LaPorte County
Soil & Water
Conservation District

State of Indiana
Department
of Natural Resources

Galena River Watershed Diagnostic Study and Management Plan

Baetis®
Environmental Services, Inc.

June 2010

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GALENA RIVER WATERSHED
DIAGNOSTIC STUDY AND MANAGEMENT PLAN

Prepared for

La Porte County

Soil and Water Conservation District

By

Baetis Environmental Services, Inc.

June 2010

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EXECUTIVE SUMMARY

Under a grant from the Indiana Department of Natural Resources (IDNR) Lake and River Enhancement Program (LARE), the LaPorte County Soil and Water Conservation District (SWCD) retained Baetis Environmental Services, Inc. to develop a diagnostic study and watershed management plan (WMP) for the Galena River watershed in northeast LaPorte County and northwest St. Joseph Counties, in north-central Indiana. The Galena River is part of the Little Calumet-Galien Watershed (Hydrologic Unit Code 04040001) which spans coastal areas of Illinois, Indiana, and Michigan. The headwaters of the Galena River are near Springfield Township in LaPorte County, approximately five miles north of LaPorte, Indiana and flow northeast through the northwest corner of St. Joseph County, Indiana and into Berrien County, Michigan.

The Galena River watershed is 112,222 acres; approximately one-quarter of the watershed, 29,684 acres, lies in Indiana, the remainder in Berrien County, Michigan. This WMP concerns only on the Indiana portion of the watershed, where the drainage is the Galena River. A WMP covering the river as it flows through Berrien County, Michigan, where it is referred to as the Galien River, has been previously prepared by Fishbeck, Thompson, Carr, and Huber (2003).

In Indiana, the Galena watershed remains relatively undeveloped; the two principal land uses are forest and agriculture. There are no large urbanized areas in the watershed. In comparison to other areas in the Little Calumet-Galien Watershed, the Galena River has not been significantly impacted by human influence. This is important to the watershed planning process; many of the recommendations involve conservation and preservation of existing environmental features, rather than remediation of already degraded environments.

In 2002, the Galena River was included on the Indiana Department of Environmental Management's (IDEM)'s 303(d) list of impaired waters and has remained on this list through 2008. *E. coli* bacteria were identified as the cause of water use impairment. Surface waters that do not meet water quality standards, that is, do not support their designated uses, require development of TMDLs (Total Maximum Daily Load). In 2008, IDEM completed an extensive water quality study of the Galena River and its tributaries to measure *E. coli,* general chemistry, and nutrients to determine if the Galena River now supported its designated uses or a TMDL was indeed required. The results of that study confirmed that *E. coli* exceeded the water quality standards at eight of the nine sites selected for testing. Subsequently the IDEM prepared a draft TMDL for *E. coli*; IDEM is currently finalizing the TMDL report.

In concert with the 2008 IDEM field studies, the IDNR and the LaPorte County SWCD completed habitat and biological assessments (October-November, 2008) at the same water quality sampling sites. Further information on the watershed was developed in 2009 and included a stream buffer analysis (by the IDNR) and a nonpoint source windshield survey of the watershed (by the Steering Committee).

According to the IDEM water quality study, *E. coli* was the only parameter impairing water use and exceeded applicable water quality standards. Other chemical and nutrient parameters met standards, indicating that, with the exception of contact recreation, the stream's designated uses were supported. Water quality results did not vary significantly, even during high flow events. As the Galena River leaves Indiana and flows through Michigan (where it is named the Galien River), the water quality problems become more numerous and more severe. In addition to *E. coli*, the watershed management plan for the Galien River identified the following causes of use impairments: sedimentation, elevated nutrient levels, changes in flow patterns, chemical contamination from fertilizers/urban sources, among other things.

This planning effort included the formation of a Steering Committee. Landowners, resource agency representatives, and non-governmental environmental organizations were invited to participate. The Steering Committee's purposes included:

- Providing a forum for hearing stakeholder perspectives on current and desired watershed health
- Directing planning efforts to protect and restore water quality, including promoting implementation of the upcoming *E. coli* TMDL
- Generating goals and prioritizing projects for protecting and improving watershed quality
- Assisting with field reconnoitering and identification of nonpoint pollution source areas

The following goals for the WMP were developed by the Steering Committee. These were developed after active discussion over several meetings.

Goal 1: Hire a dedicated watershed coordinator for LaPorte County.

Goal 2: Protect the rural character and natural resources of the watershed by incorporating 'Smart Growth' and low impact development principles into local planning and development.

Goal 3: Reduce *E. coli* loads to meet water quality standard of a monthly geometric mean of 125 cfu/100 ml and a maximum daily standard of 235 cfu/100 ml.

Goal 4: Restore 10% of potential wetland restoration areas to wetland habitat within the next ten years.

Goal 5: Preserve natural areas through government coordination and/or land trusts

Goal 6: Reduce sediment loads in the Galena River

Goal 7: Restore the natural hydrology and hydraulics of the watershed to the extent possible, including the ability of migratory fishes to utilize all habitats.

Using information provided by the water quality study, the habitat and biological assessments, the draft TMDL, the stream buffer analysis, and the windshield survey, the Steering Committee was able to identify the problems and sources of those problems for the Galena River watershed.

The Steering Committee developed a list of projects to be implemented to meet each goal. Table 5-1 of the watershed management plan lists each project (action item), estimated costs, priority, and responsible parties.

Because the Galena River as it flows through Indiana has few measureable water quality problems, it was recognized that this watershed management plan should not focus strictly on improving water quality, but should also have a strong land preservation component, given the undeveloped and sensitive nature of the area.

High priority watershed projects to be initiated within 1-2 years include:

- Assist LaPorte County in identifying and acquiring funds to hire a part- or full-time watershed coordinator.
- Partner with the Michigan City Sanitary District and the Trail Creek Watershed Steering Committee to make a presentation to LaPorte County government on *E. coli* issues in the watershed and resident concerns.
- Set up watershed subcommittee that will attend zoning committee meetings and work to get model EPA ordinances, or other protective ordinances adopted.
- Model watershed water quality- existing conditions and future conditions under the new zoning.
- Develop dialogue with County Health Department to share data and work together on *E. coli* issues and actions in the watershed.
- Coordinate with County Health Department on new tracking system (ITOSS) to help with outreach and education efforts.
- Perform color infrared tracking, or dye tracing, to identify failing septic systems
- Identify agricultural lands not currently implementing the erosion control or range and pasture components of a Conservation Management System. Promote existing cost share programs.
- Increase public outreach for Best Management Practices (BMPs).
- Identify land-owners agreeable to restoration of stream buffer on their property. Restore inadequate buffer areas identified in stream buffer analysis.
- Develop brochure describing all the different programs available to private landowners for setting aside land for resource protection.
- Identify larger property owners interested in easement programs.

Medium priority projects, to be completed within 3-5 years, include:

- Work with LaPorte County to establish point-of-sale ordinance for septic inspections and a maintenance program.
- Perform a stream geomorphological study *(Medium-High priority*)
- Complete a Landscape Level Wetland Functional Analysis.
- Restore historic wetland areas (hydric soils that are currently being farmed). Identify landowners willing to restore wetlands.
- Complete stream bank restoration at Site 6.
- Streamline process by which property owners can enroll in Forest Legacy Program
- Implement two-stage ditch demonstration program.
- Conduct a fish survey to determine need for dam removal and fish passage projects.

Low priority projects, to be completed within 5-10 years, include:

- If fish survey results indicate need, conduct feasibility study on dam removal.
- If fish survey results indicate need, conduct feasibility study for fish passage at culverts that currently do not allow passage.
- Establish dialogue with the County on identification of problem culverts.

To meet many of the goals, a robust and comprehensive public education campaign will be developed. An active dialogue will be initiated with local landowners. Public education and outreach will include, but not be limited to, the following:

- Visiting landowners in person
- Mailing campaign
- Handouts/brochures
- Seminars
- Website education campaigns and local recognition
- Other projects to be identified

Implementation of the above projects will meet the goals set by the Committee for the Galena River Watershed.

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ANOVA	Analysis of Variance
BMP	Best Management Practice
CFO	Confined Feeding Operation
CRP	Conservation Reserve Program
CSO	Combined Sewer Overflow
EPA	US Environmental Protection Agency
EPT	Ephemeroptera, Plecoptera, Tricopera
EQIP	Environmental Quality Incentive Program
FLP	Forest Legacy Program
GIS	Geographic Information System
HRFP	Healthy Reserve Forest Program
HUC	Hydrologic Unit Code
IAC	Indiana Administrative Code
IDEM	Indiana Department of Environmental Management
IDNR	Indiana Department of Natural Resources
LARE	Lake and River Enhancement Program
LUST	Leaking Underground Storage Tank
MDEQ	Michigan Department of Environmental Quality
NHD	National Hydrography Dataset
NIRPC	Northwestern Indiana Regional Planning Commission
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPS	Non-point Source
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NWI	National Wetland Inventory
QHEI	Qualitative Habitat Evaluation Index
RBP	Rapid Bioassessment Protocols
SSURGO	Soil Survey Geographic
SWCD	Soil and Water Conservation District
TKN	Total Kjeldahl Nitrogen

TSS	Total Suspended Solids
TMDL	Total Maximum Daily Load
USDA	United States Department of Agriculture
UST	Underground Storage Tank
WHIP	Wildlife Habitat Incentives Program
WQS	Water Quality Standard
WMP	Watershed Management Plan
WRP	Wetlands Reserve Program

ACKNOWLEDGEMENTS AND CREDITS

Baetis Environmental Services, Inc. (Baetis) gratefully acknowledges the financial support of the LaPorte County Soil and Water Conservation District and the Indiana Department of Natural Resources' Lake and River Enhancement Program. This report could not have been written without the combined, collaborative efforts of the Indiana Department of Environmental Management (IDEM), Indiana Department of Natural Resources (IDNR), the LaPorte County Soil and Water Conservation District (SWCD), and the Galena River Watershed Management Plan Steering Committee. These groups provided an assortment of data critical to the development of the watershed management plan.

Baetis' Principal Investigators for this study were Ms. Shannon Donley and Mr. David Pott. The LaPorte County SWCD lead was Ms. Nicole Messacar. Mr. Joe Exl, IDNR, provided data, analyses, and portions of this report that were very important to the overall project.

1.0 INTRODUCTION

1.1 Purpose and Scope

Under a grant from the Indiana Department of Natural Resources (IDNR) Lake and River Enhancement Program (LARE), the LaPorte County Soil and Water Conservation District (SWCD) developed a diagnostic study and watershed management plan (WMP) for the Galena River Watershed in northeast LaPorte County and northwest St. Joseph Counties. The goals of this watershed management plan are to:

- To characterize watershed and stream quality, condition, and trends,
- To identify potential sources of water quality problems,
- To identify and prioritize watershed land treatment projects,
- To propose non-point source (NPS) controls,
- To develop success factors and benchmarks for water quality improvements, and
- To improve coordination between local residents and local and state agencies in an effort to protect and improve the watershed.

The Galena River Watershed is on the State's 303(d) list of impaired waters for elevated concentrations of *Escherichia coli* bacteria that exceed water quality standards. This WMP was scoped for partnering and concurrent completion with a Total Maximum Daily Load (TMDL) for *E. coli* bacteria by the Indiana Department of Environmental Management (IDEM). A draft TMDL document was released in July 2009.

1.2 Public Involvement

A series of three public meetings, sponsored by the LaPorte County Soil and Water Conservation District, were held for the watershed management plan. The first public meeting was held on April 29, 2009 at LaLumiere School, to inform the public about the watershed planning effort and to encourage interested parties to participate on the Steering Committee. A second public meeting was held on September 22, 2009 to update the public, to gather information, and to identify any concerns held by the public. The third public meeting was held May 13, 2010 to review the report and watershed management plan. Summaries of the first two public meetings are reprinted in Appendix A.

In addition to these public meetings, two public meetings were sponsored by the IDEM to discuss the TMDL development for the Galena River. These meetings were held on January 21, 2009 and July 14, 2009 at the Spicer Creek Nature Preserve and LaLumiere School, respectively.

1.3 Formation of a Steering Committee

This watershed management plan could not have occurred without the significant input from the Steering Committee and the general public. A group of stakeholders representing federal, state, and local agencies, agriculture, environmental groups, and local citizens were solicited for input

and involved with the development of the watershed management plan. With the majority of the watershed located in Berrien County, Michigan, a representative from Michigan was invited to participate (note that a watershed management plan has been completed for the Galien River in Michigan and projects are being implemented). Active Steering Committee members are listed below.

Galena River Watershed Management Plan Steering Committee List

Name	Representing
Nicole Messacar	LaPorte County Soil and Water Conservation District
Myrna Harder	LaPorte County Soil and Water Conservation District
Sheila Batchelor	LaPorte County Soil and Water Conservation District
Rick McVay	LaPorte County Highway Department
Garry Traynham	Indiana Dunes National Lakeshore, National Park Service
Lee Reinfurth	LaPorte County Drainage Board
Steve Barker	LaPorte County Conservation Trust/Shirley Heinz Land Trust
Peg Kohring	The Conservation Fund
Joe Exl	Indiana Department of Natural Resources
Jenny Orsburn	Indiana Department of Natural Resources
Steve West	Indiana Department of Environmental Management
Tom Anderson	Save the Dunes Council and Conservation Fund
Christine Livingston	Save the Dunes Conservation Fund
Elizabeth McCloskey	U.S. Fish and Wildlife Service
Terry McCloskey	Save the Dunes Council and Conservation Fund
Rick Knoll	Landowner
John Dittmar	Landowner
James Simon	Landowner
Nick Timm	Landowner
Deb Longworth	Landowner
June Kirchatter	Landowner
Roberta Jannsen	Landowner
Shannon Donley	Baetis Environmental Services, Inc.

Monthly Steering Committee meetings began on June 3, 2009 and continued through January, 2010. Copies of the meeting minutes are included in Appendix A.

1.4 Vision Statement

At the first public meeting the following concerns were voiced by the meeting attendees:

- Concerns about zoning and development within the watershed.
- The difficulties in identifying the source(s) of *E. coli*.
- Concerns over point source discharges.
- Trash/debris at Springfield Fen Nature Preserve (Galena River headwaters)

Once the Steering Committee was created, one of the first activities initiated by the Steering Committee was to review the concerns voiced at the public meeting and to identify the concerns that the Steering Committee had for the watershed. Over the course of several meetings, the Steering Committee voiced the following concerns:

- Rapid pace of development – badly planned, high density will degrade watershed
- Reduction of *E. coli* bacteria
- Historic wetland loss
- Protection of sensitive natural resources
- Insufficient stream buffer
- Sedimentation
- Hydrologic and hydraulic modification
- Insufficient staff to implement watershed program – no watershed coordinator

Using the concerns as a guide, the Steering Committee developed this Vision Statement for the watershed:

The Galena River Watershed –

Protecting and Enhancing Clean Water,

Species Diversity and Quality of Life

The Steering Committee wanted a concise statement that captured their primary concerns of improving water quality and protecting a beautiful watershed with high quality habitat that supported a diversity of plant and animal life. The Steering Committee's concerns and their Vision Statement were used during development of the goals and objectives for the watershed.

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2.0 WATERSHED CHARACTERISTICS

2.1 Past and Current Studies

Numerous studies and reports were reviewed to understand the past and current condition of the Galena River watershed. These include the following:

- *Countywide Land Development Plan* prepared by Duncan Associates for LaPorte County.
- Watershed Restoration Action Strategy for the Little Calumet-Galien Watershed (IDEM).
- Watershed Management Plan for Lake, Porter, and LaPorte Counties (Northwest Indiana Regional Planning Commission).
- *A Tale of Two Creeks, Trail Creek Watershed Management Plan* (American Structurepoint, Inc. for the Sanitary District of Michigan City).
- Water Quality Assessment for Escherichia coli (E. coli) Bacteria in the Galena River Watershed (IDEM).
- 2005 Indiana Coastal Nonpoint Pollution Control Program (IDNR).
- *Galien River Watershed Management Plan* (Fishbeck, Thompson, Carr, and Huber for the Berrien County Drain Commissioner)
- Draft Total Maximum Daily Load for Escherichia coli (E. coli) for the Galena River Watershed, LaPorte and St. Joseph Counties (IDEM)

Complete citations for these reports are given in the Reference Section.

An important resource to this project was the *Galien River Watershed Management Plan* prepared by Fishbeck, Thompson, Carr, and Huber for the Berrien County Drain Commissioner (2003). Review of the report and frequent coordination with the staff at the Conservation Fund[1] provided valuable information on the condition of the river as it flows through Michigan and on projects that were being implemented. During preparation of this plan, staff from the Conservation Fund in Michigan worked closely with the LaPorte County SWCD on identifying funding opportunities for the watershed and preparing grant applications.

In addition to the above, IDEM sent out their draft for public review of the *Total Maximum Daily Load for Escherichia coli (E. coli) for the Galena River Watershed, LaPorte and St. Joseph Counties*, in June 2009, during the development of this WMP. This document is summarized in Section 3.2.

Other sources of information used to establish baseline conditions include Geographic Information System (GIS) datasets from the Indiana Geological Survey's Lake Rim website (http://lakerim.indiana.edu/index.html) and the Indiana DNR. This information was used to create many of the maps in this report. Members of the Steering Committee provided valuable observations collected during a windshield survey of the watershed. Macroinvertebrate and

[1] The Conservation Fund and its partners are working to implement the Galien River Watershed Management Plan.

habitat data, the stream buffer analysis, windshield survey results, and several of the report figures were provided by the Indiana DNR's Lake Michigan Coastal Program.

2.2 General

The Galena River Watershed (HUC 0404000110) is located in LaPorte and St. Joseph Counties, in north-central Indiana (Figure 1). The watershed is part of the Little Calumet-Galien tri-state management area which spans coastal areas of Illinois, Indiana, and Michigan. The headwaters of the watershed begin in Springfield Township in LaPorte County, approximately five miles north of LaPorte, Indiana and flow northeast through the northwest corner of St. Joseph County, Indiana and into Berrien County, Michigan.

This chapter presents several maps and tables containing spatial statistics about the study area. Watershed data tables and maps were developed using ArcGIS (version 9.3.1, ESRI, Redlands, CA). In the course of conversion between raster imagery and vector data, and processing to generate subwatershed data, the acreages of subwatersheds sometimes differ by approximately one percent.

The watershed is 112,222 acres; approximately one-quarter of the watershed, 29,684 acres, lies in Indiana; the remainder lies across the state line in Berrien County, Michigan. This watershed management plan focuses only on the Indiana portion of the watershed. A watershed management plan for the Galien River[2], covering the river as it flows through Berrien County, Michigan, has been prepared by Fishbeck, Thompson, Carr, and Huber (2003).

In Indiana, the watershed remains relatively undeveloped; the two principal land uses are forest and agriculture. There are no large urbanized areas in the watershed. In comparison to other watersheds along the Lake Michigan coastal area, the Galena River has not been significantly impacted by human influence (IDNR 2005). In 2002, the Galena River was included on IDEM's 303(d) list of impaired waters and has remained on this list through 2008 (IDEM 2008). *E. coli* bacteria were the identified causes of impairment. Waters that do not meet water quality standards, that is, do not support a designated use, require development of TMDLs (Total Maximum Daily Load). In 2008, IDEM completed an extensive water quality study of the Galena River and its tributaries to measure *E. coli*, general chemistry, and nutrients to determine if conditions and the Galena River now supported its designated uses or a TMDL was needed (Prast et. al 2009). The results showed that *E. coli* exceeded the water quality standards at eight of nine sampling sites. Other chemical and nutrient parameters met water quality standards indicating that the designated uses were supported except recreation. IDEM subsequently prepared a draft TMDL for *E. coli* in 2009; IDEM is currently preparing the final TMDL and response to public and agency comments.

[2] In Indiana it is the Galena River; in Michigan it is the Galien River.

2.3 Human Settlement

According to the 2000 U.S. Census, the population for LaPorte County was 110,106. The 2007 estimate, based on the 2005-2007 American Community Survey[3], was 109,440. This is a 0.3% decline from the 2000 census. According to the Northwestern Indiana Regional Planning Commission (NIRPC), LaPorte County's population has hit a plateau being only slightly higher than it was in 1980. NIRPC also notes that the latest estimates show a slight population loss (NIRPC 2008). For St. Joseph County, the population was 265,559 according to the 2000 U.S. Census and 265,507 based on the 2007 estimate. This represents a 0.2% decrease. It is important to note that these numbers do not reflect the actual population living in the Galena River watershed. For example, only a small portion of St. Joseph County lies within the Galena River watershed.

The current population in the watershed is approximately 4,340 persons, estimated using the average population density of the seven census blocks closest to the study area. LaPorte County has an average household size of 2.52 persons; therefore it is reasonable to assume that there are approximately 1,720 residential units in the watershed. All of these residential units use on-site septic systems for domestic wastewater treatment.

Property within the watershed is held by both private and public landowners. Parcels containing sensitive and high quality natural resources are currently being studied, assessed, and prioritized for planning purposes by several agencies and organizations including the U.S. Fish and Wildlife Service, the IDNR, and the Shirley Heinz Land Trust.

In 2008, the Countywide Land Development Plan was completed for LaPorte County (Duncan Associates 2008). This document analyzed current conditions and recommended land development strategies for the county. In 2009, LaPorte County continued with the next phase and began an effort to update the county zoning ordinances. Because updated zoning could lead to changed land uses and impact sensitive natural resources in the Galena River watershed, the Steering Committee formed a Subcommittee for the rezoning effort to press for ordinances protective of the watershed's natural resources.

Figure 2 shows the change in population density in the watershed between 1990 and 2000. The loss in population is apparent with most of the watershed experiencing a two to five percent decline. The southern tip of the watershed, nearer the City of LaPorte, is the only area that experienced growth between 1990 and 2000.

Agriculture is a primary source of income in both LaPorte and St. Joseph Counties. A variety of crops and livestock are produced within the two counties. Figure 3 shows the areas of prime farmland and farmland of statewide importance. Table 2-1 provides 2007 acres of the major

[3] The American Community Survey is an ongoing survey prepared by the U.S. Census Bureau that is sent to a small sample of the population to gather information about the population.

crops produced as provided by the USDA 2007 Agricultural Census by county (USDA 2009). Table 2-2 provides livestock numbers by county. Corn is the number one crop produced; corn and soybeans are the primary crops on the basis of acreage.

Table 2-1

CROPS PRODUCED IN LAPORTE AND ST. JOSEPH COUNTIES, INDIANA

Source: USDA, 2007 Census of Agriculture (USDA 2007)

County	Number of Farms	Land in Farms (ac)	Corn for Grain (ac)	Corn for silage or greenchop (ac)	Wheat for Grain (ac)	Soybeans (ac)
LaPorte	869	256,159	131,354	4,524	5,958	70,142
St. Joseph	712	178,674	96,963	1,632	3,221	51,157

Table 2-2

LIVESTOCK INVENTORY, LAPORTE AND ST. JOSEPH COUNTIES, INDIANA

Source: USDA, 2007 Census of Agriculture (USDA 2007)

County	Hogs and Pigs	Cattle and Calves	Sheep and Lamb	Horses and Ponies	Layers 20 Weeks and Older (Chickens)
LaPorte	67,514	19,675	528	1,111	851
St. Joseph	25,063	5,749	354	81+6	(D)

(D) – Withheld by USDA to avoid disclosing data for individual farms.

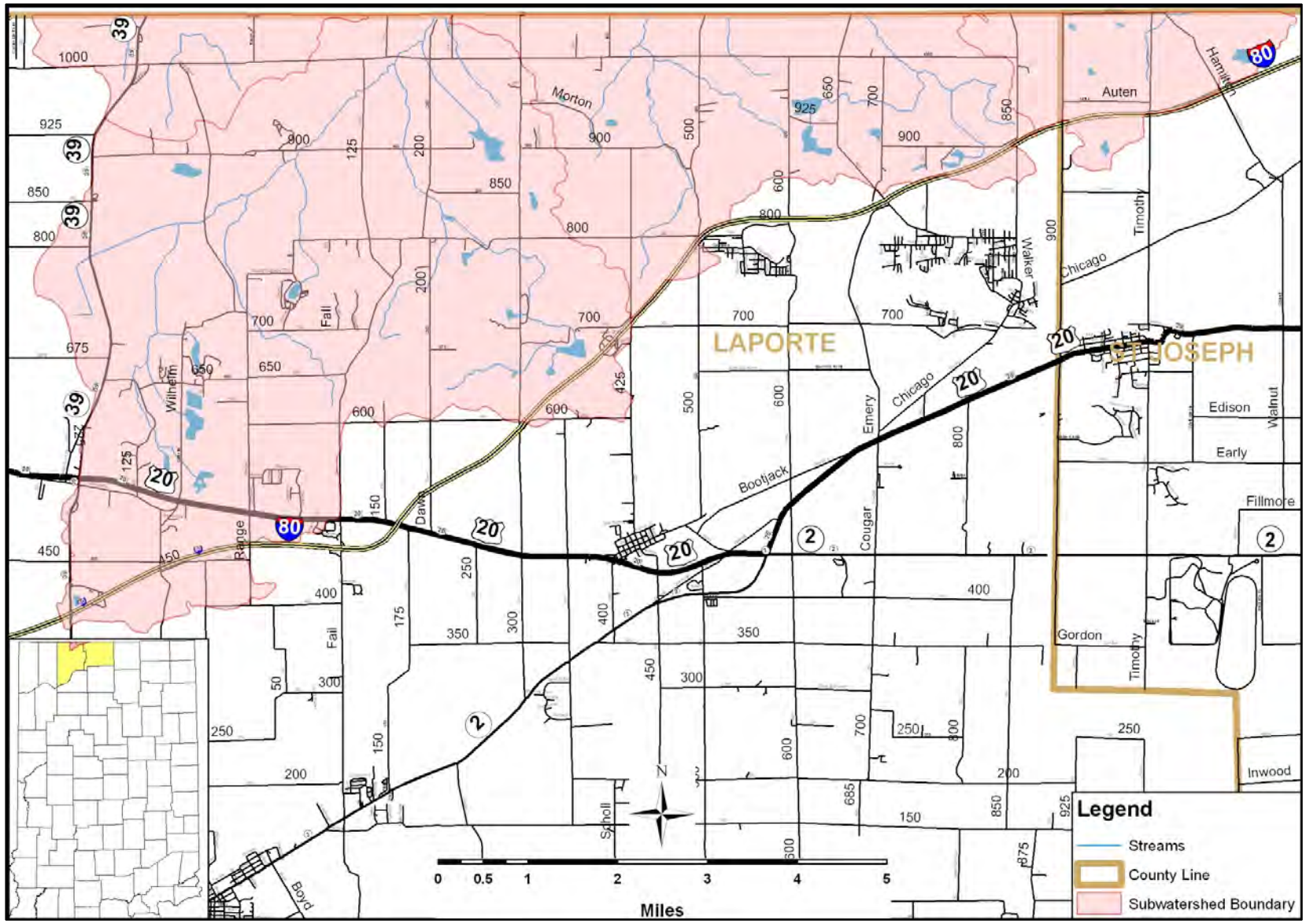

Figure 1. Location Map, Galena River Watershed

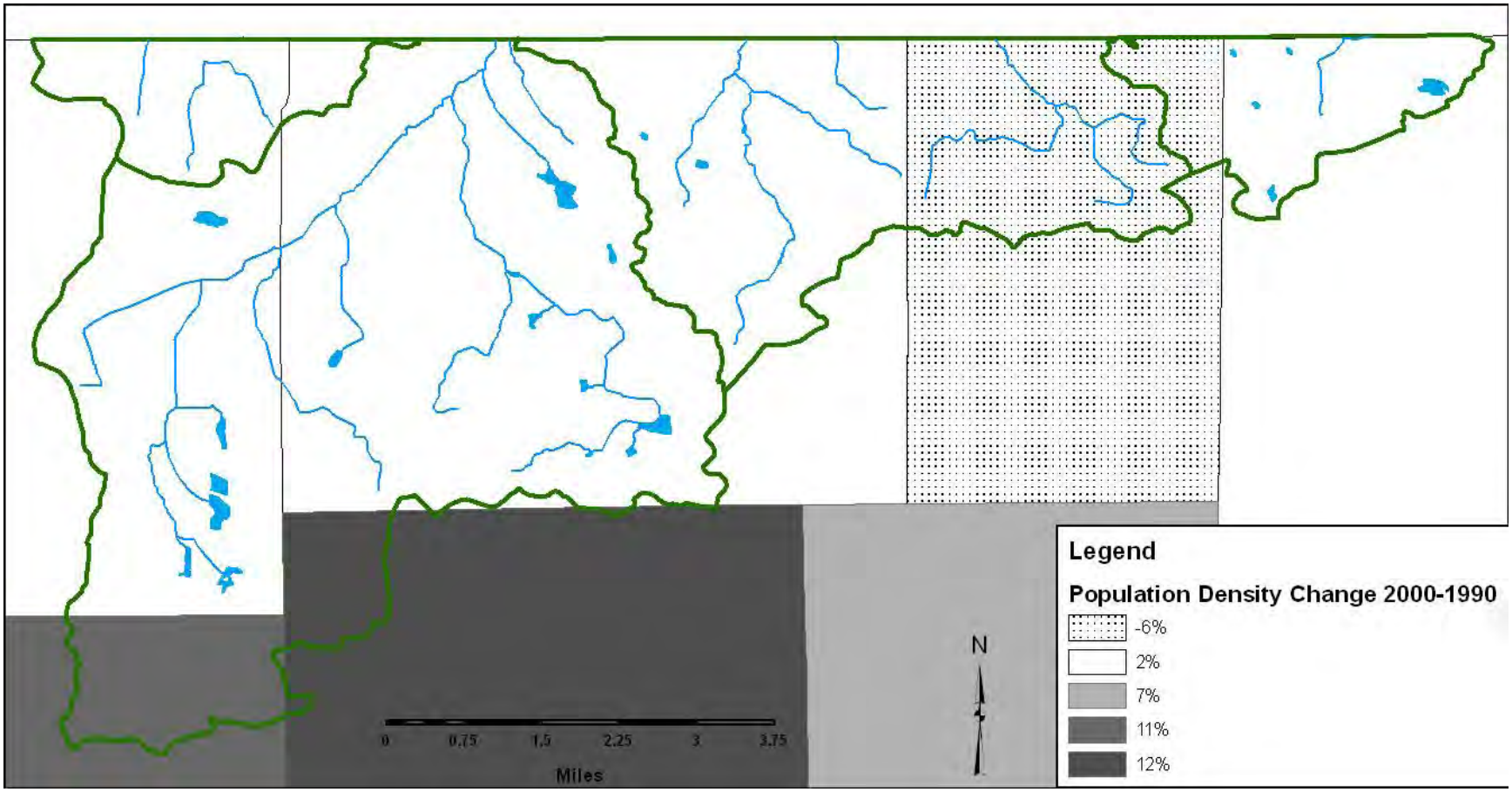

Figure 2. Changes in Population Density from 1990 to 2000, by Census Block.

(Source: http://census_mcd_popchange_in :Population Densities and Changes of Densities of Minor Civil Divisions in Indiana from 1890 to 2000. United States Census Bureau, 1:500,000 Polygon shapefile, published by Indiana Geological Survey, 2004). Accessed 4/15/09.

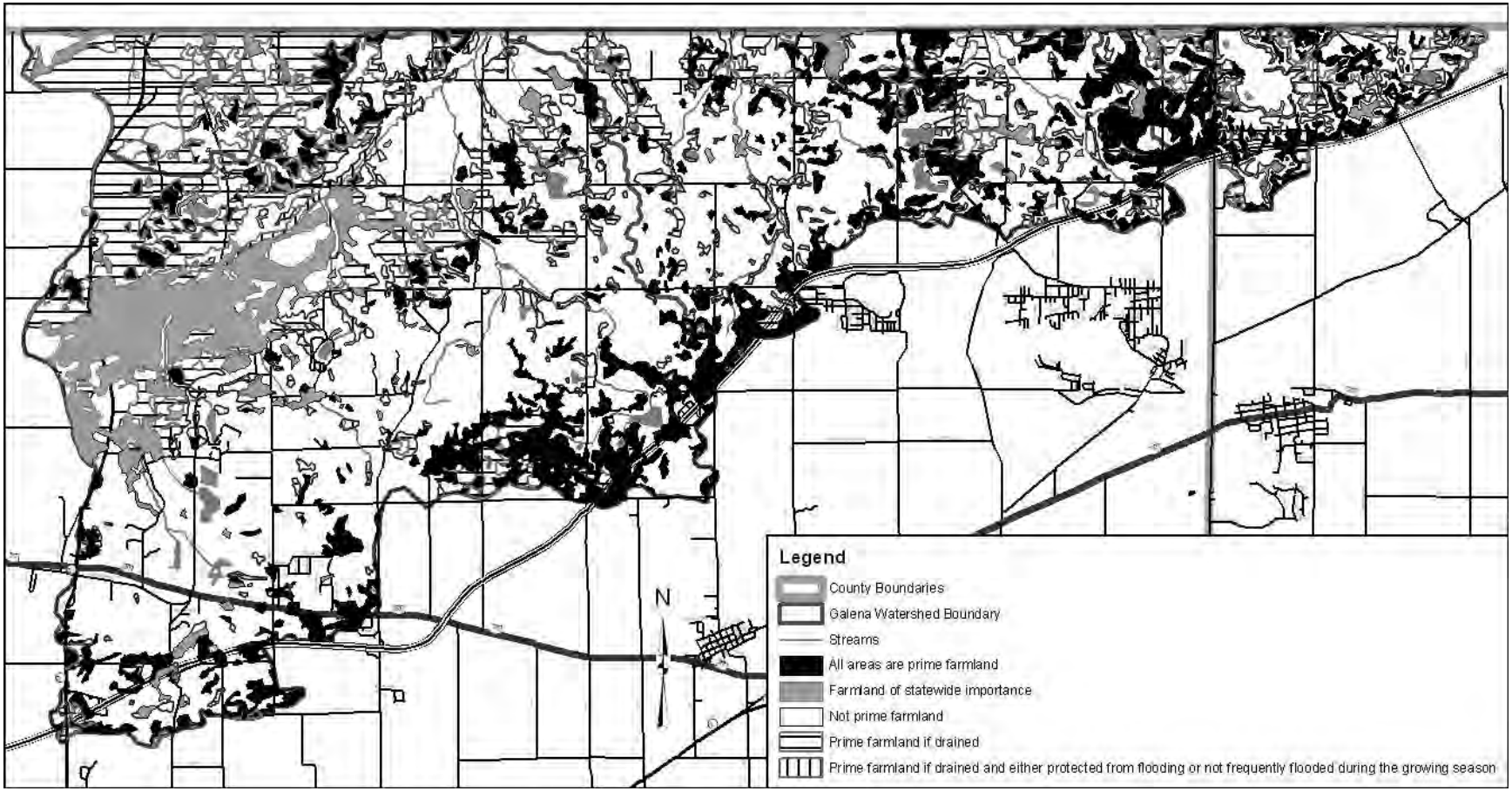

Figure 3. Locations of Prime Farmland and Farmland of Statewide Importance.

(Source: Soil Survey Geographic (SSURGO) Database, published by the USDA NRCS for LaPorte and St. Joseph Counties, IN. http://soildatamart.nrcs.usda.gov). Accessed 6/8/09.

Confined feeding is the raising of animals for food, fur or recreation in lots, pens, ponds, sheds or buildings, where they are confined, fed and maintained for at least 45 days during any year, and where there is no ground cover or vegetation present over at least half of the animals' confinement area. According to Indiana law, an operation must have at least 300 cattle, 600 swine/sheep or 30,000 fowl to be considered a Confined Feeding Operation (CFO). There are no CFOs in the Galena River watershed.

There are, by casual observation, several landowners in the watershed that keep horses.

2.4 Physiography and Climate

Within Indiana, the Galena River watershed is located within the physiographic unit known as the Valparaiso Morainal Area. The Valparaiso Moraine, located south of the Lacustrine Plain, is an arc-shaped moraine complex that parallels the southern shore of Lake Michigan. The moraine is higher than other parts of the County, dividing it into northern (Lake Michigan) and southern (Kankakee River) drainage areas. Elevations along the moraine range from about 800 feet (245 m) to 950 feet (290 m). Numerous kettle lakes sit on the moraine.

Lake Michigan has a large influence on the local climate. This influence is most pronounced just inland (within a mile or two) from the lake, although several lake effect features can extend farther inland to central Indiana if driven by strong northwesterly winds. It is well documented that Northwest Indiana experiences cooler springs, warmer autumns, and heavier winter precipitation than other areas of similar latitude (Indiana State Climate Office, www.agry.purdue.edu/climate/index.asp). Average annual rainfall in northern Indiana is 37 inches. Table 2-3 provides monthly means for temperature and precipitation.

Table 2-3

CLIMATE IN LAPORTE AND ST. JOSEPH COUNTIES (30 year normals)

Source: Indiana State Climate Office, 1970-2000 data. www.agry.purdue.edu/climate/

	Mean Temperature (ºF)		Monthly Precipitation (in)	
Month	**LaPorte Co.**	**St. Joseph Co.**	**LaPorte Co.**	**St. Joseph Co.**
January	23	23	2.30	2.30
February	27	27	1.90	2.00
March	38	38	3.10	2.90
April	49	48	3.50	3.60
May	60	60	3.50	3.50
June	69	69	4.40	4.20
July	74	73	3.80	3.70
August	72	71	4.20	4.00
September	64	63	3.90	3.80
October	53	52	3.20	3.30
November	40	40	3.80	3.40
December	28	29	3.20	3.10

2.5 Hydrology and Hydrogeology

Gently rolling hills and low depressional areas contribute to the numerous lakes, small drainages, and wetlands within the watershed. The Galena River headwaters originate from two wetland sources, the Galena Wetland Conservation Area and the Springfield Fen Nature Preserve, both located in the southwest corner of the watershed. The Galena Wetland Conservation Area is approximately 165 acres and is managed as a wildlife management area. Springfield Fen Nature Preserve is a prairie fen, approximately 45 acres, located at the base of a high hill from which calcareous seepage has created a wetland. These streams join to form the Galena River downstream of the wetlands. Several small tributaries flow into the Galena River before it reaches the Michigan boundary. These include Warwick Ditch, the unnamed tributary east of the Galena River, and several smaller, intermittent tributaries. Another tributary, Spring Creek, drains the northeastern catchment of the watershed then flows north into Michigan.

The watershed is subdivided into the following four subbasins represented by 12-digit Hydrologic Unit Code (HUC) parcels (Figure 4):

- South Branch of Galena River (Blood Run) (HUC 040400010206) – 1,918 acres, rises in Springfield Township in LaPorte County and flows north and east.
- Galena River headwaters (HUC 040400010205) – 17,886 acres, rises in Galena Township in LaPorte County near Springville.
- Spring Creek (HUC 040400010204) – 7,509 acres, rises in Hudson Township in the northeast corner of LaPorte County.
- Dowling Creek (HUC 040400010201) – 2,371 acres, rises on the southern edge of Galien Township near the Indiana border where LaPorte and St. Joseph counties meet.

There are no major impoundments or reservoirs in the watershed. Three low-head dams are known to be present (Figure 4).

According to the Indiana Water Pollution Control Board, the Galena River and its' tributaries in LaPorte County are designated as salmonid waters and shall be capable of supporting a salmonid fishery (327 IAC 2-1.5-5; 1997). This requires a more stringent set of water quality standards than those applied to general use in streams.

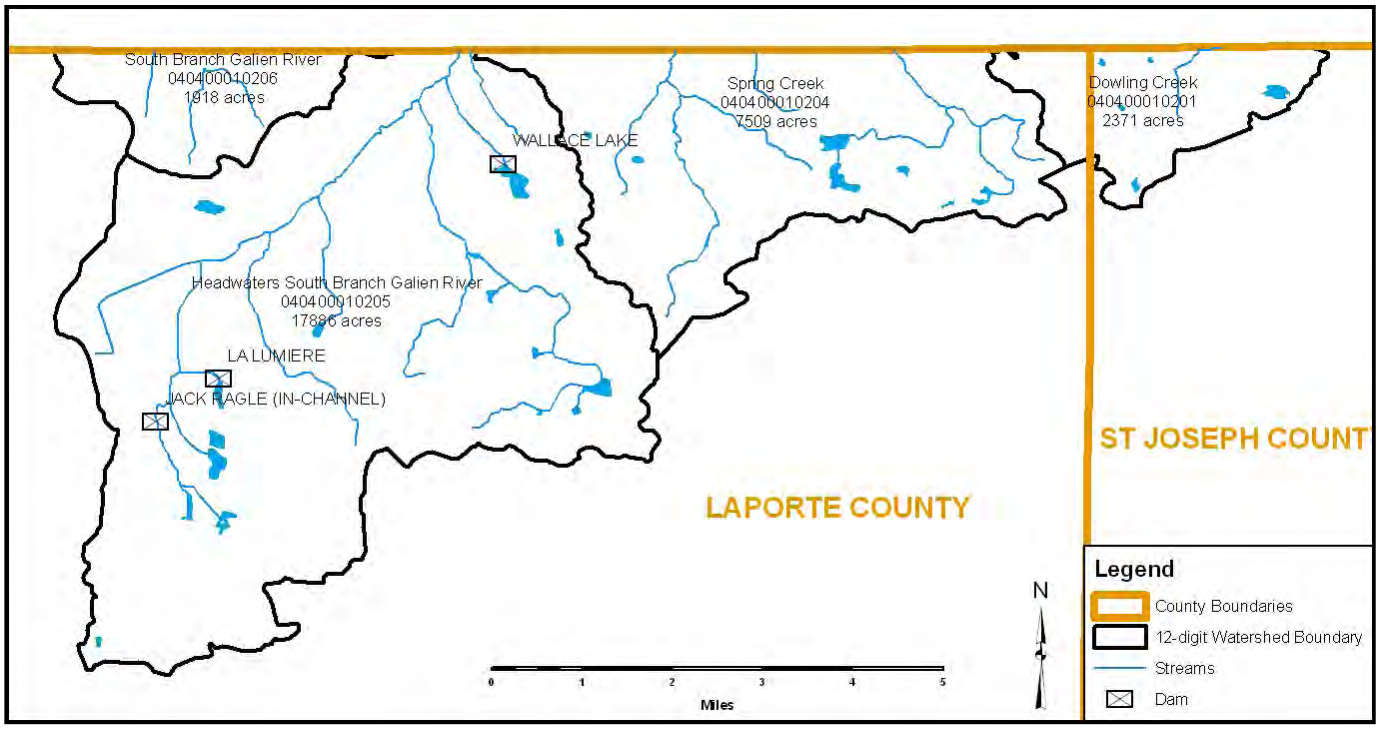

Figure 4. Subwatersheds in the Galena River Watershed.

(Source: 12-digit HUC shapefiles provided by IDEM, 3/12/09).

Groundwater provides drinking water for the residents in the watershed. Several major unconsolidated aquifer systems offer the area an abundant supply for irrigation and drinking. Groundwater movement is constrained by the Valparaiso Moraine; groundwater north of the moraine flows north towards Lake Michigan. Groundwater south of the moraine flows south and west. In the Valparaiso Moraine groundwater recharges at a rate of 3 inches per year (Purdue University Extension, cobweb.ecn.purdue.edu/~frankenb/watershed/index.html). A 1994 study of the groundwater quality in LaPorte County found elevated levels of nitrate in 11% of all wells tested and elevated levels of acetanilide products 9% of the wells (Wallrabenstein *et al*. 1994).

2.6 Soils

Common soils in the Galena River watershed include Blount, Adrian, Chelsea, Martisco, Maumee, Milford, Morocco, Selfridge, Tracy, and Riddles (USDA 1982, USDA 2004). Soils range from very poorly drained muck soils to well-drained loams and fine sands. The source of the Galena River is located in the Adrian-Houghton-Edwards association, which is described as 'nearly level, very poorly drained soils that formed in organic material over sand and marl. This map unit consists of deposits of muck within large depressions. Within LaPorte County this map unit has largely been drained and farmed although ponding on agricultural land can often be a problem. Because of the wet conditions, this map unit is unsuitable for the development of sanitary facilities and building developments. Other general soil map units within the watershed include the following:

- Tracy-Chelsea: Nearly level to very steep, well drained and excessively drained soils that formed in loamy and sand outwash and eolian material. Slopes can range from 0 to 45%. Within the county most of this map unit has been cleared and converted to cropland. This map unit is suitable for tree growth but very poorly suited for sanitary facilities. Some soils within the map unit are poorly suited for building development. Limitations include slope, pollution of groundwater, droughty conditions, and erosion.
- Riddles: Nearly level to very steep, well drained soils that formed in loamy glacial till. The soils are nearly level or gently sloping on knolls and ridges and moderately sloping to steep soils on side slopes. Slopes range from 0 to 45%. This map unit is used primarily for woodland and pasture although the flatter areas have been cleared and converted to cropland. These soils are suited for sanitary facilities and building development. Slope and hazard of erosion are the main limitations with this map unit.
- Blount-Selfridge: Nearly level and gently sloping, somewhat poorly drained soils that formed in loamy glacial till and in sandy deposits over loamy material. This map unit is on till plains, lake plains, and moraines with gentle swales. Slopes range from 0 to 6%. The majority of this map unit has been cleared, drained, and converted to cropland. This map unit is suited to tree growth but unsuitable for sanitary facilities and building site development. Slow permeability, ponding, and wetness are the main limitations.

According to the NRCS SSURGO (Soil Survey Geographic) database, with few exceptions, the entire watershed is listed 'Very Limited' for septic system absorption fields. In other words, the watershed is highly unsuitable for septic systems. Appendix B includes a map showing the limitations for septic systems. The dark red area is rated as 'Very Limited.'

The LaPorte and St. Joseph County Health Departments issue permits for construction of septic systems in the watershed. They are able to do this because site conditions may be suitable for septics on a site-by-site basis that cannot be captured on a large scale. Health department staff visit each property individually and assess soil suitability of the precise location for the proposed septic system. Site conditions may change dramatically within just a few feet, moving from suitable to unsuitable or vice versa, thus requiring an on-site field inspection. Regulations governing on-site septic systems are summarized in a subsequent section.

Cultivation has been made possible in some areas in the watershed by artificial drainage improvements: open ditches and subsurface tiles. Much of the watershed has been drained to allow for planting and harvesting of crops.

Figure 5 shows the location of hydric (wetland) soils in the watershed. Table 2-4 provides the acres of hydric soils by subbasin. While hydric soils are scattered throughout the watershed, the largest concentrated area of hydric soils are associated with the wetlands that are the headwaters of the Galena River. Prior to European settlement and drainage improvement, this was a much larger wetland complex. By comparing Figure 3 and Figure 5, one can see that hydric soils cover land that is now designated as farmland of statewide importance.

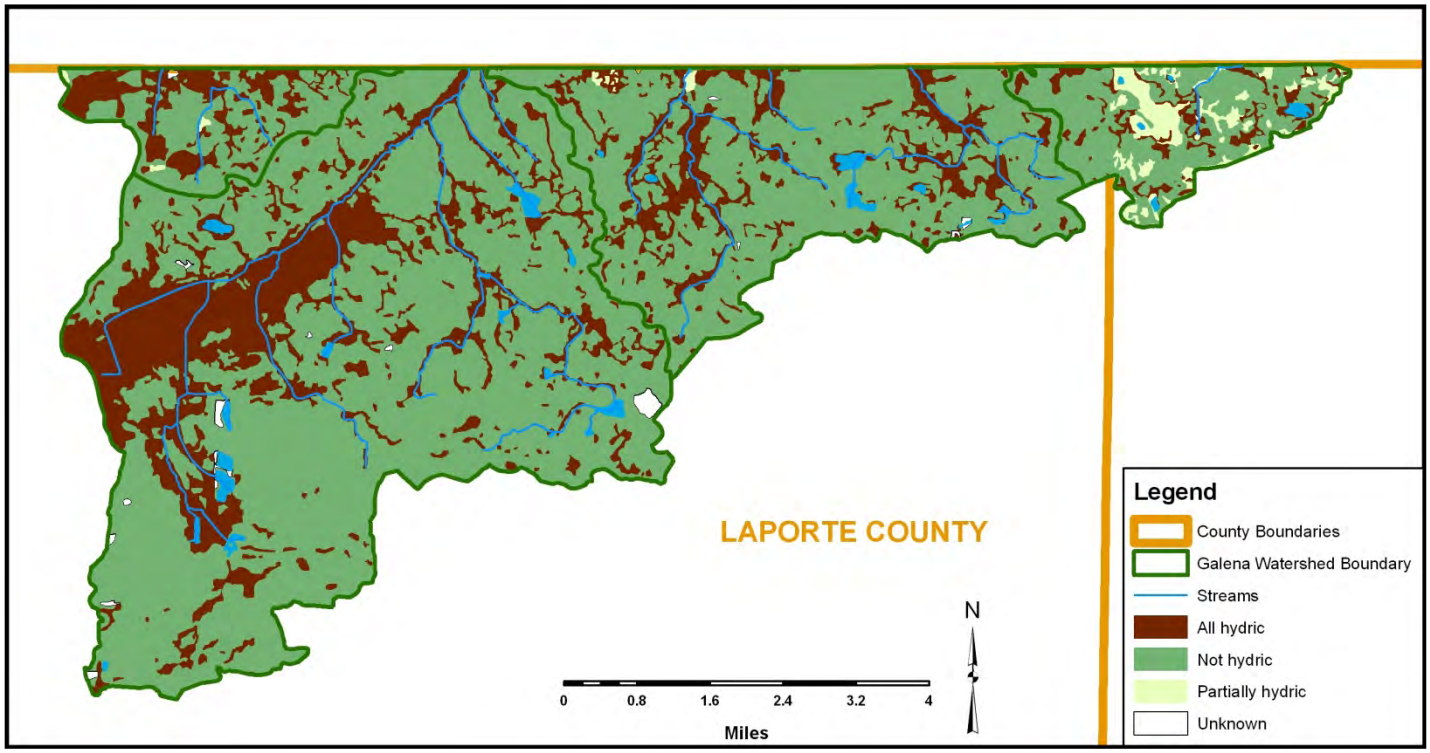

Figure 5. Hydric soils within the Galena River Watershed.

(Source: Soil Survey Geographic (SSURGO) Database, published by the USDA NRCS for LaPorte and St. Joseph Counties, IN. http://soildatamart.nrcs.usda.gov). Accessed 6/8/09.

Table 2-4

ACRES OF HYDRIC SOILS BY SUBBASIN

Source: SSURGO Database, http://soildatamart.nrcs.usda.gov. Accessed 6/8/09.

Subbasin	All Hydric	Partially Hydric	Not Hydric	Unknown
Spring Creek	1,599	30	5,844	20
Headwaters	4,543	0	13,240	98
South Branch	697	19	1,194	6
Dowling Creek	359	431	1,573	0
Total	7,198	480	21,851	124

2.7 Wetlands

In 2009, Ducks Unlimited completed an updating of the National Wetland Inventory (NWI) for Indiana. According to this update there are approximately 4,478 acres of wetlands in the watershed. The majority of these wetlands are forested wetlands as shown on Figure 6, although wetland types also include shallow and deep marsh, scrub/shrub, bog, fen and wet meadow. Table 2-5 provides a definition of the NWI wetland classifications and Table 2-6 lists acreages.

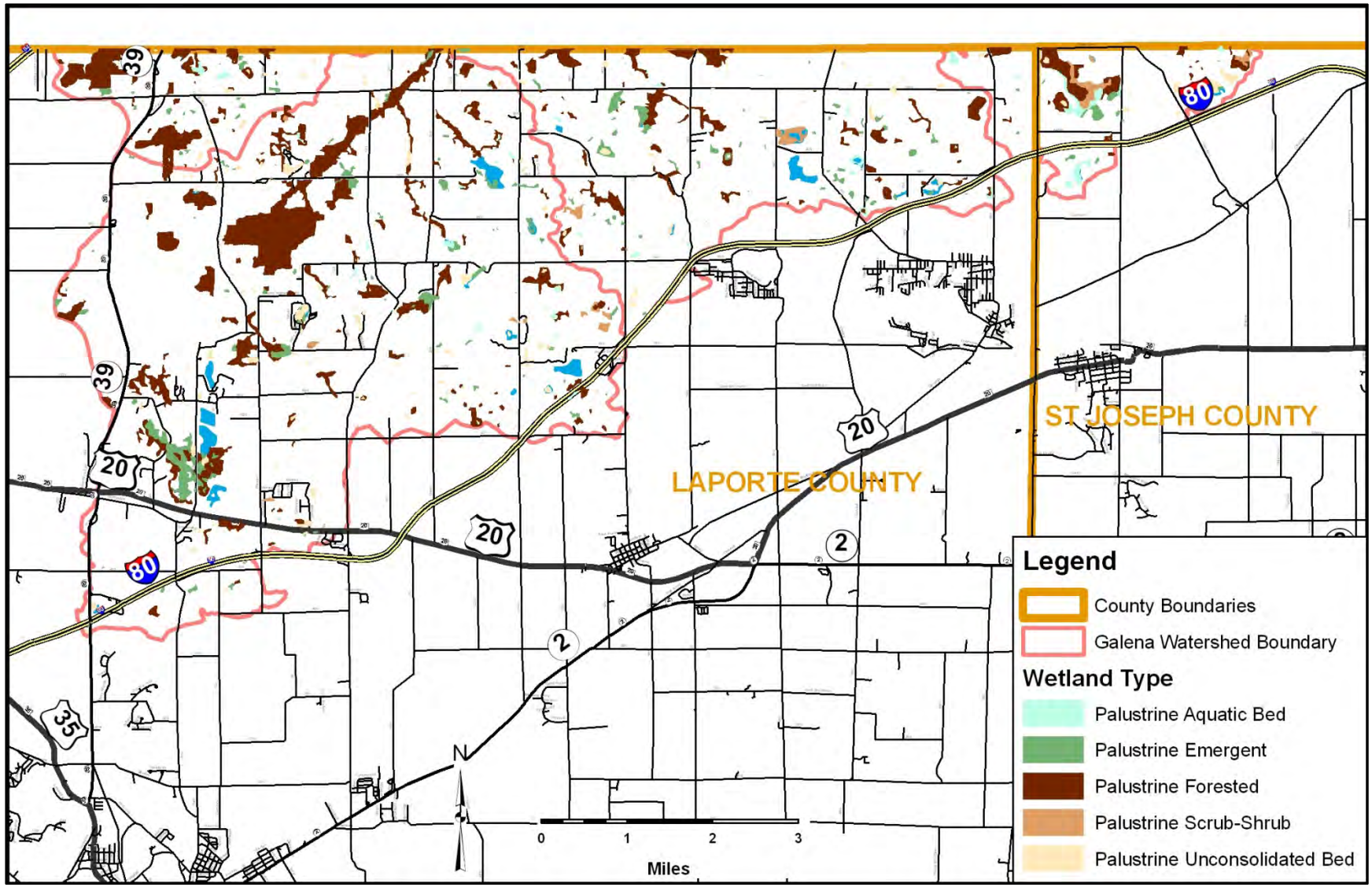

Figure 6. National Wetland Inventory Wetlands in the Galena River Watershed.

Source: Ducks Unlimited www.ducks.org/Conservation/GLARO/3752/GISNWIUpdate.html

Table 2-5

DEFINITION OF WETLAND CLASSIFICATIONS

(Source: USFWS National Wetland Inventory Mapper, www.fws.gov/wetlands/data/webatx/atx.html)*

Wetland Classification	Definition
Lacustrine	Wetlands with the following characteristics: 1) situated in a topographic depression or a dammed river channel; 2) lacking trees, shrubs, persistent emergents, ergent mosses or lichens with greater than 30% areal coverage; 3) total area exceeds 8 hectares (20 acres)
Palustrine	All nontidal wetlands dominated by trees, shrubs, emergents, mosses, or lichens.
Littoral	All wetlands habitats in the Lacustrine System. Extends from shoreward boundary to 2 meters (6.6 feet) below annual low water or to the maximum extent of nonpersistent emergents, if these grow at depths greater than 2 meters.
Limnetic	Extends out from Littoral boundary and includes all deep-water habitats within the Lacustrine system.
Aquatic bed	Includes wetlands and deepwater habitats dominated by plants that grow principally on or below the surface of the water for most of the growing season in most years. Aquatic beds generally occur in water less than 2 meters (6.6 feet) deep.
Emergent vegetation	Characterized by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years. These wetlands are usually dominated by perennial plants.
Scrub shrub	Includes areas dominated by woody vegetation less than 6 m (20 feet) tall. The species include true shrubs, young trees (saplings), and trees or shrubs that are small or stunted because of environmental conditions.
Forested	Characterized by woody vegetation that is 6 m tall or taller.
Unconsolidated bottom	Includes all wetlands and deepwater habitats with at least 25% cover of particles smaller than stones (less than 6-7 cm), and a vegetative cover less than 30%.

*Attribute classification definitions derived from: Cowardin, L.M., V. Carter, F. Golet, and E. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Fish and Wildlife Service. 103 pp.

There are 2,537 acres of wetlands in the Galena River headwaters subbasin. Forested wetlands are the most common type present within this subbasin. The second highest acreage of wetland habitat, 456 acres, is in the Spring Creek subbasin. Forested wetland is also the most common wetland type there.

Overall, forested wetlands cover 2,578 acres in the watershed; the second highest wetland type in the study area is palustrine emergent (i.e. wet meadow, fen). Table 2-6 provides the acreage of each wetland type by subbasin.

In comparison to other more developed areas of Indiana that have lost most of their wetlands, the Galena River watershed is fortunate in that many wetlands still exist. Today, wetlands comprise 15 percent of the watershed. However, the percentage that exists today is far less than was existing prior to European settlement. Historically, many wetlands have been drained for agricultural purposes (see Figure 14 for the location of wetlands that have been drained and are being used for agriculture).

Table 2-6

ACREAGES OF EACH WETLAND TYPE BY SUBBASIN

Type	Subbasin				Total
	Spring Creek	Dowling Creek	Headwaters	South Branch Galena River	
Lacustrine,	30.7	0	177.1	0	**207.7**
Aquatic bed	40.4	72.2	38.4	13.4	**164.3**
Emergent	332.8	53.4	454.9	53.9	**894.9**
Forested	546.0	159.9	1535.7	336.8	**2578.4**
Scrub-shrub	91.3	52.2	142.4	24.8	**310.6**
Unconsolidated	65.8	44.5	189.4	22.5	**322.3**
TOTAL	**1107.0**	**382.1**	**2537.8**	**451.4**	**4478.3**

An Advanced Identification (ADID) Study was completed in 2002 by the EPA, the Army Corps of Engineers, and other parties to further the protection of wetlands in the area. ADID studies identify high quality wetlands based on three functional values: habitat, stormwater storage, and water quality. ADID wetlands are those wetlands that are critical to controlling stormwater and reducing water pollution, that provide good wildlife and plant habitat, and may, in cases, represent a regionally rare system. With the development pressure on northwestern Indiana, having information on ADID wetlands enables decision makers to provide protection when making land use decisions. Figure 7 maps the ADID wetlands in the study area.

2.8 Forest Legacy Program

The Forest Legacy program is a federal program, administered by the State of Indiana, established to identify and protect environmentally important forest lands that are threatened by conversion to non-forest uses. In Indiana, such forests are protected by purchasing development rights from willing sellers. The owners retain all other rights, including the right to harvest timber and sell or bequest the remaining rights, with a preference for preserving large parcels. Because there tends to be larger parcels available in Southern Indiana, the money is often used for preserving forested land in the southern part of the state.

Forests within LaPorte County represent the disappearing northwest morainal forest type. Only one Forest Legacy Area is located within the watershed (in the Spring Creek subbasin) although a number of areas identified by the Indiana DNR as Classified Forest and Wildlands are present. The Classified Forest and Wildlands are private lands whose landowners have entered into an agreement with the State to manage for timber production, watershed protection, and wildlife habitat management and, in return, receive a tax reduction and free technical assistance from Indiana DNR foresters and biologists. The minimum size allowed in the program is 10 acres of forest, wetland, shrubland, and/or grassland. Figure 8 maps the Forest Legacy and Classified Forest and Wildland areas.

The Shirley Heinz Land Trust, a non-profit organization established to preserve the unique ecosystems of the Indiana Dunes region, is currently in the process of prioritizing and identifying parcels in Porter and LaPorte Counties that are part of the Northwest Moraine Forest. Forested areas will be evaluated in the field by experienced biologists and botanists and assigned a priority rating of ‘high’, ‘medium’, and ‘low’. The goal will be to use this information to develop sustainable conservation and development strategies for the area, protecting priority forested areas. The results will be available later in 2010.

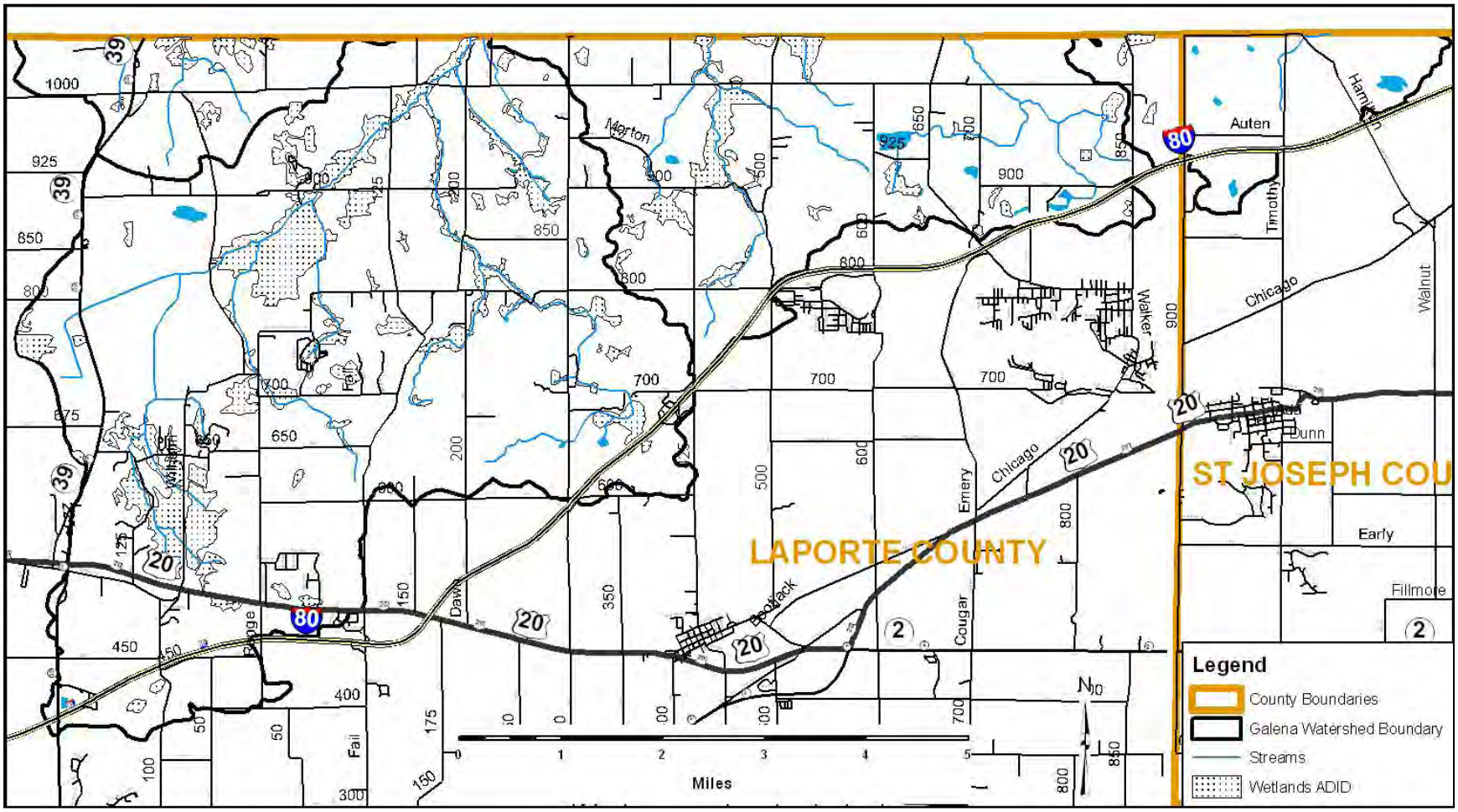

Figure 7. ADID Wetlands in the Galena River Watershed.

(Source: WETLANDS_ADID_LAKERIM_IN: Advanced Identification, ADID Wetlands in Lake, Porter and LaPorte Counties, IN (1:24,000 Polygon Shapefile), published by the Indiana Geological Survey, 2002). Accessed 4/1/09.

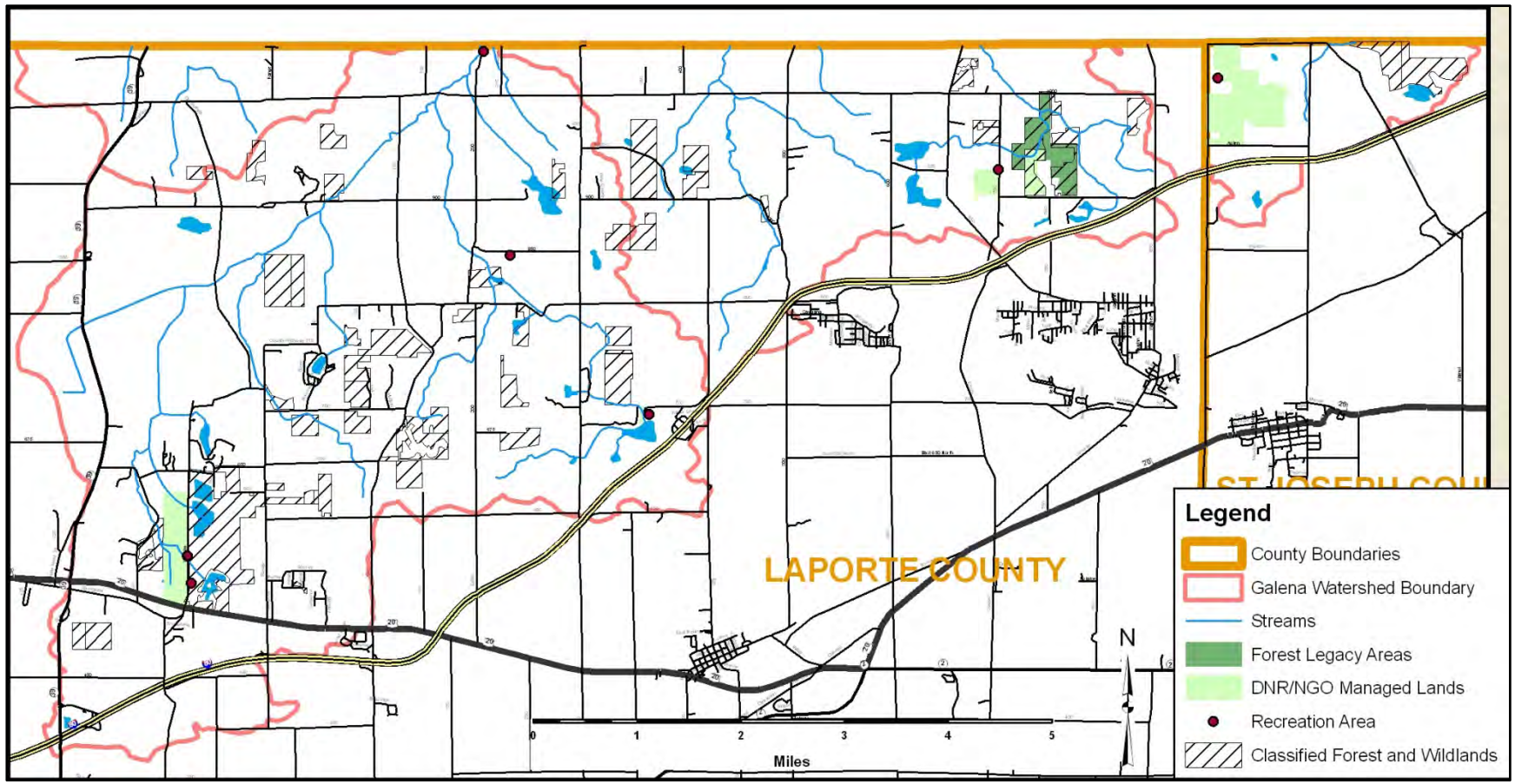

Figure 8. Classified Forest and Wildlands, Forest Legacy, and Recreation Areas in the Galena River Watershed.

(Source: IDNR, 10/28/09)

2.9 Threatened and Endangered Species

Consultation with the IDNR Natural Heritage Database Program was performed to identify state- and federal-listed threatened, endangered and sensitive species and high quality natural areas within the Galena River watershed. Appendix C lists the species and significant natural communities identified in the Galena River watershed during the Natural Heritage Database search. Table 2-7 summarizes the state- and federal-listed species in the watershed.

Table 2-7

THREATENED AND ENDANGERED SPECIES AND HIGH QUALITY NATURAL COMMUNITIES IN THE GALENA RIVER WATERSHED

Location	Subwatershed	Number of Species		High Quality Natural Communities
		State-listed[4]	Federal-listed[5]	
Various locations	various	23	1	-
Hog Lake	headwaters	2	-	-
Willow Lake	headwaters	2	-	-
Galena Wetland Conservation Area	headwaters	3	-	-
Springfield Fen Nature Preserve	headwaters	76	1	Two high quality communities: 1) Wetland-Fen and 2) Wetland-Seep

Being relatively undeveloped and comprising a diverse landscape of forests and wetlands, the watershed is particularly rich in wildlife and plant life and supports a high number of sensitive species. Ninety-four state-listed species, one federal candidate species, and two high quality natural areas are present in the watershed according to the Natural Heritage Program. The Springfield Fen Nature Preserve, located in the headwaters, is a particularly rich area with seventy-six state-listed, one federal candidate species, and two high quality natural communities (Wetland –Fen and Wetland –Seep) in the preserve.

2.10 Cultural Resources

Appendix D provides a list of the properties on the National Register of Historic Places (NRHP) in LaPorte and St. Joseph Counties. According to the NRHP website there are 16 properties listed for LaPorte County (Table 2-8). In St. Joseph County eighty-seven properties are listed on the National Register of Historic Places. The vast majority of these properties are located in South Bend, outside of the watershed boundaries. Because only a small corner of St. Joseph

[4] Includes state-endangered, state-threatened, state rare, state species of special concern, state significant, and watch list species.

[5] Federal candidate species.

County is located within the watershed, the listed properties in the county are not identified individually here (see Appendix D for complete list).

None of the National Register properties are located in the watershed.

2.11 Land Use and Cover

Land use data for the Galena River watershed were downloaded from the Indiana Lakerim website (http://lakerim.indiana.edu/downloads.html). Figures 9a and 9b show land use/land cover in the watershed from 2001 USGS satellite imagery. Table 2-8 lists the acreages of each in the watershed.[6] The Galena River watershed has numerous lakes, small drainages, and marshes. The land is largely undeveloped with considerable areas of forest, wetlands, lakes, agricultural fields and livestock farms. Typical presettlement vegetation consisted of extensive forests, specifically oak-hickory forests in uplands, and beech or northern swamp forest in wetlands (USEPA 2002). Today old growth forests are absent, having been cleared and converted to cropland and pasture, or harvested for wood.

The watershed is likely to become increasingly urbanized, given the excellent access to road and rail connections to the Chicago metropolitan area along the South Shore Railroad and Interstate Highways 94 and 80-90.

Figure 10 shows the imperviousness of the Galena River Watershed in 2001; imperviousness corresponds closely with the existing land use/land cover in the watershed. Because the watershed is relatively undeveloped, only a small portion is impervious. The dominant impervious features are roads and highways.

[6] Note that wetland acreages in Table 2-8 differ from the acreages in Table 2-6. Two different data sources were used. Table 2-6 was created from the National Wetlands Inventory update completed by Ducks Unlimited. Table 2-8 was created from the USGS Land Cover Database. For this report, the wetland acreages from the NWI update by Ducks Unlimited is considered a more accurate acreage for wetlands in the Galena River watershed.

Table 2-8

LAND USE/COVER IN THE GALENA RIVER WATERSHED (in acres)

Source: USGS 2001 National Land Cover Dataset

Land Use /Land Cover	Dowling Creek	Headwaters	South Branch	Spring Creek	Total
Open Water	23	189	7	59	277
Developed, Open Space	103	903	46	391	1444
Developed, Low Intensity	53	447	61	92	654
Developed, Medium Intensity	16	120	9	30	175
Developed, High Intensity	0	14	5	0	19
Barren Land	0	5	0	0	5
Deciduous Forest	926	9393	805	4041	15165
Evergreen Forest	0	122	1	13	136
Grassland/Herbaceous	136	1445	192	646	2419
Pasture/Hay	335	1208	255	978	2775
Cultivated Crops	575	3666	428	1104	5773
Woody Wetlands	149	416	111	159	835
Emergent Herbaceous Wetlands	1	0	0	5	6
Total	2,318	17,928	1,919	7,518	29,684

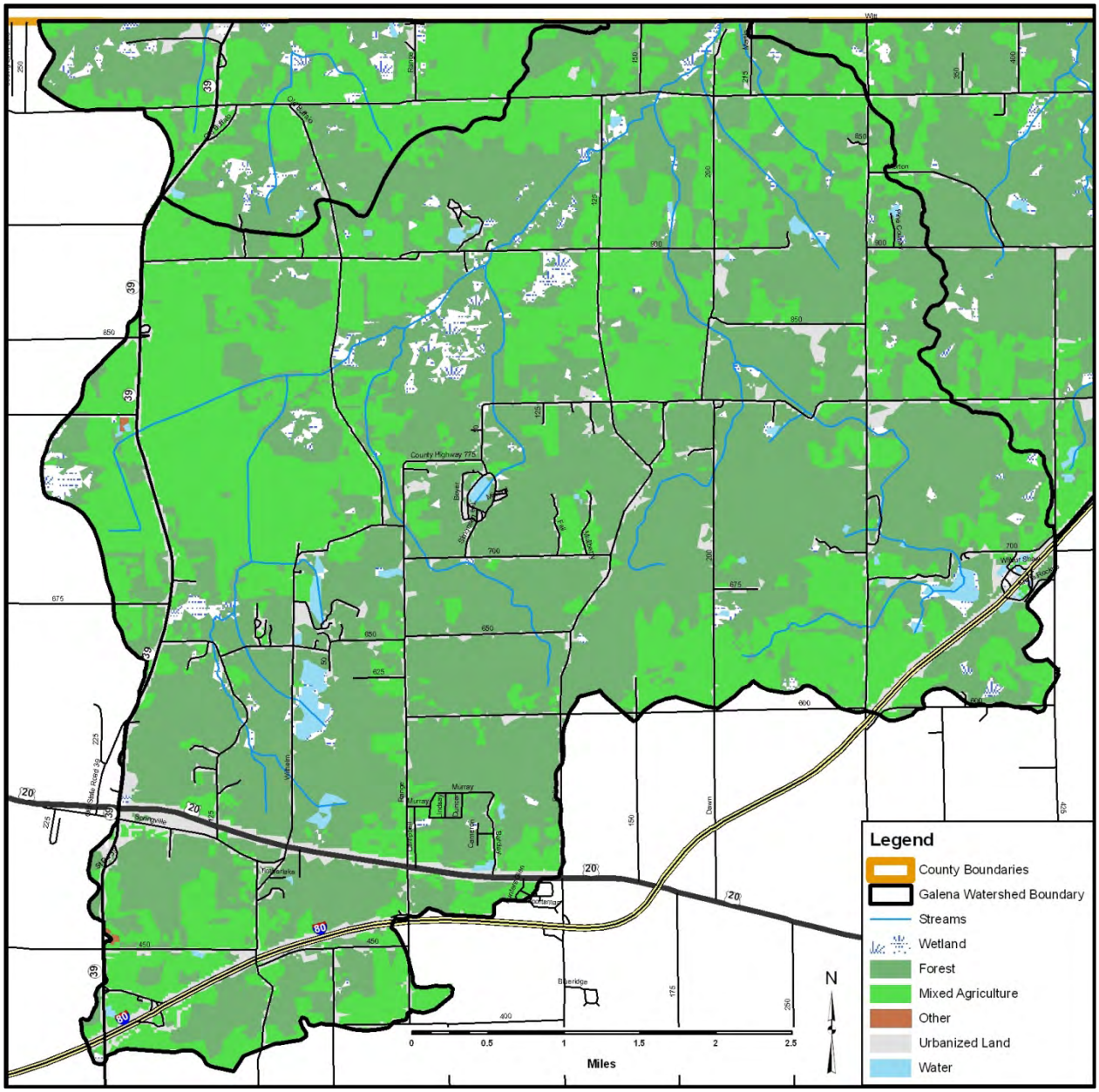

Figure 9a. Land Use/Land Cover in the Galena River Watershed (western portion)

(Source: LC2001USGS_IN: 2001 Land Cover in Indiana, derived from the National Land Cover Database, USGS, 30-meter grid).

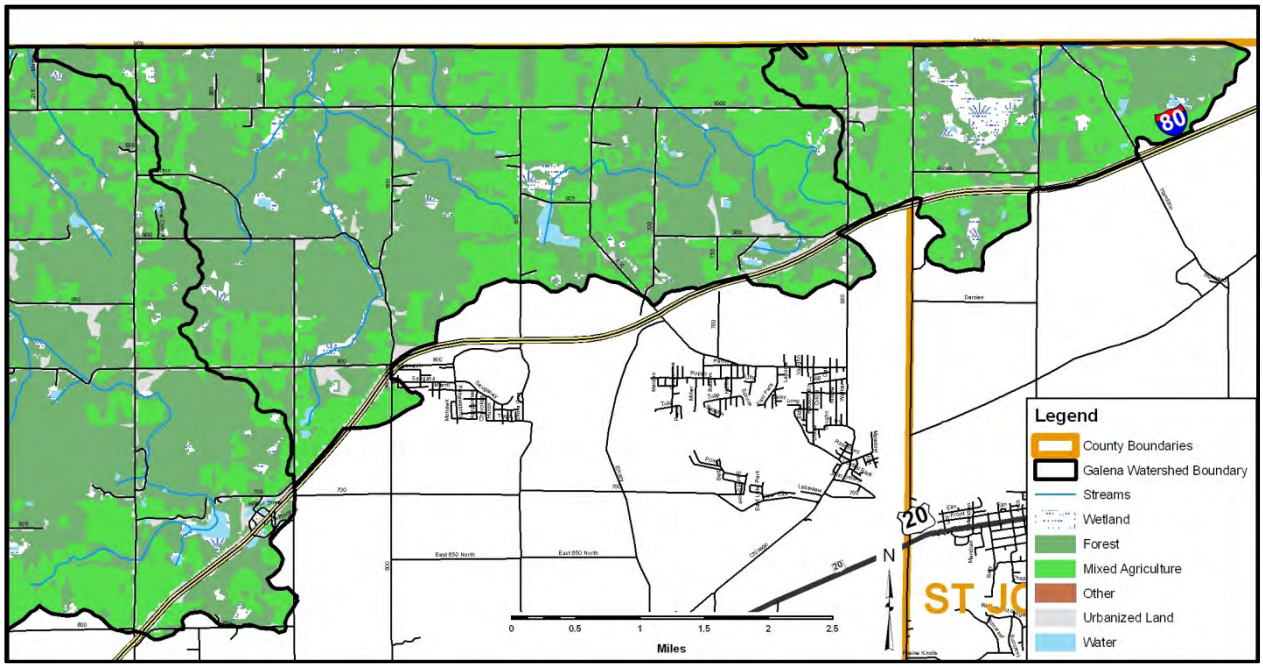

Figure 9b. Land Use/Land Cover in the Galena River Watershed (eastern portion)

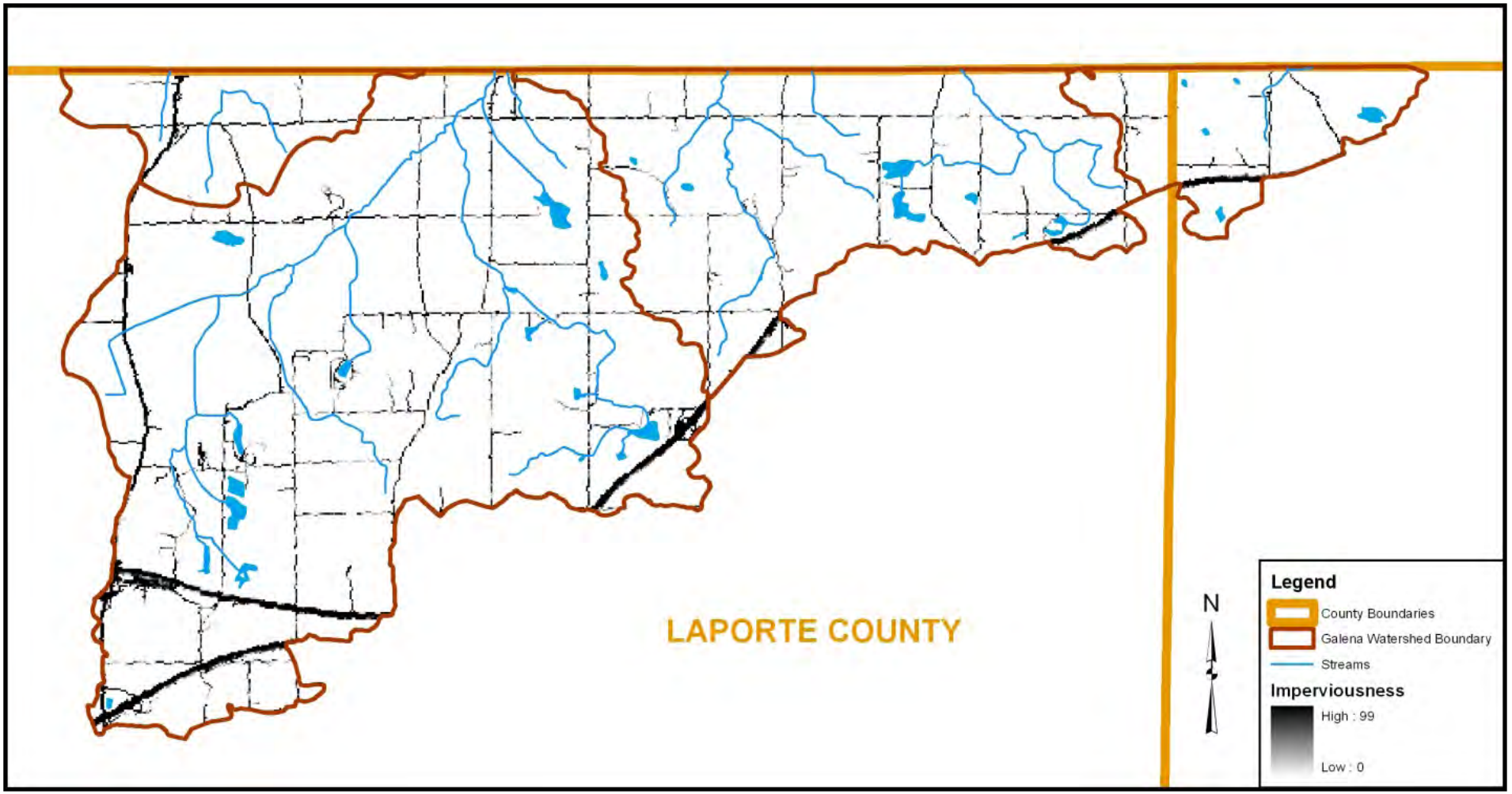

Figure 10. Imperviousness in the Galena River Watershed.

(Source: IS2001USGS_IN: 2001 National Land Cover in Indiana, derived from the National Land Cover Database, USGS, 30-meter grid).

2.12 Point and Nonpoint Source Pollution

The watershed is forested and undeveloped and the population density is low with agriculture a primary land use. Given these characteristics, nonpoint sources are likely the primary causes of pollution entering the streams and drainages within the watershed. Ditches and subsurface drain tiles carry stormwater off agricultural land and into nearby rivers and streams. Runoff from agricultural fields and livestock areas introduce fertilizers, pesticides, sediment, and bacteria into local drainages. Failing septic systems may also contribute nonpoint source pollution to area waterways. The draft TMDL for *E. coli* did not identify any specific sources of nonpoint pollution for this contaminant; Section 3 includes more information on nonpoint sources of pollution based upon our regression analysis of water quality and land cover in each subwatershed.

Potential point sources include wastewater discharges, hazardous waste storage and management facilities, and underground storage tanks. Figure 11 shows the point sources in the watershed. There are no permitted landfills or Superfund sites in the watershed. As discussed earlier there are no CFOs in the watershed. There are, however, three active NPDES permitted facilities within the watershed (Table 2-9).

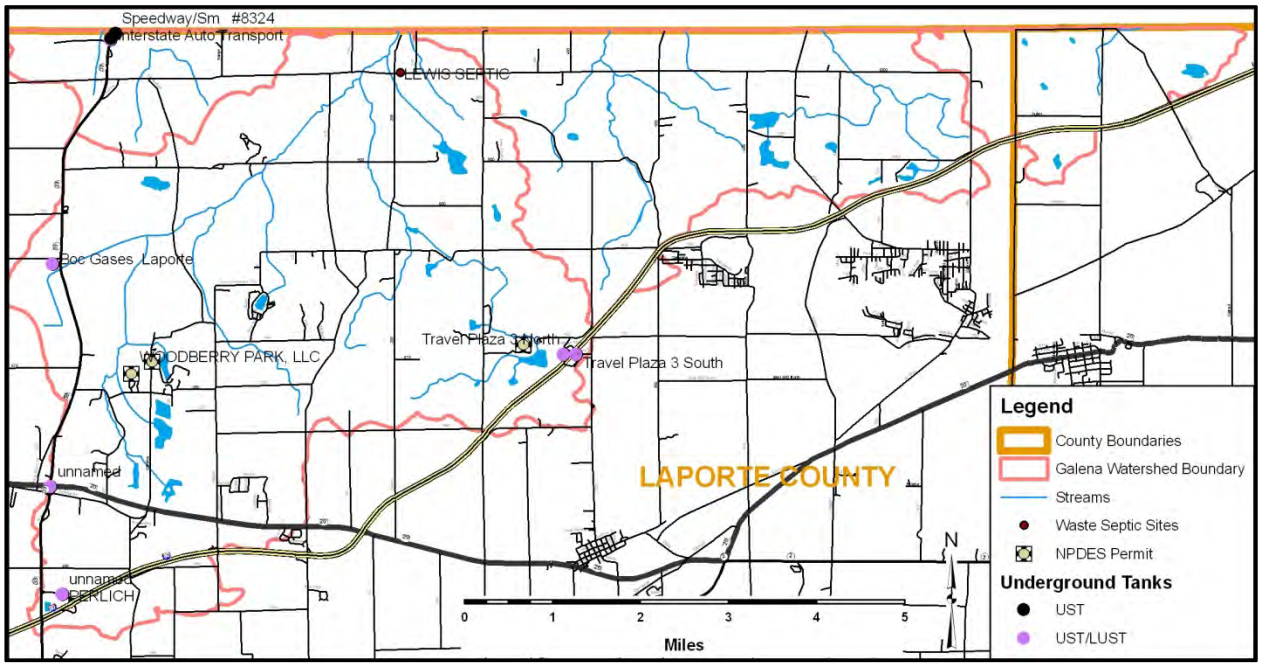

Figure 11. Point sources in the Galena River Watershed

(Source: NPDES_FACILITY_IDEM_IN: Facilities in the NPDES (Shapefile, published by the Indiana Geological Survey, 2002), and LUST_IDEM_IN: Leaking Underground Storage Tanks in Indiana (Shapefile, published by the Indiana Geological Survey, 2005)). Accessed 4/1/09.

Table 2-9

FACILITIES WITH NPDES PERMITS LOCATED WITHIN THE WATERSHED

(Source: U.S. EPA Envirofacts Data Warehouse, www.epa.gov/enviro/index.html)

NPDES Permit #	Facility	Description	Location	County
IN0020931	Indiana DOT SA 3S WWTP Toll Rd. Milepost 56 (Rolling Prairie Service Area)	Regulation and administration of transportation programs	Rolling Prairie, IN	LaPorte
IN0036803	Lalumiere School	Elementary and secondary schools	LaPorte, IN	LaPorte
IN0039535	Woodberry Park, LLC	Operators of residential mobile home sites	LaPorte, IN	LaPorte

IDEM and USEPA provide the public with online access to underground storage tank (UST) information (http://igs.indiana.edu/arcims/statewide/download.html). Underground storage tanks generally present low risk to surface water bodies. Leakages however, do occur, and IDEM has records of leaking UST's (LUST) in a separate database. Figure 11 shows the underground storage tanks and leaking underground storage tanks in the study area. Additional LUST data may be found at http://www.in.gov/idem/files/lust_report.xls.

2.13 On-Site Septic Systems

In LaPorte County, on-site septic systems are governed under Ordinance No. 1996-22, Private Sewage Disposal System Regulations. The 1996-vintage ordinance mirrors the regulations of the Indiana State Department of Health in 410 IAC 6-8.1-1 *et seq.* and 410 IAC 6-10-1 *et seq.* LaPorte County requires that if a sanitary sewer exists or becomes available within 300 feet of the property line of the residential or commercial property, it is to be utilized; otherwise, an on-site sewage disposal system may be used. New developments require a permit for an on-site system. The County Health Officer inspects the work during construction, and, before any underground portions are covered. On-site septic system owners are responsible for ongoing maintenance. Unless the Health Department receives a complaint, no inspections or further consultation is performed by the County.

In 2007 St. Joseph County enacted Ordinance 58-07, new regulations covering water and sewerage. This ordinance also references 410 IAC but is more detailed and addresses residential septic systems (new and replacements), cluster systems (new and replacements, operation), commercial and experimental septic systems, and sanitary privies. When the St. Joseph County Health Department becomes aware of any direct discharge of septic waste or effluent from any structure to the surface or a drain tile, ditch, stream, lake, or other surface water, the Health

Department orders the owner to address this problem by connecting to an available sewer system or installing a new septic system. When the Health Department has reason to believe that a septic system has failed, representatives of the Health Department may enter upon and inspect any private property for such purposes as inspecting, observing, measuring, sampling, testing, and examining records necessary to carry out the provisions of Ordinance 58-07 and protecting public health.

The LaPorte County SWCD, in consultation with the Health Department has a grant proposal pending before the US EPA to perform infra-red thermal aerial imagery of the watershed, inspect and test visibly failing septic systems, and to prepare a GIS for on-site septic systems for the watershed.

3.0 WATERSHED DATA ANALYSIS

In 2002, the Galena River was included on IDEM's 303(d) list of impaired waters and has remained on this list through 2008 (IDEM 2008; Prast and Ak 2009). *E. coli* bacteria were the identified cause of impairing full-body contact recreation use. In 2008 IDEM completed an extensive water quality sampling program to determine if the Galena River and its tributaries were meeting water quality standards. Their study showed that the river and tributaries had elevated levels of *E. coli* that exceeded the water quality standard for full-body contact recreation and therefore a TMDL was required. In 2009, IDEM drafted a TMDL for *E. coli* in the Galena River (but has not yet finalized that document). In concert with these studies, the Indiana DNR and the LaPorte County SWCD completed a habitat and biological assessment at IDEM's water quality sampling sites. Further information on the watershed was provided by a stream buffer analysis completed by the Indiana DNR and a windshield survey performed by Steering Committee volunteers. The results of these studies are summarized below.

3.1 Water Quality

IDEM's 2008 field data are reprinted in Appendix E. In addition to *E. coli*, general chemistry, several nutrient parameters and field parameters (water temperature, pH, turbidity and specific conductance) were also measured. Their sampling sites are shown in Figure 12.

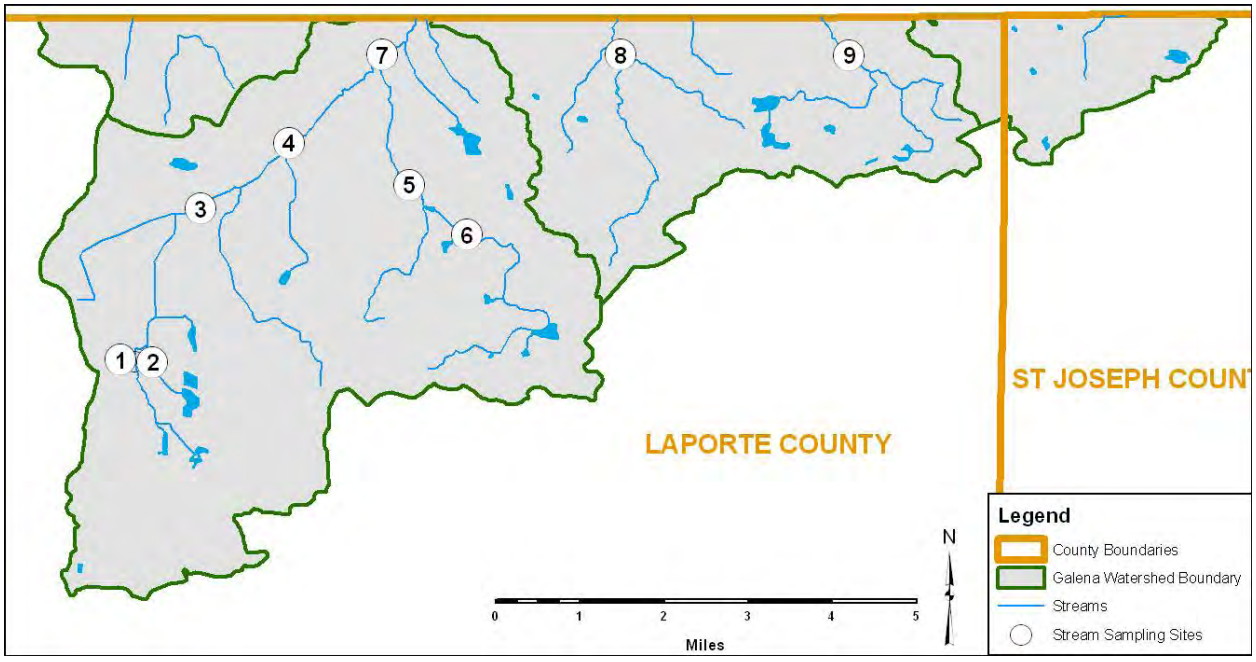

Figure 12. Location of TMDL Sampling Sites.

Summary statistics for *E. coli* counts, nutrient concentrations and suspended solids concentrations for each of the nine sampling sites are in Appendix G. ANOVA was used to

compare site means for selected water quality variables. ANOVA is a statistical test of whether the means of several groups are all equal; ANOVA generalizes Student's *t*-test to multiple groups. For *E. coli*, ANOVA found that not all site means are equal (F=2.41; p-value=0.031), and multiple pairwise comparisons found that the mean *E. coli* at Site 1 is significantly different from Site 6; no other pairwise comparisons showed significant differences between sampling sites.

Table 3-1

DESCRIPTIVE STATISTICS FOR CONCENTRATIONS (MPN/100mL) OF *E. COLI*

(Source: adapted from Prast and Ak 2008)

Site	N	Mean ± 95%Conf. Int.	Median
Galena River (#1)	6	618 ± 401	588
Galena River East (#2)	6	203 ± 216	148
Galena River (#3)	5	449 ± 341	461
Galena River (#4)	5	371 ± 319	308
Main Trib East of Galena River (#5)	6	302 ± 52	317
Main Trib East of Galena River (#6)	6	116 ± 64	102
Galena River (#7)	6	337 ± 256	189
Spring Cr (#8)	5	432 ± 254	435
Trib to Spring Cr (#9)	5	479 ± 319	411

The results of IDEM's 2008 water quality study found that *E. coli* concentrations exceeded the water quality standard at eight of nine sampling sites (Prast and Ak 2009). Indiana's water quality standard for *E. coli* bacteria for full-body contact recreational uses during the recreational season is:

> April 1st through October 31st *E. coli* shall not exceed 125 cfu per 100 milliliters as a geometric mean based on not less than five samples equally spaced over a 30-day period nor exceed 235 cfu per 100 milliliters in any one sample in a 30-day period (327 IAC 2-1-6(d)).

For nitrate+nitrite nitrogen concentrations measured in the watershed, ANOVA found that not all site means are equal (F=8.77; p-value = 0.000+), and multiple pairwise comparisons found that the mean nitrate+nitrite-N at Site 6 is significantly different each other site, that is, much higher. This is an interesting contrast to the relatively low *E. coli* concentrations at Site 6. While there is a 10 mg/L water quality standard for this parameter for designated water supplies, IDEM's draft TMDL target for nitrate-nitrogen in streams is 10 mg/L (see http://www.in.gov/idem/6242.htm). The maximum concentration is any sample collected during IDEM's field study was 1.7 mg/L (Prast and Ak 2008). Means and medians are much lower (Table 3-2).

Table 3-2

DESCRIPTIVE STATISTICS FOR CONCENTRATIONS OF NITRATE+NITRITE NITROGEN (mg/L)

(Source: adapted from Prast and Ak 2008)

Site	N	Mean ± 95%Conf. Int.	Median
1	6	0.100 ± 0.081	0.05
2	6	0.067 ± 0.027	0.05
3	5	0.540 ± 0.208	0.5
4	7	0.483 ± 0.223	0.4
5	6	0.192 ± 0.084	0.2
6	6	1.000 ± 0.632	1.1
7	6	0.400 ± 0.115	0.4
8	5	0.180 ± 0.056	0.2
9	5	0.280 ± 0.136	0.3

For total phosphorus concentrations measured in the watershed, ANOVA testing indicates that all site means are equal (F=0.79; p-value = 0.611). Because site means are equivalent, we can compute a grand mean for phosphorus in the study area streams. Total phosphorus concentration averages 0.024±0.005 mg/L, which is rather low for Indiana streams. IDEM's draft TMDL target for total phosphorus is 0.3 mg/L (see http://www.in.gov/idem/6242.htm). The maximum measured by Prast and Ak (2008) in the watershed was 0.08 mg/L.

Table 3-3

DESCRIPTIVE STATISTICS FOR PHOSPHORUS CONCENTRATIONS (mg/L)

(Source: adapted from Prast and Ak 2008)

Site	N	Mean ± 95%Conf. Int.	Median
1	6	0.023 ± 0.014	0.015
2	6	0.015 ± 0.000	0.015
3	5	0.020 ± 0.014	0.015
4	8	0.031 ± 0.021	0.015
5	6	0.019 ± 0.011	0.015
6	6	0.034 ± 0.023	0.028
7	6	0.021 ± 0.015	0.015
8	5	0.024 ± 0.025	0.015
9	5	0.031 ± 0.035	0.015

According to ANOVA, all site means of total Kjeldahl nitrogen (TKN) concentrations measured by IDEM in the watershed are equal (F=1.33; p-value = 0.254). TKN concentration in stream water averages 0.54±0.06 mg-N/L, which is also rather low for Indiana streams.

Table 3-4

DESCRIPTIVE STATISTICS FOR TKN CONCENTRATIONS (mg/L)

(Source: adapted from Prast and Ak 2008)

Site	N	Mean ± 95%Conf. Int.	Median
1	6	0.53 ± 0.16	0.50
2	6	0.52 ± 0.10	0.50
3	5	0.66 ± 0.29	0.50
4	8	0.66 ± 0.27	0.60
5	6	0.45 ± 0.14	0.40
6	6	0.62 ± 0.17	0.60
7	6	0.47 ± 0.23	0.40
8	5	0.40 ± 0.25	0.30
9	5	0.48 ± 0.24	0.40

Lastly, ANOVA testing of total suspended solids concentrations indicates that all site means are equal (F=0.69; p-value = 0.695). TSS concentration in the streams averages 7.7±2.1 mg/L. The highest TSS measurements were associated with the high flow event of September 16, 2008, and the maximum TSS measured by IDEM was 35 mg/L at Site 6. IDEM's draft TMDL target for TSS is 30 mg/L (see http://www.in.gov/idem/6242.htm), and there was only 1 (of IDEM's 45 measurements) exceeding this target.

Table 3-5

DESCRIPTIVE STATISTICS FOR TSS CONCENTRATIONS (mg/L)

(Source: adapted from Prast and Ak 2008)

Site	N	Mean ± 95%Conf. Int.	Median
1	6	5.5 ± 3.2	6.0
2	6	4.3 ± 2.4	4.0
3	5	12.0 ± 7.1	10.0
4	8	10.8 ± 10.0	7.0
5	6	5.2 ± 2.0	5.0
6	6	9.8 ± 13.6	4.0
7	6	7.8 ± 10.4	4.0
8	5	7.6 ± 8.9	5.0
9	5	6.0 ± 7.0	4.0

We were able to calculate instantaneous pollutant loads and areal loads for suspended sediment, total phosphorus and total nitrogen for the grab samples collected by IDEM for their TMDL (Prast and Ak 2009). If the water quality measurement was reported to be less than the method detection limit, we used 50% of the detection limit as the estimate of pollutant concentration.

Tables 3-6 and 3-7 contain the estimates of instantaneous loads for the three sampling sites where IDEM measured discharge data concurrently with their sampling. Their sampling activities took place in September and October, 2008. There were two wet weather events during their field sampling; on September 15, 2008 rains from Hurricane Ike brought approximately 10 inches of precipitation the day before sampling on September 16. The Galena River was flowing high at Site # 7 during sampling on Sept. 16 and, because of dangerous conditions, discharge was estimated at that time. Concurrently, IDEM measured discharge at the other two stream sites, Spring Creek Site #8, and Unnamed Tributary to Spring Creek Site #9 on Sept. 16. It also rained on September 30, 2008, when approximately 1.5 inches fell in the watershed about four hours prior to sampling. The collections that occurred on September 16, 2008 particularly illustrate the effect of higher runoff on pollutant loads.

Table 3-6

INSTANTANEOUS SUSPENDED SOLIDS AND NUTRIENT LOADS

(Source: adapted from Prast and Ak 2008)

Site Name	Date	Suspended Solids Load (lbs/d)	P Load (lbs/d)	N Load (lbs/d)
Galena River (#7)	9/16/2008	7,627	14	409
Galena River (#7)	9/23/2008	303	1.1	61
Galena River (#7)	9/30/2008	440	1.3	70
Galena River (#7)	10/7/2008	258	1.0	39
Galena River (#7)	10/14/2008	102	0.8	36
Spring Cr (#8)	9/16/2008	774	2.3	31
Spring Cr (#8)	9/23/2008	61	0.1	4.4
Spring Cr (#8)	9/30/2008	44	0.2	4.4
Spring Cr (#8)	10/7/2008	52	0.2	7.3
Spring Cr (#8)	10/14/2008	20	0.1	5.0
Trib to Spring Cr (#9)	9/16/2008	564	2.8	32
Trib to Spring Cr (#9)	9/23/2008	25	0.2	4.9
Trib to Spring Cr (#9)	9/30/2008	28	0.1	4.8
Trib to Spring Cr (#9)	10/7/2008	22	0.1	4.4
Trib to Spring Cr (#9)	10/14/2008	13	0.1	3.8

Table 3-7

INSTANTANEOUS *ESCHERICHIA COLI* LOADS

(Source: adapted from Prast and Ak 2008)

Site Name	Date	E. coli Load (MPN per d)
Galena River (#7)	9/16/2008	167,014
Galena River (#7)	9/23/2008	13,839
Galena River (#7)	9/30/2008	60,476
Galena River (#7)	10/7/2008	11,146
Galena River (#7)	10/14/2008	9,472
Spring Cr (#8)	9/16/2008	26,565
Spring Cr (#8)	9/23/2008	3,818
Spring Cr (#8)	9/30/2008	3,799
Spring Cr (#8)	10/7/2008	1,520
Spring Cr (#8)	10/14/2008	5,429
Trib to Spring Cr (#9)	9/16/2008	14,477
Trib to Spring Cr (#9)	9/23/2008	3,570
Trib to Spring Cr (#9)	9/30/2008	2,379
Trib to Spring Cr (#9)	10/7/2008	1,075
Trib to Spring Cr (#9)	10/14/2008	5,427

E. coli was the only parameter that exceeded water quality standards in IDEM's survey. Nutrient levels were well below the targets set by IDEM, 10 mg/L for nitrate-nitrogen and 0.30 mg/L for phosphorus (http://www.in.gov/idem/6242.htm). Other than *E. coli*, the values for each parameter showed no violations or exceedances of the water quality standard or IDEM benchmark. Water quality results did not vary significantly even during high flow events (Prast and Ak 2009).

It should be noted that as the Galena River leaves Indiana and flows through Michigan (where it is named the Galien River), the water quality problems become more numerous and more severe. In addition to *E. coli*, the watershed management plan for the Galien River identified the following causes of use impairments: sedimentation, elevated nutrient levels, changes in flow patterns, chemical contamination from fertilizers/urban sources, among other things (Fishbeck *et al.* 2003).

3.2 Load Reductions

Section 303(d) of the Federal Clean Water Act requires states to develop Total Maximum Daily Loads (TMDLs) for waterbodies that are not meeting Water Quality Standards (WQS). A TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still

meet water quality standards. In other words, it determines the pollutant reductions necessary from point and nonpoint sources to meet water quality standards or benchmarks. The purpose of the Galena River TMDL was to determine the reductions in *E. coli* bacteria needed to meet the applicable water quality standard for the stream, that is, to support full body contact recreation. IDEM's draft TMDL for coliform bacteria has not yet been finalized. Other water quality parameters are within applicable water quality standards and do not cause water use impairment; no other pollutants require load reductions at this time.

Table 3-8 reprints the draft TMDL recommendations for reductions in *E. coli* levels at the different sampling sites to meet water quality standards (IDEM 2009). Out of nine sampling sites, only Site 6 met the water quality standards for *E. coli.*

Table 3-8

LOAD REDUCTIONS RECOMMENDED FOR THE GALENA RIVER

(Source: Draft TMDL Report, IDEM 2009)

Stream Name	Geometric Mean (MPN/100mL)	Percent Reduction Needed
Galena River (#1)	613	80%
Galena River East (#2)	144	13%
Galena River (#3)	379	67%
Galena River (#4)	288	57%
Main Trib East of Galena River (#5)	287	56%
Main Trib East of Galena River (#6)	116	N/A
Galena River (#7)	297	58%
Spring Cr (#8)	383	67%
Trib to Spring Cr (#9)	424	71%

According to the draft TMDL, the sources for *E. coli* likely include the following: wildlife, failing septic systems, small livestock operations, and the three NPDES permitted facilities (all three have *E. coli* limits in their permits). In subsequent sections, we present analyses that strongly associate *E. coli* levels with grass and pasture lands.

The draft TMDL report recommended the following actions to reduce *E. coli* in runoff: riparian area management, manure collection and storage, contour row crops, no-till farming, manure nutrient testing (for manure application), drift fences for directing livestock, pet cleanup/education, and septic management/public education.

3.3 Habitat

IDNR and the SWCD performed habitat assessments at each sampling site in Figure 12 in October and November 2008. For the Galena River, the Ohio EPA's Qualitative Habitat

Evaluation Index (QHEI) assessment was used. This approach rates and quantifies the condition of the in-stream and the near-stream habitat. The QHEI ranking tool consists of seven habitat metrics (Table 3-9). The maximum QHEI score is 100. The higher the QHEI score the more diverse the habitat which in turn can support a greater diversity of fish and macroinvertebrates. According to IDEM, a QHEI score less than 51 indicates poor habitat (IDEM 2008). Only one site, Site 6, has a score lower than 51. Figure 13 shows the results graphically; a horizontal red line represents the IDEM threshold for poor habitat.

Table 3-9

QHEI RESULTS FOR THE GALENA RIVER, LAPORTE AND ST. JOSEPH COUNTIES

(Source: IDNR)

Habitat Parameters	Total Points Available	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9
Substrate	20	14	12	11	8.5	12.5	3	14	13	14
Instream Cover	20	13	12	14	15	12	12	15	12	12
Channel Morphology	20	10	11	8	15	16	12	14	13	12
Bank Erosion and Riparian Zone	10	5	9	7	10	10	8.5	10	10	8.5
Pool/Glide Quality	12	7	4	7	7	4	5	7	4	4
Riffle/Run Quality	8	0	0	0	0	0	0	2	1	2
Gradient	10	8	6	10	6	8	4	6	6	4
Total	**100**	**57**	**54**	**57**	**61.5**	**62.5**	**44.5**	**68**	**59**	**56.5**

Site 7 had the highest QHEI value (68); Site 6 had the lowest (44.5). Habitat quality at several of the sampling sites ranked just above IDEM's threshold for poor habitat. The low score at Site 6 may be attributed to livestock having had direct access to the stream at this site in the past. The stream banks continue to erode even though livestock no longer have access. Site 6 also had some of the highest nutrient and TSS concentrations measured by IDEM.

Riffles are generally considered the most biologically productive habitat type found in streams. During the habitat assessment, riffles were generally found to be lacking or poorly developed at all sites. This was largely due to the low gradient of the landscapes, unstable substrates types, and shallow water depths. Additionally, the stream substrate at most sites was found to be moderately embedded. Sources of increased sediment loading include streambank erosion and runoff from upland sources. Moderate to heavy/severe streambank erosion was observed at Sites 1, 3, 6, and 9.

Where riffle habitat does not occur, large woody debris becomes an important component of the available substrate for macroinvertebrates. Large woody debris was found to provide habitat at all sites except Site 6.

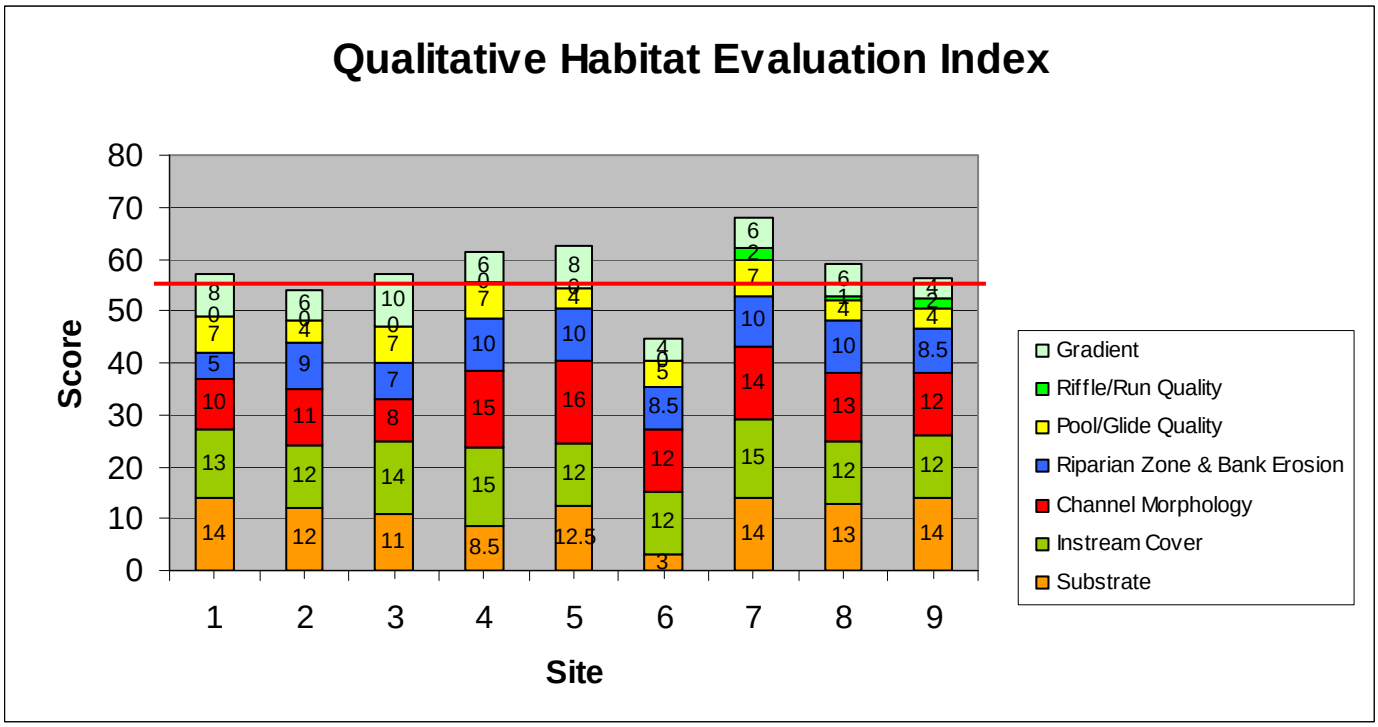

Figure 13. QHEI Results for the Nine Sampling Sites in the Galena River Watershed. (note the red horizontal line signifies the score, <51, IDEM considers indicative of poor habitat). Figure provided by IDNR.

A stream hydrology and morphology assessment was completed as part of Michigan's Galien watershed management plan. The morphological assessment was performed using the Rosgen Level 2 classification system to assess the stability of the river system. Inclusion of an assessment methodology such as the Watershed Assessment of River Stability and Sediment Supply (WARSSS), which incorporates Rosgen's assessment methodology, would enhance the Galena watershed management plan in more accurately identifying sediment sources and restoration expectations, priorities and needs (Rosgen 1996).

3.4 Macroinvertebrates

Macroinvertebrate are animals without a backbone that are big enough to see with the naked eye that spend all or part of their life cycle in or on the stream bottom (most aquatic insects, snails, mollusks, and crayfish). They are frequently used in biological assessments for the following reasons (Barbour *et al.* 1999):

- They are ubiquitous in most streams and sampling is relatively easy.
- They exhibit a wide range of trophic levels and pollution tolerances which allows a wide range or responses to pollution
- They are sedentary, relative to fish, which provides information on localized conditions.
- Degraded conditions can be easy to detect by an experienced biologist with a quick examination.
- They serve as a primary food source for fish, including many recreationally and commercially important species.
- Macroinvertebrate data are routinely collected and analyzed by most state water quality agencies.

Macroinvertebrates were collected at the nine water quality sampling sites by Indiana DNR and LaPorte County SWCD staff using IDEM bioassessment procedures in October and November 2008. Macroinvertebrates were preserved in the field and then counted and identified to family-level in the laboratory.

Impairment of the macroinvertebrate community may be manifested by reduced taxa richness, and/or shifts in community composition in comparison to a reference condition, and by the absence of pollution intolerant taxa such as Ephemeroptera (mayfly), Plecoptera (stonefly), and Tricoptera (caddisfly) (EPT). Data analysis of the macronvertebrate community was done using the EPA's Rapid Bioassessment Protocols (RBP) II for family level identification (Barbour *et al.* 1999). The macroinvertebrate analysis used a variety of richness, abundance, community composition, tolerance, and trophic structure measures to assess the condition of the macroinvertebrate community in the Galena River and tributaries. Table 3-10 lists several of the metrics investigated and the expected response to increasing disturbance.

Table 3-10

MACROINVERTEBRATE METRICS AND EXPECTED RESPONSE TO DISTURBANCE

Metric	Definition	Expected Response to Increasing Stress
Taxa Richness	Number of distinct taxa	Decrease
Family Biotic Index	Index based on Hilsenhoff (1987), reflects tolerance to pollution	Increase
Scrapers/Filter Collectors	Ratio of the numbers of scrapers to the numbers of filter collectors.	Increase or decrease
EPT/Chironomid	Ratio of the number of individuals in the orders of Ephemeroptera, Plecoptera, and Tricoptera to the number of individuals in the family Chironomidae	Decrease
% Dominant	Relative abundance of the most common taxa	Increase
EPT Richness	Number of distinct taxa in the orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Tricoptera (caddisflies)	Increase
Community Loss Index	Index that estimates the loss of taxa between comparison samples and reference samples.	Increase
% Shredders	Relative abundance of the functional group shredders	Decrease

Table 3-11 provides the results of the macroinvertebrate study; the values represent scores, taxa numbers, ratios or percentages. An index and ranking system was created using the scores from Table 3-11. Site 4 was selected as a reference condition. While it did not have the best score for all metrics, the project biologists felt that this was the best site based on macroinvertebrate metric scores, habitat scores, and best professional judgment. Table 3-12 provides the index and ranking for each sampling site; Table 3-13 provides a narrative and numerical key to assessing each sampling site in comparison to the reference site.

Table 3-11

MACROINVERTEBRATE SCORES

(Source: IDNR)

Metric	Site								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Taxa Richness	16	11	12	17	13	12	14	13	14
Family Biotic Index	5.61	4.04	4.66	3.86	4.38	3.95	3.90	3.95	3.94
Scrapers/Filter-Collectors	0.1	1.4	3.0	1.8	0.5	0.0	3.0	2.4	2.0
EPT/Chironomid	0.2	4.0	8.0	2.1	0.6	5.3	3.6	3.1	8.3
% Dominant Taxa	39.6	86.2	40.0	29.3	33.8	50.5	78.6	75.0	37.3
EPT Richness	3	3	3	6	5	3	5	6	7
Community Loss Index	0.7	1.1	0.7	0.0	0.6	0.5	0.5	0.7	0.7
% Shredders	5.7	1.4	0.0	8.6	5.0	24.8	4.8	10.2	18.6

According to Tables 3-12 and 3-13, the majority of sampling sites indicate a moderately impaired biological condition. Sites 4 and 9 are not impaired, however, Sites 1, 2, 3, 5, and 6 are moderately impaired. Sites 7 and 8 have intermediate values between non-impaired and moderately impaired biological condition. Habitat quality, in particular sediment loading and poorly developed or absent riffles, may be a limiting factor for the macroinvertebrate community at many of the sites. Again, completion of a Rosgen-based analysis such as the WARSSS would identify stream channel instability problems, and confirm the likelihood of sediment limiting the diversity of the macroinvertebrate community.

Table 3-12

MACROINVERTEBRATE RANKING BASED ON MULTIMETRIC INDEX[1]

(Source: IDNR)

Metric	Site								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Taxa Richness	6	3	3	6	3	3	6	3	6
Family Biotic Index	6	6	3	6	6	6	6	6	6
Scrapers/Filter-Collectors	0	6	6	6	3	0	6	6	6
EPT/Chironomid	0	6	6	6	3	3	6	6	6
% Dominant Taxa	3	0	3	6	3	0	0	0	3
EPT Richness	0	0	0	6	3	0	3	6	6
Community Loss Index	3	3	3	6	3	3	3	3	3
% Shredders	6	0	0	6	6	6	6	6	6
Total	24	24	24	48	30	21	36	36	42
% of Reference Site	50	50	50	100	63	44	75	75	88
Impairment	M	M	M	N	M	M	M	M	N

[1]Results from Table 3-11 have been ranked and converted into an index for the Galena River. Site 4 is used as the reference condition

Table 3-13

KEY TO ASSESSING STREAM HEALTH AT EACH SAMPLING SITE IN COMPARISON TO THE REFERENCE SITE

(Source: Barbour *et al.* 1999)

Percent Comparison to Reference Score	Biological Condition	Description
>79%	Non-impaired	Balanced trophic structure. Optimum community structure for stream size and habitat
29-72%	Moderately impaired	Fewer species due to loss of most intolerant forms. Reduction in EPT index.
<21%	Severely impaired	Few species present. Only tolerant species present.

3.5 Examination of Biotic and Abiotic Relationships

As part of the watershed management planning effort, correlation and trend analyses were performed on water quality, habitat, and macroinvertebrate data to examine the relationship between biotic and abiotic variables. Results are summarized below; more complete details are included in Appendix G.

Limited data were available for this analysis. The water quality data collected in 2008 by IDEM for the draft *E. coli* TMDL were utilized, as well as some older data collected in 2000. The habitat and macroinvertebrate data the Indiana DNR collected in 2008 at the TMDL water quality sampling locations were also used in the analyses.

Spearman (rank) correlation coefficients and p-values for 595 unique bivariate combinations were calculated. Of the 595 coefficients, 59 are statistically significant (α=0.05) although little valuable information for managing the watershed can be drawn from the results. For example, *E. coli* data correlated significantly with alkalinity (r=0.683) and numbers of Ephemeroptera taxa found at a site (r=0.692). Such correlations do not indicate cause and effect relationships and may be simply random associations. The habitat index, QHEI, was only associated with one other variable, Riparian Zone & Bank Erosion Score, which is part of the QHEI score. The Family Biotic Index, FBI, which reflects pollution tolerance at the family level, was not associated with any pollutant or habitat variable.

The most informative statistical analyses were those using land use/land cover data to predict water quality. To aid identification of nonpoint sources of pollutants, regression analyses were performed, where land use/land cover upstream of each sampling site was used as predictor variables and median pollutant concentrations as the response variable. To simplify the analysis, land use types were consolidated to seven categories: grassland (type 71), pasture (type 81), crops, forest, wetland, developed land, and open water. The USGS definitions for land cover types 71 and 81 have subtle differences. Type 71, grassland, is characterized by natural or semi-natural herbaceous vegetation, accounting for 75 to 100 percent of the cover, and is dominated by upland grasses and forbs. These areas are not subject to intensive management, but are often utilized for grazing. Type 81, pasture, is characterized by herbaceous vegetation that has been planted or is intensively managed for the production of grasses, legumes, or grass-legume mixtures for livestock grazing or the production of seed or hay crops. In other words, both land cover types 71 and 81 may be used for grazing livestock.

For the impairment caused by E. coli bacteria concentrations, the best regression model included pasture and grass land as predictors (p=0.0005), accounting for 88% of the variability in median coliform concentrations. The regression equation is:

$$Ecoli = 19.21 * Grass + 10.68 * Pasture$$

where *Grass* and *Pasture* are the fractions the drainage classified as that particular land cover type, and *Ecoli* is the median coliform concentration (CFU per 100 mL). While such a regression using observational data does not indicate causation, it strongly suggests that grasslands and

pasturelands are source areas for coliform bacteria in the watershed. Increases in the drainage area used for grass or pasture can be expected to result in increased median stream concentrations of *E. coli*. Therefore, we recommend that these land uses, especially those containing horses or other livestock, be given particular attention in the implementation phases of watershed management.

When median concentrations of nitrate+nitrate nitrogen (NO3+NO2) were used as the response variable, another statistically significant regression was derived (p=0.0006), accounting for more than 78% of the variability of nitrate+nitrate nitrogen. The regression equation is:

$$NO3 + NO2 = 0.022 * Crop$$

where *Crop* is the fraction of the drainage area classified as cropland. The regression indicates that for each percentage increase in the drainage area used for crop production, a 0.022 mg/L increase can be expected in median stream nitrate+nitrate nitrogen concentration.

We also used median concentrations of total phosphorus, total Kjeldahl nitrogen and total suspended solids as response variables. No land use types were significant predictors of concentrations of total phosphorus, Kjeldahl nitrogen or suspended solids (p>0.05).

3.6 Stream Buffer Analysis

Stream buffers, also known as riparian buffers, are vegetated zones adjacent to the stream. Stream buffers have many benefits. They help prevent sediment, nutrients, pesticides and other pollutants from reaching the stream. They help maintain cool water temperatures by shading the stream which is critical for certain fish and macroinvertebrate species. Riparian buffers are a major source of energy and nutrients for the streams biological community especially in headwater tributaries. They also slow down flood waters and help with groundwater recharge. Riparian buffers are most effective when they include a native grass or herbaceous filter strip along with deep rooted trees and shrubs along the stream.

A stream buffer analysis was performed by IDNR Coastal Program staff using the NOAA's Coastal Change Analysis Program (www.csc.noaa.gov/crs/lca/ccap.html). This is a standardized database of land cover and change information developed using remotely sensed imagery for the coastal regions of the U.S. A 100-foot zone on each side of the stream was used to compare riparian buffer widths. Given that the satellite imagery available is a 30-m grid raster, this 100-ft distance (actually 98.4 feet) is convenient for GIS processing. Analysis using a smaller zone, say based on 30-ft buffers, would require higher resolution imagery, which is not currently available. Pragmatically, 100-ft stream buffers may not be achievable. IDNR Coastal Program, LaPorte County SWCD, and USDA Natural Resource Conservation Service staff felt that the 100-ft buffer would be effective in this screening level tool to identify priority areas for implementation. The information gathered from the analysis can be further refined and field verified by land owners and SWCD and NRCS staff. Actual buffer needs will be dependent on factors such as soil conditions, adjacent land cover, and slope.

The analysis showed that approximately 6.45 miles of stream may not have sufficient buffer on at least one bank. For both banks, the area is about 162 acres. A figure showing the locations where the riparian buffer may not be sufficient is included in Appendix B. The CCAP database indicates that a majority of the land cover within the 100-ft buffer is comprised of agricultural land with small inclusions of development.

We also computed the distance of streams with less than 100-ft buffers in each drainage upstream of the TMDL sampling sites. We used these stream lengths as predictors of median pollutant concentrations and did not find any significant models for *E. coli*, nitrate+nitrite nitrogen, total phosphorus, Kjeldahl nitrogen or suspended solids ($p>0.05$).

3.7 Windshield Survey

The Steering Committee performed a visual assessment of the watershed to identify potential problem areas. In September 2009 Steering Committee volunteers drove the watershed and completed USEPA's Visual Assessment Protocol (see Appendices B and I). At each intersection where a road crossed the Galena River or one of its tributaries, volunteers completed the USEPA's Watershed Survey Visual Assessment form, took photos, marked the area on a map, and took general notes on the stream condition at that site. A figure showing the location of the sampling sites is included in Appendix B; 37 sites were assessed during the windshield survey. Most volunteers observed that the river and tributaries were in good condition. In general, fairly wide riparian buffer were present at many of the visual survey sites, good stream flow was observed in the larger tributaries, the stream and tributaries had low turbidity, and culverts were in relatively good condition. Sites G1, G2, G24, and G28 were located on regulated drains. At Site G1 no water was observed in the channel and likely only conveyed flows during wet weather events. Site G2 did have water downstream of CR 1000 North however it was not flowing and was turbid. There appeared to be an adjacent horse pasture with fencing, but no horses were observed at the time of the survey. Site G24 did have water present with minimal flow. Some erosion was observed along with concrete rubble used to stabilize some areas.

Site G28, located on Warwick Ditch off of SR 39, was the largest regulated drain observed during the windshield survey. There was no flow present at the time of the survey and the water was extremely turbid. A narrow dirt access road bordered the southern top of bank. Riparian vegetation was only within the steep ditch banks. Row crops were present to near the top of bank for approximately 1.3 miles downstream towards sampling Site 3. No berms or spoil pile that could divert runoff from the channel were observed. Warwick Ditch drains primarily hydric soils. If wetland restoration is not feasible or desired by the current landowner, Site G28 may be a good candidate for a two-stage ditch or vegetative buffer along the top of bank to capture sediment and nutrient runoff.

While the USGS National Hydrography Dataset (NHD) does not show the presence of a stream at Site G4, a perennial stream is present. The stream crosses CR 1000 North just east of CR 125 East through two large culverts measuring approximately 10 feet in diameter. Based on National

Wetland Inventory (NWI) and NHD data, the stream appears to be a headwater tributary originating in a small series of wetlands to the north. The bottom elevation of the two culverts through which the stream flows under CR 1000 North is approximately three feet above the water level on the downstream side creating a fish passage barrier. The stream bank downstream of the culvert is also severely eroded. The site should be investigated further as a potential restoration area, especially given the presence of wetlands upstream that could provide fish spawning and nursery habitat.

At Site G8 spoils from what appeared to be culvert flow maintenance were observed placed on the bank within a wetland. Downstream of the culvert, the water was stagnant and turbid.

Grazing pastures and fencing for horses was observed at Site G19. While no horses were observed at the time of the survey, they appeared to have access to the stream for watering based on the fencing. There was minor evidence of stream bank erosion from trampling. The stream bottom also had periphyton growth indicating potential nutrient runoff contribution.

At sampling Site 9 and upstream tributaries (Sites G29, G33, G34, G35, G36, and G37) 50 percent of the land was observed to be fallow. The western tributary upstream of Site 9 (Sites G29, G33, G34) had no noticeable input from septic or livestock sources. This may be a good tributary to sample to understand the wildlife influences in the area. Cattle, horses, and possible septic sources are present on the eastern tributary upstream of Site 9 (Sites G35 and G36).

3.8 Tillage

We were provided datasets for LaPorte County's 2004, 2007 and 2009 cropland roadside surveys (available online at http://www.in.gov/isda/2354.htm). These surveys gather information on various agricultural practices, primarily tillage and crop residue management systems. Relatively few of the county's overall field examinations were made in the Galena watershed. In 2004 and 2007, 44 fields had tillage practices recorded and crop residues measured; 42 were examined in 2009. Data on agricultural fields in the study area are summarized in Tables 3-14 and 3-15.

A proper analysis of trends in tillage practices or crop residue cover should use more than these three years, but some generalizations can be made. Clearly, conventional tillage practices for corn are diminishing, in favor of other crops and tillage practices, particularly no-till soybeans. Further, Table 3-15 suggests an increase in crop residue cover on the fields in the Galena Watershed since 2004.

Table 3-14

CROPPING AND TILLAGE PRACTICES IN THE GALENA WATERSHED

(Source: Indiana Department of Agriculture)

		Percent of Fields		
Present Crop	**Tillage**	**2004**	**2007**	**2009**
Corn	Conventional	23%	14%	5%
Corn	Mulch-till	2%	2%	5%
Corn	No-till	7%	9%	12%
Corn	Reduced-till	7%	5%	5%
CRP	Not applicable	7%	5%	7%
Fallow	Not applicable	5%	5%	5%
Hay	Not applicable	16%	14%	19%
other	Not applicable	2%	2%	0%
other	Conventional	0%	0%	2%
other	other	5%	0%	0%
other	Reduced-till	0%	2%	0%
Small grains	Conventional	5%	2%	0%
Small grains	No-till	0%	5%	2%
Soybean	Mulch-till	0%	2%	0%
Soybean	No-till	0%	5%	0%
Soybean, drill	Mulch-till	0%	2%	2%
Soybean, drill	No-till	11%	14%	17%
Soybean, drill	Reduced-till	0%	0%	2%
Soybean, narrow	Conventional	2%	0%	0%
Soybean, narrow	Mulch-till	0%	7%	0%
Soybean, narrow	No-till	7%	2%	17%
Soybean, narrow	Reduced-till	0%	2%	0%
Soybean, wide	Mulch-till	0%	2%	0%
Soybean, wide	No-till	2%	0%	0%

Table 3-15

CROP RESIDUE ON FIELDS IN THE GALENA WATERSHED

(Source: Indiana Department of Agriculture)

	Percent of Fields		
Residue Cover	**2004**	**2007**	**2009**
Not applicable	41%	25%	31%
0-15%	23%	16%	7%
16-30%	5%	9%	7%
31-50%	9%	11%	12%
51-75%	11%	18%	5%
76-100%	11%	20%	38%

4.0 WATERSHED PROBLEMS, SOURCES AND CRITICAL AREAS

Using information from the 2008-2009 water quality, habitat, and macroinvertebrate studies, the draft TMDL, the stream buffer analysis, the windshield survey, the biotic-abiotic regression analyses, and personal experience, the Steering Committee was able to identify the following issues and problems for the Galena River watershed (Table 4-1). Table 4-1 also identifies the causes of nonpoint source pollution and their sources. Additional detail, including identification of critical areas for nonpoint source controls are included in the sections that follow.

Table 4-1

WATERSHED ISSUES, PROBLEMS AND CAUSES

Issue:	Insufficient staff to implement watershed plan
Problem Statement:	Without a dedicated Watershed Coordinator it will be difficult to implement key aspects of the watershed management plan.
Cause:	Lack of funding for watershed coordinator position.
Issue:	Future development
Problem Statement:	Unplanned development may have a negative impact on sensitive natural resources and the rural character of the watershed.
Cause:	High development pressure for area
Issue:	Impaired water use (303(d) listing)
Problem Statement:	*E. coli* levels exceed the State standard of 235 colonies/100 mL throughout the watershed because of human (septic), livestock, and wildlife influences.
Cause:	*E. coli* levels exceed the water quality standard.
Sources:	On-site septic systems, wildlife, horses and other livestock, and pets. Strongly associated with grass and pasture land.
Issue:	Historic wetland loss
Problem Statement:	The hydric soils map shows that historic acreages of wetlands were greater than exist today throughout the watershed. Over time may wetlands have been drained and converted to agriculture.
Cause:	Conversion of wetlands to agriculture

Issue:	Sensitive natural resources (linked to Future Development issue)
Problem Statement:	Most of the growth projected in the LaPorte County Land Development Plan will occur north of Interstate 80/90 where high quality wetlands and forests exist. Currently there are few policies or guidelines in place to protect some these areas.
Cause:	High development pressure for area
Issue:	Stream buffer
Problem Statement:	Approximately 6.4 miles of stream do not meet the recommended 100-foot riparian buffer because of adjacent land uses.
Cause:	Riparian buffer removed to create additional farm land.
Issue:	Sedimentation (linked to Future Development issue)
Problem Statement:	High sediment loads from stream bank erosion and adjacent land uses may be negatively affecting the macroinvertebrate community.
Cause:	Total suspended solids concentrations are high during wet weather, but not currently impairing stream use.
Source:	Changes in land use increasing runoff volumes and rates. Insufficient or no riparian buffer along streams. Horses and other livestock appear to have limited access to streams. Soil erosion on row crops is increased by tillage.
Issue:	Hydrologic and hydraulic modification (linked to Future Development issue)
Problem Statement:	Historically, the river and tributaries have been hydraulically and hydrologically altered by culverts, small impoundments, and by other actions.
Cause:	Culverts, small impoundments, wetland loss.
Source:	Changes in land use increasing runoff volumes and rates.

4.1 Staffing

Currently there is no dedicated Watershed Coordinator for the county and existing county staff may not have the time or resources to implement the watershed plan. A Watershed Coordinator will identify funding opportunities, write grants to fund projects, implement projects, collect and analyze water quality and biological data, and build and strengthen relationships with stakeholders. Without this position, it will be difficult to implement key aspects of this watershed plan.

4.2 Future Development

As discussed earlier, LaPorte County recently completed the Countywide Land Development Plan and is now in the process of updating the county zoning ordinances. Because of the attractive character of the area, the proximity to the Chicago metropolitan area, and other factors, the Galena River watershed is experiencing development pressure.

The issue of watershed development is linked to other issues of concern to the Steering Committee. Unplanned or poorly planned development that does not account for the sensitive natural resources could result in degradation of habitats, loss of wetlands and forest, reduced species diversity, and continued *E. coli* problems, among other effects.

Addressing this issue involves protection and conservation of watershed resources and values that are known to be important to the stakeholders. Watershed management recommendations are based upon preserving existing values and protection against further degradation.

4.3 *Escherichia coli*

IDEM identified this issue as a watershed problem many years ago, and is presently finalizing the TMDL for this pollutant. *E. coli* are bacteria commonly found in the lower intestine of warm-blooded animals. Most *E. coli* are harmless and, in fact, many are beneficial and are part of the normal flora of the gut helping with food digestion. A few types are harmful, however, and can cause sickness and infection. *E. coli* bacteria are excreted by warm blooded animals in solid waste. For the Galena River watershed, IDEM identified the sources for *E. coli* as wildlife, runoff from pastures and livestock pens, septic systems, and possibly illicit discharges (IDEM 2009). Our field observations suggest that horses in the watershed may be a source as well. And further, there is strong evidence that high coliform levels in streams are associated with grass and pasture lands in the drainage area upstream of the sampling sites.

The Draft TMDL provided load reduction targets for *E. coli* necessary to meet water quality standards (IDEM 2009).

E. coli bacteria loads were estimated and tabulated in Section 3. Perhaps more important in determining critical areas for implementing control measures are the areal loads, that is, the numbers of bacteria leaving a drainage area per unit area over time. Figure 14 is a map of unit areal loads of *E. coli*, computed from the median concentrations from the IDEM field data (Prast and Ak 2008). The areal loads are based only upon the upstream drainage areas where IDEM measured stream discharge (Sites 7, 8, and 9). Based upon the 2008 data, the two drainages in the Spring Creek subwatershed are about double the coliform loads in the Headwaters subwatershed.

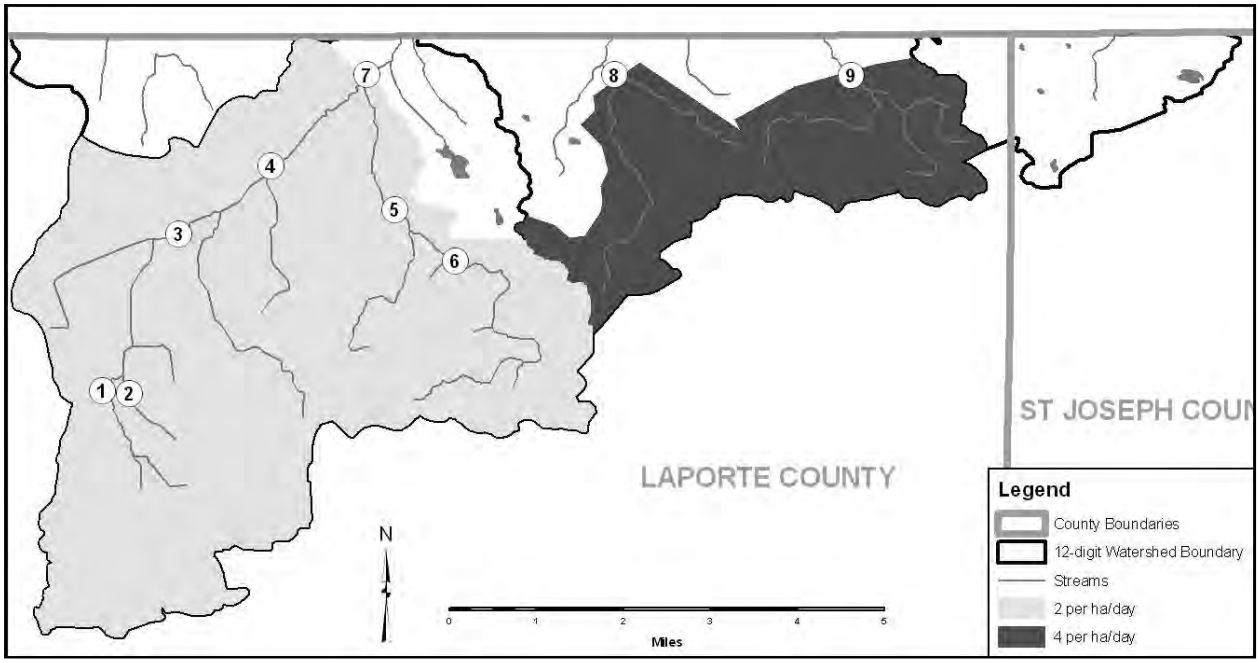

Figure 14. Median Unit Area Loads (in CFU/100mL per ha/day) for *E. coli* Bacteria.

Our study also shows a strong association of *E. coli* with the occurrence of pasture and grassland in the watershed. And, given the presence of an undocumented number of horses being kept by landowners, we believe that these animals warrant inclusion in future watershed management efforts. Figure 15 is a map of probable *E. coli* source areas, that is, lands classified as open space, pasture, or grass that are located within 100 feet of a stream. It does not map septic systems, but these may also be sources and can be further assessed in the near future. In the meantime, Figure 15 can be used as a guide to evaluate watershed BMPs, particularly for livestock (horse) exclusions and alternate watering practices.

Therefore, we recommend that areas shown in Figure 15 that are in the Spring Creek subwatershed be a priority for coliform BMPs. These critical areas should be updated after further studies are completed. Priority studies that we recommend include:

- Assessing the effects of poorly performing on-site septic systems (SWCD proposals for funding are currently pending evaluation)
- Identifying pasture areas that are not currently implementing application components of a Conservation Management System:
    - Deferred grazing (NRCS Practice 352)
    - Planned grazing (Practice 556)
    - Proper grazing use (Practice 528)
    - Pasture and hayland management (Practice 510)
    - Alternate water supply practices

- Livestock access limitation practices
- Vegetative stabilization practices

4.4 Other Pollutants

E. coli is the only pollutant causing water use impairment in the Galena River watershed (Prast and Ak 2008). However, stakeholders have identified other pollutants as concerns and are interesting in protecting of the watershed against degradation of existing conditions.

We estimated unit areal loads for phosphorus, nitrogen and suspended solids (Figures 16, 17, and 18). As with coliform bacteria, these areal loads are estimated from median pollutant concentrations measured by IDEM in 2008 for those sampling sites that also had discharge measured.

Median total phosphorus areal loads are mapped below for the three drainages to IDEM's sampling sites 7, 8, and 9. Drainages to sites 7 and 8 have essentially equal unit areal phosphorus loads, and site 9 drainage is about two-thirds that of the other two drainages. These unit areal loads are rather low in comparison to literature values for other regions of the country (Reckhow *et al*. 1980), lending support to the finding that, other than *E. coli* loadings, stream water quality is rather good in this watershed. Given that, we recommend that the approach to nutrient management in the study area focus on protection of the existing resource base.

Median total nitrogen areal loads are mapped in Figure 17. The two drainages in the Spring Creek subwatershed have median total nitrogen loads of 2.3 g/ha/day, slightly more than half of the unit areal load estimated for the Headwaters subwatershed (Site 7).

Median suspended solids areal loads are mapped in Figure 18. Based on the IDEM data, the Spring Creek site 8 drainage has the highest median TSS areal load (about 25 g/ha/day) and the eastern tributary to Spring Creek (Site 9) has the lowest areal load, about 12 g/ha/day.

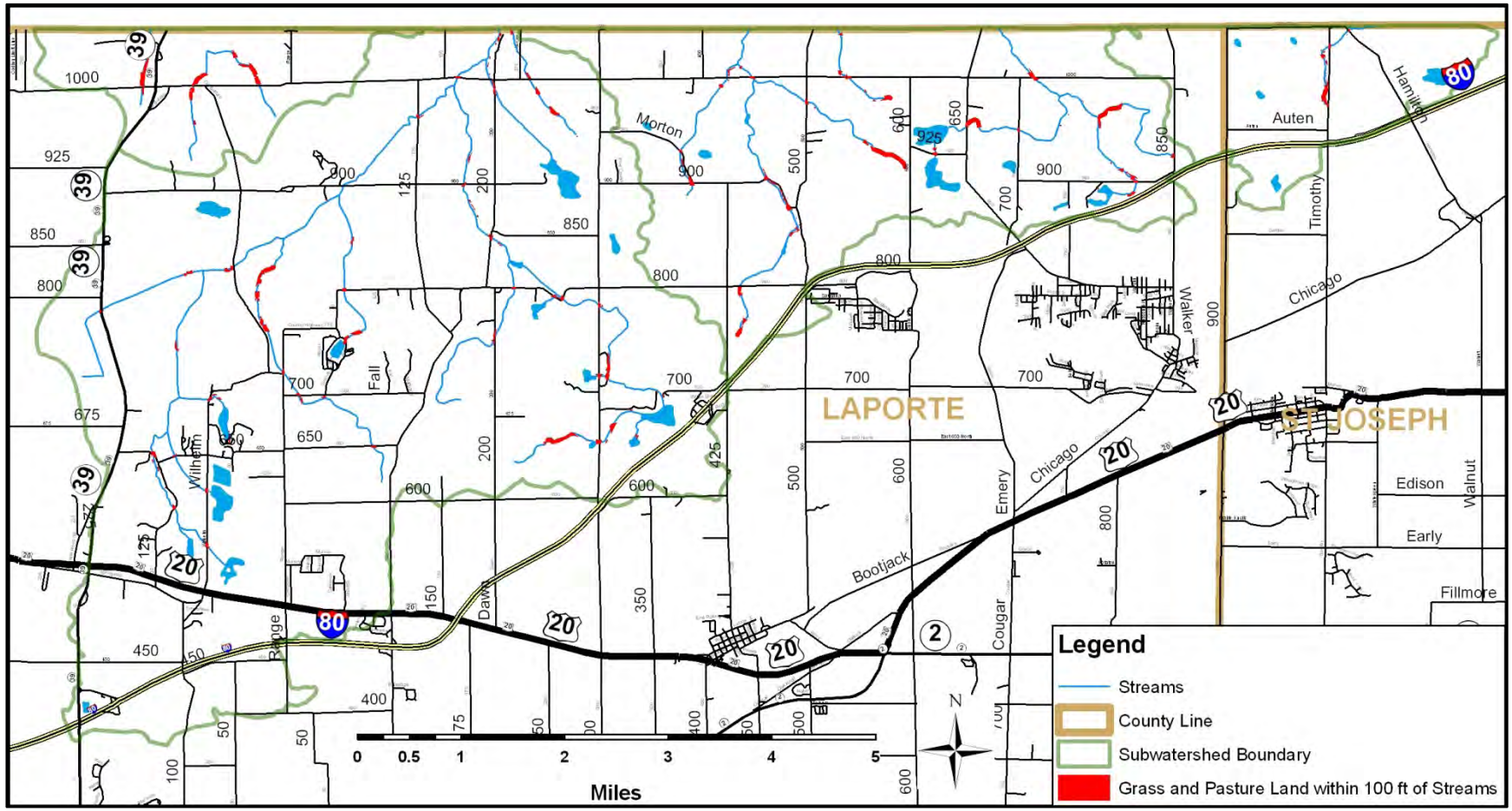

Figure 15. *E. coli* Critical Areas

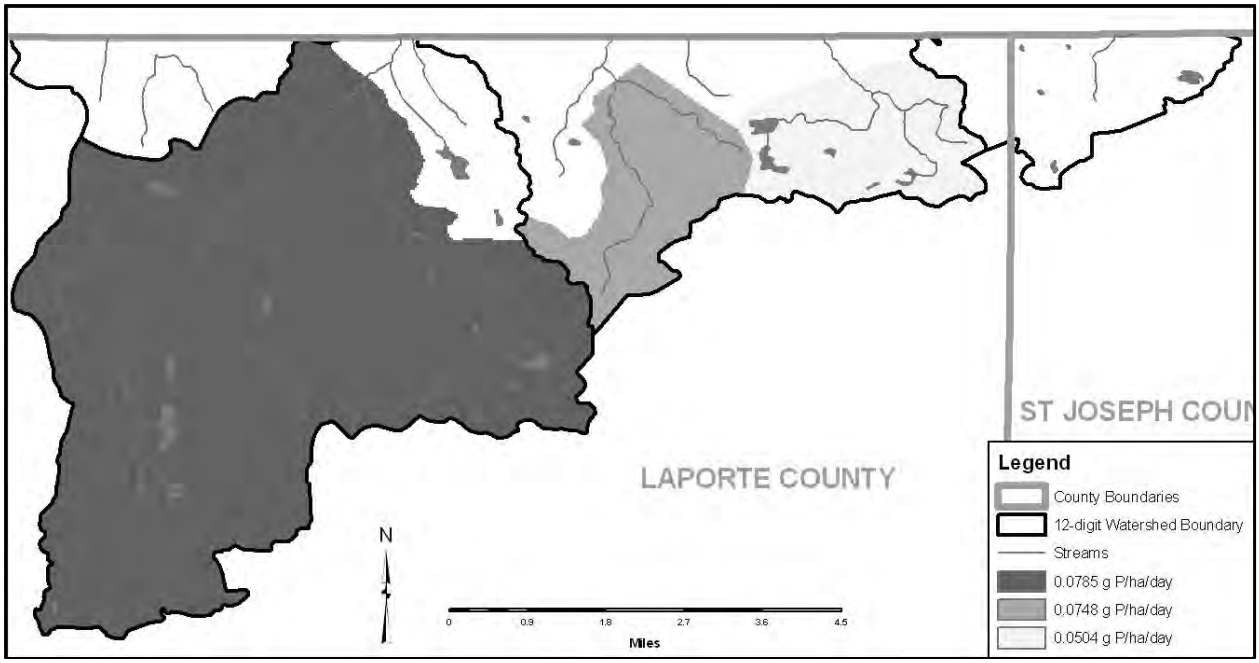

Figure 16. Unit Area Loads of Total Phosphorus

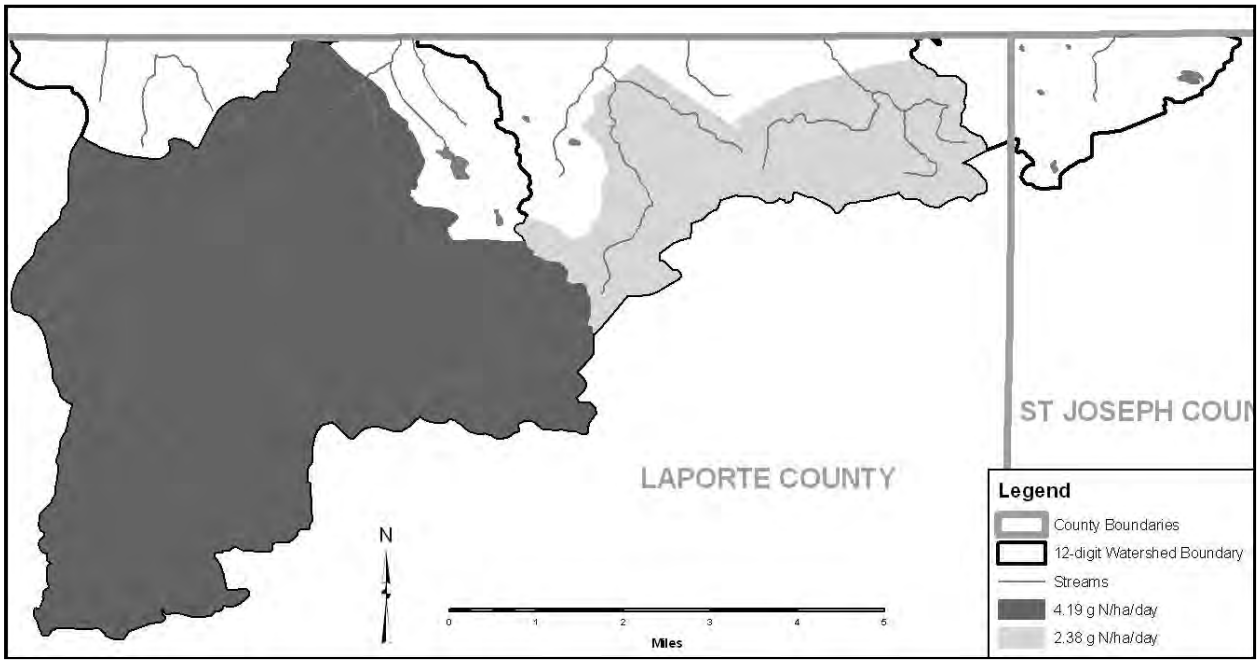

Figure 17. Unit Area Loads of Total Nitrogen

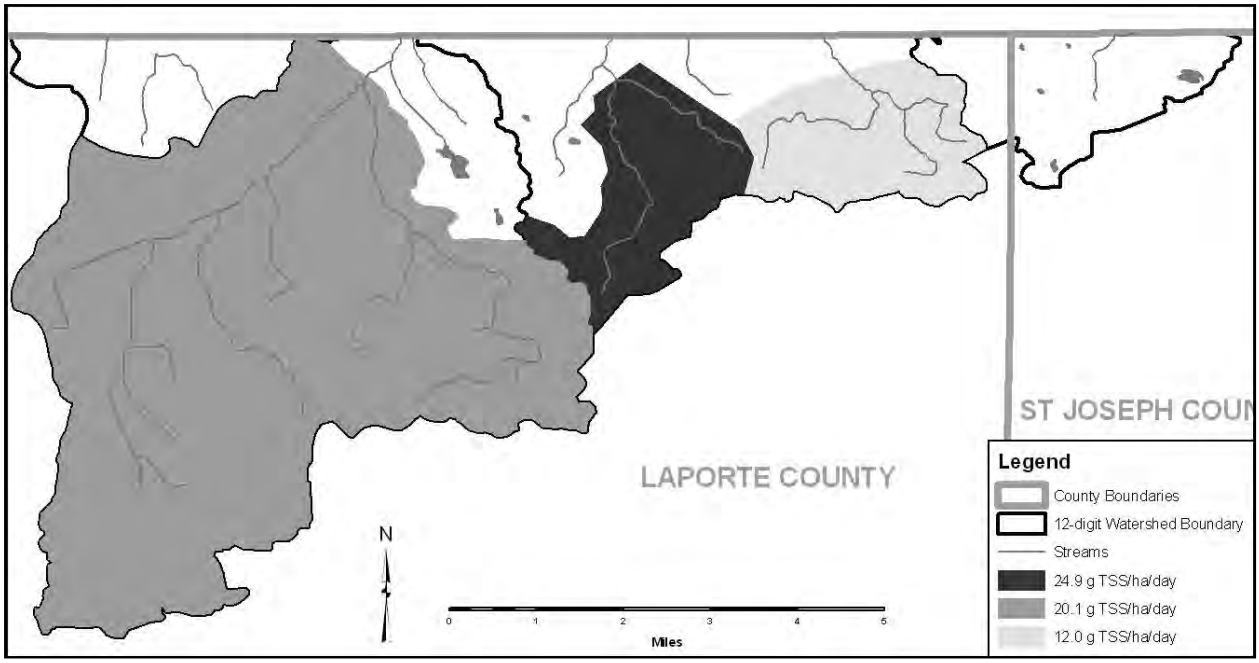

Figure 18. Unit Area Loads of Total Suspended Solids

4.5 Historic Wetland Loss

In comparison to parts of Indiana that have lost most of their wetlands, the Galena River watershed is fortunate in that many wetlands still exist. Currently the wetland to watershed ratio is fifteen percent for our study area, much less than that prior to European settlement. Historically, many wetlands through Indiana have been drained for agricultural purposes, linking this issue to that of hydrologic/hydraulic modifications.

There are approximately 2,131 acres of hydric soil that have been drained and are now under cultivation in the watershed. Historically, these soils were wetlands; today they are drained and cultivated, but represent potential wetland restoration areas. Figure 19 shows the locations of potential wetland restoration areas in the watershed. The majority of the potentially restorable wetland acreage is located in the Headwaters subbasin (Table 4-2).

Table 4-2

POTENTIAL AREAS FOR WETLAND RESTORATION

Subbasin	Acres
Dowling Creek	229
Headwaters	1,523
South Branch Galena River	221
Spring Creek	158
Total	2,131

Restoration of wetlands within the watershed will provide the following benefits:

- Improved water quality
- Flood control
- Less erosion of uplands
- Increased wildlife habitat, particularly for many of the threatened, endangered, and sensitive species in the watershed
- Increased wildlife diversity
- Improved groundwater recharge
- Increased recreational opportunities

4.6 Sensitive Natural Resources

The watershed is unique in that it remains relatively undeveloped and still retains large areas of sensitive habitat including, forested and emergent wetlands, bogs, fens, seeps, and high quality forest which support a diverse assemblage of plants and animals. Ninety-four (94) state-endangered, threatened and sensitive species, one federal candidate species, and two high quality natural areas have been identified by the Indiana DNR's Natural Heritage Program.

The Steering Committee has voiced concern over the possible loss and/or degradation of the watershed's sensitive natural resources from unplanned development, closely aligning this issue with others: watershed development, historic loss of wetlands, and hydrologic/hydraulic modifications. In particular, the following resources were identified for preservation:

- The headwaters including Springfield Fen Nature Preserve, the Galena Wetland Conservation Area, and other lands adjacent.
- Legacy Forest Areas and other large tracts of high quality forested land.
- ADID wetlands
- All areas in close proximity to threatened, endangered and sensitive species

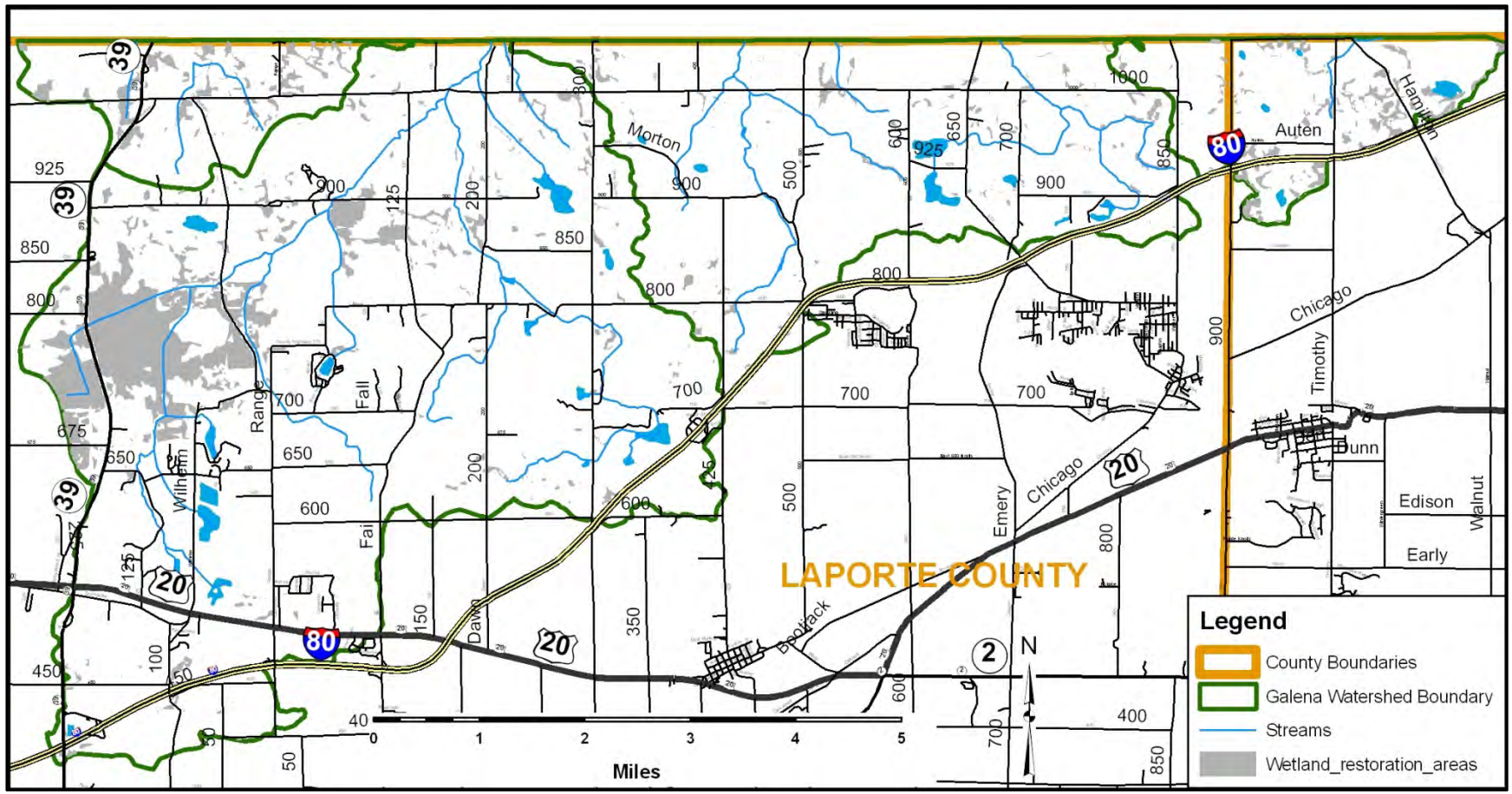

Figure 19. Potential Wetland Restoration Areas in the Galena River Watershed.

4.7 Stream Buffer

Stream buffers were identified as an issue by the Steering Committee. Buffers are a valuable BMP, offering a myriad of benefits (discussed in Section 3.6). As identified in the stream buffer analysis, approximately 6.45 miles of stream within the Galena River watershed currently do not contain the NOAA's recommended 100-foot buffer and are candidate areas for the conservation buffer program (see Appendix B for a map), although we recognize that a 100-ft buffer may not be realistic on private lands. Nearly all of the deficient areas are located on farmed land. During implementation, smaller buffer, including filter strips, should be considered.

Because removal of stream buffers can be caused by poor development, and, can increase bank erosion and sedimentation, this issue is linked to these other issues.

4.8 Sedimentation

Sedimentation is the process in which particulate matter is carried from its point of origin and deposited elsewhere on land or in water. Erosion is the wearing away of rock and soil by water and wind. These two processes work together and are natural processes. However, the sediment load may be dramatically increased by human practices in the watershed, such as altering the rates and volumes of storm runoff, removal of stream bank vegetation, construction, removal of forests, agriculture, and allowing livestock access.

No state water quality standard has been established for sedimentation or turbidity within a stream. IDEM's water quality target for total suspended sediment (TSS) is a maximum of 30.0 mg/L (http://www.in.gov/idem/6242.htm). TSS ranges between 25.0-80.0 mg/L have been found to reduce fish populations (Waters 1995). Even during periods of high flow and stormwater runoff, TSS levels for eight out of nine sampling sites for the Galena River and tributaries were below the IDEM maximum TSS target of 30.0 mg/L. The exception was found at Site 6 which had a TSS measure of 35.0 mg/L during high flow.

Sedimentation was however identified as an issue by the Steering Committee for the Galena River primarily from visual observation at several locations of heavy stream bank erosion coupled with a mucky bottom substrate with a high degree of embeddedness (embeddedness is the degree to which cobble, gravel, and boulder substrates are covered by fine particulate materials such as silt). The study area however is in the Adrian-Houghton-Edwards soil association and has naturally occurring muck soils. Further, it was the general consensus of the field team that, while sedimentation may not be severely impacting stream quality, the watershed needs to be protected against the sudden effects of massive erosion that occur during construction events or freshly plowed cropland after large rainstorms.

Because the data suggests that the TSS concentrations in the Galena River and tributaries, in most instances, are well below IDEM's recommended targets, the Steering Committee has not set alternative benchmarks for reducing sedimentation. Rather, the focus will be on reducing embeddedness and improving in-stream habitat at specific sites through agricultural Best

Management Practices (BMPs), stream bank restoration, and buffer installation. Additional study of this issue has been recommended by the Steering Committee.

Locations of bank erosion were recorded and categorized during the windshield survey and are mapped in Figure 20.

4.9 Hydrologic and Hydraulic Modification

Hydrologic modifications affect the natural flow of a stream or river by changing the way water moves through the landscape. Such modifications influence water quality, runoff rates, runoff volumes, and habitat quality. Some types of modifications include dredging, dams, levees, spillways, impoundments, diversions, wetland draining, channelization, forest clearing, construction of bridges and culverts, and development of large impervious areas through urbanization.

Historically, the primary sources of hydromodification, in the study area have been draining of wetlands and channelization of headwater tributaries for agricultural purposes, and, the construction of dams, bridges, and culverts.

There are three known dams in the watershed: 1) Jack Ragle, 2) Lalumiere, and 3) Wallace Lake (IGS's Lakerim website, http://lakerim.indiana.edu/downloads.html) (Figure 4).

Over 2,000 acres of wetlands have been drained and converted to row crops. Most of these former wetland are located in the headwaters subbasin. Again, in addition to many ecological and social benefits, wetland restoration will restore missing hydrological functions in the headwaters of the watershed.

The County performs routine maintenance on the bridges and culverts in the watershed. During the windshield survey most culverts appeared in good condition, although improperly disposed spoil from culvert maintenance activities was observed at one site. Some culverts were observed to be elevated above the streambed and likely impede fish passage. Figure 21 maps the locations of culverts that likely represent fish passage barriers in the watershed, and upon reconstruction, should be remedied.

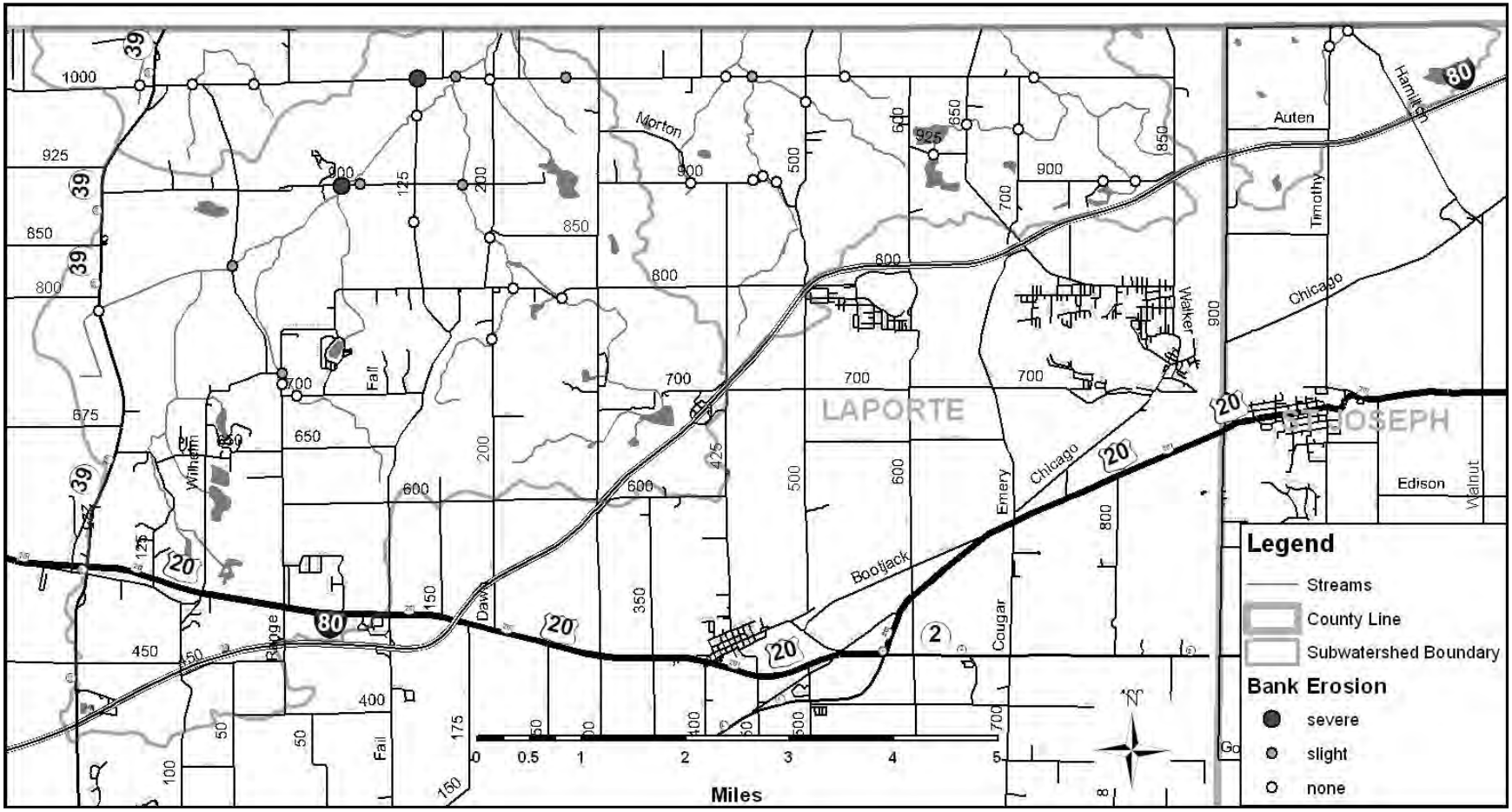

Figure 20. Stream Bank Erosion Observed During the Windshield Survey.

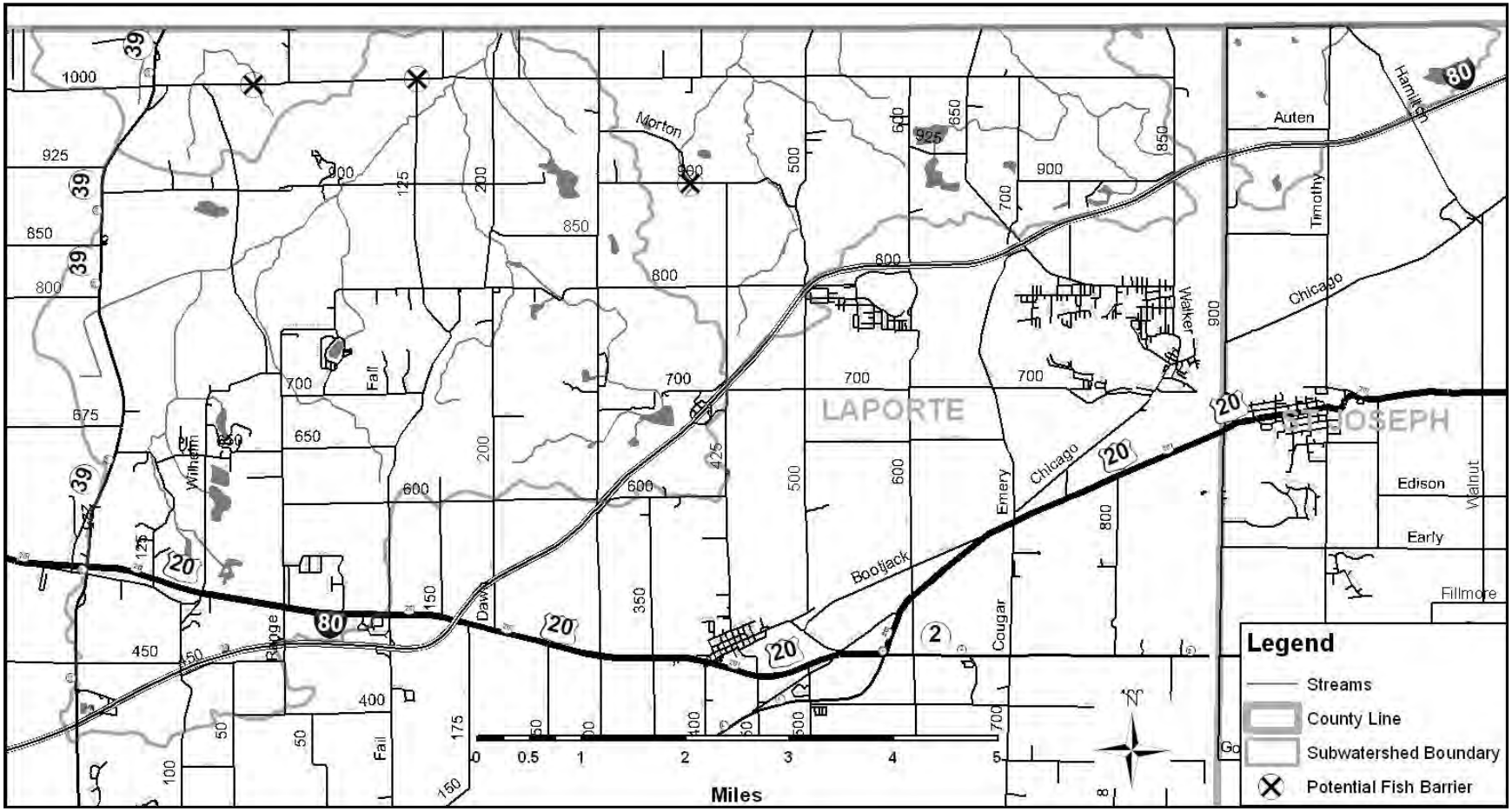

Figure 21. Culverts Representing Potential Fish Passage Barriers.

5.0 GOALS AND ACTION ITEMS

Table 5-1 details the goals and action items developed by the Steering Committee. The action items are based upon these broad goals for the Galena River watershed:

Goal 1: Hire a dedicated watershed coordinator for LaPorte County.

Goal 2: Protect the rural character and natural resources of the watershed by incorporating 'Smart Growth' and low impact development principles into local planning and development.

Goal 3: Reduce *E. coli* loads to meet water quality standard of a monthly geometric mean concentration of 125 cfu/100 mL and a maximum daily concentration of 235 cfu/100 mL.

Goal 4: Restore 10% of potential wetland restoration areas within the next ten years.

Goal 5: Preserve natural areas through government coordination and/or land trusts.

Goal 6: Reduce sediment loads in the Galena River.

Goal 7 Restore the natural hydrology and hydraulics of the watershed to the extent possible, including the ability of migratory fishes to utilize all habitats.

Specific action items were developed to meet each goal. The Steering Committee assigned a priority rating to each item:

- High priority – Implementation within 1-2 years
- Medium priority – Implementation within 3-5 years
- Low priority – Implementation within 5-10 years or longer

The Steering Committee agreed that some action items should be initiated within one or two years but could take five or more years to fully implement, e.g. a high priority project that will occur over a long period of time. Table 5-1 also shows provides the responsible parties, cost estimates, and measures (indicators) of success.

The Steering Committee recognized that many of the goals could be met by implementing a robust and comprehensive public education campaign. To meet most goals an active dialogue will need to be initiated with local landowners. Public education and outreach will include the following:

- Visiting landowners in person
- Mailing campaign
- Handouts/brochures
- Seminars
- Website education campaigns and local recognition

Table 5-1. GOALS, ACTION ITEMS, AND PRIORITY RANKINGS FOR THE GALENA RIVER WATERSHED

Issue	Critical Areas	Goals	Action Items	Priority[7]	Responsible Parties	Cost Estimate	Indicator(s) of Success
INSUFFICIENT STAFF TO IMPLEMENT WATERSHED PROGRAM		Goal 1. Hire watershed coordinator.	Assist LaPorte Co SWCD in identifying and acquiring funds to hire a part- or full-time watershed coordinator.	High	SWCD, IDNR, IDEM	$40,000 - $80,000 year	Experienced watershed coordinator is hired.
POORLY PLANNED DEVELOPMENT		Goal 2. To protect the rural character and natural resources of the watershed by incorporating 'Smart Growth' and Low Impact Development principles into local planning and development.	Partner with Michigan City Sanitary District and Trail Creek Watershed Steering Committee to make presentation to LaPorte Co government on *E. coli* issues in the watershed.	High	Galena R. Steering Committee, Michigan City Sanitary District, LaPorte County Health Dept.	Minimal cost; volunteer effort.	Presentation made to County
			Establish Land Use Subcommittee to attend zoning meetings and coordinate to incorporate model ordinances protective of open space, stream buffers, septic O&M, post-construction stormwater management.	High	SWCD, LaPorte County Zoning Committee	Minimal cost; volunteer effort.	Adoption of protective ordinances
			Watershed modeling: Phase I – model existing conditions; Phase II – model future conditions.	High	SWCD, IDNR, IDEM	$40,000	Modeling report published

[7] Implementation Schedule: High priority: 1-2 years; Medium priority: 3-5 years; Low priority: 5-10 years or longer.

Issue	Critical Areas	Goals	Action Items	Priority[7]	Responsible Parties	Cost Estimate	Indicator(s) of Success
E. COLI	Grass and pasture lands in Spring Creek subwatershed. Failing septic systems may also be critical, but require further studies.	Goal 3. Reduce *E. coli* loads to meet water quality standard of a monthly geometric mean of 125 cfu/100 mL and a daily maximum of 235 cfu/100 mL.	Develop dialogue with Health Dept. to share data and work together on *E. coli* issues and actions in the watershed.	High (note that this has been initiated)	SWCD, LaPorte Co Health Dept.	Conducted through the normal operations of the NRCS and LaPorte County Health Dept.	*E. coli* levels reduced to target levels Number of joint activities between two agencies
			Coordinate with Health Dept. on new tracking system for septic permits (ITOSS) to help with homeowner outreach programs.	High	Galena R. Steering Committee, SWCD, LaPorte Co Health Dept.	Conducted through the normal operations of the NRCS and Health Dept.	Number of landowners contacted in person. Number of public education mailers distributed
			Develop brochure on septics for watershed residents containing information on maintenance.	High	LaPorte Co Health Dept.	$10,000	Number of landowners that undertook septic maintenance following the public education campaign.
			Perform color infrared analysis, or dye tracing, to identify failing septic systems.	High	LaPorte CoHealth Dept., SWCD, IDNR, IDEM	$50,000-75,000	Failing septic systems identified and mapped.
			Partner with Michigan City Sanitary District and Trail Creek Watershed Committee to make presentation to County government on *E. coli* issues in the watershed.	High	Galena R. Steering Committee, Michigan City Sanitary District, LaPorte Co Health Dept.	Minimal cost; volunteer effort.	Presentation made to County

Issue	Critical Areas	Goals	Action Items	Priority[7]	Responsible Parties	Cost Estimate	Indicator(s) of Success
			Work with County to establish septic system maintenance ordinance or point-of-sale ordinance.	Medium	LaPorte Co Health Dept.	Conducted through the normal operations of County Government.	Ordinance enacted
			Promote existing cost share programs that would implement the range and pasture components of a Conservation Management System (grazing management, alternative water supply, livestock exclusion) and other agricultural BMPs[8].	High	SWCD, NRCS, IDEM	$5,000-$10,000. Some of these activities can be conducted through the normal operations of the SWCD.	Number of seminars or participating landowners.

[8] All BMPs will be implemented in accordance USEPA's *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters* (1993).

Issue	Critical Areas	Goals	Action Items	Priority[7]	Responsible Parties	Cost Estimate	Indicator(s) of Success
			Create adequate stream buffers. Actions include: 1) Distribute NRCS literature to property owners, 2) Visit properties with inadequate buffers to discuss possible restoration with the owners.	High[9]	SWCD	$200 /acre.	Acres of riparian buffer restored.
HISTORIC WETLAND LOSS		Goal 4. Restore 10% of potential wetland restoration areas to wetland habitat within the next ten years to help meet recommended wetland to watershed ratios.	Complete landscape-level wetland functional analysis to identify priority areas.	Medium	SWCD, IDNR	$35,000	Wetland functional analysis report published
			Approach landowners farming on hydric soils for potential restoration. Provide information on incentive programs.	Medium	SWCD	$500 to $1,200/acre	Number of landowners approached on potential wetland restoration.
			Promote existing NRCS and USFWS programs to remove drain tiles by distributing existing literature to residents in watershed.	Medium	SWCD, USFWS	$500 to $1,200/acre	Acres of wetlands restored.

[9] Note that November 1, 2009 the LaPorte County SWCD submitted a grant proposal under the Clean Water Indiana Grant program to restore stream buffers on selected property. A decision will be made by the end of November 2009.

Issue	Critical Areas	Goals	Action Items	Priority[7]	Responsible Parties	Cost Estimate	Indicator(s) of Success
SENSITIVE NATURAL RESOURCES		Goal 5. Preserve natural areas through government coordination and/or land trusts.	Establish Land Use Subcommittee to attend zoning meetings and coordinate to incorporate model ordinances protective of open space, stream buffers, septic O&M, post-construction stormwater management.	High	SWCD	Minimal cost; volunteer effort	Adoption of protective ordinances
			Develop brochure describing all the different programs available to private landowners for setting aside land for resource protection.	High	SWCD, IDNR, Shirley Heinz Land Trust	$10,000	Brochure printed
			Identify larger property owners interested in easement programs	High	SWCD, Shirley Heinz Land Trust	Minimal cost	Number of parcels >10 acres identified as candidates for easement programs
			Streamline process by which property owners can enroll land in Forest Legacy Program.	Medium	IDNR	Conducted through normal operations	Number of acres enrolled in FLP
SEDIMENTATION		Goal 6. Reduce sediment loads in the Galena River.	Restore stream buffer along areas identified in the stream buffer analysis.[10]	High	SWCD	$200 per acre	Miles of riparian buffer restored.

[10] The LaPorte County SWCD has been awarded two grants to restore stream buffers on selected properties.

Issue	Critical Areas	Goals	Action Items	Priority[7]	Responsible Parties	Cost Estimate	Indicator(s) of Success
			Perform a stream geomorphological study (Rosgen or WARSSS)	Med-High	SWCD, IDNR	$50,000	Publish study, including recommendations.
			Identify agricultural lands not currently implementing the erosion control or range and pasture components of a Conservation Management System for sedimentation. Promote existing programs that would implement appropriate CMS. Encourage alternative till practices.	High	SWCD	It is expected that this task to be conducted through the normal operations of the SWCD.	Acres identified and mapped in GIS.
			Increase outreach campaign. Actions may include: 1) Hold seminars, 2) Mail literature to area residents, 3) Door to door visits to discuss issues, 4) Highlight a 'landowner of the month' on the SWCD website for landowners implementing BMPs.	High	NRCS, SWCD	$5,000-$15,000. Some of these activities can be conducted through the normal operations.	Number of seminars or participating landowners, mailings, or visits.
			Complete stream bank restoration at Site 6.	Medium	IDNR, IDEM	$500 per lineal foot	Improvement in the QHEI at Site 6. Visually assess stream substrate including degree of embeddedness.

Issue	Critical Areas	Goals	Action Items	Priority[7]	Responsible Parties	Cost Estimate	Indicator(s) of Success
HYDROLOGIC AND HYDRAULIC MODIFICATION		Goal 7. Restore the natural hydrology and hydraulics of the watershed to the extent possible, including the ability of migratory fishes to utilize all habitats.	Fish survey to determine need for dam removal and fish passage projects.	Medium	IDNR	Conducted through normal IDNR operations.	Determination of fish passage needs (report published)
			Restore historic wetland areas (hydric soils that are currently farmed). Approach landowners farming on hydric soils to see if agreeable to restoration. Provide information on financial incentive programs.	Medium	NRCS, IDNR	$500 to $1,200/acre	Acres of wetlands restored.
			Implement 2-stage ditch demonstration program	Medium	County Drainage Board	$50,000	Demonstration project constructed.
			If fish survey results indicate need, modify culverts, remove dams	Low	IDNR, County Highway Dept., County Drainage Board	$50,000-$75,000	Number of culverts improved for fish passage. Number of impoundments removed.

6.0 IMPLEMENTATION

To assist states in the development of their Coastal Nonpoint Programs (CNP), the US EPA issued guidance (6217(g) guidance) specifying management measures for nonpoint source pollution to be incorporated into their programs. The management measures cover five source categories of nonpoint pollution including agriculture, forestry (silviculture), urban, marinas, and hydromodification. The 6217(g) guidance also provides measures for the protection, restoration, and construction of wetlands, riparian areas, and vegetated treatment systems. One of Indiana's primary means of implementing its CNP is to coordinate with watershed stakeholders in developing watershed management plans that are consistent with the 6217(g) guidance.

The management measures and practices identified in the EPA guidance document provide a framework that can be easily incorporated by watershed groups into their planning and implementation efforts. For example in watersheds where there are agricultural activities that cause erosion, the Erosion and Sediment Control Management Measure calls for the application of the erosion control component of a Conservation Management System as defined in the NRCS Field Office Technical Guide. Implementation practices could include filter strips, grassed waterways and conservation tillage to name a few. Future updates to the Galena River Watershed Plan should incorporate measures that are consistent with this guidance. The 6217(g) guidance is available from the EPA at www.epa.gov/owow/nps/MMGI/.

6.1 Implementation Schedule

During the planning process it was recognized by the Steering Committee that full implementation of the watershed management plan would take up to 10 years or even longer. The implementation schedule established by the Steering Committee is as follows:

- High priority – Implementation within 1-2 years
- Medium priority – Implementation within 3-5 years
- Low priority – Implementation within 5-10 years or longer

Table 5-1 provides the priority ranking for each action item to be implemented in the watershed. The Steering Committee agreed that some action items should be initiated within 1-2 years but could take 3-5 or more years to fully implement, i.e. a high priority project that will occur over a long period of time.

It is expected that implementation will begin in Spring 2010. An important first step identified by the Steering Committee will be to establish a part-time or full-time watershed coordinator position for LaPorte County to oversee implementation of the watershed management plan.

High priority projects to be initiated within 1-2 years include:

- Assist LaPorte County in identifying and acquiring funds to hire a part- or full-time watershed coordinator

- Partner with Michigan City Sanitary District and Trail Creek Watershed Steering Committee to make a presentation to LaPorte County government on *E. coli* issues in the watershed and resident concerns
- Set up watershed subcommittee that will attend zoning committee meetings and work to get model ordinances protective of open space, stream buffers, etc. adopted. *(Note that this was initiated Fall 2009)*
- Model watershed water quality- existing conditions and future conditions under the new zoning
- Develop dialogue with County Health Department to share data and work together on *E. coli* issues and actions in the watershed *(Note that this was initiated Fall 2009)*
- Coordinate with County Health Department on new tracking system (ITOSS) for septic system permits to help with homeowner outreach and education
- Perform color infrared tracking, or dye analysis, to identify failing septic systems and map them
- Identify agricultural lands not currently implementing the erosion control or range and pasture components of a Conservation Management System for sedimentation. Promote existing programs that would implement appropriate CMS
- Increased public outreach campaign on Best Management Practices directed at watershed residents
- Identify landowners agreeable to restoration of stream buffer on their property. Restore inadequate buffer areas identified in stream buffer analysis
- Develop brochure describing all the different programs available to private landowners for setting aside land for resource protection
- Identify larger property owners interested in easement programs

Medium priority projects, to be completed within 3-5 years, include:

- Work with LaPorte County to establish septic system operation and maintenance ordinance or point-of-sale ordinance
- Perform a stream geomorphological study *(Medium-High priority*)
- Complete a Landscape Level Wetland Functional Analysis
- Restore historic wetland areas (hydric soils that are currently being farmed). Identify landowners willing to restore wetlands
- Stream bank restoration at TMDL Sampling Site 6
- Streamline process by which property owners can enroll in Forest Legacy Program
- Implement two-stage ditch demonstration program
- Conduct a fish survey to determine need for fish passage projects

Low priority projects, to be completed within 5-10 years, include:

- If fish survey results indicate need, conduct feasibility study on dam removal and/or culvert modification

It is apparent that many of the project goals will not be met without a robust and comprehensive public education and outreach campaign. To meet many goals an active dialogue will need to be initiated with local landowners. Again, public education and outreach will include, but not be limited to, the following:

- Visiting landowners in person
- Mailing campaign
- Handouts/brochures
- Seminars
- Website education campaigns and local 'landowner of the month' recognition
- Other efforts to be identified

All public education and outreach projects are identified as high priority due to the importance of engaging the public early on. Often these are lower-cost projects that can be implemented fairly easily.

6.2 BMP Load Reductions

Based on the TMDL, information obtained at the public meetings, the scientific literature and case studies from experiences in other watersheds, a number of NPS control measures have been identified for reducing *E. coli* loads and improving water quality in the watershed. These measures are focused on critical areas contributing fecal coliform bacteria to the stream, but are generally accepted to coincidentally reduce loads of other nonpoint source pollutants. Alternatives to reduce coliform loads from wildlife sources are not recommended at this time. Control measures to address NPS pollution include:

- Conservation Buffers
- Private Sewage Disposal System Inspection and Maintenance Program
- Wetland Restoration

Each of these measures is described briefly below, including information about their costs and effectiveness in reducing coliform bacteria loadings and other nonpoint source pollutants to streams.

We have also recommended several programmatic efforts to reduce *E. coli* loads and improve water quality. A variety of public education endeavors are recommended in Table 5-1, as are conservation ordinances. Additionally, follow-up studies are recommended to address uncertainties in the pollutant source assessment or to plan BMP implementation.

Conservation Buffers

Conservation buffers are strips of land in permanent native vegetation that help control pollutants. Ancillary benefits include fish and wildlife habitat. Filter strips, riparian buffers, grassed waterways, contour strips are all examples of conservation buffers.

Vegetated filter strips and riparian buffers can reduce bacteria in runoff under wet hydrologic conditions; riparian buffer zones have excellent bacteria removal efficiencies for manure applied to uplands (Tate *et al.* 2006). Buffers have also been recommended as a component in the implementation of various TMDLs.

Study results vary on the effectiveness of buffers to reduce nonpoint source pollutants. Castel *et al*. (2005) found that a naturally occurring riparian buffer could remove up to 99 percent of the bacteria from stormwater. According to Clar *et al.* (2004) vegetated filters can reduce concentrations of TSS by 70 percent, total phosphorus by 10 percent and total nitrogen by 30 percent.

Lastly, riparian buffers can work to improve instream dissolved oxygen concentrations by promoting increased infiltration and baseflow, and lowering stream temperature.

All types of conservation buffers are voluntarily implemented. Conservation buffers are economically feasible because of financial incentives available through USDA conservation programs: Conservation Reserve Program (CRP), Environmental Quality Incentives Program (EQIP), Wildlife Habitat Incentives Program (WHIP), Wetlands Reserve Program (WRP), and Stewardship Incentives Program (SIP).

Private Sewage Disposal System Inspection and Maintenance Program

Watershed residences and businesses utilize private on-site systems for wastewater treatment, typically septic tanks and leach fields. A more proactive program to keep better records, maintain functioning systems, and address nonfunctioning systems could be developed to minimize the potential for releases from private sewage disposal systems. The U.S. EPA has developed guidance for managing private sewage disposal systems (EPA 2005). This guidance includes procedures for assessing existing conditions, assessing public health and environmental risks, selecting a management approach, and implementing a management program (including funding information). This alternative would require the commitment of staff time for county health department personnel; cost depends on whether the additional inspection activities could be accomplished by existing staff or would require additional personnel. Costs for annual maintenance agreements are estimated at $200/year per household. Proper septic system maintenance will be highly effective at reducing coliform bacteria and nutrient loadings streams if a system is, in fact, failing.

Operation and maintenance for most on-site systems includes some user awareness of inputs that might impact treatment processes, such as strong cleaners, lye, acids, biocides, paint wastes, oil and grease. Gravity-flow soil-infiltration systems require little maintenance beyond limiting

inputs to normal residential wastes, cleaning effluent screens/filters, and periodic (e.g. every three to seven years) pumping of the accumulated solids. Systems employing advanced treatment technologies and electromechanical components require more intensive attention, such as checking switches and pumps, measuring and managing sludge levels, monitoring and adjusting treatment process and system timers, and checking effluent filters. Operators, inspectors, and service technicians should be trained and certified for the types of systems they will be servicing; services should be logged and reported to the county health department so that long-term performance can be tracked.

Wetland Restoration

Wetland restoration involves the rehabilitation of a drained or degraded wetland to its natural condition, including its vegetation, soils and hydrology. Wetland restoration can be an effective BMP for reducing loading of bacteria, sediments, nutrients, and oxygen-demanding substances (Johnston *et al*. 1990). Wetlands reduce coliform bacteria concentrations in accordance with first-order decay kinetics (Struck *et al.* 2006).

Like all BMPs the effectiveness of wetlands at removing nonpoint source pollutants varies by study. Winer (2000) found ponds and wetlands to be 65-75 percent effective at removing bacteria, and about 76 percent effective at removing TSS.

Currently there are over 2,100 acres of hydric soils in the watershed that are not developed, forested or already have wetland hydrology and vegetation. These are potential areas where wetlands could be restored. A wetland restoration project may be as simple as breaking drain tiles and blocking drain ditches, or it may require more engineering effort to restore hydrology and hydric vegetation communities. In addition to improving water quality, wetland restoration provides additional benefits for flood control, habitat, and recreation.

Costs for wetland restoration vary widely, depending on the acreage, the nature of the work, and land/easement costs. However, a general unit cost of $500 to $1,200 per acre has been suggested (FWS 2006) for simple restoration projects in Illinois. CRP payments are approximately $50 per acre per year for qualifying lands.

6.3 Funding Sources

There are numerous grant programs to support implementation of improvement projects for the Galena River watershed. Many require a local cost-share either in cash or in-kind services. IDEM's Indiana Watershed Planning Guide provides a good starting place for identifying potential funding sources (http://www.in.gov/idem/files/watershed_planning_guide.pdf). A summary of several funding programs is included below.

Lake and River Enhancement Program

LARE grants through the Indiana Department of Natural Resources Division of Fish and Wildlife are available on a competitive basis for lake and watershed improvements. The website,

http://www.in.gov/dnr/fishwild/2364.htm, provides detailed information on the LARE program. All grants require a local cost share.

LARE grants are available for any of the following "traditional" efforts:

- Lake or stream diagnostic studies
- Lake or stream strategic management plans, such as this endeavor
- Engineering feasibility studies of pollution control measures
- Construction projects (e.g. wetlands, shoreline or streambank stabilization)
- Performance appraisals of constructed pollution control measures
- Watershed land treatment projects
- Watershed land treatment project summaries
- Water quality monitoring

The schedule for these "traditional" projects is as follows:

November 1 - Contact LARE staff to discuss project potential

January 15 - Grant application due

May 1 - Revise proposal details as needed, including exact funding amount

July 1 - DNR funding decisions

Grants for approved projects will be awarded in the month of July every year.

Clean Water Act Section 319

Section 319(h) of the Clean Water Act provides funding for various types of projects that work to reduce nonpoint source water pollution. All states receive funding for nonpoint source pollution control under Section 319. In Indiana, IDEM administers these funds; their website (http://www.in.gov/idem/4103.htm) describes the program. Section 319 funds are used to conduct assessments, develop and implement TMDLs and watershed management plans, provide technical assistance, demonstrate new technology, and provide education and outreach on pollution prevention. Organizations eligible for funding include nonprofit organizations, universities, and local, State or Federal government agencies. A 40% (non-federal) in-kind or cash match of the total project cost must be provided. LARE grants can be used for the match.

The timeframes are subject to change, however, the grant applications are typically due September 1. Applicants are officially notified of the grant award after Congress releases funds in June or July. Applicants should plan that if a grant is awarded, project start dates would be the last quarter of the year awarded.

Clean Water Act Section 205(j)

These grants are funded under Section 205 of the Clean Water Act. The grants are for water quality management planning, and are used to determine the nature, extent and causes of point and nonpoint source pollution problems, and to develop plans to resolve these problems. The

focus is on watershed management planning and protection or restoration of critical ecosystems. No local match is required. Municipal governments, county governments, regional planning commissions, and other public organizations are eligible. Additional information on Section 205 is available on IDEM's website (http://www.in.gov/idem/5226.htm).

From the IDEM website it appears that funding through this program was halted temporarily in 2008. It is not clear whether funding will be available through this program for implementation of Galena River projects in coming years.

Lake Michigan Coastal Grants Program

The Coastal Grant program (www.in.gov/dnr.lakemich) provides funding to communities and organizations for social, economic, and environmental solutions that balance the use and protection of the coast's valuable resources. Funding for this program is provided by the National Oceanic and Atmospheric Administration (NOAA). Eligible applicants include local and state government agencies, state colleges and universities, area-wide agencies, and non-profit organizations (special conditions apply). Projects must be located within the Lake Michigan Coastal Program boundary, and the Galena River watershed falls within this boundary. There is a 1:1 funding match rate. The following project categories are funded though the program:

- Low-cost construction
- Land acquisition
- Planning/coordination/management
- Education/outreach
- Applied research
- Emerging issues that may have an impact on coastal health

The deadline to submit pre-proposals is in September; full proposals are due in January. Selections are announced in February and grant funds are released in July.

National Fish and Wildlife Foundation

There are numerous grant opportunities provided through the National Fish and Wildlife Foundation's Sustain our Great Lakes Program. Information can be found online at http://www.nfwf.org. This is a public-private partnership among ArcelorMittal, the National Oceanic and Atmospheric Administration, the National Fish and Wildlife Foundation, the Natural Resources Conservation Service, the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, and the U.S. Forest Service.

The program supports habitat restoration, protection and enhancement projects, invasive species control, water quality improvements, and watershed planning and management within the great lakes basin.

Applications are due in October but specific deadlines vary by grant program.

Agricultural Programs

There are several federally-funded programs for soil and water conservation in agricultural watersheds, including the Conservation Reserve Program (CRP), Wetlands Reserve Program (WRP), and Environmental Quality Incentive Program (EQIP).

CRP is a voluntary program encouraging landowners for long-term conservation of soils, water, and wildlife resources. CRP is the USDA's single largest environmental improvement program. It is administered though the farm service Agency (FSA) and involves 10 to 15 year contracts. Further information is available through the LaPorte County SWCD or online at http://www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=crp.

The WRP is also a voluntary program (http://www.nrcs.usda.gov/programs/wrp/). WRP also provides technical and financial assistance to eligible landowners to restore, enhance, and protect wetlands. At least 70 percent of each project area will be restored to the original natural condition, to the extent practicable. The program is offered on a continuous sign-up basis and is available nationwide. It is administered though the NRCS and under the 2008 Farm Bill offers three enrollment options:

1. Permanent Easement is a conservation easement in perpetuity. USDA pays 100 percent of the easement value and up to 100 percent of the restoration costs.
2. 30-Year Easement is an easement that expires after 30 years. USDA pays up to 75 percent of the easement value and up to 75 percent of the restoration costs.
3. Restoration Cost-Share Agreement is an agreement to restore or enhance the wetland functions and values without placing an easement on the enrolled land. USDA pays up to 75 percent of the restoration costs.

The Environmental Quality Incentive Program (EQIP) is another voluntary USDA conservation program for farmers faced with serious threats to soil, water, and related natural resources (general information at http://www.nrcs.usda.gov/PROGRAMS/EQIP/; Indiana information and materials at http://www.in.nrcs.usda.gov/programs/eqip/eqiphomepage.html). EQIP provides technical, financial, and educational assistance primarily in designated "priority areas". Landowners, in consultation with a local NRCS representative or technical service provider, are responsible for development of a site-specific conservation plan, including nutrient management planning.

The Wildlife Habitat Incentives Program (WHIP) (materials available online at) (http://www.in.nrcs.usda.gov/programs/whip/whip.html), is a NRCS program for developing and improving wildlife habitat, primarily on private lands. It provides both technical assistance and cost-share payments to help establish and improve fish and wildlife habitat.

The Healthy Reserve Forest Program (HRFP) is a voluntary program established for the purpose of restoring and enhancing forest ecosystems to: 1) promote the recovery of threatened and endangered species, 2) improve biodiversity; and 3) enhance carbon sequestration (general

information at http://www.nrcs.usda.gov/programs/HFRP/ProgInfo/Index.html). There are three enrollment options: land may be enrolled through 10-year restoration cost-share agreements; 30-year easements; or 99-year easements.

Clean Water Indiana

Funding is available through the Clean Water Indiana grant program for education and outreach to improve water quality, and capacity building. Program is available only to the State Soil and Water Conservation Districts. Maximum amount available is $7,000 and the proposal deadline each year is November 1.

The LaPorte County SWCD was recently awarded a grant under this program to finance installation of stream buffers on selected property.

Great Lakes Restoration Initiative

Under the President's 2010 budget, $475 million has been dedicated to the Great Lakes Restoration Initiative (GLRI) which targets significant environmental problems in the Great Lakes Region, under five major focus areas:

- Toxic substances and areas of concern
- Invasive species
- Nearshore health and nonpoint source protection
- Habitat and wildlife protection and restoration
- Accountability, education, monitoring, evaluation, communication, and partnerships

In January 2010, two proposals were submitted for potential funding under this program. The first, submitted by the LaPorte County SWCD is entitled "Galena Watershed BMP Planning and Implementation". A second proposal was submitted by The Conservation Foundation and is entitled "Galena/Galien Watershed: Meeting Water Quality Standards". Neither proposal was awarded a GLRI grant.

6.4 Updating the Watershed Plan

High and medium priority projects recommended in this WMP will be underway in five years. At that time, we recommend that the SWCD undertake a plan update. At that point, technical committees can address any deficiencies in the plan which are uncovered by the monitoring component (Chapter 7) and evaluation criteria.

In 2013, IDEM's rotating intensive watershed monitoring program will return to the Galena River and specifically assess if *E.* coli load reductions have restored designated stream use. The data collected by IDEM would be useful to those preparing the plan update.

Deficiencies in the WMP which are uncovered by water quality indicators (monitoring data) may not become apparent for several years. For other indicators, like plan implementation,

deficiencies may become apparent more quickly. The watershed committees should seek to revise the plan and address the underlying causes or reasons behind the deficiencies.

Revision of the plan will essentially entail repeating the planning process outlined in this document, paying special attention to new data sources that can help guide goal-setting, watershed characterization, and management measure recommendations.

7.0 METRICS FOR EVALUATION

7.1 Monitoring Plan

A good monitoring program will allow the project stakeholders to assess the effectiveness of the management practices implemented and to identify areas that can be improved. A monitoring program for the Galena River watershed will consist of both quantitative and qualitative measures. Quantitative measures will include but not be limited to:

- Water quality monitoring (at the nine sampling locations) at specified intervals to measure concentrations of E. coli, nutrients, total suspended solids, dissolved oxygen, and to measure other parameters such as turbidity and flow.
- Biological monitoring and habitat assessment (at the nine sampling locations) to measure any improvements (or degradation) in the macroinvertebrate community or in the in-stream and near-stream habitat.
- Number of acres of stream buffer restored.
- Number of acres of wetland restored.
- Increase in the number of landowners implementing BMPs.
- Number of workshops held and the attendance at each.

Qualitative measures will include but not be limited to:

- Routine visual observations of the watershed prior to, and after, restoration efforts or installation of BMPs
- Increased public awareness of the sensitive nature of the watershed and the issues facing it
- Increased willingness by the community to implement projects to protect the watershed

Water quality monitoring will be performed twice a year at the nine sampling locations on the Galena River; biological (macroinvertebrate) and habitat monitoring will take place a minimum of every five years. More frequent *E. coli* sampling may occur and new locations added to develop a better understanding of the *E. coli* concentrations, variance, and sources. The LaPorte County Health Department has volunteered the use of their laboratory, within reason, for water quality analysis. Data collection efforts will be coordinated with IDEM.

Additional sediment monitoring and data collection is recommended to better understand the degree to which erosion and sedimentation may be affecting the Galena River. A Rosgen-based analysis would identify sediment sources and restoration expectations, priorities and needs (Rosgen 1996).

Visual observations will occur periodically, with special visits to a particular site prior to, and after, restoration efforts or installation of BMPs. A photographic record should be made to assess the effectiveness of the different projects. Visits to each site and interviews with landowners will

create a better understanding of the issues the landowners faced and the benefits that were generated by each project.

The LaPorte County SWCD, or other lead agency, will follow each project closely. Project reports and results will be prepared as part of different funding requirements and on an annual basis for the project stakeholders.

7.2 Interim Milestones for Plan Implementation

The interim measurable milestones for determining whether plan recommendations are being implemented are described in Section 6.1 as high priority (< 2 years), medium priority (3 to 5 years) and low priority (>5 years) timeframes. We further recommend that the SWCD (or Steering Committee) track progress with implementation through an annual review (or more frequent if preferred) where all parties that are listed as having a lead role with implementation provide a report on the status of their activities. The IDNR Coastal Program can participate in the annual reviews and lend assistance were appropriate.

7.3 Ensuring Load Reductions are Being Achieved

The coliform bacteria sampling and analysis will be used to determine whether loading reductions are being achieved over time and whether progress is being made towards attaining the water quality standard for primary contact recreation. The water quality monitoring scheme recommended will generate data at a much improved resolution across both space and time than the TMDL sampling of 2008. This data collection effort will enable an analysis of the efficacy of plan recommendations as they manifest in changes or trends in ambient water quality.

Further, habitat and biological sampling as recommended above is a critical component for judging the efficacy of other (non-TMDL) watershed plan recommendations. Regular monitoring of physical habitat and macroinvertebrate community metric scores (every five years) will track progress towards improved water quality.

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APPENDIX A

Summaries of Public Meetings and Steering Committee Meetings

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GALENA RIVER WATERSHED MANAGEMENT PLAN
FIRST KICKOFF STAKEHOLDER MEETING

Meeting Summary

Date: April 29, 2009

Time: 7:00 p.m. Central Time

Location: LaLumiere School, 6801 N. Wilhelm Road, LaPorte, Indiana 68350

Summary:

The meeting was sponsored by the LaPorte County Soil and Water Conservation District (SWCD). The meeting invitation and list of attendees are attached.

Shannon Donley, of Baetis Environmental Services, Inc., the firm hired to write the Galena River Management Plan, began the meeting by introducing the project and giving a slideshow presentation. Nicole Messacar, Education Coordinator of the LaPorte County SWCD and local sponsor of the project, assisted Ms. Donley with the presentation. Joe Exl, Coastal Nonpoint Coordinator for the Indiana Department of Natural Resources, summarized the habitat and macroinvertebrate results on the Galena River that had been developed to date. During the meeting support was also provided by Gwen White, LARE Biologist for the Indiana Department of Natural Resources (IDNR), and Peg Kohring, Midwest Director for The Conservation Fund.[1]

During the presentation the importance of public involvement was stressed; individuals interested in the project were encouraged to sign up for the Steering Committee. The audience was asked to voice their concerns about the watershed and goals they might like to see for the Management Plan.

The following is a list of comments and concerns publicly voiced during the meeting:

- LaPorte County zoning shows the Galena watershed as urbanized; the current Master Plan has designated the Galena watershed as residential development. The speaker voiced concern about the development of the Galena area. Heston Preserves is a residential

[1] Ms. Kohring was involved with the development of the Watershed Management Plan for the Galien (Galena) River as it flows through Michigan.

subdivision that had a significant negative impact on one of the most beautiful wetlands in the area.

  - The population numbers (provided during the presentation - according to the U.S. Census data the population in LaPorte Co. has decreased slightly) do not take into account the second homes that are being built throughout the watershed. People living in other places are building vacation homes in the area and impacting the watershed.

- There was discussion on septic systems and sewer systems. A county-wide sewer district is being created. The speaker feels that it is needed; that the area will be better off with a regional sewer district. But development follows the sewer lines. The speaker encouraged the audience to get involved and voice concerns about water issues to City Council. The discussion turned to the cost of hooking up to the sewer system with a property owner in the audience concerned about the cost of hooking up to the system.
- There was discussion about the difficulties in identifying the source(s) of *E. coli* and how it is very likely caused by multiple sources including leaking septic fields, livestock, and wildlife.
- Peg Kohring, of the Conservation Fund in Michigan, stressed that the water quality in the Galena River is very good and it is important to protect it. It is one of the best in the surrounding counties in Indiana and Michigan.
- Ms. Kohring also reminded the audience that the Galena River in Indiana is sending *E. coli* to Michigan. Michigan is going door to door to discuss septic systems with property owners in the Galien River watershed.
- This is a great opportunity because it is such a good watershed. It is difficult to fix a water body after it is impaired; it is much easier to protect it ahead of time.
- A question was raised regarding the compliance of the three point source dischargers in the watershed. The speaker recalled hearing that there were compliance issues with one permit holder. Ms. Messacar and Ms. Donley told the audience that the NPDES information was available to the public and would be part of the TMDL report currently being prepared for the Galena River by the Indiana Department of Environmental Management.
- The schedule for development of the management plan was discussed. Ms. Messacar told the audience that she would like the management plan to be completed in time to enable the SWCD to apply for grant funding under the IDNR LARE program's September 30, 2009 deadline.
- Ms. Messacar ended the meeting by summarizing work done by LaPorte high school students at the Springfield Fen Nature Preserve. The wetlands in this preserve are the headwaters to the Galena River. The high school students found the nature preserve to be highly polluted with trash and debris and would like to organize a cleanup.

GALENA RIVER WATERSHED MANAGEMENT PLAN
SECOND STAKEHOLDER MEETING

Meeting Summary

Date: September 22, 2009

Time: 7:00 p.m. Central Time

Location: LaLumiere School, 6801 N. Wilhelm Road, LaPorte, Indiana 68350

Summary:

The meeting was sponsored by the LaPorte County Soil and Water Conservation District (SWCD). The meeting invitation and list of attendees are attached.

It was a small group, in part, because of inclement weather and heavy rains that fell shortly before the meeting. The meeting attendees served on the Steering Committee so they were familiar with the evening's presentation. Rather than sit through the presentation those present reviewed maps created by Joe Exl of the Indiana Department of Natural Resources, and discussed the condition of the watershed and possible improvement projects.

The meeting adjourned at approximately 7:45 pm.

GALENA RIVER WATERSHED MANAGEMENT PLAN
FIRST STEERING COMMITTEE MEETING

Meeting Summary

Date: June 3, 2009

Time: 3:00 p.m. Central Time

Location: LaPorte County SWCD, 100 Legacy Plaza West, LaPorte, Indiana 46350

Meeting Attendees:

Name	**Organization**
Ken Purze	LaPorte Co. Drainage Board
Elizabeth McCloskey	USFWS
Peg Kohring	Conservation Fund
Tom Anderson	Save the Dunes
June Kirchgatter	Property owner
Rick Knoll	Property owner
Steve Barker	Shirley Heinz Land Trust
Jenny Orsburn	Indiana DNR
Gwen White	Indiana DNR
Joe Exl	Indiana DNR
Steve West	IDEM
Nicole Messacar	LaPorte Co. SWCD
Shannon Donley	Baetis Environmental Services

Summary:	**Actions**
The meeting was called to order at 3:10. Introductions were made. Donley provided an overview of the agenda. The agenda for the meeting called for the following: 1) identify major concerns for the watershed, 2) develop a clear, practical vision statement, 3) develop measurable goals, and 4) discuss USFWS grant opportunity.	

Summary:	Actions
Identify Major Concerns for the Watershed Donley summarized the major concerns brought up at the April 29th public meeting. These were: • Concerns about zoning and development within the watershed. • The difficulties in identifying the source(s) of E. coli. • Concerns over point source discharges. • Springfield Fen Nature Preserve (Galena River headwaters) was found recently by local high school students to be filled with trash/debris. There was discussion by several members of the Steering Committee regarding the trash at Springfield Fen Nature Preserve. The Indiana DNR regularly cleans up the area; DNR staff were out recently so the trash should have been removed. Each member of the Steering Committee was asked to voice a major concern that they had for the watershed. This initial list included the following concerns: 1) Development – Rapid Pace/Badly Planned, 2) Degraded septic systems at older trailer courts, 3) Water from Indiana that is swimmable, drinkable, and fishable, 4) Identification of sources of *E. coli*, 5) Keep development density low, 6) Protect high quality habitat, 7) Protect morainal forest and bogs, 7) Need to understand system better, 8) Michigan moving faster than Indiana to protect watershed/work with Michigan because they have good plan in place, and 9) Required inspection of septic systems, Donley mentioned that there are no agricultural related concerns. Barker stated that there is an interest in the rural heritage of the area and sustainable agriculture. A final concern was brought up: 10) Protecting for agricultural use (primarily livestock, equestrian use). Exl brought up point-of-sale septic inspections. They are currently not required. Khoring told the group that the point-of-sale inspections are just getting started on the Michigan side of the watershed. Members were asked to place an 'X' by their top three concerns. Concerns that were similar were combined. Results were tallied and four primary concerns were identified for the watershed. The final concerns are: 1) *Rapid pace of development – badly planned, high density will degrade watershed* 2) *Reducing E. coli bacteria* 3) *Protection of high quality habitat* 4) *Maintain water source for agricultural use (primarily livestock, equestrian use)*	

Summary:	Actions
Develop Vision Statement Ms. Donley handed out examples of vision statements and goals from other watershed management plans. The group discussed likes and dislikes of the examples. Messacar did not want to include a year of completion since it sets unrealistic standards. Khoring and Anderson recommended the inclusion of economic viability language. Other comments were made. Using the examples, the group began creating a vision statement that incorporated each of the four concerns listed above. Due to time constraints, the vision statement was not completed. It was agreed by the group that the vision statement would be 'homework'; each member would continue developing the vision statement and would send his/her ideas to Nicole Messacar prior to the next Steering Committee meeting on July 1, 2009.	Steering committee members to continue developing vision statement. Email ideas to Nicole Messacar prior to July 1 meeting.
Develop Measureable Goals The group focused on development of goals for the watershed. Provided below are the draft goals that were developed. It was agreed that the goals still need work and additional goals may be developed. 1) *The water quality standard for E. coli will be met or surpassed.* 2) *The LaPorte County Master Plan will incorporate practices consistent with recommendations from the Galena River Watershed Management Plan.* 3) *The amount of protected land in the watershed will be increased from _____ acres to _____ acres.* 4) *The amount of agricultural land managed using conservation practices will be increased from _____ acres to _____ acres.* 5) *A public education program will be implemented to educate the public on the definition of a watershed and morainal forest, and to explain why watersheds are important, and how human actions can affect the watershed health.* There was considerable discussion on the need to engage the people working on the County rezoning so that the LaPorte County Master Plan will be consistent with the Galena River Watershed Management Plan. Williams Creek is the consulting firm hired by LaPorte County to provide environmental and review services on the updated zoning ordinances. The Steering Committee needs to contact the person at Williams Creek who is working closely with the County Zoning Department. There was discussion on the use of GIS to calculate acreages and meet several of the goals. It was mentioned that Melissa Mitchell, GIS coordinator for LaPorte County, may be able to provide, or could develop, some of the data needed.	After July, contact project manager or other person at Williams Creek responsible for helping County with rezoning.

Summary:	**Actions**
<u>USFWS Grant Opportunity</u> Messacar informed the group about a USFWS grant opportunity to control invasive species. The group discussed different grants that are available, particularly grants offered through the National Wildlife Federation and the U.S. Fish and Wildlife Service. It was agreed that Donley will begin to compile grant opportunities and deadlines into a calendar. Orsburn and Barker to email USFWS and NWF grant opportunities that they are aware of to Donley.	Jenny Orsburn and Steve Barker to email grant opportunities to Shannon Donley.
<u>Other</u> Steve West informed the group that the TMDL public meeting was scheduled for July 14, 2009 at Lalumiere School.	
Meeting adjourned at 5:00 pm	

GALENA RIVER WATERSHED MANAGEMENT PLAN
SECOND STEERING COMMITTEE MEETING

Meeting Summary

Date: July 1, 2009

Time: 3:00 p.m. Central Time

Location: LaPorte County SWCD, 100 Legacy Plaza West, LaPorte, Indiana 46350

Meeting Attendees:

Name	**Organization**
Roberta Jannsen	Property owner
Lee Reinfurth	LaPorte Co. Drainage Board
June Kirchgatter	Property owner
Nicholas Timm	Property owner
Deb Longworth	Property owner
Elizabeth McCloskey	USFWS
Jon Dittmar	Property owner
Rick McVay	Property owner
Gwen White	Indiana DNR
Garry Traynham	National Park Service
Christine Livingston	Save the Dunes
Steve Barker	Shirley Heinz Land Trust
Rick Knoll	Property owner
Nicole Messacar	LaPorte Co. SWCD
Shannon Donley	Baetis Environmental Services

Summary:	**Actions**
The meeting was called to order at 3:10. Since there were so many new faces, introductions were made. Donley summarized the discussion from the June meeting. The list of concerns that were identified during the first meeting was presented to the group. These were: 1) *Rapid pace of development – badly planned, high density will degrade watershed* 2) *Reducing E. coli bacteria* 3) *Protection of high quality habitat* 4) *Maintain water source for agricultural use (primarily livestock, equestrian use)*	

The group worked on developing a final vision statement. There was discussion on length and scope of the statement. The group reduced the list to two alternatives: 1. Clean Water to Sustain Every Species 2. Protecting Our Beautiful Rural River Since so many attendees from the 1st meeting were absent from the 2nd meeting, Donley will email the choices to the entire Steering Committee for selection. The goals developed from the 1st meeting were presented to the group. *1) The water quality standard for E. coli will be met or surpassed.* *2) The LaPorte County Master Plan will incorporate practices consistent with recommendations from the Galena River Watershed Management Plan.* *3) The amount of protected land in the watershed will be increased from _____ acres to _____ acres.* *4) The amount of agricultural land managed using conservation practices will be increased from _____ acres to _____ acres.* *5) A public education program will be implemented to educate the public on the definition of a watershed and morainal forest, and to explain why watersheds are important, and how human actions can affect the watershed health.*	Donley to email two Vision Statement alternatives to the full Steering Committee for selection.
Donley asked the group if they were in agreement or disagreement with the goals or had other comments. Livingston told the group that goals #3 and #4 should be considered as action items or objectives, not goals. It was also determined that the group's concerns should be written as goals. Objectives would be developed for each goal. Donley will rewrite the group's concerns and include them as goals and work with the group members to develop objectives for each goal.	Donley to rewrite several goals and work with members of the Steering Committee to develop objectives for each goal.
There were questions on the purpose to the watershed management plan and the steering committee. It was suggested that the IDEM checklist and scope be provided to the steering committee.	Donley to distribute IDEM checklist and scope.
Kirchatter asked that the group identify the different audiences for the plan and discuss ways of contacting the different audiences. After some discussion the group determined that the primary audiences of concern are the 1) landowners, 2) County Commissioners, and 3) County Health Department.	Messacar to prepare letter to send to County Zoning Board.
There was discussion on whether or not the County was aware of, and supportive of, the Watershed Management Plan. It was determined that Messacar would draft a letter to the County Zoning Board informing them of the development of the Watershed Management Plan and listing the names of all the steering committee members. There was confusion on the status of the LaPorte County Master Plan. Messacar clarified that the Master Plan is complete; it is the zoning update that is currently being done. The zoning update can be influenced by the Watershed	Messacar/Donley to send out link to the LaPorte County Master Plan.

Management Plan. There was discussion on doing a 'buildout' analysis for the watershed. This analysis would show how future land uses would affect pollutant loadings into the Galena River. It would give the Steering Committee a tool to take to the zoning board to help make land use decisions that would best protect the watershed. Currently there is no funding to do this analysis; Messacar is investigating a possible Indiana Coastal grant to pay for the analysis. It was recommended that there be prioritization of wetland habitat for preservation within the watershed. Wetland enhancement and restoration should be considered first; wetland creation should be considered later due to the much larger effort and costs. McCloskey informed the group about the moraine forest prioritization initiative that is currently underway and funded by the Coastal Grants Program, the Donnelly Foundation, and the Shirley Heinz Land Trust.	
<u>Other</u> The stakeholder meeting for the TMDL is scheduled for July 14, 2009 at Lalumiere School at 6 pm (CST).	
Meeting adjourned around 5:00 pm	

GALENA RIVER WATERSHED MANAGEMENT PLAN
THIRD STEERING COMMITTEE MEETING

Meeting Summary

Date: August 6, 2009

Time: 3:00 p.m. Central Time

Location: LaPorte County Library, 904 Indiana Avenue, LaPorte, IN

Meeting Attendees:

Name	**Organization**
Roberta Jannsen	Property owner
Peg Kohring	The Conservation Fund
June Kirchgatter	Property owner
Joe Exl	Indiana DNR
Deb Longworth	Property owner
Elizabeth McCloskey	USFWS
Steve West	Indiana DEM
Rick McVay	Property owner
Garry Traynham	National Park Service
Nicole Messacar	LaPorte Co. SWCD
Shannon Donley	Baetis Environmental Services

Summary:	**Actions**
Meeting was called to order at 3:05. Peg Kohring told the committee about funding opportunities available through the Great Lakes Restoration Initiative which has $475 million in stimulus funds. Kohring asked if the committee would be interested in teaming with Michigan on a grant application. A meeting will be held to discuss on August 11 at the Stray Dog Restaurant in New Buffalo at 12:00 ET. Donley showed the committee the written resources used to guide the development of the watershed plan. These are: 1) Indiana Watershed Planning Guide, 2) 2003 Watershed Management Plan Checklist, and 3) Scope of Services for the Galena River Watershed Management Plan. Donley summarized IDEM's draft TMDL report and presented a series of maps showing the following: nitrogen and phosphorus export rates, land use, hydric soils, prime farmland and farmland of statewide importance, crop type, point sources, imperviousness, and publicly managed lands. Site 6 was the only site with E. coli levels that met water quality standards.	Nicole and Joe to attend meeting.

The group discussed Site 1 which, according to the draft TMDL report, needs E. coli load reductions of nearly 80%. According to several committee members, during sampling La Lumiere school had a broken sewer pipe which might have contributed to the high E. coli levels. The pipe has since been fixed. It was decided that another water sample should be collected at Site 1 to evaluate E. coli levels now that the pipe has been fixed. West informed the committee that IDEM has no plans to do any resampling; resampling will need to be done by the committee. Exl showed the committee the conversion rate of wetland and forest to other land use he calculated using NOAA's Coastal Change Analysis Program. Between 1996 and 2006 only 29 acres of wetlands and 60 acres of forest within the watershed were lost, mostly to agriculture. Exl presented the results of the macroinvertebrate sampling and habitat assessment. Every sample site had issues with silt cover and embeddedness, riparian width and quality, and bank erosion. Site 6 had the lowest (poorest) QHEI score, well below the minimum score of 53 that IDEM sets for warm water communities. Cattle had access to this site 20 years ago. Today the stream at this site is a muck bottom with little habitat heterogeneity. Site 7 had the best QHEI score, however, the macroinvertebrate community collected at this site did not match the higher QHEI score. Site 4 was selected as a reference site based on the habitat and macroinvertebrate results. This site had the highest taxa richness, highest percent EPT[1], and the lowest (best) Hilsenhoff biotic index score. Exl presented the results of a stream buffer analysis. A 100-foot buffer (on both sides of the stream) was used in the calculation. According to the results, 7.5 miles of stream in the watershed do not have sufficient buffer. Within this 7.5 miles, 6,138 acres of agricultural land and 165 acres of developed land exist within the 100-foot buffer. Based on the information presented at the meeting the committee formed the following problem statements (rough cut): 1) E. coli levels exceed the State standard of 235 colonies/100 mL throughout the watershed because of human (septic), livestock, and wildlife influences. 2) The hydric soils map shows that historic acreages of wetlands were greater than exist today throughout the watershed. Over time many wetlands have been drained and converted to agriculture. 3) Most of the growth projected in the LaPorte County Land Development Plan will occur north of Interstate 80/90 where high quality wetlands and forests exist. Currently there is no policy or guidelines in place to protect these areas. 4) Approximately 7.5 miles of stream do not meet the recommended 100-foot riparian buffer because of adjacent land uses. 5) High sediment loads from streambank erosion and adjacent land uses	Committee members to make arrangements for additional sampling at Site 1.

[1] Percentage of taxa that are within the orders ephemeroptera, plecoptera, and tricoptera.

throughout the watershed are negatively affecting the macroinvertebrate community. 6) Historically, the river and tributaries have been hydraulically and hydrologically altered by culverts, small impoundments, and by other actions. A discussion ensued on the importance of the steering committee surveying the watershed to find specific problem areas. It was decided that volunteers from the committee would take sections of the watershed and perform windshield surveys. West agreed to send field forms that IDEM uses to complete windshield surveys. Messacar and Exl agreed to develop a standardized process for volunteers to survey the watershed and collect information. Donley agreed to create a map of field use. Lastly, Messacar informed the group about a phone call received from the MDEQ regarding high sediment loads entering Michigan from Indiana. The sediment problem originates from Spring Creek. Kohring expressed interest in taking on this area for the field survey to further investigate the issue.	Messacar and Exl to develop a standardized approach for the field survey. Donley to create map for field survey.
<u>Next Meeting</u> The next Steering Committee meeting will be held on September 3, 2009, at 3 pm (CST) at the LaPorte County Library, 904 Indiana Avenue.	
Meeting adjourned around 5:00 pm	

GALENA RIVER WATERSHED MANAGEMENT PLAN
FOURTH STEERING COMMITTEE MEETING

Meeting Summary

Date: September 3, 2009

Time: 3:00 p.m. Central Time

Location: LaPorte County Library, 904 Indiana Avenue, LaPorte, IN

Meeting Attendees:

Name	**Organization**
Rick Knoll	Property owner
Peg Kohring	The Conservation Fund
June Kirchgatter	Property owner
Rich Mrozinski	LaPorte County Council
Deb Longworth	Property owner
Nick Timm	Property owner
Elizabeth McCloskey	USFWS
Steve West	Indiana DEM
Steve Barker	Shirley Heinz Land Trust
Garry Traynham	National Park Service
Jim Simon	Property owner
Myrna Harder	LaPorte Co. SWCD
Nicole Messacar	LaPorte Co. SWCD
Sheila Batchelor	LaPorte Co. SWCD
Shannon Donley	Baetis Environmental Services

Summary:	**Actions**
Meeting was called to order at 3:05. Peg Kohring told the group about Michigan's efforts to improve septic systems in the watershed. During door to door surveys, volunteers noticed that houses were not weatherized. They've since implemented a program where weatherizing (caulking, etc) and septic system evaluations are combined. Homeowners are much more receptive to this approach. On Sept. 12, 2009 a Weatherization Community Fair is being held in the New Troy, MI. Septic system maintenance will be one of the issues discussed. Kohring left flyers and a poster for the group. Messacar, Traynham, Timm, and Longworth summarized the results of the windshield surveys they completed on different areas of the watershed. Both Messacar and Traynham had positive things to say…good buffer, good flow, low turbidity, culverts in relatively good condition. Messacar found one site where horses could reach water from the river but could not enter the river.	

Timm and Longworth described their area (Sampling Site 9 and upstream tributaries) as being 50% fallow land. They identified four areas where water was entering the Galena River from the fields. Upstream of Site 9, the western tributary has no noticeable input from septic or livestock sources. This may be a good tributary to sample for *E. coli* to understand the wildlife influences in the area. The eastern tributary has some possible septic sources and cattle.

It was acknowledged that background wildlife levels for *E. coli* might be high in the watershed and that DNA testing could be used to determine the type of animal that is the *E. coli* source. West informed the group that IDEM is reluctant to fund DNA work; the results of DNA testing can be imprecise and the results are often not helpful. IDEM prefers that the group focus on implementation of BMPs to reduce *E. coli* levels. IDEM will fund BMPs. If *E. coli* levels cannot be reduced by BMPs then the TMDL stands. The group recognized that there is not much that can be done if the high *E. coli* levels are caused by wildlife.

Messacar informed the group that the County zoning meetings had been postponed until October or November.

Mrozinski told the group that there are a large number of failing septic systems in Rolling Prairie. In some areas, septic and drinking water sources are in close proximity. He added that funding from the County was not available and wanted to work with the Steering Committee on the issue. Rolling Prairie is planning a public meeting to discuss septic issues although a date has not been set. It would be helpful to have members of the Galena River Steering Committee attend. West stressed that there were funds for septic improvements available through the Great Lakes Restoration Initiative.

Donley presented several maps showing 1) possible wetland restoration areas, and 2) locations of threatened/endangered/sensitive species. It was noted that 76 state-listed[1] species and one federal candidate species are located in the Springfield Fen Nature Preserve at the headwaters to the Galena River. This preserve also has two high quality natural communities, fen and seep. Donley then gave a summary of the recommendations in the County Land Development Plan for the northeastern part of the county which includes the Galena River watershed.

The group worked through the problem statements developed in August and identified critical areas for possible projects. Provided below is a summary of the Powerpoint notes provided by Donley:

Issue: *E. coli*
Problem statement: *E. coli levels exceed the State standard of 235 colonies/100 mL throughout the watershed because of human (septic), livestock, and wildlife influences.*
Critical areas: *Residential sources (septic), Livestock sources*

[1] For brevity the term 'state-listed' here includes the following: state-endangered, state-threatened, state rare, state species of special concern, state significant, and watch list species.

Issue: *Historic wetland loss* Problem statement: *The hydric soils map shows that historic acreages of wetlands were greater than exist today throughout the watershed. Over time many wetlands have been drained and converted to agriculture.* Critical areas: *Potential wetland restoration areas (as shown on map).* Issue: *Sensitive natural resources* Problem statement: *Most of the growth projected in the LaPorte County Land Development Plan will occur north of Interstate 80/90 where high quality wetlands and forests exist. Currently there is no policy or guidelines in place to protect these areas.* Critical areas: *Land around headwaters (Springfield Fen Nature and Galena Wetland Conservation Area), large tracts of forested land (location?), all areas in close proximity to T&E and sensitive species.* Issue: *Stream buffer* Problem statement: *Approximately 7.5 miles of stream do not meet the recommended 100-foot riparian buffer because of adjacent land uses.* Critical areas: *Buffer areas identified in the Stream Buffer Analysis.* Issue: *Sedimentation* Problem statement: *High sediment loads from streambank erosion and adjacent land uses throughout the watershed are negatively affecting the macroinvertebrate community.* Critical areas: *Buffer areas identified in the Stream Buffer Analysis, agricultural lands not managed using BMPs, areas with livestock access to stream.* Issue: *Hydraulic and hydrologic modification* Problem statement: *Historically, the river and tributaries have been hydraulically and hydrologically altered by culverts, small impoundments, and by other actions.* Critical areas: *Potential wetland restoration areas, undersized and/or blocked culverts, impoundments.* The group spent time discussing sensitive natural resources. In addition to the headwaters to the river, areas with T&E species, and large tracts of forested land, other sensitive areas were mentioned as possible critical areas. It was noted Donley needed to get the Forest Legacy Areas into a map. Timm and Longworth told that group that their land is in an easement under the Forest Legacy Program and that they have state-listed species on the property. Thompson Bog was mentioned and a large wetland on the east side of Heston Preserves near Spring Creek (south of 1000 Rd.). There was discussion on Seven Springs, over 400 acres privately owned, located in the headwaters, and is managed by Rick Knoll, a Steering Committee member. Seven Springs is being restored to its natural state and invasive species are being removed. Knoll told the group that he could arrange to allow for a plant and animal inventory. On sedimentation, the group discussed possible areas where sedimentation is problematic. While not present during the meeting, Joe Exl, IDNR, had requested that Site 6 be listed as a critical area. Erosion and sedimentation is a	Donley to place Forest Legacy Areas into a map.

problem at this site but it has good potential for restoration. It was noted that Site 6 may be the site of a fen. On the issue of hydrologic/hydraulic modifications it was decided that culverts would be identified on an individual basis. At least six impoundments were identified during the meeting. The Lake Rim website has GIS locations and information on many of the impoundments.	Donley to gather locations of impoundments from Lake Rim website.
<u>Next Meeting</u> The next Steering Committee meeting will be held on Thursday, October 8, 2009, at 3 pm (CDT) at the LaPorte County Library, 904 Indiana Avenue. The second Public Meeting will be held on Tuesday, September 22, at 7 pm (CDT) at Lalumiere School, 6801 N. Wilhelm Road, LaPorte, IN 46350.	
Meeting adjourned around 5:00 pm	

GALENA RIVER WATERSHED MANAGEMENT PLAN
FIFTH STEERING COMMITTEE MEETING

Meeting Summary

Date: October 8, 2009

Time: 3:00 p.m. Central Time

Location: LaPorte County Library, 904 Indiana Avenue, LaPorte, IN

Meeting Attendees:

Name	**Organization**
Rick Knoll	Property owner
Peg Kohring	The Conservation Fund
June Kirchgatter	Property owner
Deb Longworth	Property owner
Nick Timm	Property owner
Elizabeth McCloskey	USFWS
Steve West	Indiana DEM
Joe Exl	Indiana DNR
Garry Traynham	National Park Service
Jim Simon	Property owner
Shannon Donley	Baetis Environmental Services

Summary:	**Actions**
Meeting was called to order at 3:05. The group reviewed the draft goals, and the issues and critical areas identified during previous meetings and began developing goals, objectives and identifying action items. Exl recommended that "Future Urban Development" be added to the list and identified as a separate issue. During the course of the meeting, the group threw out many ideas for goals, objectives, and action items for each of the issues. It was agreed that Donley will organize all ideas in a table and email to the meeting attendees so that they can continue working on this task. The possibility of a field trip was discussed. Donley will try to arrange a field trip in late October if there is enough interest.	Donley to create table and send to meeting attendees for review and continued work.
<u>Next Meeting</u> The next Steering Committee meeting will be held on Thursday, November 5, 2009, at 3 pm (CDT) at the LaPorte County Library, 904 Indiana Avenue.	
Meeting adjourned around 5:00 pm	

GALENA RIVER WATERSHED MANAGEMENT PLAN
SIXTH STEERING COMMITTEE MEETING

Meeting Summary

Date: November 5, 2009

Time: 3:00 p.m. Central Time

Location: LaPorte County Library, 904 Indiana Avenue, LaPorte, IN

Meeting Attendees:

Name	**Organization**
Tony Mancuso	LaPorte County Health Dept.
Nicole Messacar	LaPorte County SWCD
Kris Krouse	Shirley Heinz Land Trust
Steve Barker	Shirley Heinz Land Trust
June Kirchgatter	Property owner
Deb Longworth	Property owner
Nick Timm	Property owner
Elizabeth McCloskey	USFWS
Steve West	Indiana DEM
Joe Exl	Indiana DNR
Garry Traynham	National Park Service
Shannon Donley	Baetis Environmental Services

Summary:	**Actions**
Meeting was called to order at 3:05. The group reviewed and revised the table of goals and action items Donley had created from the October meeting discussion. Priority rankings were assigned to each action item. The final product from this meeting will be distributed to the Steering Committee and incorporated into the draft watershed plan. As the table was reviewed/revised the following topics were brought forth by meeting attendees: • Exl made an announcement that the group that did the Trail Creek watershed plan was looking for teaming partners for a grant proposal to do a Particle Tracking Study and genetics on *E. coli* under the Great Lakes Restoration Initiative. The Steering Committee agreed to team with Trail Creek and to inform Michigan (those responsible for the Galien River watershed plan) about the opportunity. • Mancuso from the County Health Dept. discussed ways in which the Health Dept. can work with the Steering Committee. Within reason the Health Dept. is willing to donate their laboratory and to analyze water samples for E. coli. The Health Dept. is, however, understaffed and will not be able to collect samples. • Exl presented a map showing that the vast majority of the watershed is	

rated as 'very limited' for septic systems. Mancuso responded that Health Dept. staff are aware of the soil limitations of the area but do issue septic permits. They are able to do this because site conditions may be suitable for septics on a site-by-site basis that cannot be captured by the large scale watershed map. Health department staff visit each property individually and assess soil suitability of the precise location for the proposed septic system. Site conditions may change dramatically within just a few feet, moving from suitable to unsuitable or vice versa, thus requiring an actual field assessment. • Mancuso informed the Steering Committee that establishing a point-of-sale ordinance for septic inspections (one of the action items) can be problematic if there is insufficient staffing. He added that it is possible to do but you need adequate staffing to implement such a program effectively. A septic maintenance and monitoring program can be worked into the ordinance. • It was decided that a Zoning Subcommittee will be started. This subcommittee would focus solely on the rezoning currently being done for the County. It will be the intent of this subcommittee to become involved with the County's rezoning efforts and ensure the ordinances adopted will be protective of the area's natural resources. • Exl informed the group that he had provided model EPA ordinances on septic, open space, aquatic buffer, and post-construction stormwater runoff, to a participant on the County Zoning Committee. • Kris Krouse, Executive Director of the Shirley Heinz Land Trust, told the Steering Committee about the Moraine Conservation Project, where they are identifying and prioritizing parcels for preservation within the moraine forest. • It was determined that there is insufficient staff to implement the watershed plan. A high priority action item identified by the group is the development of a County Watershed Coordinator position. • At the meeting the wetland acreage within the watershed was in question as Baetis' and Exl's wetland acres did not match. The correct acres will determine what wetland goal and action items will be developed for the watershed. This issue will be resolved soon. • Messacar informed the Steering Committee that she had applied Nov. 1, 2009 for a Clean Water Indiana Grant to restore stream buffers on private property. It is a $7,000 grant with a cost-share component. • During a discussion on sensitive natural resource protection, Timm and Longworth spoke of the cumbersome nature of the Forest Legacy Program. The group should identify ways to supplement the program or make it less cumbersome.	
<u>Next Meeting</u> A Steering Committee meeting will not be held in December. A Steering Committee meeting will be held in January at a date to be determined.	
Meeting adjourned around 5:45 pm	

GALENA RIVER WATERSHED TOTAL MAXIMUM DAILY LOAD
KICKOFF STAKEHOLDER MEETING

Meeting Summary

Date: January 21, 2009

Time: 6:00 p.m. Central Time

Location: Spicer Lake Nature Preserve, 50840 County Line Road, New Carlisle, Indiana

Summary:

This meeting was sponsored by the LaPorte County Soil and Water Conservation District (SWCD) and the Indiana Department of Environmental Management (IDEM). The meeting invitation and the list of attendees are included in the appendix.

Nicole Messacar, Education Coordinator of the Laporte County SWCD, began the meeting by welcoming the participants and introducing the work being done in the Galena River Watershed including the Total Maximum Daily Load (TMDL) development and the Watershed Management Plan.

The Indiana Department of Environmental Management, Office of Water Quality gave two slideshow presentations on Total Maximum Daily Loads (TMDL). Andrew Pelloso, Chief of the NPS/TMDL Section, presented "TMDL 101 – Everything You Ever Wanted to Know About Total Maximum Daily Loads." Selena Medrano, TMDL Project Manager, presented "Galena River TMDL – Kickoff Meeting Technical Presentation."

Questions were taken verbally from the audience during the presentation. The issues voiced by the audience include:

- Was Indiana coordinating closely with the work that had been done in the watershed by the State of Michigan?
- What is the compliance history of the three NPDES permitted facilities in the Galena River watershed?
- Given the undeveloped nature of the watershed, what are the possible sources of the high E. coli concentrations?

Baetis®
Environmental Services, Inc.

MEETING DOCUMENTATION

Meeting Date:	July 14, 2009	Project Name:	Galena Watershed Management
Meeting Location:	La Lumiere School, Laporte, Indiana	Project Number:	
Meeting Subject:	**Draft TMDL Report**		

Attendees:

12 people, including 4 from IDEM

The meeting was rather casual, as the regular meeting room (with projector, etc.) was locked and inaccessible. Andrew Pelloso chaired the meeting, providing an introduction to TMDLs and leading the Q&A. Selena Melano presented the technical portion of the TMDL. Length of the meeting was 1½ hours.

Discussion:	Action/Response:
AP apologized for late posting of draft report to website. Additional time can be provided for comment period if needed.	Email Selena if we require more time to get review comments to IDEM.
Only 2008 E coli data used from TMDL.	IDEM policy is to exclude data older than 5 years. Data from 2000 sampling was therefore not used.
Macroinvertebrates have been identified, but vouchers are in SWCD office awaiting hand-delivery to Purdue and confirmation.	
Final TMDL scheduled for the fall and subsequent delivery to EPA Region 5. This TMDL will not be included in this year's "counting".	
Baetis will lead preparation of review comments on the draft TMDL.	Comments will be coordinated with the steering committee (Aug. 6 meeting) and be submitted under Nicole's signature.

APPENDIX B

Figures Provided by the IDNR

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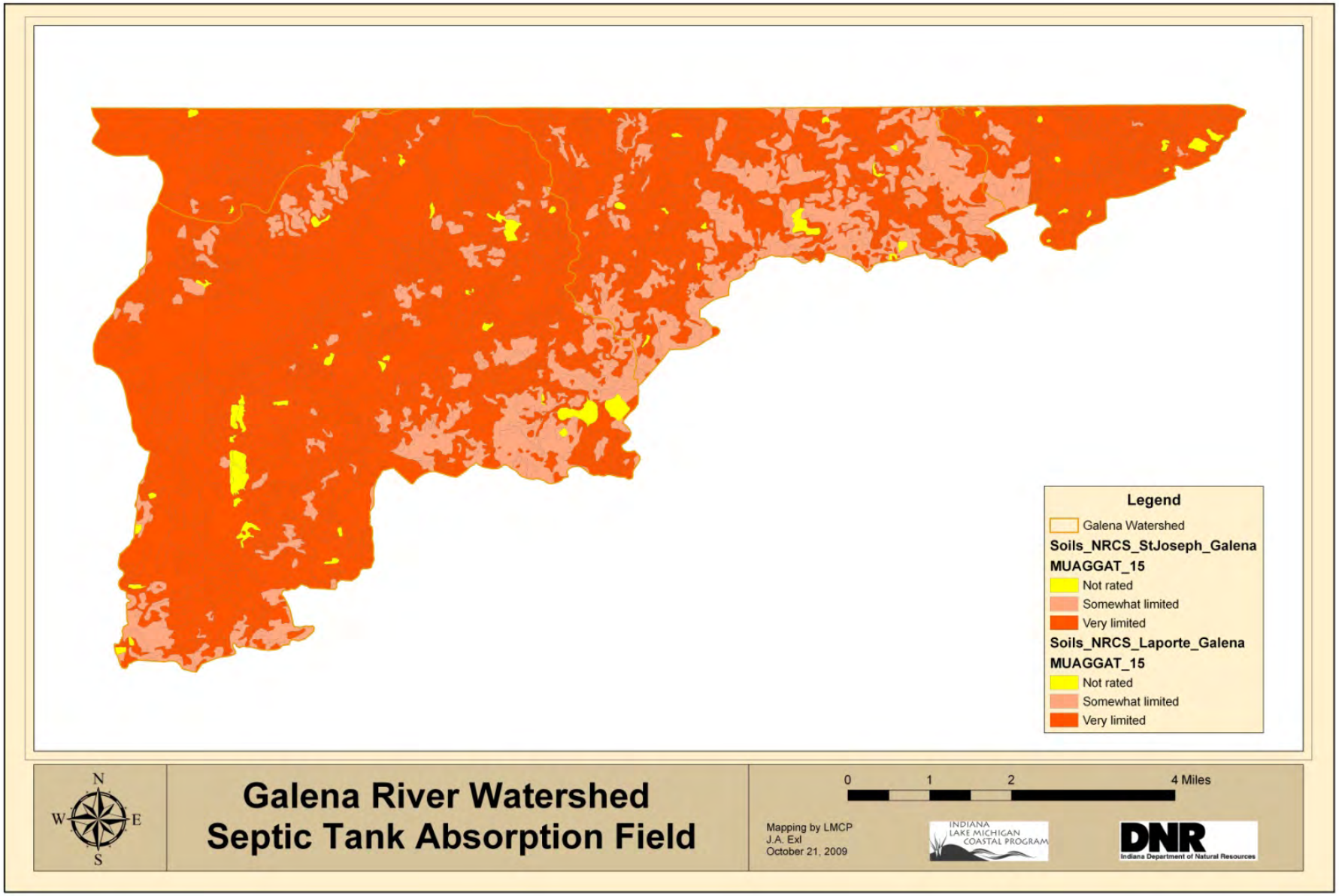
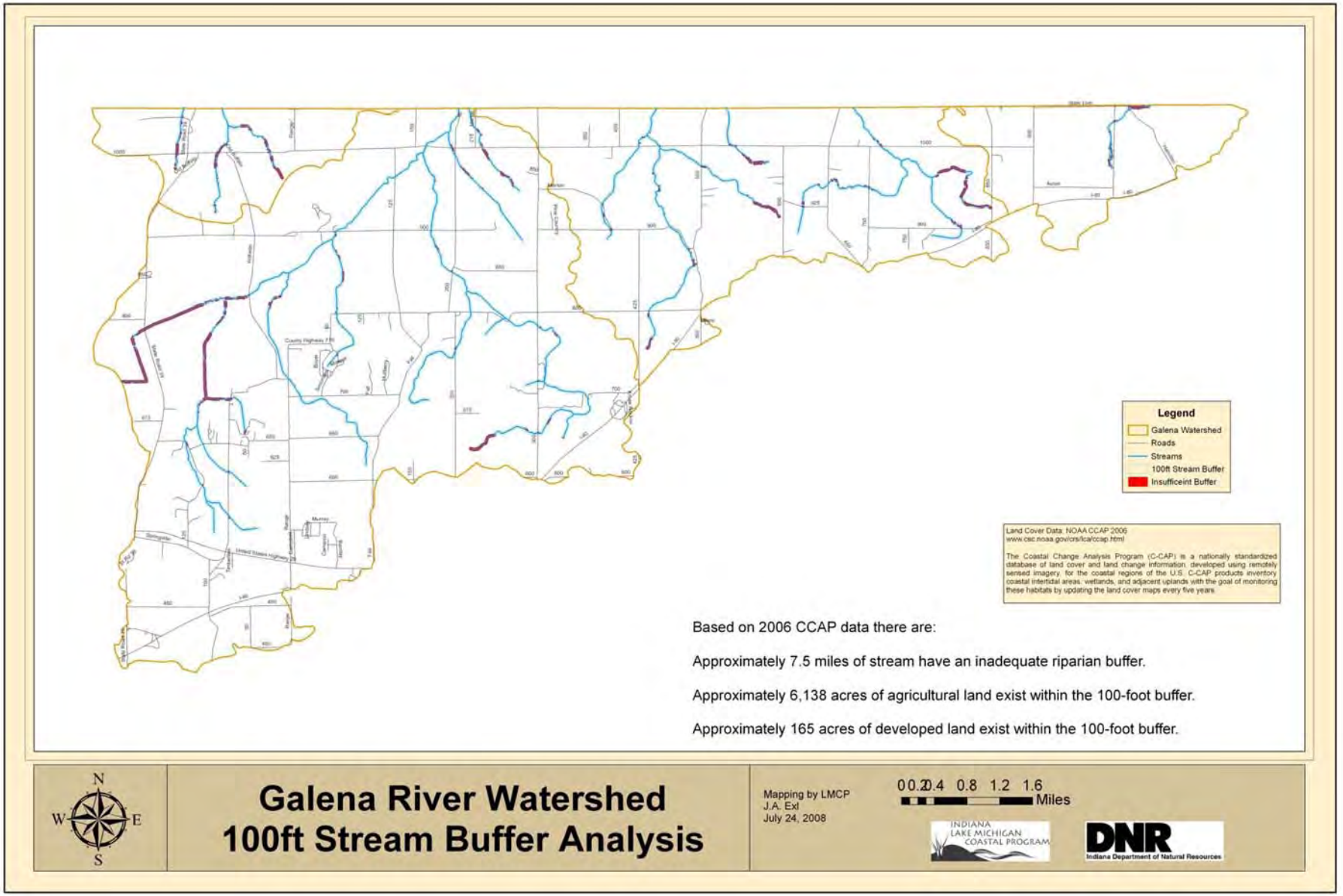
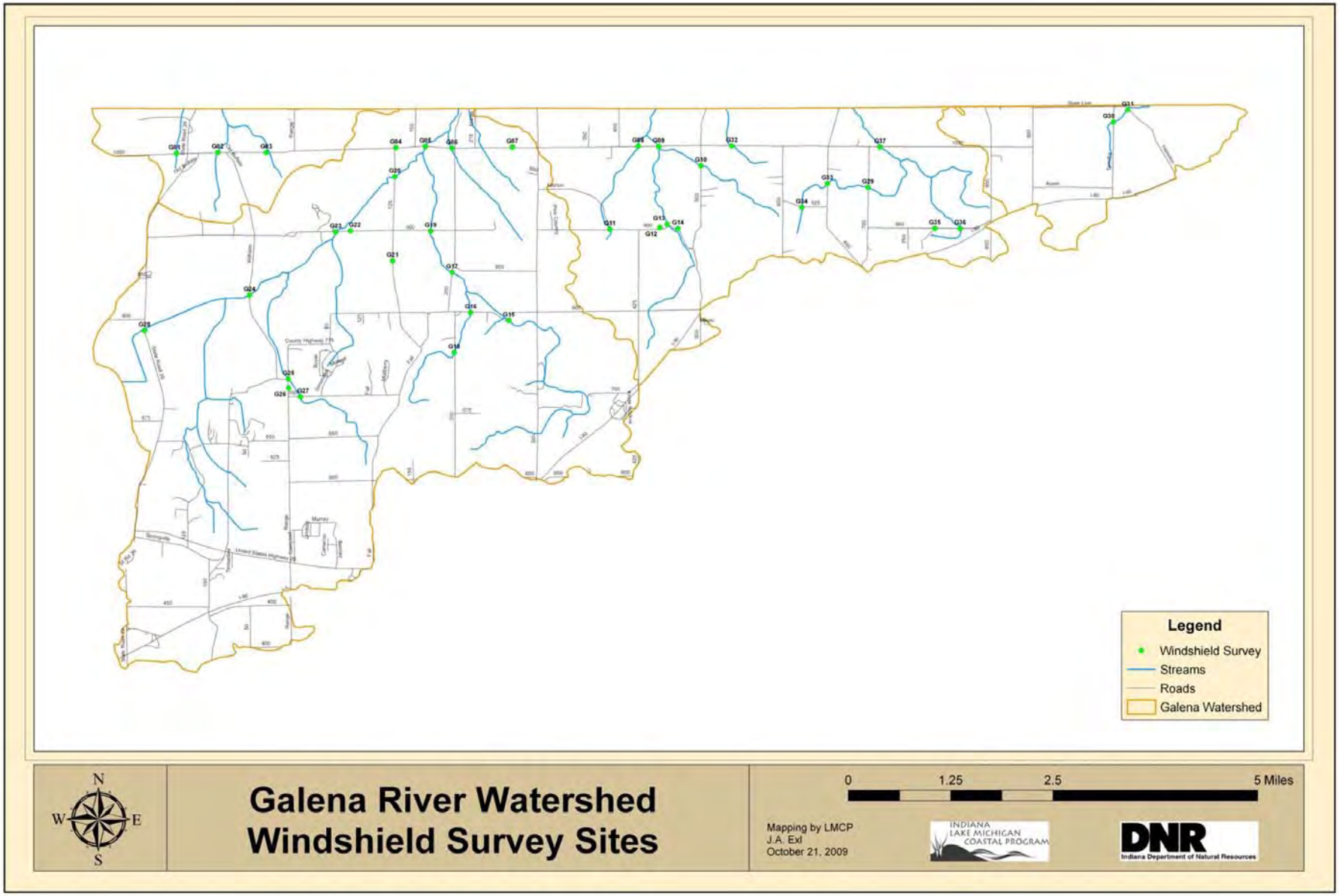


Limitations for Septic System Absorption Field



Results of the Galena River Watershed 100-foot Stream Buffer Analysis



Windshield survey locations within the Galena River Watershed

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APPENDIX C

Listing of Threatened, Endangered and Rare Species, Natural Heritage Program Results

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State and Federal-listed Species for the Galena River Watershed as Provided by IDNR's Natural Heritage Database Program

Type	Species Name	Common Name	State Status	Federal Status
High Quality Natural Community	Wetland – seep circumneutral	Circumneutral seep	Significant	-
High Quality Natural Community	Wetland fen	Fen	Significant	-
Mammal	*Myotis lucifugus*	Little brown bat	Special Concern	-
Mammal	*Myotis septentrionalis*	Northern myotis	Special Concern	-
Mammal	*Taxidea taxus*	American badger	Special Concern	-
Mammal	*Lynx rufus*	Bobcat	Special Concern	-
Bird	*Dendroica cerulea*	Cerulean warbler	Endangered	-
Bird	*Wilsonia cetrina*	Hooded warbler	Special Concern	-
Bird	*Botaurus lentiginosus*	American bittern	Endangered	-
Bird	*Ixobrychus exilis*	Least bittern	Endangered	-
Bird	*Buteo platypterus*	Broad-winged hawk	Special Concern	-
Bird	*Buteo lineatus*	Broad-winged hawk	Special Concern	-
Bird	*Lanius ludovicianus*	Loggerhead shrike	Endangered	-
Bird	*Empidonax alnorum*	Alder flycatcher	Tracked to Monitor Status	-
Amphibian	*Rana pipiens*	Northern leopard frog	Special Concern	-
Amphibian	*Hemidactylium*	Four-toed salamander	Endangered	-
Amphibian	*Acris crepitans blanchardi*	Blanchard's cricket frog	Special concern	-

Type	Species Name	Common Name	State Status	Federal Status
Reptile	*Emydoidea blandingii*	Blanding's turtle	Endangered	-
Reptile	*Clemmys guttata*	Spotted turtle	Endangered	-
Reptile	*Sistrurus catenatus catenatus*	Eastern massasauga	Endangered	Candidate Species
Insect - Lepidoptera	*Spartiniphaga inops*	Spartina borer moth	Rare	-
Insect - Lepidoptera	*Poanes viator viator*	Big broad-winged skipper	Threatened	-
Insect - Lepidoptera	*Apamea lutosa*	Opalescent Apamea	Endangered	-
Insect - Lepidoptera	*Apamea nigrior*	Black-dashed Apamea	Rare	-
Insect - Lepidoptera	*Apamea indocilis*	The spastic Apamea	Tracked to Monitor Status	-
Insect - Lepidoptera	*Apamea lignicolora*	The wood-colored Apamea	Threatened	-
Insect - Lepidoptera	*Papaipema maritima*	The giant sunflower borer moth	Threatened	-
Insect - Lepidoptera	*Papaipema limpida*	The ironweed borer moth	Rare	-
Insect - Lepidoptera	*Papaipema lysimachiae*	The St. John's wort borer moth	Rare	-
Insect - Lepidoptera	*Papaipema rutila*	The mayapple borer moth	Rare	-
Insect - Lepidoptera	*Papaipema rigida*	A borer moth	Rare	-
Insect - Lepidoptera	*Papaipema harrisii*	Heracleum stem borer moth	Rare	-
Insect -	*Papaipema beeriana*	Beer's blazing star borer	Threatened	-

Type	Species Name	Common Name	State Status	Federal Status
Lepidoptera		moth		
Insect - Lepidoptera	*Papaipema cerina*	Golden borer moth	Threatened	-
Insect - Lepidoptera	*Papaipema speciosissima*	The royal fern borer moth	Threatened	-
Insect - Lepidoptera	*Leucania inermis*	A moth	Rare	-
Insect - Lepidoptera	*Macrochilo louisiana*		Threatened	-
Insect - Lepidoptera	*Meropleon ambifuscum*	Newman's brocade	Threatened	-
Insect - Lepidoptera	*Macrochilo hypocritalis*	A noctuid moth	Rare	-
Insect - Lepidoptera	*Meropleon diversicolor*	A noctuid moth	Rare	-
Insect - Lepidoptera	*Gabara subnivosella*	A noctuid moth	Rare	-
Insect - Lepidoptera	*Homophoberia cristata*	A noctuid moth	Rare	-
Insect - Lepidoptera	*Capis curvata*	A noctuid moth	Threatened	-
Insect - Lepidoptera	*Hypenodes caducus*	Large hypenodes	Rare	-
Insect - Lepidoptera	*Nola cilicoides*		Rare	-
Insect - Lepidoptera	*Grammia phyllira*	The sand barrens Grammia	Rare	-
Insect - Lepidoptera	*Grammia virguncula*		Rare	-

Type	Species Name	Common Name	State Status	Federal Status
Insect - Lepidoptera	*Aethes patricia*		Endangered	-
Insect - Lepidoptera	*Leucania linita*	Salt marsh wainscot	Rare	-
Insect - Lepidoptera	*Polites mystic*	Long dash skipper	Rare	-
Insect - Lepidoptera	*Acronicta dactylina*		Rare	-
Insect – Lepidoptera	*Catocala gracilies*	Graceful underwing	Rare	-
Insect - Lepidoptera	*Eubaphe meridiana*	A moth	Rare	-
Insect - Lepidoptera	*Notodonta scitipennis*	A notodontid moth	Tracked to Monitor Status	-
Insect - Lepidoptera	*Eucosma giganteana*		Rare	-
Insect - Lepidoptera	*Eucosma bipunctella*	A moth	Rare	-
Insect - Lepidoptera	*Eucosma bilineana*		Rare	-
Insect - Lepidoptera	*Peoria gemmatella*	Gemmed cordgrass borer	Rare	-
Insect - Lepidoptera	*Crambus bidens*		Rare	-
Insect - Lepidoptera	*Poanes massasoit*	Mulberry wing skipper	Rare	-
Insect - Lepidoptera	*Polygonia progne*	Gray comma	Rare	-
Insect -	*Agrotis stigmosa*		Threatened	-

Type	Species Name	Common Name	State Status	Federal Status
Lepidoptera				
Insect - Lepidoptera	*Odontosia elegans*	Elegant prominent	Rare	-
Insect - Lepidoptera	*Parasa indetermina*	A moth	Rare	-
Insect - Lepidoptera	*Spartaphaga includens*	The included cordgrass borer	Threatened	-
Insect - Lepidoptera	*Fagitana littera*	The marsh fern moth	Threatened	-
Insect - Lepidoptera	*Euphydryas phaeton*	Baltimore	Rare	-
Insect - Lepidoptera	*Catocala praeclara*	Praeclara underwing	Rare	-
Insect - Lepidoptera	*Macrochilo absorptalis*	A moth	Rare	-
Insect - Lepidoptera	*Leucania multilinea*		Rare	-
Insect - Lepidoptera	*Boloria selene myrina*	Silver-bordered fritillary	Threatened	-
Insect - Homoptera	*Laevicephalus acus*		Rare	-
Insect – Homoptera	*Bruchomorpha extensa*	Long-nosed elephant hopper	Rare	-
Insect - Homoptera	*Mesamia nigridorsum*	A leafhopper	Rare	-
Insect - Homoptera	*Scaphoideus ochraceus*		Rare	-
Insect - Homoptera	*Flexamia reflexus*	Indiangrass Flexamia	Threatened	-

Type	Species Name	Common Name	State Status	Federal Status
Insect - Homoptera	*Cosmotettix bilineatus*	Two-lined cosmotettix	Threatened	-
Insect - Homoptera	*Cicadula straminea*		Threatened	-
Insect - Orthoptera	*Neoconocephalus exiliscanorus*	A katydid	Rare	-
Insect - Orthoptera	*Melanoplus gracilis*	Graceful spur-throated grasshopper	Rare	-
Vascular Plant	*Poa alsodes*	Grove meadow grass	Rare	-
Vascular Plant	*Poa paludigena*	Bog bluegrass	Watch List	-
Vascular Plant	*Dryopteris clintoniana*	Clinton woodfern	Tracked to Monitor Status	-
Vascular Plant	*Milium effusum*	Tall millet-grass	Rare	-
Vascular Plant	*Sorbus decora*	Northern mountain ash	Tracked to Monitor Status	-
Vascular Plant	*Wolffiella gladiata*	Sword bogmat	Endangered	-
Vascular Plant	*Satureja vulgaris var. neogaea*	American wild basil	Watch List	-
Vascular Plant	*Cypripedium candidum*	Small white lady's-slipper	Watch List	-
Vascular Plant	*Panicum boreale*	Northern witchgrass	Rare	-
Vascular Plant	*Panicum leibergii*	Leiberg's witchgrass	Threatened	-
Vascular Plant	*Valeriana uliginosa*	Marsh valerian	Endangered	-
Vascular Plant	*Valeriana edulis*	Hairy valerian	Endangered	-
Vascular Plant	*Conioselinum chinense*	Hemlock Parsley	Endangered	-
Vascular Plant	*Satureja glabella var. angustifolia*	Calamint	Endangered	-

Type	Species Name	Common Name	State Status	Federal Status
Vascular Plant	*Deschampsia cespitosa*	Tufted hairgrass	Rare	-
Vascular Plant	*Carex debilis var. rudgei*	White-edge sedge	Rare	-
Vascular Plant	*Zigadenus elegans var. glaucus*	White carnas	Rare	-

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APPENDIX D

Properties Listed on the National Register of Historic Places for LaPorte and St. Joseph Counties

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Hammond
Architecture

John Wood Old Mill, 1838.
Merrillville vicinity
Architecture, Commerce, Exploration/Settlement

Wilbur Wynant House, 1916.
Gary
Architecture

LaPORTE COUNTY
County Seat: LaPorte

John H. Barker Mansion, 1905.
Michigan City
Architecture, Industry

Barker House, c.1900.
Michigan City
Architecture

Downtown LaPorte Historic District, 1850-1914.
LaPorte
Archiecture, Community Planning and Development

First Congregational Church of Michigan City, 1881 / 1909.
Michigan City
Architecture

Garrettson-Baine-Bartholomew House, 1908.
Michigan City
Archtiecture

Michigan City East Pierhead Light Tower and Elevated Walk (Michigan City Lighthouse), 1904.
Eastside of entrance to Michigan City Harbor
Architecture, Transportation

Michigan City Lighthouse, 1858.
Michigan City
Conservation, Architecture

Michigan City Post Office, 1909.
Michigan City

Architecture

Francis H. Morrison House, 1904.
LaPorte
Architecture, Commerce

MUSKEGON Shipwreck Site.
Archaeology

William Orr House, 1875.
LaPorte
Archtiecture

Pinehurst Hall, 1853.
LaPorte
Architecture

Marion Ridgeway Polygonal Barn, 1878.
LaPorte
Agriculture, Architecture
(Round and Polygonal Barns of Indiana Multiple Property Listing)

Everel S. Smith House, 1879.
Westville
Architecture, Commerce

Washington Park, 1891, 1933-1941.
Michigan City
Entertainment/Recreation, Landscape Architecture, Social History, Architecture

LAWRENCE COUNTY
County Seat: Bedford

Bedford Courthouse Square Historic District, c.1850-1945.
Bedford
Commerce, Politics/Government, Architecture

Bono Archaeological Site.
Archaeology

Helton-Mayo Farm, c.1837.
Bedford
Agriculture, Exploration/Settlement, Architecture

Indiana Limestone Company Building, 1927.

ST. JOSEPH COUNTY
County Seat: South Bend

Battell Park Historic District, 1881-1937.
Mishawaka
Entertainment/Recreation, Landscape Architecture

Beiger House, 1909.
Mishawaka
Architecture, Industry

W.N. Bergen - J.C. Lauber Company Building, 1882, 1900, 1924.
South Bend
Commerce, Industry, Architecture
(East Bank Multiple Property Listing)

Horatio Chapin House, 1857.
South Bend
Architecture

Chapin Park Historic District, 1871-1910.
South Bend
Architecture, Community Planning and Development

Children's Dispensary, c.1910.
South Bend
Health/Medicine, Social History

Colonial Gardens Commercial Historic District, 1925-1947.
South Bend
Architecture, Commerce

Dille-Probst House, 1888.
South Bend
Architecture

Dodge House, 1889.
Mishawaka
Architecture, Social History

Downtown South Bend Historic Multiple Resources Area
South Bend
Architecture, Commerce

All American Bank Building, 1924; Berteling Building, 1905; Blackstone-

State Theater, 1919; Cathedral of St. James and Parish Hall, 1894; Central High School and Boys Vocational School, 1913, 1928; Citizens Bank, 1913; Commercial Building, 1922; Farmer's Security Bank, 1915; Former First Presbyterian Church, 1888; Hager Residence, 1910; W.R. Hinkle and Company, 1922; Hoffman Hotel, 1930; I & M Building, 1929; J.M.S. Building, 1910; John G. Kerr & Company, 1891; Knights of Columbus, 1924; Knights of Pythias Lodge, 1922; LaSalle Annex, 1925; LaSalle Hotel, 1921; Morey Lampert House, 1896; Morey House, 1909; Northern Indiana Gas and Electric Company Building, 1915; Palace Theater, 1921; Second Saint Joseph Hotel, 1868; South Bend Remedy Company, 1895; Sommers-Longley Residence, 1910; Third Saint Joseph County Courthouse, 1897; Tower Building, 1929.

East Washington Street Historic District, c.1800-1947. .
South Bend
Industry, Architecture
(East Bank Multiple Property Listing)

Maurice Egan House, 1889.
South Bend
Architecture, Education
(East Bank Multiple Property Listing)

Eller-Hosford House, 1875.
Mishawaka
Architecture

Ellis-Schindler House, 1834.
Mishawaka
Architecture

Evergreen Hill, 1839-1919.
South Bend vicinity
Architecture, Exploration/Settlement, Industry

Fire House No. 3, 1892.
South Bend
Architecture, Politics/Government
(East Bank Multiple Property Listing)

Fire House No. 7, 1904.
South Bend
Architecture, Politics/Government
(East Bank Multiple Property Listing)

Martin Hoban House, 1896. .

South Bend
Architecture
(East Bank Multiple Property Listing)

Howard Park Historic District, 1880-1947.
South Bend
Architecture, Industry, Transportation, Landscape Architecture
(East Bank Multiple Property Listing)

I & M Electric Company Building - Transformer House and Garage, 1911, 1929.
South Bend
Industry
(East Bank Multiple Property Listing)

James A. Judie House, 1930.
South Bend
Architecture, Landscape Architecture

Kamm and Schellinger Brewery, 1853-1870.
Mishawaka
Architecture, Industry

Kelley-Frederickson House and Office Building, 1892.
South Bend
Architecture, Commerce

Lakeville High School, 1929.
Lakeville
Education, Architecture

LaSalle Street Bridge, 1907.
South Bend
Engineering
(East Bank Multiple Property Listing)

Chauncey N. Lawton House, 1872.
South Bend
Architecture, Industry

Samuel Leeper, Jr. House, 1888.
South Bend
Architecture, Commerce, Exploration/Settlement

Leeper Park, 1895-1940.
South Bend
Landscape Architecture

Charles McCormick Building, 1904.
South Bend
Commerce, Architecture
(East Bank Multiple Property Listing)

Merrifield-Cass House, 1837, 1867.
Mishawaka
Architecture, Education

Mishawaka Carnegie Library, 1916.
Mishawaka
Architecture, Education, Social History

Mishawaka Reservoir Caretaker's Residence, 1938.
Mishawaka
Social History, Architecture

Muessel - Drewry's Brewery, c.1865-1949.
South Bend
Industry

New Carlisle Historic District, 1835-1940.
New Carlisle
Architecture, Commerce

New Deal Work Relief Projects in St. Joseph County MPDF, 1933-1942.
St. Joseph County
Architecture, Social History

North Liberty Park, 1935-1955.
North Liberty
Entertainment/Recreation, Social History, Architecture

North Pumping Station, 1912.
South Bend
Architecture

Northside Boulevard Riverwall, 1935-1955.
South Bend
Entertainment/Recreation, Social History, Landscape Architecture

Normain Heights Historic District, 1946-1951.
Mishawaka
Community Planning and Development, Social History

O’Brien Electric Priming Company, 1882.
South Bend
Industry

Old Courthouse, 1854.
South Bend
Architecture, Politics/Government

Joseph D. Oliver House (Copshaholm), 1896.
South Bend
Architecture, Art, Industry, Invention

Palais Royale Building, 1922.
South Bend
Architecture, Commerce, Entertainment/Recreation

St. Casimir Parish Historic District, c.1880-1945.
South Bend
Ethnic Heritage, Industry, Religion

St. Joseph County Infirmary, 1906-1948.
South Bend
Social History, Architecture

St. Joseph School, 1925.
South Bend
Architecture, Education
(East Bank Multiple Property Listing)

Jeremiah Service House (Old Republic), 1861.
New Carlisle
Architecture

Singer Manufacturing - South Bend Lathe Company Historic District, 1868-1947.
South Bend
Industry
(East Bank Multiple Property Listing)

Sommerer House, c.1875.
South Bend
Architecture
(East Bank Multiple Property Listing)

South Bend Brewing Association, 1905.
South Bend
Industry

South Bend Remedy Company, 1895-1951.
South Bend
Architecture

South Michigan Street Historic District, c.1911-1947.
South Bend
Commerce

Stephenson Underwear Mill, 1916.
South Bend
Industry, Architecture

Studebaker Clubhouse and Tree Sign, 1926, 1938.
New Carlisle vicinity
Architecture, Entertainment/Recreation, Social History

Tippecanoe Place (Studebaker House), 1889.
South Bend
NHL
Architecture, Transportation, Industry

University of Notre Dame Main and South Quadrangles, 1913-1938.
Notre Dame
Architecture, Education, Exploration/Settlement, Landscape Architecture, Religion

Walker Field Shelterhouse, 1938-1955.
South Bend
Entertainment/Recreation, Social History, Architecture

Water Street / Darden Road Bridge, 1885.
South Bend vicinity
Engineering, Transportation

Martin Wenger Farm, c.1851-1902.
South Bend
Architecture, Exploration/Settlement

Wertz-Bestle Farm, c.1872-1949.
South Bend
Agriculture, Architecture

West Washington Historic District, 1850-1920.
South Bend
Architecture, Commerce, Industry, Politics/Government

APPENDIX E

Galena River General Water Chemistry and Nutrient Measurements

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Galena River Watershed General Chemistry and Nutrients Measurements

(Table taken from: Prast, J. and M. AK. 2009. Water Quality Assessment for *Escherichia coli (E. coli)* Bacteria in the Galena River Watershed. Indiana Department of Environmental Management, Assessment Branch).

Galena River Site #1 LMG100-0010	9/16/08 AA54766	9/23/08 AA54777	9/30/08 AA54788	10/07/08 AA54799	10/14/08 AA54810
Hardness mg/L	NA	234	274	273	265
T. Solids mg/L	288.0	351	413	434	432
S. Solids mg/L	8.0	<4.0	5.0	7.0	<4.0
D Solids mg/L	280.0	333	397	404	400
Alkalinity mg/L	132.0	199	231	255	247
Nitrogen- Ammonia mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
TKN mg/L	0.6	0.4	0.4	0.5	0.5
Nitrogen- Nitrate+ Nitrite mg/L	0.2	<0.1	<0.1	<0.1	<0.1
T Phosphorus mg/L	0.04	<0.03	<0.03	<0.03	<0.03
Sulfate mg/L	30	35	39	41	44
Chloride mg/L	28	41	47	49	49

Galena River East Site #2 LMG100-0008	9/16/08 AA54769	9/23/08 AA54779	9/30/08 AA54790	10/07/08 AA54801	10/14/08 AA54811
Hardness mg/L	NA	176	235	209	214
T. Solids mg/L	235	249	309	267	293
S. Solids mg/L	6.0	8.0	4.0	4.0	<4.0
D Solids mg/L	216	224	298	251	273
Alkalinity mg/L	124	132	206	174	191
Nitrogen- Ammonia mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
TKN mg/L	0.7	0.5	0.4	0.5	0.5
Nitrogen- Nitrate+ Nitrite mg/L	0.1	<0.1	0.1	<0.1	<0.1
T Phosphorus mg/L	<0.03	<0.03	<0.03	<0.03	<0.03
Sulfate mg/L	30	33	28	30	30
Chloride mg/L	18	20	17	20	19

Galena River Site #3 **LMG100-0012**	9/16/08 AA54770	9/23/08 AA54780	9/30/08 AA54791	10/07/08 AA54802	10/14/08 AA54814
Hardness mg/L	NA	387.0	306.0	317.0	372.0
T. Solids mg/L	402.0	499.0	485.0	454.0	492.0
S. Solids mg/L	19.0	17.0	10.0	6.0	8.0
D Solids mg/L	361.0	473.0	445.0	420.0	449.0
Alkalinity mg/L	153.0	218.0	222.0	230.0	234.0
Nitrogen- Ammonia mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
TKN mg/L	1.0	0.8	0.5	0.5	0.5
Nitrogen- Nitrate+ Nitrite mg/L	0.8	0.6	0.4	0.4	0.5
T Phosphorus mg/L	0.04	<0.03	<0.03	<0.03	<0.03
Sulfate mg/L	90	114.0	82.0	91.0	105.0
Chloride mg/L	22	26.0	34.0	32.0	32.0

Galena River Site #4 **LMG100-0013**	9/16/08 AA54771	9/23/08 AA54781	9/30/08 AA54792	10/07/08 AA54803	10/14/08 AA54815
Hardness mg/L	NA	374.0	315.0	325.0	304.0
T. Solids mg/L	390.0	480.0	458.0	445.0	347.0
S. Solids mg/L	16.0	6.0	7.0	4.0	<4.0
D Solids mg/L	351.0	457.0	458.0	412.0	322.0
Alkalinity mg/L	145.0	227.0	223.0	236.0	251.0
Nitrogen- Ammonia mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
TKN mg/L	1.2	0.7	0.4	0.4	0.3
Nitrogen- Nitrate+ Nitrite mg/L	0.8	0.4	0.3	0.3	0.2
T Phosphorus mg/L	0.05	<0.03	<0.03	<0.03	<0.03
Sulfate mg/L	76.0	112.0	92.0	89.0	28.0
Chloride mg/L	17.0	20.0	29.0	25.0	15.0

Unnamed Tributary East to Galena River Site #5 **LMG100-0014**	9/16/08 AA54772	9/23/08 AA54782	9/30/08 AA54793	10/07/08 AA54804	10/14/08 AA54816
Hardness mg/L	NA	234.0	207.0	268.0	304.0
T. Solids mg/L	201.0	288.0	314.0	336.0	347.0
S. Solids mg/L	8.0	5.0	5.0	6.0	<4.0
D Solids mg/L	188.0	265.0	300.0	315.0	322.0
Alkalinity mg/L	78.0	187.0	206.0	241.0	251.0
Nitrogen- Ammonia mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
TKN mg/L	0.7	0.4	0.4	0.5	0.3
Nitrogen- Nitrate+ Nitrite mg/L	<0.1	0.2	0.2	0.3	0.2
T Phosphorus mg/L	0.04	<0.03	<0.03	<0.03	<0.03
Sulfate mg/L	12.0	19.0	25.0	27.0	28.0
Chloride mg/L	46.0	21.0	22.0	17.0	15.0

Unnamed Tributary East to Galena River Site #6 **LMG100-0011**	9/16/08 AA54773	9/23/08 AA54783	9/30/08 AA54794	10/07/08 AA54805	10/14/08 AA54817
Hardness mg/L	NA	142.0	164.0	232.0	277.0
T. Solids mg/L	199.0	230.0	258.0	320.0	354.0
S. Solids mg/L	35.0	12.0	6.0	<4.0	<4.0
D Solids mg/L	171.0	211.0	248.0	298.0	334.0
Alkalinity mg/L	44.0	111.0	134.0	206.0	236.0
Nitrogen- Ammonia mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
TKN mg/L	0.8	0.8	0.6	0.6	0.4
Nitrogen- Nitrate+ Nitrite mg/L	0.1	0.6	0.8	1.4	1.7
T Phosphorus mg/L	0.06	0.06	0.04	<0.03	<0.03
Sulfate mg/L	6.8	12.0	18.0	27.0	25.0
Chloride mg/L	50.0	32.0	38.0	28.0	23.0

Galena River Site #7 **LMG100-0015**	9/16/08 AA54774	9/23/08 AA54784	9/30/08 AA54795	10/07/08 AA54806	10/14/08 AA54818
Hardness mg/L	NA	354.0	332.0	324.0	354.0
T. Solids mg/L	349.0	443.0	450.0	427.0	445.0
S. Solids mg/L	28.0	4.0	5.0	4.0	<4.0
D Solids mg/L	339.0	429.0	440.0	401.0	412.0
Alkalinity mg/L	132.0	220.0	222.0	236.0	238.0
Nitrogen- Ammonia mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
TKN mg/L	0.9	0.4	0.4	0.3	0.4
Nitrogen- Nitrate+ Nitrite mg/L	0.6	0.4	0.4	0.3	0.3
T Phosphorus mg/L	0.05	<0.03	<0.03	<0.03	<0.03
Sulfate mg/L	65.0	100.0	89.0	76.0	88.0
Chloride mg/L	21.0	19.0	26.0	22.0	22.0

Spring Creek Site # 8 **LMG100-0017**	9/16/08 AA54775	9/23/08 AA54785	9/30/08 AA54796	10/07/08 AA54807	10/14/08 AA54819
Hardness mg/L	NA	351.0	337.0	315.0	305.0
T. Solids mg/L	254.0	403.0	411.0	410.0	411.0
S. Solids mg/L	20.0	7.0	4.0	5.0	<4.0
D Solids mg/L	222.0	373.0	400.0	388.0	380.0
Alkalinity mg/L	146.0	269.0	276.0	286.0	285.0
Nitrogen- Ammonia mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
TKN mg/L	0.7	0.3	0.2	0.5	0.3
Nitrogen- Nitrate+ Nitrite mg/L	0.1	0.2	0.2	0.2	0.2
T Phosphorus mg/L	0.06	<0.03	<0.03	<0.03	<0.03
Sulfate mg/L	19.0	34.0	34.0	32.0	33.0
Chloride mg/L	13.0	23.0	23.0	23.0	23.0

Unnamed Tributary to Spring Creek Site #9 **LMG100-0009**	9/16/08 AA54776	9/23/08 AA54786	9/30/08 AA54797	10/07/08 AA54808	10/14/08 AA54820
Hardness mg/L	NA	276.0	312.0	319.0	352.0
T. Solids mg/L	207.0	335.0	384.0	396.0	413.0
S. Solids mg/L	16.0	4.0	4.0	4.0	<4.0
D Solids mg/L	178.0	314.0	364.0	373.0	378.0
Alkalinity mg/L	113.0	221.0	251.0	277.0	289.0
Nitrogen- Ammonia mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
TKN mg/L	0.8	0.5	0.4	0.4	0.3
Nitrogen- Nitrate+ Nitrite mg/L	0.1	0.3	0.3	0.4	0.3
T Phosphorus mg/L	0.08	0.03	<0.03	<0.03	<0.03
Sulfate mg/L	14.0	19.0	24.0	27.0	24.0
Chloride mg/L	10.0	19.0	22.0	23.0	25.0

N/A = No sample was collected

For General Chemistry and Nutrient WQS and Interim Criteria see Galena River Sampling and Analysis Workplan, and Indiana Rules 327-IAC 2-1-6 and 327 IAC 2-1.5-8.

Galena River Watershed YSI Field Measurements

(Table taken from: Prast, J. and M. AK. 2009. Water Quality Assessment for *Escherichia coli (E. coli)* Bacteria in the Galena River Watershed. Indiana Department of Environmental Management, Assessment Branch.

Stream Name Site # / Lsite	Date	DO (mg/L)	% Saturation	pH (SU)	Temperature (° C)	Specific Conductance (µS/cm)	Turbidity (NTU)
Galena River #1 LMG100-0010	9/16/08	8.69	101.3	7.73	21.42	415	24.5
	9/23/08	8.5	91.8	7.75	19.27	560	4.7
	9/30/08	9.61	97.7	7.73	15.93	651	12.3
	10/07/08	10.39	101.4	7.59	14.20	358	7.9
	10/14/08	9.03	94.5	7.72	17.43	691	8.5
Galena River East #2 LMG100-0008	9/16/08	8.9	92.5	7.45	18.95	495	19.5
	9/23/08	8.08	90.0	7.95	20.92	374	7.1
	9/30/08	9.87	100.4	7.75	15.60	490	5.0
	10/07/08	10.73	105.1	7.71	14.56	427	7.8
	10/14/08	9.86	100.8	7.81	16.46	468	4.7
Galena River #3 LMG100-0012	9/16/08	8.38	90.4	7.46	19.31	542	21.7
	9/23/08	7.75	82.9	7.62	18.97	694	9.7
	9/30/08	9.46	94.1	7.65	14.96	692	17.3
	10/07/08	10.54	103.4	7.61	14.18	685	23.5
	10/14/08	9.72	99.1	7.72	16.26	716	13.3
Galena River #4 LMG100-0013	9/16/08	8.59	91.3	7.4	18.12	516	19.7
	9/23/08	8.81	88.0	7.66	16.26	680	13.7
	9/30/08	9.84	96.8	7.70	14.50	667	6.7
	10/07/08	11.23	106.0	7.65	12.87	664	7.9
	10/14/08	9.51	93.9	7.74	15.38	690	6.9
Unnamed Tributary East to Galena River #5	9/16/08	8.27	90.3	7.65	19.98	331	43.8
	9/23/08	8.38	84.7	7.63	17.57	456	4.8
	9/30/08	9.66	96.0	7.64	14.50	504	5.0

Stream Name Site # / Lsite	Date	DO (mg/L)	% Saturation	pH (SU)	Temperature (° C)	Specific Conductance (µS/cm)	Turbidity (NTU)
LMG100-0014	10/07/08	10.33	97.0	7.62	12.99	533	18.5
	10/14/08	10.03	99.9	7.69	15.36	552	4.9
Unnamed Tributary East to Galena River #6 LMG100-0011	9/16/08	8.99	96.5	7.6	18.83	287	17.5
	9/23/08	7.87	83.5	7.47	18.16	350	14.8
	9/30/08	8.21	81.8	7.50	15.24	419	5.0
	10/07/08	9.31	95.7	7.46	13.42	513	6.5
	10/14/08	8.35	80.6	7.51	14.12	561	5.5
Galena River #7 LMG100-0015	9/16/08	9.54	94.5	7.92	17.35	389	15.9
	9/23/08	8.15	85.4	7.67	17.50	640	5.5
	9/30/08	9.44	92.9	7.72	14.60	645	9.7
	10/07/08	10.32	99.1	7.73	13.45	638	4.6
	10/14/08	10.06	101.4	7.80	15.88	662	5.9
Spring Creek #8 LMG100-0017	9/16/08	8.93	92.6	7.62	17.37	368	13.5
	9/23/08	8.27	87.8	7.65	18.25	620	4.2
	9/30/08	9.09	89.2	7.66	14.36	638	8.6
	10/07/08	10.58	103.9	7.57	14.10	642	5.3
	10/14/08	8.83	88.7	7.72	15.67	644	4.8
Unnamed Tributary to Spring Creek #9 LMG100-0009	9/16/08	9.47	97.9	7.81	17.24	290	16.5
	9/23/08	8.13	84.5	7.64	17.33	508	5.1
	9/30/08	9.85	94.2	7.68	13.87	578	3.4
	10/07/08	10.15	96.2	7.64	13.06	608	9.1
	10/14/08	10.39	102.9	7.71	14.86	639	3.7

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APPENDIX F

Macroinvertebrate Survey Data

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Macroinvertebrate Survey Results, Galena River

	SITE NO.								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Amphipoda									
Gammaridae	6	119	18	33	24	53	132	132	60
Talitridae	2		2						
Decapoda									
Cambaridae						1			
Ephemeroptera									
Baetidae	2		2						3
Caenidae			1	2					
Heptageniidae	1	6		1	1		5	3	9
Leptophlebiidae			5	34	9		7	6	1
Plecoptera									
Taeniopterygidae				2			2	3	12
Trichoptera									
Brachycentridae							1	1	
Hydropsychidae		1			1	9		1	20
Leptoceridae	1					21			
Limnephilidae				6	3		3	11	12
Philopotamidae		1							1
Phryrganeidae				1	1	2			
Megaloptera									
Corydalidae				1		5	2		
Sialidae					1				
Coleoptera									
Elmidae	2	1	1		3		1	1	21
Haliplidae	1			1					
Gyrinidae				1					
Diptera									
Ceratopogonidae	1								
Chironomidae	21	2	1	22	27	6	5	8	7
Tabanidae	4	1					2	1	7
Tipulidae	1	2				3	2	3	6
Pelecypoda									
Sphaeriidae	2	1			3	1			
Odonata									
Aesnidae	2	1	2	2	3		2	4	
Calopterygidae	2	3	6	5	2	1	3	2	
Coenagrionidae	4		5	2					
Cordulegastridae									1
Gomphidae			1	1	2				1
Libellulidae						1			
Hemiptera									
Belostomatidae			1	1		2	1		
Corixidae				1					
Notonectidae	1								

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APPENDIX G

Memorandum: Examination of the Biotic and Abiotic Relationships in the Galena River Watershed

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Baetis
ENVIRONMENTAL SERVICES, INC.

Memorandum

SUBJECT	Examination of Biotic and Abiotic Relationships – Revision 2			PROJECT	Galena River Watershed Management Plan
FROM	D. Pott	DATE	6/8/2010		
CLIENT	Laporte SWCD			Page 1 of 5	

As part of the watershed management planning effort, Baetis is to perform correlation and trend analyses on newly collected and the historical ecological data to examine relationships between biotic and abiotic variables. This memorandum documents these analyses.

Available Data

Limited water quality, habitat and macroinvertebrate community data were available for this analysis. Data collected in 2008 by the IDEM for their E. coli TMDL were utilized, as well as some data collected in 2000 that were available from the IDEM's files. The DNR collected habitat and macroinvertebrate data in 2008 at the TMDL water quality sampling locations. Nine locations overall were including their sampling program. The boundaries of the drainage areas for the nine sampling locations were delineated, and land use types quantified for each. We were also provided a shapefile delineating unbuffered stream reaches in the watershed, and we further processed it to quantify the length of unbuffered streams that drain to each sampling site.

Methods

Minitab Ver. 14 software was used to compute descriptive statistics and bivariate correlation coefficients (Minitab Inc., State College, PA). Some regression analyses were performed using SAS Ver. 9.1 (SAS Institute Inc., Cary, NC). I used Spearman correlation analysis and visual plotting to identify potential relationships between physical and chemical variables and biological community response. Locally weighted scatterplot smoothing (lowess) was used to examine possible trends along environmental gradients. The lowess technique models nonlinear relationships where linear methods do not perform well, and fits simple models to localized subsets of data to construct a function that describes the central tendency of data along a gradient. I used a smoothing factor of 0.70 to plot lowess curves.

Temporal trends were not examined due to the paucity of data over time. ANOVA, Analysis of Variance, was used to test for equality of means among sampling sties for selected water quality parameters. Pairwise comparisons used Tukey's method, with family error rate = 0.05. Least squares linear regression was performed to examine effects on land use on E. coli median concentrations.

Results

Attachment 1 is a printout from Minitab that includes a correlation matrix, matrix scatterplots, summary statistics for all sites combined, and water chemistry summary statistics by sampling site and ANOVA tables.

The correlation matrix includes Spearman (rank) correlation coefficients and p-values for 595 unique bivariate combinations. Of the 595 coefficients, 59 are statistically significant (α=0.05). E. coli data correlated significantly with alkalinity (r=0.683) and numbers of Ephemeroptera taxa found at a site (r=0.692). Such correlations do not indicate cause effect relationships and may be simply random association. The habitat index, QHEI, was only associated with one other variable, Riparian Zone & Bank Erosion Score, which is part of the QHEI score. The Family Biotic Index, FBI, which reflects pollution tolerance at the family level, was not associated with any other variable.

Summary statistics for E. coli counts, nutrient concentrations and suspended solids concentrations for each of the nine sampling sites are in Tables 1 - 5. The 95% confidence intervals are computed as the product of the standard error and the appropriate value from Student's t distribution. ANOVA was used to compare site means for selected water quality variables. ANOVA is a statistical test of whether the means of several groups are all equal; ANOVA generalizes Student's *t*-

test to multiple groups.

Table 1 provides summary data for E. coli. ANOVA found that not all site means are equal (F=2.41; p-value = 0.031), and multiple pairwise comparisons found that the mean E. coli at Site 1 is significantly different from Site 6; no other pairwise comparisons showed significant differences.

Table 1. Descriptive Statistics for E. coli Concentrations

Site	N	Mean ± Conf. Int.	Median
1	6	618 ± 401	588
2	6	203 ± 216	148
3	5	449 ± 341	461
4	5	371 ± 319	308
5	6	302 ± 52	317
6	6	116 ± 64	102
7	6	337 ± 256	189
8	5	432 ± 254	435
9	5	479 ± 319	411

Table 2 provides summary data for nitrate+nitrite nitrogen concentrations measured in the watershed. ANOVA found that not all site means are equal (F=8.77; p-value = 0.000+), and multiple pairwise comparisons found that the mean nitrate+nitrite-N at Site 6 is significantly different each other site, that is, much higher. This is an interesting contrast to the relatively low E. coli concentrations at Site 6.

Table 2. Descriptive Statistics for Concentrations of Nitrate+Nitrite Nitrogen

Site	N	Mean ± Conf. Int.	Median
1	6	0.100 ± 0.081	0.05
2	6	0.067 ± 0.027	0.05
3	5	0.540 ± 0.208	0.5
4	7	0.483 ± 0.223	0.4
5	6	0.192 ± 0.084	0.2
6	6	1.000 ± 0.632	1.1
7	6	0.400 ± 0.115	0.4
8	5	0.180 ± 0.056	0.2
9	5	0.280 ± 0.136	0.3

Table 3 provides summary data for total phosphorus concentrations measured in the watershed. ANOVA testing indicates that all site means are equal (F=0.79; p-value = 0.611). Because site means are equivalent, we can compute a grand mean for phosphorus in the study area streams. Total phosphorus concentration averages 0.024±0.005 mg/L, which is rather low for Indiana streams.

Table 3. Descriptive Statistics for Phosphorus Concentrations

Site	N	Mean ± Conf. Int.	Median
1	6	0.023 ± 0.014	0.015
2	6	0.015 ± 0.000	0.015
3	5	0.020 ± 0.014	0.015
4	8	0.031 ± 0.021	0.015
5	6	0.019 ± 0.011	0.015
6	6	0.034 ± 0.023	0.028
7	6	0.021 ± 0.015	0.015
8	5	0.024 ± 0.025	0.015
9	5	0.031 ± 0.035	0.015

Table 4 provides summary data for total Kjeldahl nitrogen (TKN) concentrations measured by IDEM in the watershed. ANOVA testing indicates that all site means are equal (F=1.33; p-value = 0.254). TKN concentration averages 0.54±0.06 mg-N/L, which is also rather low for Indiana streams.

Table 4. Descriptive Statistics for TKN Concentrations

Site	N	Mean ± Conf. Int.	Median
1	6	0.53 ± 0.16	0.50
2	6	0.52 ± 0.10	0.50
3	5	0.66 ± 0.29	0.50
4	8	0.66 ± 0.27	0.60
5	6	0.45 ± 0.14	0.40
6	6	0.62 ± 0.17	0.60
7	6	0.47 ± 0.23	0.40
8	5	0.40 ± 0.25	0.30
9	5	0.48 ± 0.24	0.40

Table 5 provides summary data for total suspended solids (TSS) concentrations measured in the watershed. ANOVA testing indicates that all site means are equal (F=0.69; p-value = 0.695). TSS concentration averages 7.7±2.1 mg/L.

Table 5. Descriptive Statistics for TSS Concentrations

Site	N	Mean ± Conf. Int.	Median
1	6	5.5 ± 3.2	6.0
2	6	4.3 ± 2.4	4.0
3	5	12.0 ± 7.1	10.0
4	8	10.8 ± 10.0	7.0
5	6	5.2 ± 2.0	5.0
6	6	9.8 ± 13.6	4.0
7	6	7.8 ± 10.4	4.0
8	5	7.6 ± 8.9	5.0
9	5	6.0 ± 7.0	4.0

To aid identification of sources of pollutants, I performed a series of stepwise least squares linear regressions of unbuffered stream lengths and land use upstream of each sampling site, with median pollutant concentrations as the response variable (Attachment 2). The fraction of land use type draining to each water quality sampling point was determined from 30-meter land use classification published by USGS using 2001 imagery. To simplify the analysis, land use types were consolidated to seven categories: grassland (type 71), pasture (type 81), crops, forest, wetland, developed land, and open water. The USGS definitions for land cover types 71 and 81 have subtle differences. Type 71 is characterized by natural or semi-natural herbaceous vegetation, accounting for 75 to 100 percent of the cover, and is dominated by upland grasses and forbs. These areas are not subject to intensive management, but they are often utilized for grazing. Type 81 is characterized by herbaceous vegetation that has been planted or is intensively managed for the production of grasses, legumes, or grass-legume mixtures for livestock grazing or the production of seed or hay crops.

For the impairment caused by E. coli bacteria concentrations, the best model included pasture and grass land as predictors (p=0.0005), accounting for 88% of the variability in median coliform concentrations. The regression equation is:

$$Ecoli = 19.21 * Grass + 10.68 * Pasture$$

where *Grass* and *Pasture* are the fractions the drainage classified as that particular land cover type. While such a regression of observational data does not indicate causation, it does suggest that grasslands and pasturelands are source areas for coliform bacteria in the watershed. Increases in the drainage area used for grass or pasture can be expected to result in increased median stream concentrations of *E. coli*.

When median concentrations of nitrate+nitrate nitrogen (NO3+NO2) were used as the response variable, another statistically significant regression was derived (p=0.0006), accounting for more than 78% of the variability of nitrate+nitrate nitrogen. The regression equation is:

$$NO3 + NO2 = 0.022 * Crop$$

where *Crop* is the fraction of the drainage area classified as cropland. The regression indicates that for each percentage increase in the drainage area used for crop production, a 0.022 mg/L increase can be expected in median stream nitrate+nitrate nitrogen concentration.

I also used median concentrations of total phosphorus, total Kjeldahl nitrogen and total suspended solids as response variables. No land use types were significant predictors of these pollutant concentrations ($p>0.05$).

In another stepwise regression of land use predictors, I used Family Biotic Index (FBI) as the response variable. Three land use types were significant variables in this model ($p=0.0007$), accounting for 96% of FBI variability. The regression equation is:

$$FBI = 5.764 - 0.019 * Forest - 0.785 * Wetland + 0.077 * Grass$$

where *Forest, Wetland* and *Grass* are the fractions of the drainage classified as that particular land cover type. The sign of the parameter estimates (i.e. slopes) are indicators of the influence that land use has on the FBI, and the macroinvertebrate community in general. Recall that high FBI suggests a community that is tolerant of pollution. Areas of forest cover and wetlands benefit FBI, while grassland contributes to a decline in FBI.

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APPENDIX H

USEPA's Visual Assessment Protocol

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WATERSHED SURVEY VISUAL ASSESSMENT

GENERAL INFORMATION

Stream name: _____

Watershed name: _____

County: _____ **State:** _____

Approximate size of study area (acres): _____

Investigators: _____

Site (description): _____

_____

_____

Date: _____ **Time:** _____

Weather in past 24 hours:

- ❑ Storm (heavy rain)
- ❑ Rain (steady rain)
- ❑ Showers (intermittent rain)
- ❑ Overcast
- ❑ Clear/Sunny

Weather now:

- ❑ Storm (heavy rain)
- ❑ Rain (steady rain)
- ❑ Showers (intermittent rain)
- ❑ Overcast
- ❑ Clear/Sunny

LAND USES IN THE WATERSHED

1. Specific uses identified *(check as many as apply)*

	Streamside	Within 1/4 mile of Stream	Within Watershed
Residential:			
Single-family housing	θ	θ	θ
Apartment building	θ	θ	θ
Lawns	θ	θ	θ
Playground	θ	θ	θ
Parking lot	θ	θ	θ
Other _____	θ	θ	θ
Commercial / Industrial / Institutional:			
Commercial development (stores, restaurants)	θ	θ	θ
Auto repair/gas station	θ	θ	θ
Factory/Power plant	θ	θ	θ
Sewage treatment facility	θ	θ	θ
Water treatment facility	θ	θ	θ
Institution (e.g., school, offices)	θ	θ	θ
Landfill	θ	θ	θ
Automobile graveyard	θ	θ	θ
Bus or taxi depot	θ	θ	θ
Other _____	θ	θ	θ
***Forest / Parkland*:**			
Recreational park	θ	θ	θ
National/State Forest	θ	θ	θ
Woods/Greenway	θ	θ	θ
Other _____	θ	θ	θ
Agricultural / Rural:			
Grazing land	θ	θ	θ
Cropland	θ	θ	θ
Animal feedlot	θ	θ	θ
Isolated farm	θ	θ	θ
Old (abandoned) field	θ	θ	θ
Fish hatchery	θ	θ	θ
Tree farm	θ	θ	θ
Other _____	θ	θ	θ

2. Summary of major land uses in the watershed *(use approx. percentages)*

Residential ____% Parkland/Forest ____%

Commercial/Industrial/Institutional ____% Other ____%

Agricultural/Rural ____%

3. Additional activities in the watershed *(check as many as apply)*

	Streamside	Within 1/4 mile of Stream	Within Watershed
Construction			
Building construction	θ	θ	θ
Roadway	θ	θ	θ
Bridge construction	θ	θ	θ
Other _____	θ	θ	θ
Logging			
Selective logging	θ	θ	θ
Intensive logging	θ	θ	θ
Lumber treatment facility	θ	θ	θ
Other _____	θ	θ	θ
Mining			
Strip mining	θ	θ	θ
Pit mining	θ	θ	θ
Abandoned mine	θ	θ	θ
Quarry	θ	θ	θ
Other _____	θ	θ	θ
Recreation			
Biking/Off-road vehicle trails	θ	θ	θ
Horseback riding trail	θ	θ	θ
Boat ramp	θ	θ	θ
Jogging paths/hiking trail	θ	θ	θ
Swimming area	θ	θ	θ
Fishing area	θ	θ	θ
Picnic area	θ	θ	θ
Golf course	θ	θ	θ
Campground/trailer park	θ	θ	θ
Power boating	θ	θ	θ
Other _____	θ	θ	θ

4. Comments on land uses

Use this space to explain or expand on land use descriptions you have identified above. For example, you might want to identify particular buildings, specify the location of construction sites, note the condition of streamside picnic areas, note the presence of cows in a stream, or note corrective measures such as swales or settling basins.

GENERAL STREAM AND WATERSHED CHARACTERISTICS

5. Note the number of hydrologic modifications *(structures that alter natural stream flow):*

None	_____	Waterfalls	_____
Dams	_____	Stream fords	_____
Bridges	_____	Beaver dams	_____

6. Note the approximate length of stream that is affected by the following:

Stream diversion _____ feet or _____ miles

Stream straightening _____ feet or _____ miles

Concrete streambank/bottom _____ feet or _____ miles

7. Check the categories that best describe the general appearance of the stream:

Litter*:*

- ❑ No litter visible
- ❑ Small litter occasionally (e.g., cans, paper)
- ❑ Small litter common
- ❑ Large litter occasionally (e.g., tires, carts)
- ❑ Large litter common

Erosion*:*

- ❑ No streambank erosion or areas of erosion very rare; no artificial stabilization
- ❑ Occasional areas of streambank erosion
- ❑ Areas of streambank erosion common
- ❑ Artificial streambank stabilization (e.g., rip rap) present

Special Problems *(note in detail in comment section below):*

- ❑ Spills of chemicals, oil, etc.
- ❑ Fish kills
- ❑ Wildlife, waterfowl kills
- ❑ Flooding
- ❑ Periods of no flow

8. Comments on general stream characteristics (e.g., date and size of fish kill, increased rate of erosion evident, litter most evident after storms)

PIPE AND DRAINAGE DITCH INVENTORY

In this section, provide information on pipes and drainage ditches found on the banks or in the stream. These pipes/ditches can be abandoned or active. Note this basic information for each pipe or drainage ditch you observe. Attach additional pages to this form.

9. This information applies to a:

❑ Pipe ❑ Drainage ditch ❑ Other _____

10. Location of pipe/ditch:

❑ In stream ❑ In streambank ❑ Near stream

Describe location:

11. Pipe/Ditch # (for mapping/locational purposes) _____

12. Identify type of pipe (check one)

❑ Industrial outfall
❑ Sewage treatment plant outfall
❑ Storm drain
❑ Combined sewer overflow
❑ Agricultural field drainage
❑ Paddock or feedlot drainage
❑ Settlement basin/pond drainage
❑ Parking lot drainage
❑ Unknown
❑ Other _____

13. Approximate Diameter of Pipe: _____ inches or

_____feet

14. Describe the discharge flow:

Rate of Flow: ❑ None ❑ Intermittent ❑ Trickle
❑ Steady ❑ Heavy

Appearance: ❑ Clear ❑ Foamy ❑ Turbid
❑ Oily sheen ❑ Colored _____

Odor: ❑ None ❑ Rotten eggs/sewage ❑ Chemical
❑ Chlorine ❑ Other _____

15. Describe the streambank/stream below pipe or drainage ditch:

❑ No problem evident
❑ Sewage litter (e.g., toilet paper)
❑ Litter (e.g., styrofoam, cans)
❑ Eroded
❑ Lots of algae
❑ Other _____

16. Comments on pipes and drainage ditches

Use this space to explain or expand on information provided on pipes and discharges you have identified above. For example, you may want to identify particular facilities, or discuss in more detail the condition of the stream below the discharge.