots represent areas of known septic systems, installed since 2003, systems installed prior to 2003 are unmapped. This map does not identify locations of older septic systems in Allen County. In Adams County, the color coded dots represent areas of known concentrated septic systems. These areas were identified by the Adams County Health Department as areas with a concentrated amount of systems. Individual septic systems have not been mapped in the county.

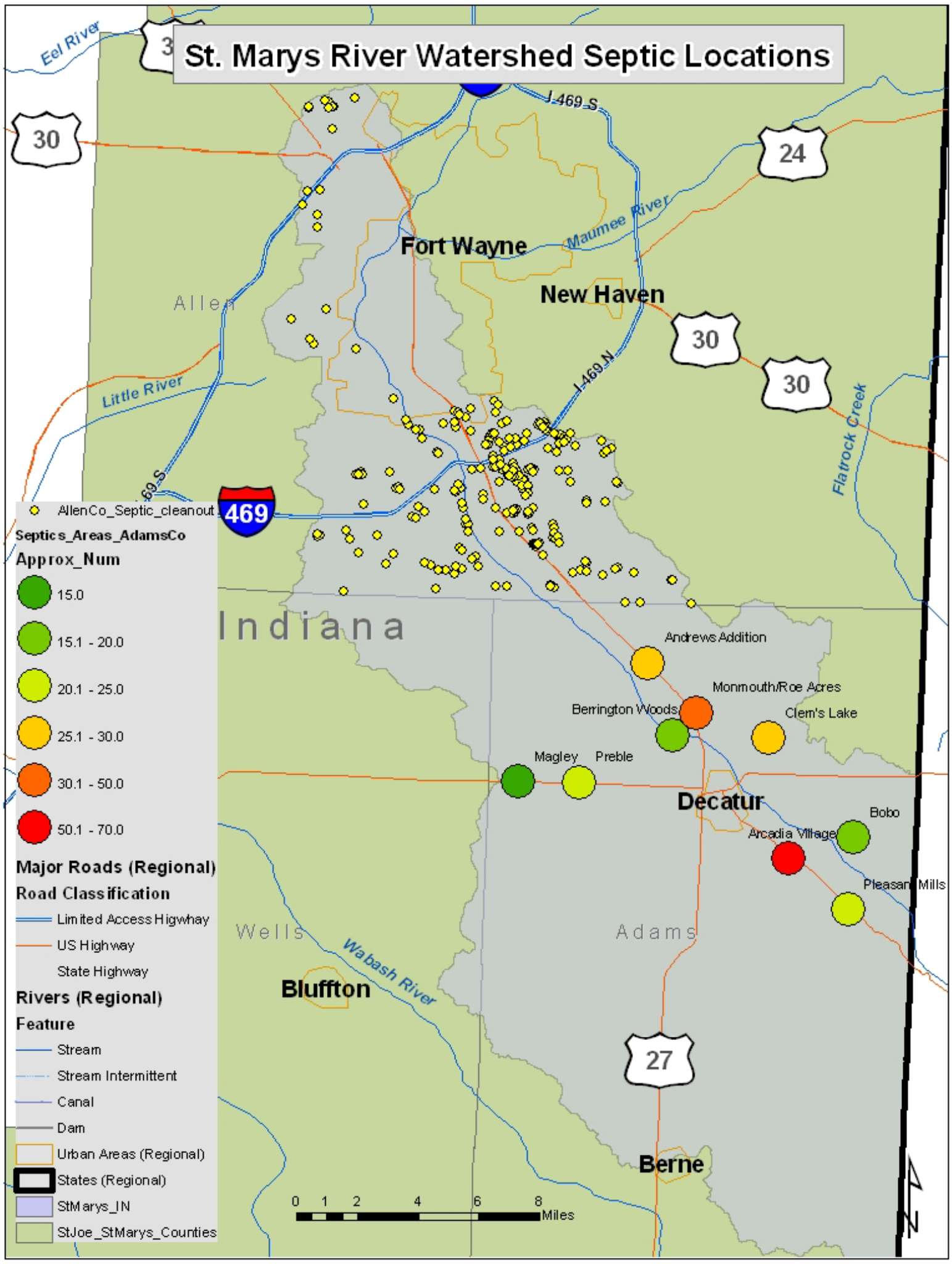

Figure 49. Areas of known septic systems in the St. Marys River Watershed

The St. Marys TMDL sampled near three communities using septic systems in the watershed. In the vicinity of all three communities *E. coli* levels were extremely elevated, consistent with septic system discharge.

In Adams County, Mr. Terry Smith, Sanitarian/Environmental Director with the Adams County Health Department estimates that 30% of the rural homes in Adams County have onsite septic systems that do not pollute the environment and are in compliance with federal, state, and local regulations. However, Mr. Smith acknowledges that the other 70% are not in compliance. He estimates that approximately 1,660 "English" and 830 "Amish" homes discharge about 500,000 gallons of untreated wastewater into the county's drainage systems every day. (T. Smith, 2007)

In July, 2003, the Allen County Board of Commissioners, with support and guidance from the Fort Wayne - Allen County Department of Health, created the Allen County Onsite Wastewater Management District. This District was created to allow Allen County to utilize legislation permitting surface discharge systems for existing homes with no other options, as well as to enforce regular maintenance on all newly installed systems. Effective September 20, 2004, owners of all newly installed, repaired, or modified septic systems must become members of the District and are charged a membership fee.

The District contracted with the Department of Health to provide many of the services required to be performed by the District. Each system is inspected when the operating permit is due for renewal. The homeowner is then notified of maintenance items which must be addressed prior to the renewal of the operating permit. The whole goal of this program is to prolong the useful life of an onsite sewage system, and to ensure the overall health of the community.

4.4.3 Wildlife & Pet Waste

Wildlife and pet wastes can contribute significantly to the concentrations of bacteria and organic matter in stormwater runoff. The St. Marys TMDL recognizes that agricultural and forested areas in the watershed create ideal wildlife habitat. Therefore, wildlife would contribute during all flow conditions with possible spikes during extreme high flow events due to runoff and flooding. The presence of wildlife has been shown to result in elevated levels of ammonia, organic nitrogen, and *E. coli* bacteria. Recent studies in Maryland and other states have shown that domestic pet waste is among the top five sources of bacteria in contaminated waters and in some areas, more of a fecal coliform contributor than humans. (Maryland Dept. of the Env., www.epa.gov) Pet wastes can be partially controlled through municipal ordinances requiring the collection and removal of the wastes from curbsides, yards, parks, roadways and other areas where the waste can be washed directly into receiving waters and/or storm drains. As the more urban areas within the watershed continue to grow in size and population, the impact of pet waste may become more of an issue and should be investigated further at that time. The St. Marys WMP recognizes that wildlife contributions may be a hard source to control, therefore public education will be conducted in regards to Canadian Geese control and wildlife feeding.

4.5 Trash and Debris

Trash and debris is a potential contributor to water quality impairments in the St. Marys River Watershed. A variety of pollutants such as oils, paints, solvents, and chemicals

have the potential to pollute surface waters in the St. Marys River Watershed. These chemicals can reach streams and ditches through illegal dumping activities, inadvertent spills, as well as lack of "good housekeeping" at industries, businesses and residential homes. Visual evidence of illegal dumping activities has been observed during windshield surveys of the watershed. Furthermore, the City of Decatur Stormwater Coordinator has expressed a concern over lack of "good housekeeping" at local businesses and industries.

4.6 Toxic Chemicals

Toxic Chemicals, mainly referring to pesticides in the agricultural sector, include a broad array of chemicals used to control plant growth (herbicides), insects (insecticides), and fungi (fungicides). These chemicals have the potential to enter and contaminate water in the St. Marys River Watershed through direct application, runoff, wind transport, and atmospheric deposition. They can kill fish and wildlife, contaminate food and drinking water sources, and destroy the habitat that animals use for protective cover. Of specific concern are Atrazine levels, which can cause health effects in both humans and wildlife. Atrazine is widely utilized in corn production and is a contaminant of concern for drinking water supplies both locally and nationally. Other herbicides and pesticides used on corn, soybeans, and for pest control on livestock also have the potential to impact surface water.

While some pesticides undergo biological degradation by soil and water bacteria, other pesticides are very resistant to degradation. Such non-biodegradable compounds may become "fixed" or bound to clay particles and organic matter in the soil. However, many pesticides are not permanently fixed by the soil, and instead they collect on plant surfaces and enter the food chain, eventually accumulating in wildlife such as fish and birds. Many pesticides have been found to negatively affect both humans and wildlife by damaging the nervous, endocrine, and reproductive systems or causing cancer (Kormandy, 1996). Excessively high levels of Atrazine were observed throughout the watershed during water quality monitoring during the 2008 growing season.

Mercury and PCB's are also a concern in the watershed. The 2008 303(d) list identifies Junk Ditch and portions of the St. Marys River as being impaired because of the aforementioned parameters. This concern was also identified in the 2008 Fish Consumption Advisory. The 2008 Fish Consumption Advisory lists advisories for a number of species in the Allen County portion of the St. Marys River. The FCA also points out that there is a statewide advisory for carp consumption due to bioaccumulation of PCB's. Appendix VI provides more information regarding specific species and locations.

A variety of pollutants such as oils, paints, solvents, and household chemicals also have the potential to pollute surface waters in the St. Marys River Watershed. Results of the Social Indicator survey show that 62.9% of respondents see improper disposal of household waste as a potential water quality problem in the watershed.

4.7 Point Source Pollution Sources

Point source contributors to pollution can be located at a particular point on a map. They are easily identified because pollution is discharged from the end of a pipe. In the state of Indiana, point sources account for about 25% of all pollution (IDNR Hoosier

Riverwatch). Point sources may include discharge sources from factories and industries, municipal sources such as combined sewer overflows (CSO) or wastewater treatment plants (WWTP). The following Figure 50 shows the geographic location of CSO's in the watershed.

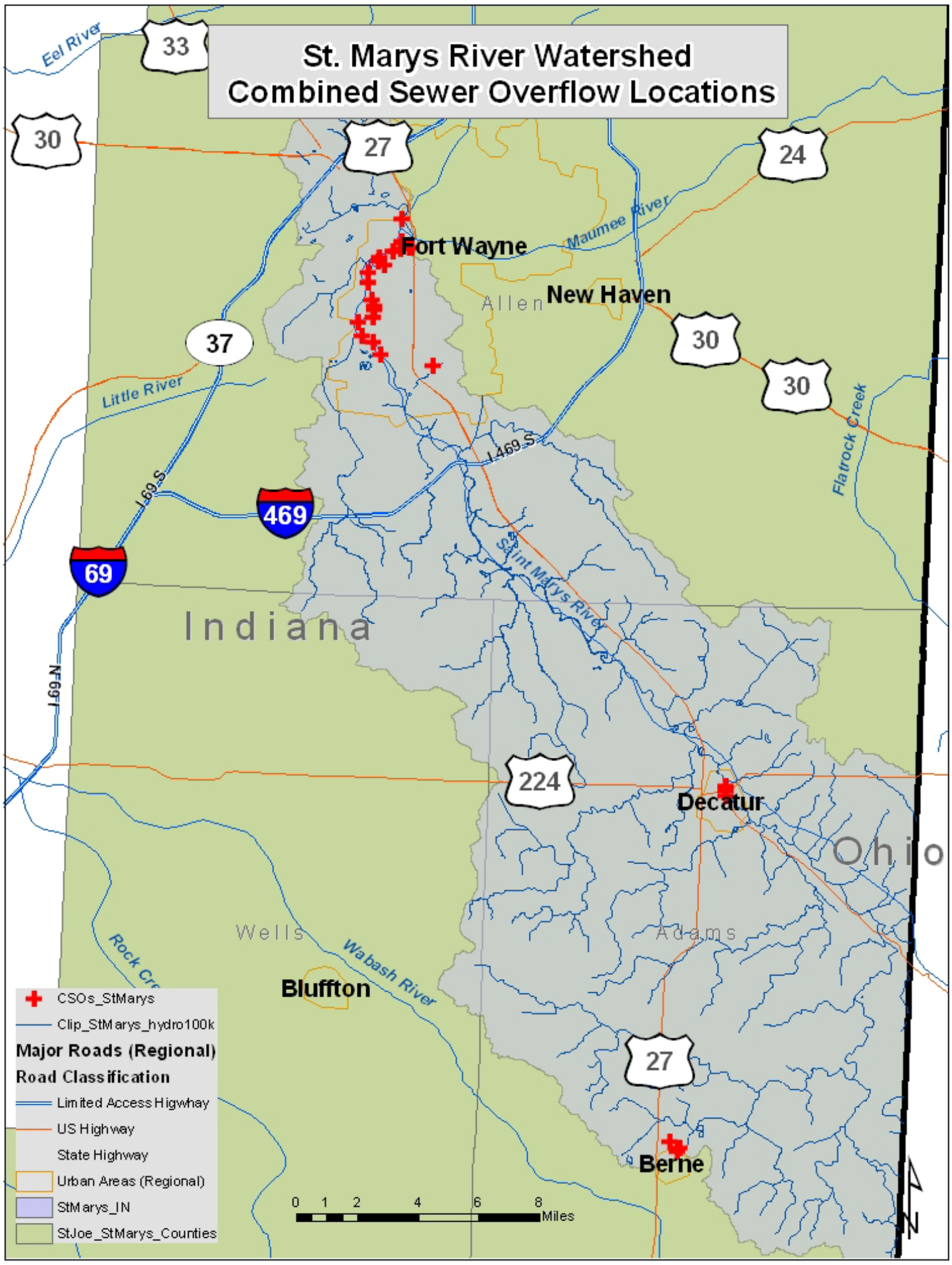

Figure 50: CSO locations in the St. Marys River Watershed.

Point sources may also include leakage or outflow from landfills, petroleum or chemical storage facilities, and any other pollution source that can be pinpointed by a discharge pipe. The primary pollutants associated with point source discharges are oxygen demanding wastes, nutrients, sediments, toxic substances, ammonia and metals. It should be noted that the WMP will not focus on resolving concerns related to point source discharges and pollution. The St. Marys River Watershed Project will acknowledge that point sources are regulated by state and federal government and regulatory measures will be left to the discretion of the appropriate governing body. However, these sources will be identified as possible pollutant sources in order to provide a comprehensive listing of potential sources.

4.7.1 Industrial Facilities

Wastewater point source discharges include municipal (city, town, or county) and industrial wastewater treatment plants and small domestic wastewater treatment systems that may serve schools, commercial offices, residential subdivisions, and individual homes. Stormwater point source discharges include stormwater discharges associated with industrial activities and stormwater discharges from Municipal Separate Storm Sewer Systems (MS4s) operated by municipalities and counties.

Point sources are regulated through the National Pollution Discharge Elimination System (NPDES) permitting process. Permits are issued in Indiana by the Indiana Department of Environmental Management (IDEM). There are approximately 20 NPDES permits in the St. Marys watershed. The following Table 62 identifies NPDES facilities in the St. Marys River Watershed.

Facility Information *(Select Name to Read Report)*	**Program ID#**	**Inspections (5 yrs)**	**Qtrs in Non Compliance (3 yrs)**	**Alleged Current Significant Violations**	**Informal Enforcement Actions/NOVs (5 yrs)**	**Formal Enforcement Actions (5 yrs)**
ALLEN COUNTY REGIONAL SEWER DISTRICT FLAT ROCK RD & MINICK RD ARCOLA, IN 46704 FRS ID: 110009974796 0.08399 MGD Houk Ditch	ICP: IN0048119	4	n/a	n/a		
B&B CUSTOM PLATING 6214 HOAGLAND RD, RR1 BOX 59 HOAGLAND, IN 46745 FRS ID: 110003082333 0.00100 MGD Unnamed Trib.	ICP: IN0052302	1	n/a	n/a		
	RCR: IND064708910			no		
BERNE MUNICIPAL WWTP SITE 1 305 S JEFFERSON ST BERNE, IN 46711 FRS ID: 110006766767 0.63800 MGD Habegger Ditch	ICP: IN0021369	4	n/a	n/a	2	1
CENTRAL SOYA INC 1200 N 2ND ST DECATUR, IN 46733 FRS ID: 110000400325 0.64999 MGD St. Marys River	AFS: 1800100005	4	12	no		1
	ICI: 05-2005-4530			no		1
	ICP: IN0000591	3	n/a	n/a		
	RCR: IND005129499			no		

Facility Information *(Select Name to Read Report)*	Program ID#	Inspections (5 yrs)	Qtrs in Non Compliance (3 yrs)	Alleged Current Significant Violations	Informal Enforcement Actions/NOVs (5 yrs)	Formal Enforcement Actions (5 yrs)
COUNTRY ACRES ASSOCIATION 4205 N 100 W DECATUR, IN 46733 FRS ID: 110009974224 0.01499 MGD Kohne Ditch	ICI: 05-2003-4035			no		1
	ICP: IN0055417	3	n/a	n/a		
DECATUR MUNICIPAL WWTP 1309 MONMOUTH ROAD DECATUR, IN 46733 FRS ID: 110006645513 2.80000 MGD St. Marys River	ICP: IN0039314	6	10	no		
	RCR: INT190014498			no		
DELI DEPOT 1810 COLISEUM BLVD FORT WAYNE, IN 46808 FRS ID: 110006767579 0.02099 MGD Spy Run Creek	ICP: ING080095	1	n/a	n/a		
FORT WAYNE METALS 9609 INDIANAPOLIS RD FT WAYNE, IN 46809 FRS ID: 110003081398 0.03999 MGD Bradbury Ditch	ICP: ING250026	2	n/a	n/a		
	RCR: IND056041122			no		
HESSEN UTILITIES INC 10744 US 27 S FT WAYNE, IN 46816 FRS ID: 110012318189 0.06400 MGD Marion Ditch	ICP: IN0045292	4	n/a	n/a	1	
MESHBERGER BROS STONE CO PLT 2 JCT OF SR 101 & SR 124 PLEASANT MILLS, IN 46780 0.81000 MGD Blue Creek	ICP: IN0044571		n/a	n/a		
MILL ROAD ESTATES 15001 MILL ROAD FT WAYNE, IN 46816 FRS ID: 110009973387 0.01530 MGD St. Marys River	ICP: IN0109835	4	n/a	n/a		1
MONROE PUBLIC WATER SUPPLY 102 S POLK MONROE, IN 46772 FRS ID: 110006680582 0.00200 MGD Yellow Creek	ICP: IN0048151	5	n/a	n/a		
OAKRIDGE ESTATES M H P 2950 W CR 100 N DECATUR, IN 46733 FRS ID: 110012139809 0.03500 MGD Bulham Ditch	ICP: IN0036901	5	n/a	n/a		
RUAN TRANSPORT CORP 910 W WASHINGTON ST DECATUR, IN 46733 FRS ID: 110006767187 0.01799 MGD N/A	ICP: INP000194	2	n/a	n/a		
SAINT JOSEPH SCHOOL 11337 OLD US 27 SOUTH FORT WAYNE, IN 46816 0.00800 MGD	ICP: IN0057207		n/a	n/a		

Facility Information *(Select Name to Read Report)*	Program ID#	Inspections (5 yrs)	Qtrs in Non Compliance (3 yrs)	Alleged Current Significant Violations	Informal Enforcement Actions/NOVs (5 yrs)	Formal Enforcement Actions (5 yrs)
Unnamed Trib.						
SOUTHCREST MOBLE HOME PARK 11410 U.S. 27 SOUTH FORT WAYNE, IN 46816 0.01200 MGD St. Marys River	ICP: IN0029831		n/a	n/a	1	
STONE-STREET QUARRIES, INC. 5536 HOAGLAND RD HOAGLAND, IN 46745 FRS ID: 110009738917 0.03999 MGD Unnamed Trib.	ICP: IN0000612	3	n/a	n/a		
TORQUE TRACTION MFG TECH INC 2100 W STATE ST FT WAYNE, IN 46808 FRS ID: 110000401155 1.36300 MGD Newhaus Ditch	AFS: 1800300003	3		no		
	ICP: IN0000388	2	7	no		
	RCR: IND005470885	1	12	no	1	
UNITED TECHNOLOGIES CORPORATION 917 LIECHTY RD BERNE, IN 46711 FRS ID: 110000400165 0.00000 MGD Habegger Ditch	AFS: 1800100023	4		no		
	ICP: INP000069	3	n/a	n/a		
	ICP: IN0058980	3	n/a	n/a		
	RCR: IND152719878	1		no	1	
WHITE HORSE MOBILE HOME PARK RR 4 DECATUR, IN 46733 FRS ID: 110012139818 0.01200 MGD Borum Run	ICP: IN0044199	3	n/a	n/a		

Table 62. NPDES facilities in the St. Marys River Watershed
www.epa-echo.gov/echo/compliance_report_water.html

Figure 51 shows locations of NPDES permitted locations in the watershed.

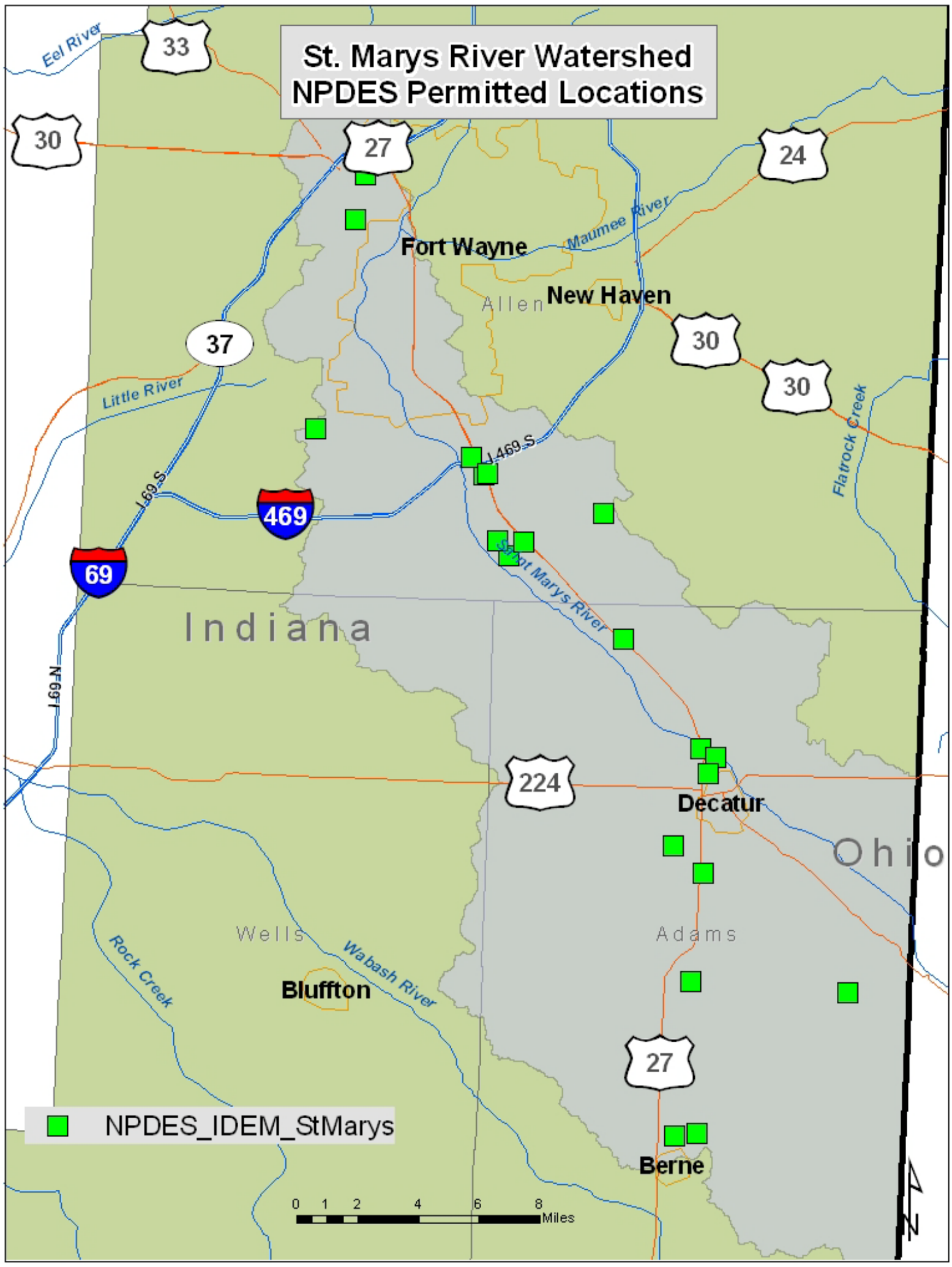

Figure 51. NPDES facilities in the St. Marys River Watershed.

4.7.2 Confined Feeding Operations

Confined Feeding Operations (CFOs) are also considered to be a potential point source discharger and are required by Indiana law to obtain a permit from IDEM's Office of Land Quality for operation. Livestock operations with at least 300 cattle, 600 swine, 600 sheep, or 30,000 fowl for at least 45 days within a 1 year period are designated as a CFO and must complete the permitting process prior to construction of the facilities. Furthermore, any existing operation with fewer animals but wishing to expand to the numbers listed above must apply for and obtain an IDEM permit. Smaller operations with a previous water quality violation may also be designated as a CFO even though they fall under the threshold limit. Larger operations known as Concentrated Animal Feeding Operations (CAFOs) are also required to obtain a permit due to the number of animals present at the operation. Table 63 summarizes CFO and CAFO limits.

CFO and CAFO Limits		
Species	**CFO**	**CAFO**
Cattle	300	
Dairy Cows		700
Veal Calves		1,000
Beef Cattle		1,000
Swine	600	
Swine, 55 lbs. or more		2,500
Swine, 55lbs. or less		10,000
Horses		500
Sheep / Lambs	600	10,000
Poultry	30,000	
Turkeys		55,000
Chickens (liquid manure)		30,000
Laying Hens (not liquid manure)		82,000
Not Laying Hens (not liquid manure)		125,000
Ducks (liquid manure)		5,000
Ducks (not liquid manure)		30,000
Source: USEPA / IDEM		

Table 63. CFO and CAFO Limits.

In order to successfully obtain the NPDES permit, a facility must prove the following: a minimum of 180 days storage for manure, adequate acreage for application of manure, minimum distances from wells and surface waters, a Manure Management Plan has been completed and that there is a sufficient level of record keeping regarding the facility and associated activities.

According to IDEM's records, there are 51 permitted facilities in the St. Marys River Watershed. Table 64 presents livestock operations by county and type. The concern surrounding these operations is the increased amount of manure, *E. coli* and nutrients produced yearly and the potential for leaching or overland runoff of those nutrients into nearby streams and tributaries. Manure contains nutrients such as nitrogen and

phosphorus that are beneficial for crop production but in large quantities, are detrimental to water quality. These nutrients, if allowed to enter the water system, will cause increased algal growth leading to increased turbidity and lower levels of dissolved oxygen as the algae and plants decompose. Also present in the manure is E. coli bacteria. E. coli presents a human health risk to both humans and livestock when present in surface waters.

Confined Livestock in the St. Marys River Watershed											
		Dairy		Beef		Swine		Poultry		Sheep	
County	CAFO/CFO	Farms	Animals	Farms	Animals	Farms	Animals	Farms	Animals	Farms	Animals
Adams	49	1	1,912	2	558	39	80,144	11	726,292	1	600
Allen	2	0	0	0	0	2	1,342	0	0	0	0
Wells	0	0	0	0	0	0	0	0	0	0	0
Totals	51	1	1,912	2	558	41	81,486	11	726,292	1	600
Source: IDEM, Office of Land Quality, 2007											

Table 64. Confined Livestock in the St. Marys River Watershed.

Figure 52 shows the locations of confined feeding operations permitted by IDEM in the St. Marys River Watershed.

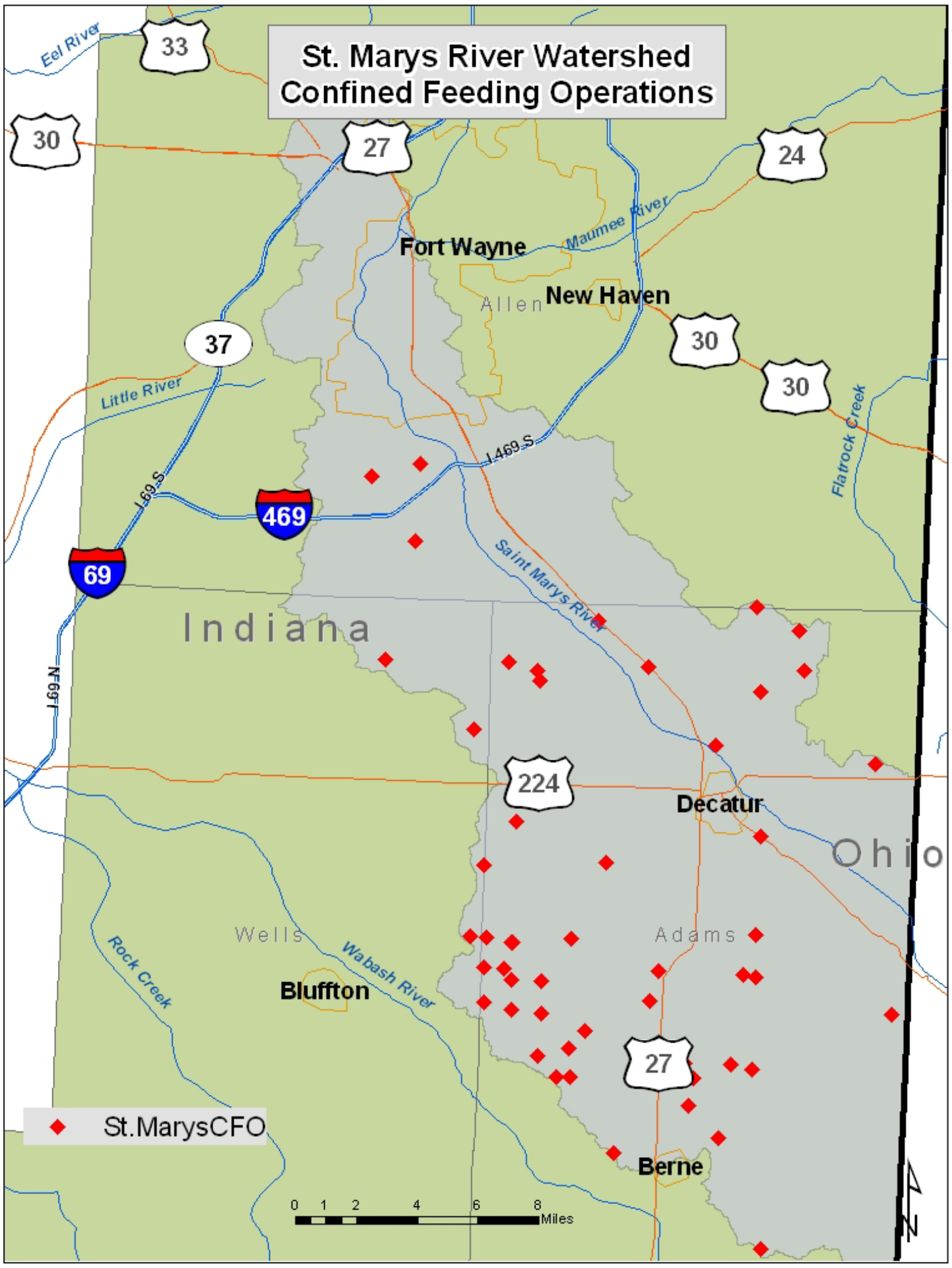

Figure 52. Confined feeding operations permitted by IDEM in the St. Marys River Watershed.

In addition to IDEM livestock permitting, the Adams County Planning Commission developed an intensive livestock operation ordinance in 1976 and modified it in 1997-1998. This ordinance was in response to the high livestock numbers within the county. Sections of this ordinance are more restrictive than corresponding state rules on confined feeding operations. Adams County is more restrictive than the sate in two areas. First, Adams County requires operations to obtain a permit if they have 400 swine, 200 cattle or 20,000 head of poultry. The State of Indiana requires a permit when numbers exceed 600 swine, 300 cattle, or 30,000 poultry. Secondly, Adams County requires operations of any size to be permitted if the landowner does not own the required acreage for manure application.

It should be noted that in addition to the facilities mentioned above, there are a substantial amount of operations with numbers of horses, sheep, hogs, cattle, and/or poultry below the minimum extent of the permitting requirement. This is especially the case in southern Adams County where there is a very large Amish community who rely on such animals for sustenance and transportation. To encompass these small livestock operations, a watershed-wide livestock inventory has been completed. Table 16 details the results of the survey.

5.0 Identification of Critical Areas

This section will identify and detail critical areas as designated by the Steering Committee. Taking a "worst-first" approach, the following critical areas have been listed by the committee as those areas being highly impaired, and being important target areas.

Conventionally Tilled Agricultural Fields Adjacent to a Stream or Ditch

Conventional tillage of crop land allows the soil to remain exposed to the elements for extended periods of time. The majority of conventional tillage is completed following the crop harvest in the fall and no crop residue remains on the surface of the field. Thus the topsoil is exposed to the snow and more importantly to the spring snow melts and rain events. As the snow melts and the rain falls, the potential for soil erosion and the resulting sedimentation of receiving waters is greatly increased and nearly guaranteed. Associated with erosion is nutrient and herbicide runoff. Nitrogen compounds are very water soluble and are carried in surface runoff. Phosphorus particles bind to soil particles and are carried into surface waters through erosion. Many common herbicides, including Atrazine are dissolved in water and carried with surface runoff or attach to soil particles and lost by erosion.

Figure 53. Conventional Tillage Adjacent to a Ditch. Photo courtesy of NRCS.

In the St. Marys River Watershed, conventional tillage continues to be the primary means of tillage for row crop production. Figure 54 shows an example of a producer using conventional tillage adjacent to a ditch. Critical areas have been identified for conventionally tilled fields located adjacent to any open ditch or stream. Figure 53 represents all land parcels in the two HUC's that are adjacent to an open ditch or stream. It should be noted that all parcels identified in Figure 54 are not necessarily currently under conventional tillage. This Figure is only meant to represent an approximate area.

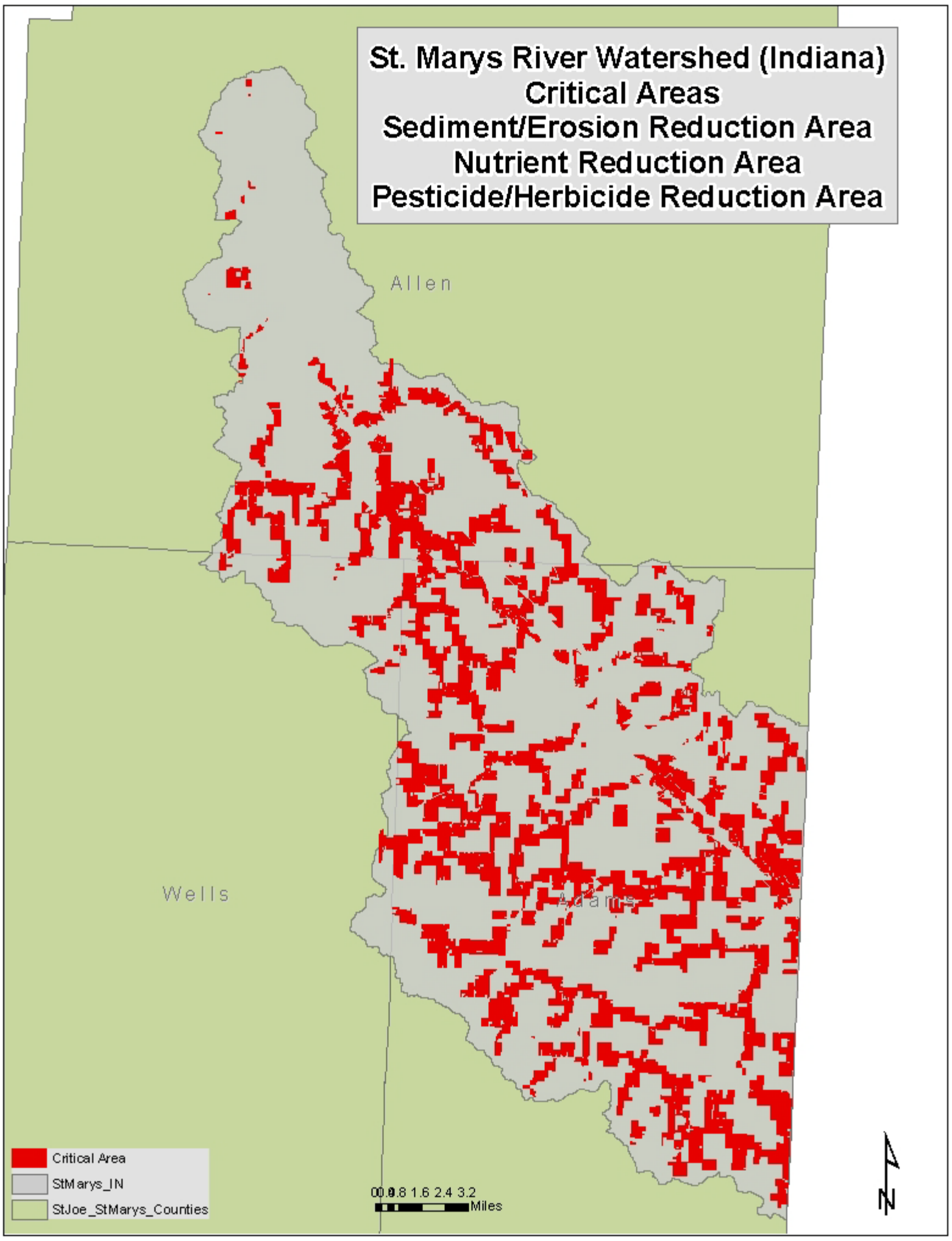

Figure 54. Critical Areas for Conventionally Tilled Agricultural Land.

Areas of Significant Erosion Resulting in Large Gullies

Gully erosion is defined as erosion in channels where runoff water accumulates and removes soils from this channel area. Gullies remove portions of land completely from production, and also contribute to downstream sedimentation problems.

Gullies often develop from intense erosion caused by flow over a steep overfall at the top of the gully. This overfall, called a headcut, moves upstream in a natural drainage way, and it can be initiated off-site and move into field. Gullies can also be enlarged by lateral erosion, sloughing of their sidewalls and cleaning out of debris by flow in the gullies.

Depending on the scale, gullies are divided into two types: ephemeral gully and classical gully. Ephemeral gullies are wider and deeper than rills, but they can be tilled and filled partially or completely. Although the ephemeral gully can be filled in or obliterated by tillage operations, it tends to reappear later at the same location because the depression formed on the landscape will concentrate the runoff. Classical gullies are eroded channels too large to cross and obliterate with tillage equipment. Figure 55 illustrates an example of a classical gully.

Figure 55. Gully Erosion in Adams County, IN. Photo courtesy of Allen Co. SWCD

For the purposes of this WMP, only classical gullies creating significant downstream sedimentation will be considered critical. Gully length, depth, slope, and proximity in the watershed will be evaluated when determining classical gully status.

Unbuffered Stream Reaches

Conservation buffers, or filter strips, are vegetated corridors with or without woody plants established along natural water courses and even constructed drainage ditches. Such buffers are an integral part of the form and function of a healthy water system. Although the appearance of conservation buffers differs between natural streams and drainage ditches, the functions remain the same – to improve water quality by filtering and trapping sediments and pollutants carried by overland runoff, to reduce the velocity of stormwater, and to create important aquatic and terrestrial wildlife habitats.

Field research on buffer width has been conducted in Indiana, Iowa, Maryland and Virginia. All research has shown that filter strips are an effective method for sediment removal, with average reductions ranging from 56-95 percent, depending on soil characteristics, slope, rainfall, runoff conditions, and buffer width. Iowa research demonstrated little improvement in filter effectiveness beyond a 30 foot buffer width. Research demonstrating the effects of buffers on nutrient removal showed mixed results. Total phosphorus removal ranged from 0 to 83%, and nitrogen removal ranged from 27 to 87% (OSU, 2009).

Figure 56. Unbuffered Stream Reach. Photo courtesy of NRCS.

Through visual inspection of digital aerial photography and on the ground inspections, it is clearly evident that there is a lack of vegetated buffers on one or both of the stream banks in the St. Marys River Watershed. Many of these stream miles are centered in row crop land use. With little to no protection and filtering capabilities, these streams have a greater risk potential of being subjected to overland runoff contaminated with excess nutrients, bacteria and soil particles. Figure 56 illustrates an example of an unbuffered stream reach. The St. Marys River Watershed Project has completed an inventory of existing buffers in the watershed. Stream reaches with an existing buffer of 20 feet or less, south of US 224 will be considered a critical area. Figure 57 geographically shows unbuffered stream reaches in the St. Marys River Watershed. The area south of 224 was selected due to the large Amish population in the area. This critical area will focus on the Amish as they are not as typical users of federal cost share programs. It is assumed that English producers in this area and to the north will utilize existing CRP programs to install buffers.

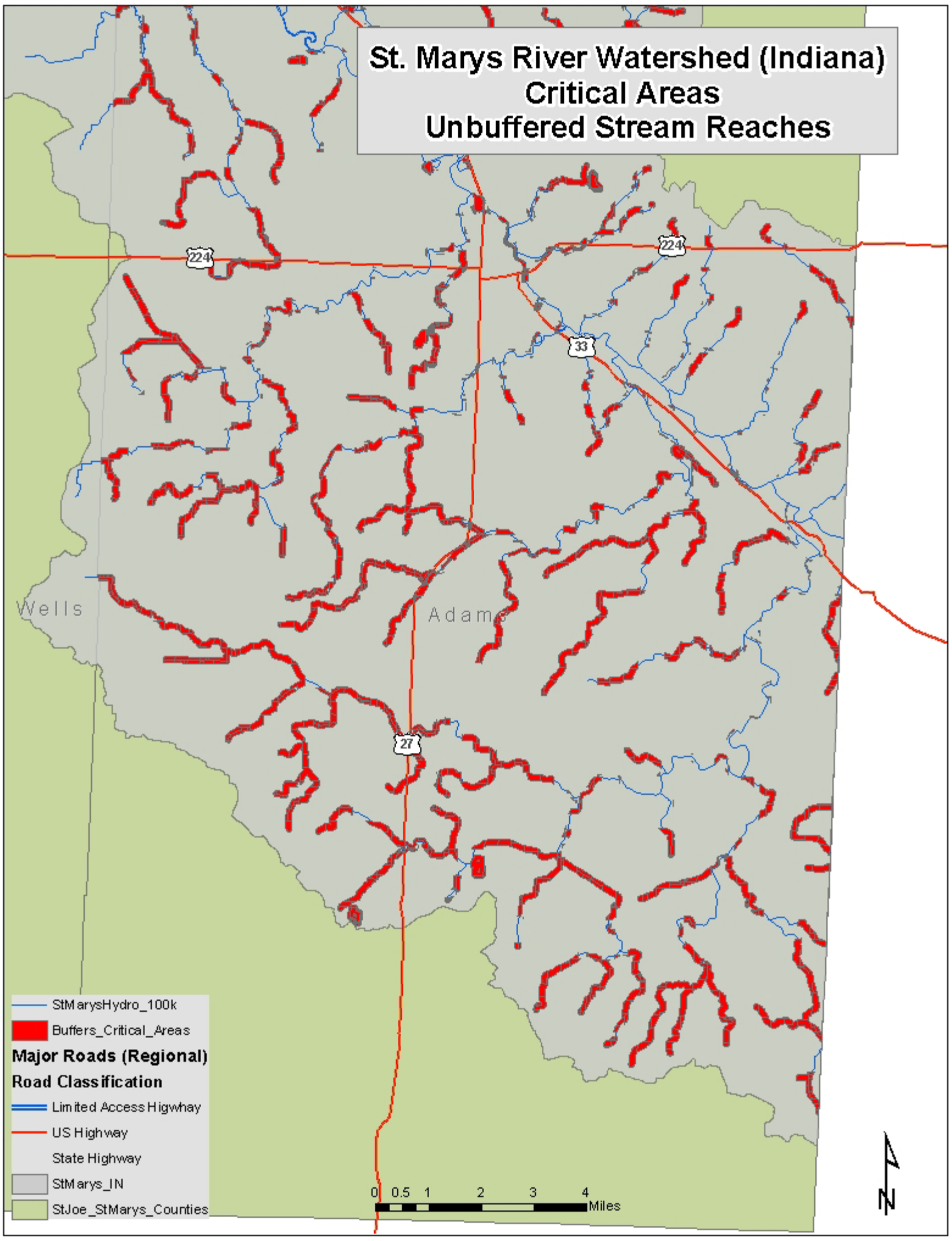

Figure 57. Stream Reaches in the St. Marys River Watershed with a buffer of 20 feet or less.

Critical Livestock Operations

Specifically in the southern portion of the St. Marys River Watershed, grazing livestock in pasture lands or livestock in feedlots have the potential to provide a significant contribution of bacteria. If livestock are allowed unrestricted access to streams and creeks bisecting pasture lands; or if feedlots are located within close proximity to a stream, stormwater runoff or the direct deposit of manure will dramatically increase levels of potentially pathogenic bacteria in the water. Livestock with unrestricted access to streams and creeks have been observed throughout the watershed. Figure 58 illustrates an example of livestock with access to a stream. The St. Marys WMP will designate Animal Feeding Operations (AFO's) and Confined Feeding Operations (CFO's) in the St. Marys River Watershed critical if they meet any of the following circumstances.

Figure 58. Livestock in Stream.
Photo courtesy of NRCS.

- Livestock have direct access to a stream or ditch
- Operation has inadequate on site waste storage
- Operation has inadequate land to apply waste
- Improper land application techniques are being utilized, allowing for direct runoff of waste to a stream or ditch

AFO's are defined by IDEM as (IDEM, 2007):

> *Any agricultural operation where animals are kept and raised in confined situations. It is a lot or facility (other than an aquatic animal production facility) where the following conditions are met:*
>
> - *Animals have been, are, or will be stabled or confined and fed or maintained for a total of 45 days or more in any 12-month period, and*
> - *Crops, vegetation, forage growth, or post-harvest residies are not sustained in the normal growing season over any portion of the lot or facility.*

CFO's are defined by IDEM as (IDEM, 2007):

> *Any AFO engaged in the confined feeding of at least 300 cattle, or 600 swine or sheep, or 30,000 fowl, such as chickens, turkeys, or other poultry. The IDEM regulates these confined feeding operations, as well as small operations which have violated water pollution rules or laws, under IC 13-18-10.*

For the purposes of the St. Marys WMP, all livestock types will be included. CAFO's are not eligible for funding. Figure 59 shows locations of identified confined livestock operations and locations where livestock have direct stream access in the St. Marys River Watershed. Note: Locations of livestock with direct access and confined livestock may exist that were not identified during the 2008 livestock survey.

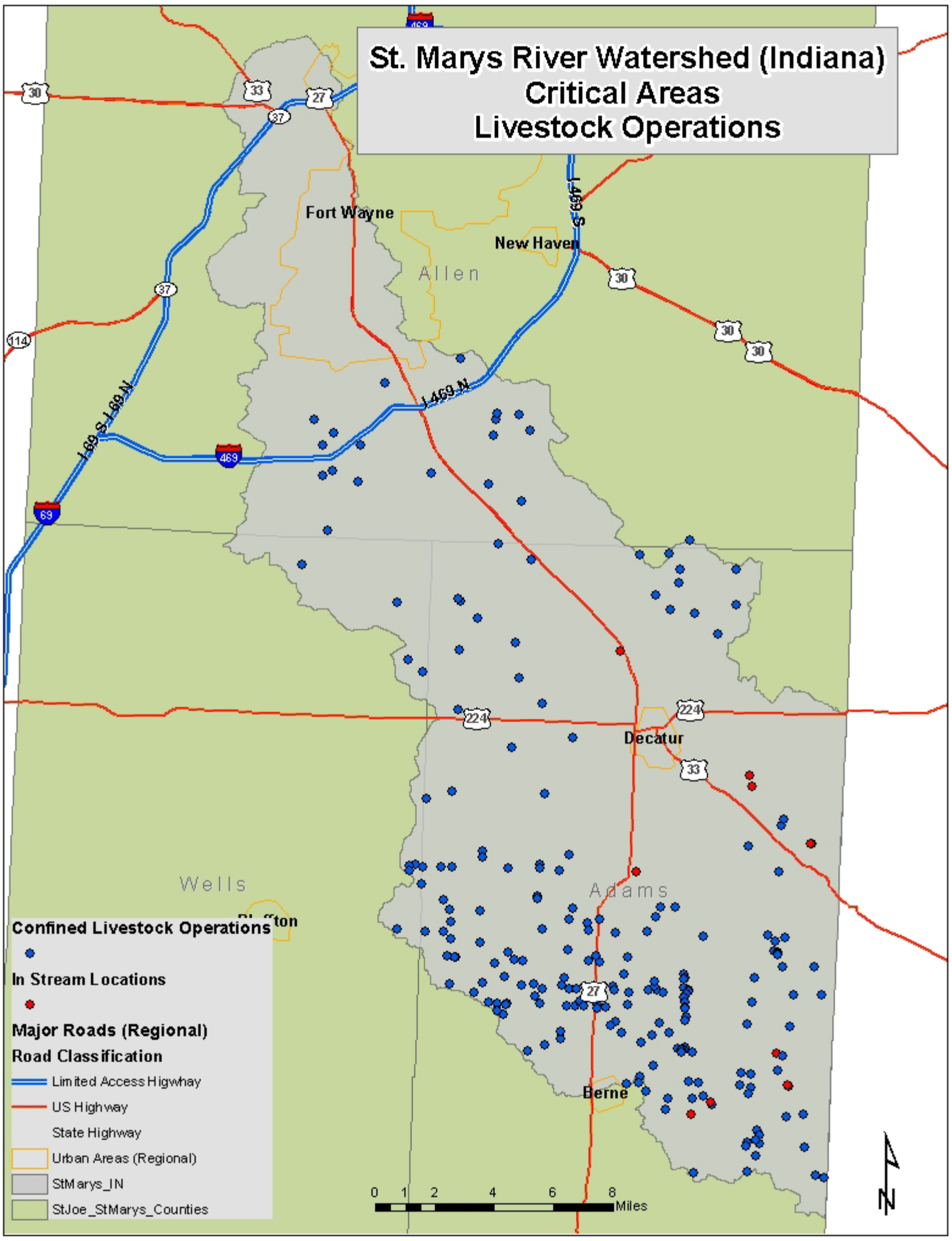

Figure 59. Livestock Operations in the St. Marys River Watershed.

The Regulatory Flood Hazard Area

Due to topography and natural features of the St. Marys River Watershed, flooding is an inevitable disaster. Structural damage and the potential for pollutant sources to enter the waters are also associated with the flooding. Therefore, the critical area will be the Regulatory Flood Hazard Area. The Steering Committee will look to the Maumee River Basin Commission for direction on these critical areas. Figure 60 illustrates a schematic of the regulatory flood hazard area.

The MRBC has played a vital role in flood protection in the St. Marys River Watershed. MRBC has developed and implemented the "Voluntary Buyout Cost-Share Assistance Program." The voluntary program is designed to acquire property in the flood zone, relocate site occupants, and clear and remove improvements on the site. MRBC also offers assistance to "floodproof" homes in the flood zone.

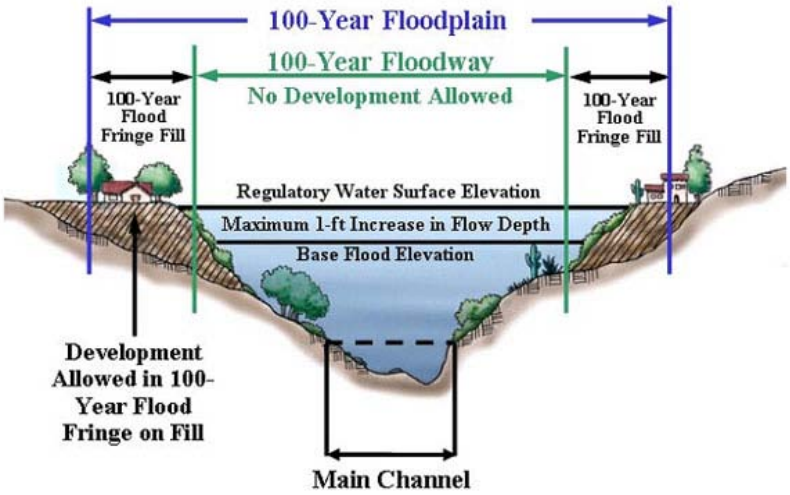

Figure 60. Schematic of the Regulatory Flood Hazard Area
Photo courtesy of Pinal County, AZ

In Allen County and the City of Fort Wayne, as of July 2008, 9 structures have been retrofitted and 110 structures have been purchased or are in the process of being purchased and demolished. These acquisitions have eliminated flood damage to individual structures as well as to whole neighborhoods. They have eliminated the need for flood fight efforts during a flood and cleanup and damage assessment after the flood. Temporary flood storage in the form of open space has also been restored. This open space can now be used for recreational purposes and natural area restoration.

In addition, the following projects are being pursued or have been completed for the purpose of protecting flood prone structures.

- St Marys River, Park Thompson/Waldron Circle Project (City of Fort Wayne funding): buy row of homes along the river and the Easter Seals ARC building. Construct berm to protect approximately 20 other homes in the neighborhood.
- Fairfield Ditch (potential Corps of Engineers project): conceptual level report has been completed recommending construction of a backwater control structure at Bluffton Road and construction of two levee/wall reaches to protect approximately 70 homes and 3 businesses.
- St Marys River, Woodhurst Levee (City of Fort Wayne funding): construct flood control levee to protect approximately 90 homes, a school, and a church

- St Marys River, Southfair Court & Kenosha Boulevard project (City of Fort Wayne funding): construct sandbag replacement berm to protect about 5 homes instead of sandbagging for frequent flood protection.
- St Marys River, Berry Thieme floodwall (City of Fort Wayne funding): this floodwall project will be dropped in favor of placing "emergency" clay berms during a flood due to stiff opposition to the floodwall, likelihood of seepage under the floodwall, and the difficulty in acquisitions due to the "Historic Designation" of the neighborhood.
- Spy Run, Eastbrook/Westbrook (City of Fort Wayne and federal money): Homes have been bought and demolished along Westbrook and a berm will be constructed to provide protection along Edgehill. Homes along Eastbrook will be bought out and the State Street Bridge raised (reducing expected water surface elevations in the vicinity upstream).
- St Marys River, Winchester Road (City of Fort Wayne funding): acquire and demolish one row of houses then construct sandbag replacement berm at the 1% annual chance flood elevation to protect around 6 homes.
- Lawrence Drain, Times Corner culvert replacement (City of Fort Wayne project): reduced Base Flood Elevations (BFE) in the reach upstream of Jefferson Boulevard. If a Letter of Map Revision (LOMR) is pursued based on this culvert replacement, three apartment buildings, a commercial area, and a retirement home could be removed from the 1% annual chance floodplain.
- Spy Run, channel improvement between Production Drive and Coliseum Boulevard (City of Fort Wayne project): proposed project that could remove approximately 8 businesses from the 1% annual chance floodplain and significantly reduce and/or eliminate the flooding potential for the 10% annual chance flood.
- St Marys River, earthen dike constructed along the east bank of the river near Pauline Street (Reach 3 (E3SM) in the 1995 Master Plan): The berm was constructed almost to the 1% annual chance flood elevation. During a flood situation, the City ties this dike to high ground by building a temporary barrier dike in the middle of a parking lot in the southern portion of the reach.
- St. Marys River, earthen dike ("Vesey Dike") constructed along the west bank of the river generally between Nuttman and Gruber Avenues (Reach W7SM in the 1995 Master Plan) to an elevation below the 1% annual chance flood elevation with the intent to add sand bags if needed per the City of Fort Wayne's plans.

In the process of selecting and designing projects, the City of Fort Wayne has also recognized the need to minimize the impact of the planned projects and has incorporated items such as compensatory storage and rain gardens to better manage stormwater runoff. (MRBC, 2008) Data for MRBC projects in Adams County has not been made available at the current date.

Failing Septic Systems

A source of the elevated pathogen bacteria in the watershed may be associated with improperly functioning, failed, or non-existent (straight pipe) residential septic systems. Many factors can lead to the failure of a residential septic system; the age of the system, lack of regular maintenance to the system, and heavy clay soils. Figure 61 illustrates a classic symptom of a failing system. Within the St. Marys River watershed, the unincorporated areas lack a centralized sewage disposal system, limiting homeowners to on-site septic systems. It is crucial that these homeowners are equipped with the necessary information and knowledge as to the proper maintenance of the system to prevent failure. Although a large portion of the watershed utilizes septic systems, critical areas have been designated as the following 14 digit HUC's:

Figure 61. A Classic Symptom of a Failing Septic System.
Photo courtesy of Shared Waters Alliance.

- St. Marys River-Buhlman Ditch (HUC 04100004050040)
- Nickelson Creek – Lambert Ditch (HUC 04100004050050)
- St. Marys River – Gerke/Weber Ditches (HUC 04100004050030)
- St. Marys River – Decatur (HUC 04100004040090)
- St. Marys River – Pleasant Mills (HUC 04100004040060)
- Yellow Creek – Martz Ditch (HUC 04100004040070)
- Fairfield Ditch – Harber/Deptmer Ditches (HUC 04100004060040)
- St. Marys River – Simmerman Ditch (HUC 04100004060010)

These locations were chosen as critical areas following conversations with the Allen and Adams County Health Department officials. These 14 digit HUC's all encompass communities utilizing septic systems. Critical areas are shown in Figure 62.

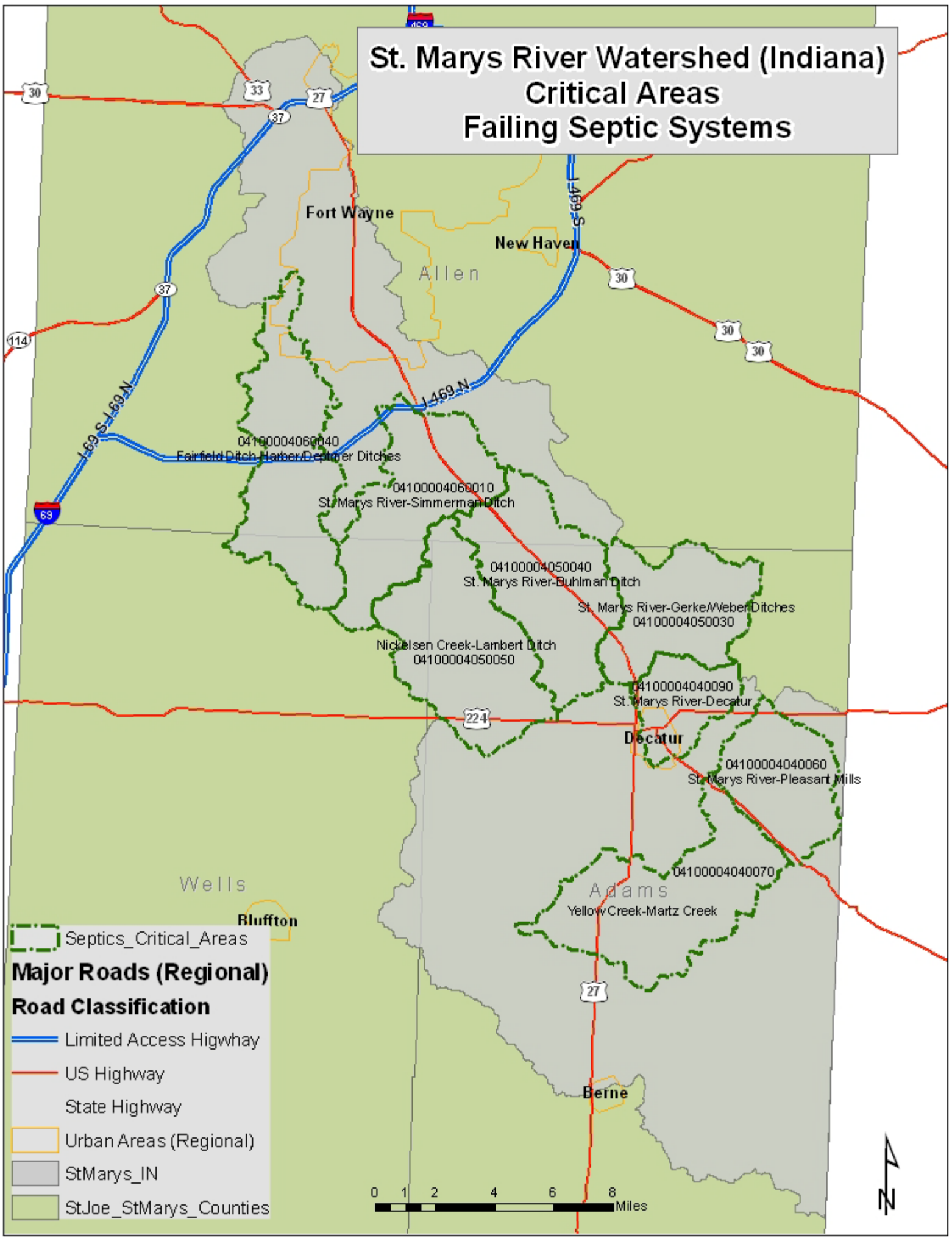

Figure 62. Critical Areas in the St. Marys River Watershed Utilizing Septic Systems.

Industrial Facilities

Many facilities in the watershed are subject to the Rule 6 permitting requirements. Facilities are required to obtain a permit if:

- run-off from a precipitation event or from ice or snow melt waters are exposed to (come into contact with) the facility's manufacturing processing activities, raw materials storage areas, or intermediate products storage areas
- that run-off then leaves the facility from one, or several, point source(s) that discharge into a Municipal Separate Storm Sewer System (MS4), or directly into the waters of the state.

Figure 63 illustrates an industrial facility discharging wastewater. Industrial facilities permitted under IDEM Rule 6 and NPDES permits are required to develop and submit a Storm Water Pollution Prevention Plan. Facilities are also required to sample at all facility outfalls. Analyses for the following parameters may be required:

Figure 63. Industrial Facility.
Photo courtesy of USEPA.

1. Oil and grease
2. Carbonaceous biochemical oxygen demand (CBOD)
3. Chemical oxygen demand (COD)
4. Total suspended solids (TSS)
5. Total Kjeldahl nitrogen (TKN)
6. Total phosphorous
7. pH
8. Nitrate plus nitrite nitrogen
9. Any pollutant attributable to a facility's industrial activity which is reasonably expected to be present in the discharge
10. Any pollutant that has the potential to be present in a stormwater discharge as requested by IDEM

Samples must be collected at least annually, with the first sample collected prior to implementation of the Storm Water Pollution Prevention Plan. Storm water outfall sample data collected more frequently than annually must be reported to IDEM. The pH measurement must be taken at the time the grab sample is collected (i.e., due to holding time exceedances, pH can not be analyzed by an off-site laboratory), and can not be estimated using a color comparison (i.e., test strips). Samples must be taken at a point representative of the discharge but prior to entry into surface waters of the state or a storm sewer conveyance. For discharges that flow through on-site detention basins, samples must be taken at a point representative of the discharge from the basin. Run-off events resulting from snow or ice melt should not be sampled and can not be used to meet the annual monitoring requirements of Rule 6. (IDEM Rule 6 Definitions)

Discussions with the City of Decatur Storm Water Manager indicate that many permitted and unpermitted facilities in the watershed lack knowledge that may help them to comply and go above and beyond permit requirements. Therefore, although the focus of the WMP is not on point source dischargers, the Steering Committee felt it was critical to address these facilities in the watershed. All permitted facilities in the watershed will be considered critical areas. The committee feels that education to the general public and to facility representatives can improve permit compliance and improve water quality. Figure 64 geographically shows locations of permitted facilities in the watershed.

Figure 64. Permitted Industrial Facilities in the St. Marys River Watershed.

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6.0 Project Goals, Objectives, and Partners

The following Tables identify project goals, objectives, short and long term milestones, and potential partners. These tables were created with the input from the St. Marys River Watershed Project Steering Committee, watershed stakeholders, potential project partners and conservation planners.

Goal: Reduce sediment in all monitored streams to an average concentration of 30 mg/l by 2028

Objective/Management Measures	Short Term Milestone	Cost	Long Term Milestone	Marketing/ Promotion	Technical/Financial Assistance
Reduce the impact of sediment resulting from surface runoff	Increase % of conservation tillage observed in transect data to 38% by 2013	Greater than $100,000	Increase % of conservation tillage observed in transect data to 53% by 2028	Extension, SWCD's, Private Industry	NRCS, ISDA, IDEM
	Support development of regionally based detention basins to detain surface runoff by 2013.	Greater than $500,000	Continue to support development of regionally based detention basins to detain surface runoff by 2017.	Extension, SWCD's, NGO's	County Government, MRBC
	Increase % of pasture and hayland acreage observed in transect data to 9% by 2013	Greater than $250,000	Increase % of pasture and hayland acreage observed in transect data to 14% by 2028	Extension, SWCD's, Private Industry	NRCS, ISDA
	1/3 of streams have a minimum of 20 ft. buffer by 2013	Less than $300,000	All streams have a minimum of 20 ft. buffer by 2028	Extension, SWCD's, Private Industry, NGO's, MRBC	NRCS, ISDA, IDEM, County Surveyors
	At least 15 producers incorporate the use of cover crops by 2013.	Greater than $300,000	Incorporate cover crops on 20% of agricultural land by 2028.	Extension, SWCD's, Private Industry, NGO's	NRCS, ISDA
	Support at least 2 demonstration sites that showcase LID BMP's that limit amount of runoff from development areas by 2013.	Greater than $25,000	Support at least 10 demonstration sites that showcase LID BMP's that limit amount of runoff from development areas by 2028.	SWCD's, Extension, MRBC, NGO's, Private Industry	IDEM
Increase adoption of BMP's during construction activities.	All construction sites of 1 acre or more meet Rule 5 and/or Rule 13 standards by 2013	Less than $10,000	All construction sites of 1/2 acre or more meet Rule 5 and/or Rule 13 standards by 2028.	SWCD's, Private Industry, NGO's, MRBC	MS4's,
Reduce stream bank erosion and destabilization	Increase public awareness and understanding of public's role in stable streambanks (measured via social indicator survey), implement at least one two stage ditch project by 2013.	Greater than $200,000	Implement an additional 5 two stage ditch projects and continue to increase public awareness and understanding of the public role in stable streambanks (measured via social indicator survey) by 2028.	SWCD's, NGO's, MRBC	County Surveyors, NRCS

	Encourage County Surveyors to install rock check-dams in regulated drains to reduce velocity, allow for sedimentation and increase dissolved oxygen levels by 2013.	Greater than $50,000	Continue to encourage County Surveyors to install rock check-dams in regulated drains to reduce velocity, allow for sedimentation and increase dissolved oxygen levels by 2017.	SWCD's, MRBC	County Surveyors
	Encourage NRCS to install rock check-dams in grassed waterways to reduce velocity, and allow sediment to settle by 2012	Greater than $50,000	Continue to encourage NRCS to install rock check-dams in grassed waterways to reduce velocity, and allow sediment to settle by 2017	SWCD's, MRBC	County Surveyors, NRCS, ISDA
	Implement 3 demonstration sites of livestock fencing, alternate water supply, stream crossing, etc by 2013.	Greater than $25,000	Have 90% of known livestock with stream access fenced from stream by 2028.	Extension, SWCD's, Private Industry	IDEM, ISDA, NRCS

Table 65. Sediment goal and milestones.

The final indicator for the success of the sediment goal will be that all monitored streams obtain average TSS concentrations of 30 mg/l by 2028. To meet this goal, average load reductions between 27.3% and 69.5% will be required. Reductions were calculated by averaging required reductions at each monitoring station. Loads under the TMDL target were not included in the average. Table 66 lists the required reductions to meet the 30 mg/l TMDL target. Other indicators that will be used to track the progress toward reaching the goal will include: the percentage of conservation tillage and pasture and hayland acreage being utilized in the watershed (measured by the annual tillage transect in the watershed), the number of acres of stream buffers installed, the number of producers using cover crops, the number of LID BMP's installed, the number of two stage ditch projects, and increased public awareness measured via the social indicator survey, number of newsletters sent, press releases published, and brochures distributed.

TSS Loading Reductions	
Monitoring Station	**% Reduction to Meet TMDL Target (30 mg/l)**
Habegger Ditch	53.2%
Gates Ditch	54.4%
Little Blue Creek	51.4%
Blue Creek	68.4%
St. Marys River – Wilshire, OH	47.1%
Martz Ditch	59.1%
Yellow Creek	54.5%
Borum Run	68.0%
Holthouse Ditch	57.2%
Gerke Ditch	60.8%
Nickelson Creek	54.8%
St. Marys River – Poe	53.4%
Upper Gates Ditch	63.9%
Upper Blue Creek	69.5%
Twentyseven Mile Creek	35.8%
Houk Ditch	65.0%
Snyder Ditch	31.2%
Harber Ditch	37.0%
Junk Ditch	27.3%
Spy Run Creek	32.1%

Table 66. Required TSS loading reductions.

Goal: Significantly reduce stormwater runoff and activity in the Regulatory Flood Hazard Area in order to reduce severity and impacts of flooding by 2028.

Objective / Management Measures	Short Term Milestone	Cost	LongTerm Milestone	Marketing / Promotion	Technical / Financial Assitance
Reduce streambank erosion and destabilization	1/3 of streams have a minimum of 20 ft. buffer by 2013	Less than $300,000	All streams have a minimum of 20 ft. buffer by 2028	Extension, SWCD's, Private Industry, NGO's, MRBC	NRCS, ISDA, County Surveyors
	Promote federal programs (WMP, FEP) and MRBC Voluntary Ag. Land Use Conversion Program by 2011.	Less than $10,000	Continue to solicit potential candidates for conservation easement programs by 2012.	SWCD's, ISDA, Extension	NRCS, MRBC
	Increase public awareness and understanding of public's role in stable streambanks (measured via social indicator survey), implement at least one two stage ditch project by 2013.	Greater than $200,000	Implement an additional 5 two stage ditch projects and continue to increase public awareness and understanding of the public role in stable streambanks (measured via social indicator survey) by 2028.	SWCD's, NGO's, MRBC	County Surveyors, NRCS
	Promote existing MRBC Log Jam Removal Program by 2009.	Less than $10,000	Encourage local communities and municipalities to adopt and implement MRBC Log Jam Removal Program by 2013.	SWCD's	MRBC, County Surveyors
Reduce the impact of generalized storm event flooding	Support and lobby for local flood mitigation programs and projects, MRBC buy outs, support INAFSM, flood proofing by 2010.	Less than $10,000	Continue to support and lobby for local flood mitigation programs and projects, MRBC buy outs, support INAFSM, flood proofing by 2013.	SWCD's	MRBC, INAFSM
	Promote implementation of local (MRBC) model floodplain and stormwater ordinances by 2013.	Less than $10,000	Continue to encourage local communities to implement ordinances set by the MRBC Master Plan, specifically in the state of Ohio.	SWCD's, MS4's	MRBC
	Promote at least 2 demonstration sites that showcase LID BMP's that limit amount of runoff from development areas by 2013.	Greater than $25,000	Develop and implement a cost share program for LID BMP's that limit amount of runoff from development areas by 2014.	SWCD's, Extension, MRBC, NGO's, Private Industry	IDEM
	Endorse map modernization process to delineate flood prone areas by 2011.	Less than $10,000	Continue endorsement of complete map modernization process to delineate flood prone areas by 2012.	SWCD's	MRBC
	Implement at least 1 demonstration wetlland restoration site that will incorporate additional stormwater holding capacity by 2011.	Greater than $50,000	Develop and implement a cost share program to retain and increase the amount of wetlands located in the watershed by 2012.	Extension, SWCD's, Private Industry, NGO's, MRBC	ISDA, NRCS

	Endorse installation of river gages and flood warning systems by 2011.	Less than $10,000	Continue endorsement of river gages to allow calibration of river models and flood warning systems and collection of discharge data by 2012.	SWCD's	MRBC, City of Fort Wayne, USGS
Improve Ag practices to reduce flooding	Support 2 demonstration sites on the use of alternative Ag BMP's that improve soil water holding capacity and soil quality by 2010.	Less than $100,000	Establish and implement a cost share on the use of alternative Ag BMP's that improve soil water holding capacity and soil quality by 2014.	Extension, SWCD's, Private Industry, NGO's, MRBC	ISDA, NRCS

Table 67. Flooding goal and milestones.

The success of the goal to significantly reduce stormwater runoff and activity in the 100 year floodplain in order to reduce severity and impacts of flooding will be measured in a variety of ways. Indicators will include the number of acres of buffers installed, the number of two stage ditch projects in the watershed, the number of LID BMP's installed, the number of agricultural BMPs to increase soil water holding capacity installed, and the number of structures located in the floodplain. Furthermore, the progress of flood policy initiatives will be measured to gage success of the goal. These policies include implementation of local model floodplain and stormwater ordinances, flood map modernization, and MRBC programs. Public awareness will be measured via the social indicator survey, number of newsletters sent, press releases published, and brochures distributed.

Goal: Reduce levels of nutrients to meet levels set forth by the TMDL: Nitrogen (10 mg/l measured as nitrate-nitrogen), Phosphorus (0.30 mg/l) by 2028. Reduce Ammonia levels so as not to exceed CCC by 2028.

Objective/ Management Measures	Short Term Milestone	Cost	LongTerm Milestone	Marketing/Promotion	Technical/Financial Assitance
Reduce the impact of nutrients from agricultural practices.	50% of producers consult with a Certified Crop Advisor, NRCS, or SWCD for nutrient management (including manure mgt. if applicable) planning by 2013.	Greater than $200,000	80% of producers consult with a CCA, NRCS or SWCD for nutrient management planning (including manure mgt. if applicable) by 2028.	SWCD's, Extension, Private Industry	IDEM, ISDA, NRCS
	Implement at least 1 demonstration wetland restoration site that will remove nutrients from agricultural runoff by 2011.	Greater than $50,000	Develop and implement a cost share program to retain and increase the amount of wetlands located in the watershed by 2012.	Extension, SWCD's, Private Industry, NGO's, MRBC	IDEM, ISDA, NRCS

	Develop cost share program and implement one demonstration site for controlled subsurface drainage by 2013.	Greater than $25,000	Implement cost share program for controlled subsurface drainage by 2018.	Extension, SWCD's, Private Industry	NRCS, ISDA, IDEM
	1/3 of streams have a minimum 20 ft. conservation buffer by 2013	Less than $300,000	All streams have a minimum 20 ft. conservation buffer by 2028	Extension, SWCD's, Private Industry, NGO's, MRBC	NRCS, ISDA, County Surveyors, IDEM
	Increase % of conservation tillage observed in transect data to 38% by 2013	Greater than $100,000	Increase % of conservation tillage observed in transect data to 53% by 2028	Extension, SWCD's, Private Industry	NRCS, ISDA, IDEM
	Increase % of pasture and hayland acreage observed in transect data to 9% by 2013	Greater than $500,000	Increase % of pasture and hayland acreage observed in transect data to 14% by 2013	Extension, SWCD's, Private Industry	NRCS, ISDA, IDEM
	Implement 3 demonstration sites of livestock fencing, alternate water supply, stream crossing, etc by 2013.	Greater than $25,000	Have 90% of known livestock with stream access fenced from stream by 2028.	Extension, SWCD's, Private Industry	IDEM, ISDA, NRCS
	Push for requirement of applicator training and certification by 2010.	Less than $10,000	Require applicators to receive training and certification by 2011.	SWCD's, Extension	ISDA, NRCS, ISCO
	Develop cost share program for alternative waste management systems by 2010.	Greater than $100,000	Implement 3 alternative waste systems by 2013.	SWCD's, Extension	IDEM, ISDA, NRCS
Reduce the impact of excessive nutrients resulting from failing on-site waste disposal systems on water quality	Support the establishment of at least one localized sewer district by 2013.	Less than $10,000	Support the establishment of all localized sewer districts by 2028.	SWCD's, Health Depts.	ISDH, IDEM
	Support State Legislation to address existing failing septic systems by 2011.	Less than $10,000	Continue to support State Legislation to address existing failing septic systems.	SWCD's, Health Depts.	ISDH
	Develop educational material for proper septic system care and maintenance by 2010.	Less than $10,000	Begin distributing educational material for proper septic system care and maintenance by 2011.	SWCD's, Health Depts.	IDEM, ISDH
Reduce the impact of excessive nutrients resulting from CSO's/SSO's	Support local municipalities as they address their Long Term Control Plan's by including updates of progress in quarterly newsletters by 2010.	Less than $10,000	Continue to support local municipalities as they address their Long Term Control Plan's by including updates of progress in quarterly newsletters by 2013.	SWCD's, Health Depts.	IDEM, ISDH

Reduce the impact of excessive nutrients from package WWTP's.	Identify areas of known failing package WWTP's and locate funds to address concerns by 2010.	Less than $10,000	Implement funds to adress failing package WWTP's by 2013.	SWCD's, Health Depts.	ISDH
Reduce the impact of excessive nutrients from pet waste.	Develop, post and distribute printed educational material, including at least 1 billboard by 2010.	Less than $10,000	Develop PSA's geared towards properly managed pet waste by 2018.	SWCD's, Health Depts., Extension	IDEM, MS4's, ISDH
Reduce the impact of excessive nutrients from wildlife waste.	Encourage public to manage open water in a way that will deter wildlife habitation by 2010.	Less than $10,000	Begin holding bi-annual workshops on controlling wildlife populations by 2013.	SWCD's, Health Depts.	IDEM, IDNR
	Encourage DNR control of wildlife by 2010.	Less than $10,000	Encourage DNR to permit hunting in nuisance areas by 2013.	SWCD's, Health Depts.	IDEM, IDNR
Reduce the impact of excessive nutrients from golf courses and lawns.	Develop educational materials for homeowners, golf course managers and lawn care professionals on the impact of over or mis-application of fertilizer by 2010.	Less than $10,000	Distribute educational materials for homeowners and golf course managers and lawn care professionals on the impact of over or mis-application by 2011.	SWCD's, Health Depts., Extension	IDEM
	Hold 1 field day or workshop by 2010 to discuss proper nutrient application.	Less than $10,000	Hold bi-annual field day or workshop by 2011 to discuss proper nutrient application.	SWCD's, Health Depts., Extension	IDEM
	Encourage golf course managers to use buffers along waterways by 2013.	Less than $10,000	Have 60% of all golf courses buffered along waterways by 2020.	SWCD's, Health Depts., Extension	IDEM

Table 68. Nutrient goal and milestones.

The success of this goal will be measured by obtaining nitrogen and phosphorus concentrations of 10.00 mg/l and 0.30 mg/l respectively in all monitored streams in the watershed. These concentrations were identified in the TMDL as target concentrations for unimpaired waters. Average nitrate-nitrogen levels in the watershed are usually under the 10.00 mg/l standard. However, all monitored sites experienced levels that far exceeded the standard during at least one sampling event. The success of the Ammonia goal will be based on the number of exceedences of the CCC. Table 69 shows average nitrate-nitrogen levels and the maximum level observed in each reach. Table 70 shows average reductions needed to meet the CCC.

Nitrate –Nitrogen Levels		
Monitoring Station	**Average Concentration (mg/l)**	**Maximum Concentration (mg/l)**
Habegger Ditch	4.11	20.10
Gates Ditch	4.53	22.60
Little Blue Creek	6.54	22.50
Blue Creek	6.60	36.40
Yellow Creek	2.89	14.10
St. Marys River – Wilshire, OH	4.86	19.30

Table 69. Nitrate-Nitrogen levels in the St. Marys River Watershed.

Ammonia Reductions	
Monitoring Station	**% Reduction to Meet CCC**
Habegger Ditch	43.0% (5*)
Gates Ditch	29.5% (2*)
Little Blue Creek	0.0%
Blue Creek	0.0%
St. Marys River – Wilshire, OH	0.0%
Martz Ditch	52.0% (4*)
Yellow Creek	0.0%
Borum Run	0.0%
Holthouse Ditch	0.0%
Gerke Ditch	0.0%
Nickelson Creek	0.0%
St. Marys River – Poe	0.0%
Upper Gates Ditch	43.5% (1*)
Upper Blue Creek	0.0%
Twentyseven Mile Creek	0.0%
Houk Ditch	0.0%
Snyder Ditch	0.0%
Harber Ditch	0.0%
Junk Ditch	0.0%
Spy Run Creek	0.0%
* Number exceedences of the CCC	

Table 70. Ammonia reductions necessary to meet the CCC.

For phosphorus to meet the 0.30 mg/l target, average loading reductions between 23.4% and 58.3% will be required. Reductions were calculated by averaging required reductions at each monitoring station. Loads under the TMDL target were not included in the average. Table 71 lists the required reductions to meet the 0.30 mg/l TMDL target for phosphorus.

Phosphorus Loading Reductions	
Monitoring Station	**% Reduction to Meet TMDL Target (0.30 mg/l)**
Habegger Ditch	42.8%
Gates Ditch	47.7%
Little Blue Creek	37.4%
Blue Creek	39.9%
St. Marys River – Wilshire, OH	29.6%
Martz Ditch	48.1%
Yellow Creek	38.2%
Borum Run	42.8%
Holthouse Ditch	38.3%
Gerke Ditch	45.5%
Nickelson Creek	45.3%
St. Marys River – Poe	40.8%
Upper Gates Ditch	42.8%
Upper Blue Creek	39.3%
Twentyseven Mile Creek	29.1%
Houk Ditch	39.2%
Snyder Ditch	40.6%
Harber Ditch	23.4%
Junk Ditch	23.4%
Spy Run Creek	58.3%

Table 71. Phosphorus Loading Reductions

Other indicators that will be used to track the progress toward reaching the goal will include: the percentage of conservation tillage and pasture and hayland acreage being utilized in the watershed (measured by the annual tillage transect in the watershed), the number of acres of stream buffers installed, the number of producers using certified crop advisors(CCA's), the number of livestock exclusion projects installed, the number of alternative waste systems installed, the number of controlled drainage structures in place, the number of installed

wetlands and increased public awareness measured via the social indicator survey, number of newsletters sent, press releases published, and brochures distributed.

Goal: Reduce levels of *E. coli* to meet IDEM water quality standards (235 cfu/100ml) by 2028.					
Objective/ Management Measures	**Short Term Milestone**	**Cost**	**LongTerm Milestone**	**Marketing/Promotion**	**Technical/Financial Assistance**
Reduce the impact of livestock on water quality	Increase producers use of manure management planning by 50% by 2013.	Greater than $100,000	Increase producers use of manure management planning by 80% by 2028.	SWCD's, Extension	IDEM, ISDA, NRCS
	Implement 3 demonstration sites of livestock fencing, alternate water supply, stream crossing, etc by 2013.	Greater than $25,000	Have 90% of known livestock with stream access fenced from stream by 2028.	Extension, SWCD's, Private Industry	IDEM, ISDA, NRCS
	Push for requirement of manure applicator training and certification by 2010.	Less than $10,000	Require applicators to receive training and certification by 2011.	SWCD's, Extension	ISDA, NRCS, ISCO
	Develop cost share program for alternative waste management systems by 2010.	Greater than $100,000	Implement 3 alternative waste systems by 2013.	SWCD's, Extension	IDEM, ISDA, NRCS
Reduce the impact of failing on-site waste disposal systems on water quality	Support the establishment of at least one localized sewer district by 2013.	Less than $10,000	Support the establishment of all localized sewer districts by 2028.	SWCD's, Health Depts.	IDEM, ISDH
	Support State Legislation to address existing failing septic systems by 2011.	Less than $10,000	Support State Legislation to address existing failing septic systems.	SWCD's, Health Depts.	ISDH
	Develop educational material for proper septic system care and maintenance by 2010.	Less than $10,000	Begin distributing educational material for proper septic system care and maintenance by 2011.	SWCD's, Health Depts.	IDEM, ISDH
Reduce the impact of CSO's/SSO's on water quality	Support local municipalities as they address their Long Term Control Plan's by including updates of progress in quarterly newsletters.	Less than $10,000	Continue to support local municipalities as they address their Long Term Control Plan's by including updates of progress in quarterly newsletters.	SWCD's, Health Depts.	IDEM, ISDH
Reduce the impact of package	Support the establishment of at least one localized sewer district by 2013.	Less than $10,000	Support the establishment of all localized sewer districts by 2028.	SWCD's, Health Depts.	IDEM, ISDH

WWTP's.	Identify areas of known failing package WWTP's and locate funds to address concerns by 2010.	Less than $10,000	Implement funds to adress failing package WWTP's.	SWCD's, Health Depts.	ISDH
Reduce the impact of pet waste on water quality.	Develop, post and distribute printed educational material, including at least 1 billboard by 2010.	Less than $10,000	Develop PSA's geared towards properly managed pet waste by 2018.	SWCD's, Health Depts.	IDEM, MS4's
Reduce the impact of wildlife waste on water quality.	Encourage DNR control of wildlife by 2010.	Less than $10,000	Encourage DNR to permit hunting in nuisance areas by 2013.	SWCD's, Health Depts.	IDEM, IDNR
	Encourage public to manage open water that will deter wildlife habitation by 2010.	Less than $10,000	Begin holding bi-annual workshops on controlling wildlife populations by 2013.	SWCD's, Health Depts.	IDEM, IDNR

Table 72. Bacteria goal and milestones.

The final indicator for the success of the bacteria goal will be that all monitored streams meet the IDEM *E. coli* single sample maximum concentration of 235 cfu/100ml by 2028. To meet this goal, average loading reductions between 40.5% and 88.4% will be required. Reductions were calculated by averaging required reductions at each monitoring station. Loads under the TMDL target were not included in the average. Table 73 lists the required reductions to meet the 235 cfu/100ml TMDL target. Other indicators that will be used to track the progress toward reaching the goal will include: the number of livestock producers using manure management plans, the number of livestock exclusion BMP's installed, the number of alternative waste management systems installed, and increased public awareness measured via the social indicator survey, number of newsletters sent, press releases published, and brochures distributed. Furthermore, the progress of environmental policy initiatives will be measured to gage success of the goal. These policies include implementation of Long Term Control Plans, implementing a regional sewer district, as well as state legislation to address failing septic systems.

E. coli Loading Reductions	
Monitoring Station	**% Reduction to IDEM single sample maximum concentration (235 cfu/100ml)**
Habegger Ditch	88.45%
Gates Ditch	86.1%
Little Blue Creek	73.5%
Blue Creek	71.6%
St. Marys River – Wilshire, OH	40.5%
Martz Ditch	81.4%
Yellow Creek	79.2%
Borum Run	63.4%
Holthouse Ditch	72.6%
Gerke Ditch	69.2%
Nickelson Creek	67.7%
St. Marys River – Poe	65.7%
Upper Gates Ditch	85.7%
Upper Blue Creek	74.7%
Twentyseven Mile Creek	53.9%
Houk Ditch	73.6%
Snyder Ditch	61.5%
Harber Ditch	70.8%
Junk Ditch	62.7%
Spy Run Creek	76.6%

Table 73. Required *E. coli* loading reductions.

Goal: Reduce amount of trash/debris in the watershed by 50% by 2028.					
Objective/ Management Measures	**Short Term Milestone**	**Cost**	**LongTerm Milestone**	**Marketing/Promotion**	**Technical/Financial Assitance**
Implement a watershed wide litter control program, "Keep the St. Marys Beautiful".	Conduct 5 (1/year) cleanup projects by 2013.	Less than $10,000	Have a fully implemented program consisting of community education and outreach, and cleanups by 2028.	SWCD's, Extension, MRBC, NGO's	MS4's, IDEM
Remove downed trees and other obstacles that provide catchments for debris	Conduct a survey that identifies existing downed trees and those leaning at 45 degrees or more that should be scheduled for removal by 2010. Develop an annual maintenance schedule to remove downed and/or leaning trees by 2010.	Less than $25,000	Implement an annual maintenace schedule to remove all downed and or/leaning trees by 2012.	SWCD's, MRBC	County Surveyor's, INDOT

Table 74. Trash/Debris goal and milestones.

Public education and outreach will be used to achieve this goal. Success of outreach efforts will be evaluated by the social indicator survey, number of newsletters sent, press releases published, and brochures distributed. Other indicators will include the amount of trash and debris collected during river cleanup projects. Local WWTP's will also be monitored to record how much trash is being removed from incoming effluent. The number of logjams and obstructions removed by Allen and Adams County, and INDOT will also be used to evaluate the success of this goal.

Goal: Reduce Atrazine levels to meet a level of 3.00 µg/l (ppb) in all monitored streams by 2028.					
Objective/ Management Measures	**Short Term Milestone**	**Cost**	**LongTerm Milestone**	**Marketing/Promotion**	**Technical/Financial Assitance**
Increase acreage of conservation buffers to reduce the amount of pesticides entering waterways through agricultural runoff.	1/3 of streams have a minimum of 20 ft. buffer by 2013	Less than $300,000	All streams have a minimum of 20 ft. buffer by 2028	Extension, SWCD's, Private Industry, NGO's, MRBC	NRCS, ISDA, County Surveyors
Utilize Integrated Pest Management (IPM) plans developed by Certified Crop Advisor (CCA)	50% of producers consult with a CCA and have IPM plans by2013.	Greater than $200,000	80% of producers consult with a CCA and have IPM plans by 2028.	SWCD's, Extension	IDEM, ISDA, NRCS

Encourage the use of on-farm chemical and fertilizer storage systems.	Indiana NRCS adopts standardized engineering plans for on-farm storage systems by 2011.	Less than $10,000	All producers meet State Chemist Office minimum secondary containment requirements where necessary. i.e 7500 gallon of liquid fertilizer by 2028.	SWCD's, Extension	IDEM, ISDA, NRCS
Encourage use of precision sprayer controllers, and guidance systems .	20% of all private applicators utilize precision spraying and/or guidance systems by 2010.	Greater than $100,000	50% of all private applicators utilize precision spraying and/or guidance systems by 2028.	SWCD's, Extension	IDEM, ISDA, NRCS
Encourage the use of non-toxic pesticides in both agricultural and non-agricultural applications.	Reduce the amount of toxic pesticides/herbicides used in the watershed by 10% (measured via WQ survey) by 2013.	Less than $25,000	Reduce the amount of toxic pesticides/herbicides used in the watershed by 30% (measured via WQ survey) by 2028.	SWCD's, Extension	IDEM, ISDA, NRCS
Encourage proper disposal of toxic household wastes.	Develop and/or sponsor annual Tox-Away Day by 2010.	Less than $10,000	Continue Tox-Away Day program on annual basis.	Solid Waste Districts	IDEM, ISDA, NRCS
Encourage proper rinsing and disposal of pesticide containers.	Develop and/or sponsor annual Pesticide Container Recycling Day by 2013.	Less than $10,000	Continue to sponsor annual Pesticide Container Recycling Day.	SWCD's, Extension	IDEM, ISDA, NRCS

Table 75. Atrazine goal and milestones.

The indicator for the success of the Atrazine goal will be the evaluation of public education and outreach efforts. Success of outreach efforts will be evaluated by the social indicator survey, number of newsletters sent, press releases published, and brochures distributed. Other indicators will include the numbers of acres of conservation buffers installed, number of producers using CCA's, IPM, and precision spraying systems. The number of residents attending "Tox-Away Day" will also be used as an indicator. The final indicator will be that all monitored streams obtain atrazine concentrations of 3.00 µg/l by 2028. To meet this goal, average loading reductions up to 67.2% will be required. Reductions were calculated by averaging required reductions at each monitoring station. Loads under the TMDL target were not included in the average. Table 75 lists the required reductions to meet the 3.00 µg/l target.

Atrazine Loading Reductions	
Monitoring Station	**% Reduction to Meet Target (3.00 µg/l)**
Habegger Ditch	41.4%
Gates Ditch	52.2%
Little Blue Creek	47.2%
Blue Creek	55.6%
St. Marys River – Wilshire, OH	58.4%
Martz Ditch	0%
Yellow Creek	38.6%
Borum Run	51.4%
Holthouse Ditch	54.8%
Gerke Ditch	67.2%
Nickelson Creek	0%
St. Marys River – Poe	52.5%
Upper Gates Ditch	51.6%
Upper Blue Creek	53.9%
Twentyseven Mile Creek	63.6%
Houk Ditch	35.9%
Snyder Ditch	37.2%
Harber Ditch	29.1%
Junk Ditch	0%
Spy Run Creek	0%

Table 76. Required atrazine loading reductions.

Goal: Increase Public Awareness and Participation by 50% by 2028.

Objective/ Management Measures	Short Term Milestone	Cost	LongTerm Milestone	Marketing/ Promotion	Technical/Financial Assistance
Develop and implement an education and outreach program about water quality in the St. Marys River Watershed.	Develop a St. Marys River Watershed Education and Outreach Program geared toward stakeholders in the watershed by 2009.	Less than $25,000	Full implementation of the St. Marys River Watershed Education and Outreach Program by 2012.	Extension, SWCD's, Private Industry, NGO's, MRBC	NRCS, ISDA, County Surveyors
	Increase public awareness and understanding of public's impact on water quality via education and outreach (measured via social indicator survey) by 2013.	Less than $10,000	Increase public awareness and understanding of public's impact on water quality via education and outreach (measured via social indicator survey) by 2028.	SWCD's, Extension, MRBC, NGO's	MS4's, IDEM
	Host at least 2 Hoosier Riverwatch training session by 2010.	Less than $10,000	Host Hoosier Riverwatch training session annually by 2011.	SWCD's, Extension, MRBC, NGO's	IDEM, Hoosier Riverwatch
	Develop an educational curriculum aimed at schools in livestock production areas by 2012.	Less than $10,000	Implement an educational curriculum aimed at schools in livestock production areas by 2013.	SWCD's, Extension, MRBC, NGO's	IDEM, Hoosier Riverwatch
Develop and institute a volunteer action program for the St. Marys River Watershed.	Begin water quality monitoring by 2013 by engaging at least five volunteers to conduct annual water quality assessments via Hoosier Riverwatch.	Less than $10,000	Engage at least 10 volunteers to conduct water quality assessment via Hoosier Riverwatch in the St. Marys River Watershed by 2018.	SWCD's, MRBC	IDEM, Hoosier Riverwatch
	Solicit volunteers to assist in collecting additional water quality data at known problem areas in the watershed by 2010. Research additional funding sources for water quality sampling by 2013.	Greater than $100,000	Conduct weekly water quality monitoring across the watershed by 2013.	SWCD's, MRBC	IDEM,
	Develop Storm Drain Marking Program and obtain volunteers to begin storm drain marking by 2013.	Less than $10,000	Complete Storm Drain Marking for all storm drains by 2028.	SWCD's	MS4's, IDEM

	Solicit volunteers to assist in staffing and planning summer field days, workshops, presentations, etc. by 2009.	Less than $10,000	Form committees through volunteers to plan annual field days, workshops, presentations, etc. by 2014.	SWCD's, Extension, MRBC, NGO's	Watershed Stakeholders
Increase public understanding of methods to decrease toxic waste in surface and ground water.	Formalize the St. Marys River Watershed Project Board of Directors by 2009.	Less than $10,000	Have a functioning Board of Directors by 2010.	SWCD's	N/A
	Develop a survey and randomly distribute to 1000 landowners to gain an understanding of public knowledge level regarding the effects of toxic residues by 2010. Determine baseline knowledge of pollution prevention/reduction measures.	Less than $25,000	Repeat survey process to determine change of public knowledge regarding pollution prevention/ reduction measures in 2014. Aim for a 25% increase from baseline survey number.	SWCD's, Extension, NGO's, Private Industry	IDEM, ISDA, NRCS
Increase awareness and understanding of general public and Rule 6 permit holders as to their responsibility in reducing off site discharges of hazardous materials.	Hold 2 public meetings, including IDEM Rule 6 permit holders by 2011.	Less than $10,000	Have all IDEM Rule 6 permit holders in compliance with their permit requirements by 2013. Recognize those facilities in compliance.	SWCD's, Extension, MRBC, NGO's	MS4's, IDEM
Reduce the impact of excessive pesticides from golf courses and lawns.	Develop educational materials for homeowners and golf course managers on the impact of over- or mis-application by 2010.	Less than $10,000	Distribute educational materials for homeowners and golf course managers on the impact of over or mis-application by 2011.	SWCD's, Extension, Private Industry	IDEM, MS4's

Table 77. Public awareness goal and milestones.

Success of outreach efforts will be evaluated by stakeholder involvement, the social indicator survey, number of newsletters sent, press releases published, and brochures distributed.

7.0 Evaluating Progress and Effectiveness

The St. Marys River Watershed Project will be implementing practices to achieve the aforementioned water quality goals over a twenty year timeline. When these goals are met, the surface water in the watershed should meet Indiana water quality standards. The primary measure of success will be the completion of this St. Marys River Watershed Project WMP. Completion of the WMP, conforming to the requirements set forth by IDEM, has set the stage for improving water quality in the watershed. Now that the WMP is complete, focus can begin on implementing practices identified in the plan to achieve water quality goals. The WMP identifies project milestones, approximate dates for completion, as well as potential project partners. A positive response by watershed stakeholders to implement the recommended practices will be key to achieving the goals identified in the watershed management plan.

Implementation of the WMP will be evaluated by both social and environmental indicators. Social indicators will be gauged by factors such as social indicator surveys, by the number of stakeholders receiving the quarterly newsletter, by volunteer hours, and the number of project partners. Environmental indicators will include the number of acres using conservation tillage, the number of acres of buffer strips, or the linear footage of stream restoration projects, for example. Furthermore, water quality monitoring results will be used to evaluate the success of installed Best Management Practices watershed wide and to make comparative observations with existing benchmark data. The USEPA Region V model will also be used to quantify pollutant loadings.

As the implementation of the WMP progresses, it will be necessary for the steering committee to evaluate the effectiveness of the plan. If necessary, the WMP will be restructured in order to meet the goals of the plan.

8.0 IMPLEMENTATION

The St. Marys River Watershed Project will be the primary party responsible for implementation of the St. Marys River Watershed Management Plan. The project partners will also play a critical role in supporting implementation of the WMP. The St. Marys River Watershed Project, in association with its partners, has begun and will continue to solicit for further funds to implement BMP's in the watershed. Funding sources include, but are not limited to: ISDA Clean Water Indiana grants, USEPA 319 grants, Western Lake Erie Basin Partnership grants, Great Lakes Commission grants and numerous other private foundations and organizations.

St. Marys River Watershed Cost Share Program

The St. Marys River Watershed will continue to seek potential partners and project locations within critical areas of the watershed. The cost share program will be promoted by the St. Marys River Watershed Project and its partners through newsletters, press releases, web pages and outreach opportunities such as summer field days and winter meetings. The cost share program will include items to address concerns in the critical areas. BMPs are listed in Tables 78-84. BMP removal efficiencies were taken from the "BMP List" worksheet located in the STEPL model (STEPL, 2006). BMPs efficiencies from alternative sources are noted.

Critical Area: Conventionally Tilled Agricultural Fields that Intersect a Stream or Ditch			
Practice	**N % Removal Efficiency**	**P % Removal Efficiency**	**TSS % Removal Efficiency**
Equipment modifications to allow producers to effectively implement conservation tillage and/or nutrient and pest management on their farms			
• Planter attachments that allow producers to implement no-till, strip-till or high residue conservation tillage	**55%**	**45%**	**75%**
• GPS systems	**55%**	**45%**	**75%**
• Light bars	**55%**	**45%**	
• Spray controllers			
• Variable rate controllers	**55%**	**45%**	
• Vertical tillage equipment attachments			**75%**
Assistance for pasture/hay planting in critical areas to decrease soil erosion			**93%**[1]
Assistance to producers who utilize cover crops to improve soil quality, reduce erosion and increase soil water holding capacity	**45%**[2]	**15%**[2]	**20%**[2]
Installation of stream buffers/filter strips to reduce sediment and nutrient loading	**70%**	**75%**	**65%**
Installation of grassed waterways to reduce soil erosion			**77%-97%**[3]
Installation of check-dams in grassed waterways to reduce water velocities and allow for sediment deposition			
Assistance for producers to implement nutrient management planning to improve water quality	**20%-30%**[4]	**20%-30%**[4]	**ND**
Assistance for producers to consult with Certified Crop Advisor to assist producers in making conservation wise farm management decisions			
Restoration or construction of wetlands to improve water	**75%-**	**30%-**	**75%-**

quality, hold floodwaters, and increase wildlife habitat Controlled subsurface drainage	**95%**[5]	**50%**[5]	**95%**[5]
Assistance for producers to implement controlled subsurface drainage	**40%-50%**[6]		
Assistance for producers to implement Integrated Pest Management (IPM) to improve water quality			
Permanent seeding of critical areas to reduce soil erosion	**70%**	**75%**	**65%**
Installation of a two stage ditch to demonstrate an alternative ditch design that improves water quality through nutrient and pesticide uptake and sediment deposition	**75%**	**75%**	**75%**
Construction of regionally based runoff detention facilities to hold excess runoff, allowing for sediment and nutrient reduction.	**55%**	**68%**	**86%**
Education and outreach to inform producers on soil erosion and water quality issues	**ND**	**ND**	**ND**
1 = (IDEM/USEPA, 2005); 2 = (Chesapeake Bay, 2004); 3 = (Fiener, 2003); 4 = (DEP, 2009); 5 = (JJR/Tilton, 1998); 6 = (ARS, 2006); ND = No Data			

Table 78. Critical Area: Conventionally Tilled Agricultural Fields that Intersect a Stream or Ditch BMP's and Removal Efficiencies

Critical Area: Areas of Significant Erosion Resulting in Large Gullies			
Practice	**N % Removal Efficiency**	**P % Removal Efficiency**	**TSS % Removal Efficiency**
Equipment modifications to allow producers to effectively implement conservation tillage and/or nutrient and pest management on their farms			
• Planter attachments	**55%**	**45%**	**75%**
• GPS systems	**55%**	**45%**	**75%**
Assistance for pasture/hay planting in critical areas to decrease soil erosion			**93%**[1]
Assistance to producers who utilize cover crops to improve soil quality, reduce erosion and increase soil water holding capacity	**45%**[2]	**15%**[2]	**20%**[2]
Installation of stream buffers/filter strips to reduce sediment and nutrient loading	**70%**	**75%**	**65%**
Installation of grassed waterways to reduce soil erosion			**77%-97%**[3]
Installation of check-dams in grassed waterways to reduce water velocities and allow for sediment deposition			
Construction of regionally based runoff detention facilities to hold excess runoff, allowing for sediment and nutrient reduction	**55%**	**68%**	**86%**
Education and outreach to inform landowners on potential practices to reduce gully erosion	**ND**	**ND**	**ND**
2 = (Chesapeake Bay, 2004); 3 = (Fiener, 2003); ND = No Data			

Table 79. Critical Area: Areas of Significant Erosion Resulting in Large Gullies

Critical Area: Unbuffered Stream Reaches			
Practice	**N % Removal Efficiency**	**P % Removal Efficiency**	**TSS % Removal Efficiency**
Installation of stream buffers/filter strips to reduce sediment and nutrient loading	**70%**	**75%**	**65%**
Assistance for pasture/hay planting in areas adjacent to unbuffered stream reaches to decrease soil erosion and nutrient and bacteria loading			**93%**[1]
Installation of a two stage ditch to demonstrate an alternative ditch design that improves water quality through nutrient and pesticide uptake and sediment deposition	**75%**	**75%**	**75%**
Assistance for riparian corridor protection to improve water quality and improve wildlife habitat	**75%**	**75%**	**75%**
Education and outreach to inform stakeholders on the importance of stream buffers and how they effect water quality	**ND**	**ND**	**ND**
1 = (IDEM/USEPA, 2005); ND = No Data			

Table 80. Critical Area: Unbuffered Stream Reaches

Critical Area: Critical Livestock Operations			
Practice	**N % Removal Efficiency**	**P % Removal Efficiency**	**TSS % Removal Efficiency**
Construction or implementation of livestock fencing from streams, alternative water supply systems, or stream crossings.	**75%**	**75%**	**75%**
Assistance to producers who implement manure/nutrient management planning (Proper waste utilization) to reduce nutrient and *E. coli* loading	**20%-30%**[4]	**20%-30%**[4]	**ND**
Assistance for producers to consult with Certified Crop Advisor to assist producers in making conservation wise farm management decisions	**8%**[2]	**15%**[2]	**25%**[2]
Installation of stream buffers/filter strips to reduce sediment and nutrient loading	**70%**	**75%**	**65%**
Assistance for pasture/hay planting in areas adjacent to unbuffered stream reaches to decrease soil erosion and nutrient and bacteria loading			**93%**[1]
Installation of alternative animal waste system (e.g. anaerobic digester, composting facility) to reduce nutrient and *E.coli* loading.	**80%**[2]	**80%**[2]	**0%**[2]
Education and outreach to inform livestock producers on the role of livestock and its effect on water quality	**ND**	**ND**	**ND**
1 = (IDEM/USEPA, 2005); 2 = (Chesapeake Bay, 2004); 4 = (DEP, 2009); ND = No Data			

Table 81. Critical Area: Critical Livestock Operations

Critical Area: The Regulatory Flood Hazard Area			
Practice	**N % Removal Efficiency**	**P % Removal Efficiency**	**TSS % Removal Efficiency**
Installation of stream buffers/filter strips to reduce sediment and nutrient loading	**70%**	**75%**	**65%**
Assistance for enrollment into landuse conversion programs (Floodplain Easement Program/Wetland Reserve Program) to reduce activity in the regulatory flood hazard area			**96%**[1]
Installation of a two stage ditch to demonstrate an alternative ditch design that improves water quality through nutrient and pesticide uptake and sediment deposition	**75%**	**75%**	**75%**
Restoration or construction of wetlands to improve water quality, hold floodwaters, and increase wildlife habitat Controlled subsurface drainage	**75%-95%**[5]	**30%-50%**[5]	**75%-95%**[5]
Assistance for the implementation of low impact development (LID) BMP's to reduce sediment and nutrient loading	**0%-50%**	**0%-81%**	**0%-90%**
Assistance to producers who utilize cover crops to improve soil quality, reduce erosion and increase soil water holding capacity	**45%**[2]	**15%**[2]	**20%**[2]
Compensation for voluntary home buyouts in flood prone areas	**ND**	**ND**	**ND**
Assistance for homeowners to flood-proof homes in the regulatory flood hazard area to reduce the impacts of flooding	**ND**	**ND**	**ND**
Assistance for riparian corridor protection to improve water quality and improve wildlife habitat	**75%**	**75%**	**75%**
Construction of regionally based runoff detention facilities to hold excess runoff, allowing for sediment and nutrient reduction	**55%**	**68%**	**86%**
Assistance to remove leaning or downed trees to prevent logjams and backups which may accelerate further streambank erosion	**ND**	**ND**	**ND**
Education and outreach to educate watershed stakeholders on the importance of the regulatory flood hazard area and the role it plays in water quality and flood control	**ND**	**ND**	**ND**
1 = (IDEM/USEPA, 2005); 2 = (Chesapeake Bay, 2004); 5 = (JJR/Tilton, 1998); ND = No Data			

Table 82. Critical Area: The Regulatory Flood Hazard Area

Critical Area: Failing Septic Systems			
Practice	**N % Removal Efficiency**	**P % Removal Efficiency**	**TSS % Removal Efficiency**
Assistance to repair/replace failing septic systems in order to reduce nutrient and *E. coli* loading	**ND**	**ND**	**ND**
Assistance to repair/replace failing package WWTP's in order to reduce nutrient and *E. coli* loading	**ND**	**ND**	**ND**
Establishment of a localized sewer district to connect homes with failing systems to a sewer system	**ND**	**ND**	**ND**
Education and outreach to inform homeowners on septic system maintenance	**ND**	**ND**	**ND**
ND = No Data			

Table 83. Critical Area: Failing Septic Systems

Critical Area: Industrial Facility Permit Compliance			
Practice	**N % Removal Efficiency**	**P % Removal Efficiency**	**TSS % Removal Efficiency**
Education and Outreach	**ND**	**ND**	**ND**
ND = No Data			

Table 84. Critical Area: Industrial Facility Permit Compliance

All BMP's will be geo-referenced to identify the locations where they have been installed. Sediment and nutrient loading reductions will be estimated using the USEPA Region V Pollutant Load Reduction Model.

The St. Marys River Watershed Steering Committee recognizes that there is a vast assortment of State and Federal cost share programs aimed at improving water quality, and reducing non-point source pollution. Therefore, for many of the above components of the cost share program, only a small dollar amount will be allotted for them in the St. Marys River Watershed Cost Share Program. For these items we feel that the producer would be making a wiser choice to use the existing programs, and the St. Marys Project will encourage them to do so. However, in rare cases, the St. Marys Steering Committee feels that the allotted dollars can be used to install BMP's on lands not meeting the requirements for other cost share programs or for individuals not interested in participating in other State and Federal programs.

This has allowed the monetary resources of the proposed cost share program to focus on three major areas; erosion, nutrient levels and *E. coli* levels. To address soil erosion, the cost share program will promote strip-till and the use of RTK guidance systems. Due to the heavy soils in the watershed strip-till is a more desirable alternative to straight no-till. In conjunction with strip-till, the use of RTK guidance becomes pertinent in order to plant directly over the tilled strip. To address stream bank erosion, the project proposes to cost share on the construction of two-stage ditch projects. This innovative ditch reconstruction method improves drainage function, reduces nutrients in surface water, allows for sediment deposition during high flows, and creates a very stable stream bank. To address nutrient levels, again strip-till and the use of RTK guidance systems will be promoted. Furthermore, the use of manure and nutrient management planning will be promoted. Finally, to address excessive *E. coli* levels, the proposed project will offer cost share assistance for livestock BMPs (e.g. exclusion fencing, alternative water supply, stream crossings, etc.). Cost share will also be available for alternative animal waste systems (e.g. anaerobic digester, composting facility). Alternative waste

systems will not only serve to reduce the occurrence of over application and improper application, but also offers the opportunity to develop an end product of animal waste.

By focusing the cost share program in the aforementioned areas, the St. Marys River Watershed Project Steering Committee feels there is great potential to decrease non-point source pollution in the St. Marys River Watershed.

St. Marys River Watershed Education and Outreach Program

The St. Marys River Watershed Project will continue to engage stakeholders within the watershed to increase the general public's awareness of water quality concerns in the watershed. The St. Marys River Watershed Project will host, sponsor and promote educational and outreach opportunities such as summer field days, winter meetings, and workshops. Other outreach material will include the development and distribution of brochures, posters, signs, newsletters, news releases and reports.

St. Marys River Watershed Water Quality Monitoring Program

The St. Marys River Watershed Project will plan to conduct a future water quality monitoring program in the watershed to evaluate the effectiveness of the installed BMP's. It has been proposed to conduct weekly grab sampling at the 20 sampling locations used previously by the St. Marys River Watershed Project in the year 2012. This data can be viewed alongside existing benchmark data to make comparative observations of water quality in the St. Marys River Watershed. Furthermore, monitoring data can be used to evaluate the WMP and allow the stakeholders to modify the WMP if necessary.

9.0 SUMMARY

The St. Marys River Watershed Management Plan was developed by the St. Marys River Watershed Steering Committee in response to the TMDL's completed for the St. Marys River watershed as well as Blue Creek/Habegger Ditch and Yellow watersheds. With the invaluable input obtained from a multitude of watershed stakeholders, local officials, and conservationists, a WMP was developed identifying water quality problems and associated impairments. The WMP also identifies critical areas in the watershed that will be targeted with specific BMP's tailored to each resource concern. Through a mix of implementation practices and education and outreach activities, the St. Marys River Watershed Management Plan hopes to be a driving force towards achieving the following goals:

Goal: Reduce sediment in all monitored streams to meet a level of 30 mg/l by 2028

Goal: Reduce amount of trash/debris in the watershed by 50% by 2028.

Goal: Reduce Atrazine levels to meet a level of 3.00 µg/l (ppb) in all monitored streams by 2028.

Goal: Reduce levels of *E. coli* to meet IDEM water quality standards (235 cfu/100ml) by 2028.

Goal: Reduce levels of nutrients to meet levels set forth by the TMDL:Nitrogen (10 mg/l), Phosphorus (0.30 mg/l) by 2028. Reduce Ammonia levels so as not to exceed Criterion Continuous Concentration by 2028.

Goal: Significantly reduce stormwater runoff and activity in Regulatory Flood Hazard Area in order to reduce severity and impacts of flooding by 2028.

Goal: Increase Public Awareness and Participation by 50% by 2028.

The overall success of the WMP will be measured by a variety of social and environmental indicators. The St. Marys River Watershed Project Steering Committee views the WMP to be a living document, in need of continuous modification as changes in the watershed occur.

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