Office of Water Quality
Total Maximum Daily Load Program

DRAFT
Total Maximum Daily Load for *Escherichia coli* (*E. coli*) For the Galena River Watershed, La Porte and St. Joseph Counties

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Indiana Department of Environmental Management
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Total Maximum Daily Load (TMDL) for *Escherichia coli* (*E. coli*) in Galena River watershed, Carroll, Clinton, Howard, Tippecanoe, and Tipton Counties, Indiana

Introduction

Section 303(d) of the Federal Clean Water Act and the United States Environmental Protection Agency's (USEPA's) Water Quality Planning and Management Regulations (Title 40 of the Code of Federal Regulations (CFR), Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for waterbodies that are not meeting Water Quality Standards (WQS). TMDLs provide states a basis for determining the pollutant reductions necessary from both point and nonpoint sources to restore and maintain the quality of their water resources. The purpose of this TMDL is to identify the sources and determine the allowable levels of *E. coli* bacteria that will result in the attainment of the applicable WQS in the Galena River watershed in La Porte and St. Joseph Counties in Indiana.

Background

In 2002, the portion of the Galena River flowing from Warrick Ditch to an unnamed tributary downstream (near site 7) was listed on Indiana's 303(d) list as impaired for *E. coli*. A reassessment using data collected in 2008 was completed. This reassessment indicated that more of the Galena River watershed is impaired, including Spring Creek and Dowling Creek.

Recently IDEM began using the high resolution National Hydrography Dataset (NHD) created by USGS. Previously IDEM could only view streams at medium resolution (1:100,000 scale). The high resolution streams are at the 1:24,000 scale, which allows for a more detailed view of the watershed. These high resolution waters have always been present; however, they have not been visible in electronic maps until now. A reassessment of the Galena River watershed was completed with regard to both medium and high resolution streams.

This TMDL will address approximately seventy-seven (77) stream miles in the Galena River watershed in La Porte and St. Joseph Counties where recreational uses are impaired by elevated levels of *E. coli* during the recreational season. The Galena River is part of the larger Little Calumet-Galien basin, 04040001. The Galena River watershed is in Northwest Indiana and sits on the Indiana-Michigan border (Figure 1). Figure 2 depicts the portion of the Galena River that was placed on the 303(d) list in 2002. The eight (8) impaired assessment units (Table 1) for this TMDL are located in the Little Calumet-Galien basin in hydrologic unit code 04040001 (Figure 3). The description of the study area, its topography, and other particulars are as follows:

Table 1: Impaired Assessment Units in the Galena River Watershed

ASSESSMENT UNIT NAME	AUID	IMPAIRMENT	MILES
GALENA RIVER	INC0125_01	*E. coli*	1.70
GALENA RIVER	INC0125_T1001	*E. coli*	1.88
GALENA RIVER - UNNAMED TRIBUTARY	INC0125_T1002	*E. coli*	0.75
GALENA RIVER	INC0125_T1071	*E. coli*	3.27
GALENA RIVER - UNNAMED TRIBUTARY	INC0125_T1006	*E. coli*	1.97
GALENA RIVER	INC0125_T1076	*E. coli*	0.76
SPRING CREEK - UNNAMED TRIBUTARY	INC0124_T1002	*E. coli*	0.92
SPRING CREEK	INC0124_T1004	*E. coli*	7.07

IDEM conducted an intensive survey of the Galena River watershed in 2008. Sites were sampled September 16, 2008 through October 14, 2008 (Figure 3; Attachment A). All sites were sampled for the 2008 Galena River Watershed Project. All sites were sampled five (5) times, evenly spaced over a thirty (30) day period. Of the nine (9) sites, one (1) site, Site 6, did not violate the geometric mean for *E. coli*. All other sites sampled violated the *E. coli* geometric mean of 125 MPN (Most Probable Number)/100 mL. The single sample maximum of 235 MPN/ 100 mL is violated 60% of the time.

All 9 sites sampled in 2008 were also sampled for nitrogen and phosphorus. Review of the data revealed that there were no violations of the nutrients benchmarks, 10 mg/L for nitrogen and 0.30 mg/L for phosphorus.

Historic data collected by IDEM's Assessment Branch in 2000 indicate high levels of *E. coli* in the Galena River watershed. Violations ranged from 250 MPN/100 mL (MPN = Colony Forming Units) to greater than 2420 MPN/100 mL (Figure 2; Attachment B). All of the 5 samples taken July through August 2000 exceed the single sample maximum.

The TMDL development schedule corresponds with IDEM's basin-rotation water quality monitoring schedule. To take advantage of all available resources for TMDL development, impaired waters are scheduled according to the basin-rotation schedule unless there is a significant reason to deviate from this schedule. Waterbodies could be scheduled based on the following:

1) Waterbodies may be given a high or low priority for TMDL development depending on the specific designated uses that are not being met, or in relation to the magnitude of the impairment.

2) TMDL development of waterbodies where other interested parties, such as local watershed groups, are working on alleviating the water quality problem may be delayed to give these other actions time to have a positive impact on the waterbody. If water quality standards still are not met, then the TMDL process will be initiated.

3) TMDLs that are required due to water quality violations relating to pollutant parameters where no EPA guidance is available, may be delayed to give EPA time to develop guidance.

This TMDL was scheduled based on the data available from the basin-rotation schedule, which represents the most accurate and current information available on water quality within waterbodies covered by this TMDL.

Numeric Targets

The impaired designated use for the waterbodies in the Galena River watershed is for total body contact recreational use during the recreational season, April 1 through October 31.

327 IAC 2-1.5-8(e)(2), establishes the full body contact recreational use *E. coli* WQS[1] for all waters in the Great Lakes system as follows:

> (2) *E. coli* bacteria, using membrane filter (MF) count, shall not exceed one hundred twenty-five (125) per one hundred (100) milliliters as a geometric mean based on not less than five (5) samples equally spaced over a thirty (30) day period nor exceed two hundred thirty-five (235) per one hundred (100) milliliters in any one (1) sample in a thirty (30) day period.

The sanitary wastewater *E. coli* effluent limits from point sources in the Great Lakes system during the recreational season, April 1 through October 31, are also covered under 327 IAC 2-1.5-8(e)(2).

For the Galena River watershed during the recreational season (April 1 through October 31) the target level is set at the *E. coli* WQS of 125 per one hundred milliliters as a 30-day geometric mean based on not less than five samples equally spaced over a thirty day period.

Source Assessment

Watershed Characterization

Waters in the Galena River watershed flows north across the border into Michigan. The waters in Galena River watershed flow through two (2) Counties. The majority of the watershed is located in La Porte County (93.96%); and 6.04% of the watershed is in St. Joseph County (Figure 1).

Landuse information was assembled in 1992 using the Gap Analysis Program (GAP). In 1992, approximately 40.45% of the landuse in the Galena River watershed was Agriculture. The remaining landuse for the Galena River watershed consisted of approximately 40.18% Forest, 13.77% Wetland, 1.03% Water, 1.02% Urban, and 3.55% was classified as Other (Figure 4). In the 1970's, 65.78% of the landuse was Agriculture, 31.80% was Forest, 1.38% was Water, 0.53% was Wetland, 0.49% was Urban, and 0.02% was classified as Other. Recent site visits report that this watershed is still primarily agricultural with mixtures of forest and wetland uses.

Wildlife is a known source of *E. coli* impairments in waterbodies. Many animals spend time in or around waterbodies. Deer, geese, ducks, raccoons, turkeys, and other animals all create potential sources of *E. coli*. Wildlife contributes to the potential impact of contaminated runoff from animal habitats, such as urban park areas, forest, and cropland.

Failing septic tanks are known sources of *E. coli* impairment in waterbodies. Both LaPorte and St. Joseph Counties have septic permitting systems in place. In 2008, 148 new septic system permits

[1] *E.coli* WQS = 125 cfu/100mL or 235 cfu/100mL; 1 cfu (colony forming units)= 1 mpn (most probably number)

were issued and 101 repairs were completed in LaPorte County (Mancuso, Personal communication, 2009). In St. Joseph County, approximately 600-800 new permits were issued in the County in the past 2 years. Often failures are identified through complaints and through the sale of older property that has not passed inspection. The St. Joseph County Health Department is notified of a failure approximately once a week (Longfellow, Personal Communication, 2009).

National Pollutant Discharge Elimination System (NPDES) Permitted Dischargers

There are three (3) NPDES permitted facilities in the Galena River watershed (Figure 5, Table 2). All three (3) discharges have *E. coli* limits in their permits.

- La Lumiere School, Inc had one (1) *E. coli* violation in the past 5 years.
- Woodberry Park, LLC had 2 violations in 2006 and 2 violations in 2008 during the sampling period. Under a different name, Pioneer Village MHP, this facility had 8 violations from 2004 through 2005.
- The Travel Plaza #3 WWTP (ITR Concession Company) has had 5 non-report violations in the past 5 years.

Storm Water General Permit Rule 13

There are two (2) municipal separate storm sewer system (MS4) communities, La Porte County (INR04107) and St. Joseph County (IN0R0041), in the Galena River watershed. Guidelines for MS4 permits and timelines are outlined in Indiana's Municipal Separate Storm Sewer System (MS4) Rule 13 (327 IAC 15-13-10 and 327 IAC 15-13-11). It is difficult to determine if these MS4 communities are a significant source of *E. coli* in the Galena River watershed.

Combined Sewer Overflows (CSO)

There are no CSO communities in the Galena River watershed.

Confined Feeding Operations and Concentrated Animal Feeding Operations

There are no CFOs or CAFOs within the Galena River watershed; however, it was noted during the watershed tour that there are many smaller operations present in the watershed.

There are many smaller livestock operations in the watershed. These operations, due to their small size, are not regulated under the CFO or CAFO regulations. These operations may still have an impact on the water quality and the *E. coli* impairment. No specific information on these small livestock operations is currently available for the Galena River watershed however; it is believed that these small livestock operations may be a source of the *E. coli* impairment.

Linkage Analysis and *E. coli* Load Duration Curves

The linkage between the *E. coli* concentrations in the Galena River watershed and the potential sources provides the basis for the development of this TMDL. The linkage is defined as the cause and effect relationship between the selected indicators and the sources. Analysis of this relationship allows for estimating the total assimilative capacity of the stream and any needed load reductions. Analysis of the data for the Galena River watershed indicates that a significant amount of the *E. coli* load enters the Galena River watershed through both wet (nonpoint) and dry (point) weather sources.

To investigate further the potential sources mentioned above, an *E. coli* load duration curve

analysis, as outlined in an unpublished paper by Cleland (2002), was developed for each sampling site in the Galena River watershed. The load duration curve analysis is a relatively new method utilized in TMDL development. The method considers how stream flow conditions relate to a variety of pollutant loadings and their sources (point and nonpoint).

In order to develop a load duration curve, continuous flow data is required. The USGS gage for the Galena River near La Porte, Indiana (04096100) located downstream on the Galena River near the Indiana-Michigan state line was inactivated in 2003; therefore, this gage could not be used for the development of load duration curves. The Little Calumet River at Porter, Indiana (04094000) gage was used for the development of the *E. coli* load duration curve analysis for the Galena River watershed TMDL. A regression was run to determine the comparability of the flow data collected during the time period when both gages were running (October 1, 1969 to September 30, 2003). The R^2 value was 0.635. The closer the R^2 value is to 1, the better the correlation between the flow data collected at each gage. Thirty (30) regressions were run to compare nearby gages to the Galena River gage in order to determine the gage that most closely resembled the flow data gathered at the Galena River gage. The Little Calumet River Gage at Porter, Indiana had the R^2 value closest to 1. The Galena River watershed has a lot of wetland area which could dampen the effects of rain events on flow. USGS gage 04094000 is located on the Little Calumet River in Porter County.

The flow data is used to create flow duration curves, which display the cumulative frequency of distribution of the daily flow for the period of record. The flow duration curve relates flow values measured at the monitoring station to the percent of time that those values are met or exceeded. Flows are ranked from extremely low flows, which are exceeded nearly 100 percent of the time, to extremely high flows, which are rarely exceeded. Flow duration curves are then transformed into load duration curves by multiplying the flow values along the curve by applicable water quality criteria values for *E. coli* and appropriate conversion factors. The load duration curves are conceptually similar to the flow duration curves in that the x-axis represents the flow recurrence interval and the y-axis represents the allowable load of the water quality parameter. The curve representing the allowable load of *E. coli* was calculated using the daily and geometric mean standards of 235 *E. coli* per 100 ml and 125 *E. coli* per 100 ml, respectively. The final step in the development of a load duration curve is to add the water quality pollutant data to the curves. Pollutant loads are estimated from the data as the product of the pollutant concentrations, instantaneous flows measured at the time of sample collection, and appropriate conversion factors. In order to identify the plotting position of each calculated load, the recurrence interval of each instantaneous flow measurement was defined. Water quality pollutant monitoring data are plotted on the same graph as the load duration curve that provides a graphical display of the water quality conditions in the waterbody. The pollutant monitoring data points that are above the target line exceed the water quality standards (WQS); those that fall below the target line meet the WQS (Mississippi DEQ, 2002).

Load duration curves were created for all the sampling sites in the Galena River watershed. However, sampling sites 7, 8, and 9 provide the best description of the sources of *E. coli* to the Galena River watershed and will be discussed in this TMDL (Figure 3, Attachment C). Site 7 (LMG100-0015) is located on the Galena River on County Road 1000 North just east of County Road 125 East. Site 8 (LMG100-0017) is located on Spring Creek on County Road 1000 North, West of County Road 500 East. Site 9 (LMG100-0009) is located on an unnamed tributary to Spring Creek on County Road 1000 North, just East of County Road 700 East. These sampling sites were intensively sampled for *E. coli* September through October 2008. The data indicate that the largest exceedances of the *E. coli* WQS are prevalent during wet weather events (noted by diamonds above the curve on the far left side of the figure in Attachment C). Dry weather

contributions are also a source of *E. coli* to the Galena River watershed (noted by the diamonds above the curve on right side of the figure in Attachment C). However, the dry weather contributions are less influential in this watershed as indicated by the diamonds on the right side of the graph being near or under the WQS target line.

To further investigate sources of pollution, *E. coli* counts in Most Probable Number (MPN)/100 mL have been plotted on precipitation graphs (Attachment C). Elevated levels of *E. coli* during and soon after rain events indicate *E. coli* contribution due to runoff. The precipitation data was collected by a weather station in La Porte County and managed by the Indiana State Climate Office at Purdue University.

Site 7 (LMG100-0015) is located on the Galena River on County Road 1000 North, just east of County Road 125 East. This site receives forested, wetland, and agricultural inputs and is in northern La Porte County. The geometric mean at this site is 297 MPN/100 mL. Two of the five samples collected during the 2008 intensive sampling were above the single standard maximum of 235 MPN/100 mL. The highest sample collected was 686.7 MPN/100 mL. The highest sample was collected on a day when the precipitation was recorded as 0.09 inches. This high reading during a relatively dry period is unusual for this watershed. This high result could be the result of livestock having unrestricted access to the streams as noted in the watershed tour. Nonpoint sources also contribute to the *E. coli* impairment at this site as violations were noted during wet periods.

Site 8 (LMG100-0017) is located on Spring Creek on County Road 1000 North, West of County Road 500 East. This area is primarily forested with wetland areas with a few agricultural inputs and is located in northern La Porte County. The stream in this area has a thin riparian buffer. The geometric mean at this site is 383 MPN/100 mL. Of the samples collected during the 2008 intensive sampling, one sample at this site was below the single sample maximum of 235 MPN/100 mL. The highest exceedence at this site is 686.7 MPN/100 mL, which occurred during a rain event indicating that *E. coli* contributions are from nearby runoff.

Site 9 (LMG100-0009) is located on an unnamed tributary to Spring Creek on County Road 1000 North, just East of County Road 700 East. This area receives inputs from forests, wetlands, and agriculture and is located in northeastern La Porte County. There is a thin riparian buffer on either side of the stream. The geometric mean at this site is 424 MPN/100 mL. Four of the five samples collected during the 2008 intensive sampling at this site were above the single sample maximum of 235 MPN/100 mL. The highest exceedence of the single sample maximum is 866.4 MPN/100 mL, which was collected on a day when the precipitation was recorded as 0.07 inches. This high reading during a relatively dry period is unusual for this watershed. This high result could be the result of livestock having unrestricted access to the streams as noted in the watershed tour. Nonpoint sources also contribute to the *E. coli* impairment at this site as violations were noted during wet periods.

While there are point source contributions, compliance with the numeric *E. coli* WQS in the Galena River watershed most critically depends on controlling nonpoint sources using best management practices (BMPs). If the *E. coli* inputs can be controlled, then total body contact recreational use in Galena River watershed will be protected.

TMDL Development

The TMDL represents the maximum loading that can be assimilated by the waterbody while still achieving the Waters Quality Standard (WQS). As indicated in the Numeric Targets section of this document, the target for this *E. coli* TMDL is 125 per one hundred milliliters as a geometric mean based on not less than five samples equally spaced over a thirty-day period from April 1 through October 31. Concurrent with the selection of a numeric concentration endpoint, TMDL development also defines the critical conditions that will be used when defining allowable levels. Many TMDLs are designed as the set of environmental conditions that, when addressed by appropriate controls, will ensure attainment of WQS for the pollutant. For example, the critical conditions for the control of point sources in Indiana are given in 327 IAC 5-2-11.1(b). In general, the 7-day average low flow in 10 years (Q7, 10) for a stream is used as the design condition for point source dischargers. However, *E. coli* sources to the Galena River watershed arise from a mixture of dry and wet weather-driven conditions, and there is no single critical condition that would achieve the *E. coli* WQS. For the Galena River watershed and the contributing sources, there are a number of different allowable loads that will ensure compliance, as long as they are distributed properly throughout the watershed.

For most pollutants, TMDLs are expressed on a mass loading basis (e.g. pounds per day). For *E. coli* indicators, however, mass is not an appropriate measure because *E. coli* is expressed in terms of organism counts (or resulting concentration) (USEPA, 2001). The geometric mean *E. coli* WQS allows for the best characterization of the watershed. Therefore, this *E. coli* TMDL is concentration-based consistent with 327 IAC 5-2-11.1(b) and 40 CFR, Section 130.2 (i) and the TMDL is equal to the geometric mean *E. coli* WQS for each month of the recreational season (April 1 through October 31).

Allocations

TMDLs are comprised of the sum of individual wasteload allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and natural background levels. In addition, the TMDL must include a Margin of Safety (MOS), either implicitly or explicitly, that accounts for uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. Conceptually, this definition is denoted by the equation:

$$TMDL = \sum WLAs + \sum LAs + MOS$$

The term TMDL represents the maximum loading that can be assimilated by the receiving water while still achieving WQS. The overall loading capacity is subsequently allocated into the TMDL components of WLAs for point sources, LAs for nonpoint sources, and the MOS. This *E. coli* TMDL is concentration-based consistent with USEPA regulations at 40 CFR, Section 130.2(i).

Wasteload Allocations

As previously mentioned, there are three (3) permitted dischargers in the Galena River watershed. All three (3) permitted dischargers have a sanitary component to their discharge. All three (3) permitted dischargers with a sanitary component already have *E. coli* limits in their permits. Woodberry MHP and La Lumiere School, Inc. still have total residual chlorine limits in their permits.

There are two (2) MS4 communities, La Porte County (INR04107) and St. Joseph County (IN0R0041), in the Galena River watershed. A permit has been issued for this MS4 community. Guidelines for MS4 permits and timelines are outlined in Indiana's Municipal Separate Storm Sewer System (MS4) Rule 13 (327 IAC 15-13-10 and 327 IAC 15-13-11).

There are no CSO communities in the Galena River Watershed.

In the event that designated uses and associated water quality criteria applicable to the Galena River are revised in accordance with applicable requirements of state and federal law, this TMDL may be revised to be consistent with such revisions.

The WLA is set at the WQS of 125 per one hundred milliliters as a geometric mean based on not less than five samples equally spaced over a thirty-day period from April 1 through October 31.

Load Allocations

The LA for nonpoint sources is equal to the WQS of 125 per one hundred milliliters as a geometric mean based on not less than five samples equally spaced over a thirty-day period from April 1 through October 31. The LA will use the geometric mean of each sampling location to determine the reduction necessary to comply with WQS at each site (Attachment D).

Load allocations may be affected by subsequent work in the watershed. Currently there is one watershed project in this area; the LaPorte County SWCD has a Lake and River Enhancement Program (LARE) Grant. It is anticipated that watershed projects will be useful in continuing to define and address the nonpoint sources of the *E. coli* in the Galena River watershed.

Margin of Safety

A Margin of Safety (MOS) was incorporated into this TMDL analysis. The MOS accounts for any uncertainty or lack of knowledge concerning the relationship between pollutant loading and water quality. The MOS can be either implicit (i.e., incorporated into TMDL analysis through conservative assumptions) or explicit (i.e., expressed in the TMDL as a portion of the loadings). This TMDL uses an implicit MOS by applying a couple of conservative assumptions. First, no rate of decay for *E. coli* was applied. *E. coli* bacteria have a limited capability of surviving outside of their hosts and therefore, a rate of decay normally would be applied. However, applying a rate of decay could result in a discharge limit that would be greater than the *E. coli* WQS, thus no rate of decay was applied. Second, the *E. coli* WQS was applied to all flow conditions. This adds to the MOS for this TMDL. IDEM determined that applying the *E. coli* WQS of 125 per one hundred milliliters to all flow conditions and with no rate of decay for *E. coli* is a more conservative approach that provides for greater protection of the water quality.

Seasonality

Seasonality in the TMDL is addressed by expressing the TMDL in terms of the *E. coli* WQS for total body contact during the recreational season (April 1 through October 31) as defined by 327 IAC 2-1.5-8(e)(2). There is no applicable total body contact *E. coli* WQS during the remainder of the year in Indiana. Because this is a concentration-based TMDL, *E. coli* WQS will be met regardless of flow conditions in the applicable season.

Monitoring

Future *E. coli* monitoring of the Galena River watershed will take place during IDEM's five-year rotating basin schedule and/or once TMDL implementation methods are in place. Monitoring will be adjusted as needed to assist in continued source identification and elimination. IDEM will monitor at an appropriate frequency to determine whether Indiana's 30-day geometric mean value of 125 *E. coli* per one hundred milliliters is being met. When results indicate that the waterbody is meeting the *E. coli* WQS, the waterbody will then be removed from the 303(d) list.

Reasonable Assurance Activities

Reasonable assurance activities are programs that are in place or will be in place to assist in meeting the Galena River watershed TMDL allocations and the *E. coli* Water Quality Standard (WQS).

National Pollutant Discharge Elimination System (NPDES) Permitted Dischargers

All permitted dischargers with a sanitary component already have *E. coli* limits and monitoring as part of their current permits.

Storm Water General Permit Rule 13

MS4 permits have been issued in the state of Indiana. The two (2) MS4 communities in the Galena River watershed are La Porte County (INR04107) and St. Joseph County (IN0R0041). Once the permits have been implemented, the water quality in the Galena River watershed will improve. Guidelines for MS4 permits and timelines are outlined in Indiana's Municipal Separate Storm Sewer System (MS4) Rule 13 (327 IAC 15-13-10 and 327 IAC 15-13-11). These permits will be used to address storm water impacts in the Galena River watershed.

Confined Feeding Operations and Concentrated Animal Feeding Operations

CFO and CAFO are required to manage manure, litter, process wastewater pollutants in a manner that does not cause or contribute to the impairment of *E. coli* WQS. There are no CFO or CAFO operations within this watershed.

Watershed Projects

Currently there is one project in the Galena River watershed. The LaPorte County Soil and Water Conservation District (SWCD) has a Lake and River Enhancement Program (LARE) grant from DNR. The Galena River Watershed Management Group is currently working on the development of a watershed management plan that focuses on defining the watershed with the goal of protecting the valuable resources within this watershed.

Members of the LaPorte County SWCD have been trained in the use of the Long-Term Hydrologic Impact Assessment (L-THIA) model. The L-THIA model is used to estimate changes that will be seen in nonpoint source pollution runoff associated with altered land uses within the watershed.

The majority of the Galena River watershed (93.96%) sits within the boundary of DNR's Lake Michigan Coastal Management Program (LMCP). A Coastal and Estuarine Land Conservation Program (CELCP) plan has been developed for the entire LMCP Area. The goals of the CELCP

plan are to identify land uses and habitats that require natural resource protection through the use of the Indiana Biodiversity Initiative (IBI) model. Identification of these areas will provide a planning resource to communities. This plan is available through DNR's LMCP.

IDEM has recently hired a Watershed Specialist for this area of the state. The Watershed Specialist will be available to assist stakeholders with starting a watershed group, facilitating planning activities, and serving as a liaison between watershed planning and TMDL activities in the Galena River watershed.

TMDLs

Currently, there is one additional TMDL project within the Little Calumet-Galien watershed basin, the Salt Creek TMDL.

Potential Future Activities

Nonpoint source pollution can be reduced by the implementation of "best management practices" (BMPs). BMPs are practices used in agriculture, forestry, urban land development, and industry to reduce the potential for damage to natural resources from human activities. A BMP may be structural, that is, something that is built or involves changes in landforms or equipment, or it may be managerial, that is, a specific way of using or handling infrastructure or resources. BMPs should be selected based on the goals of a watershed management plan. Livestock owners, farmers, and urban planners can implement BMPs outside of a watershed management plan, but the success of BMPs would be enhanced if coordinated as part of a watershed management plan. Following are examples of BMPs that may be used to reduce *E. coli* runoff:

Riparian Area Management - Management of riparian areas protects streambanks and river banks with a buffer zone of vegetation, either grasses, legumes, or trees.

Manure Collection and Storage - Collecting, storing, and handling manure in such a way that nutrients or bacteria do not run off into surface waters or leach down into ground water.

Contour Row Crops - Farming with row patterns and field operations aligned at or nearly perpendicular to the slope of the land.

No-Till Farming - No-till is a year-round conservation farming system. In its pure form, no-till does not include any tillage operations either before or after planting. The practice reduces wind and water erosion, catches snow, conserves soil and water, protects water quality, and provides wildlife habitat. No-till helps control soil erosion and improve water quality by maintaining maximum residue plant levels on the soil surface. These plant residues: 1) protect soil particles and applied nutrients and pesticides from detachment by wind and water; 2) increase infiltration; and 3) reduce the speed at which wind and water move over the soil surface.

Manure Nutrient-Testing - If manure application is desired, sampling and chemical analysis of manure should be performed to determine nutrient content for establishing the proper manure application rate in order to avoid overapplication and run-off.

Drift Fences - Drift fences (short fences or barriers) can be installed to direct livestock movement. A drift fence parallel to a stream keeps animals out and prevents direct input of *E. coli* to the stream.

Pet Clean-up / Education - Education programs for pet owners can improve water quality of runoff from urban areas.

Septic Management/Public Education - Programs for management of septic systems can provide a systematic approach to reducing septic system pollution. Education on proper maintenance of septic systems as well as the need to remove illicit discharges could alleviate some anthropogenic sources of *E. coli*.

Conclusion

The sources of *E. coli* to the Galena River watershed include both point and nonpoint sources. In order for the Galena River watershed to achieve Indiana's *E. coli* WQS, the wasteload and load allocations for the Galena River watershed in Indiana have been set to the *E. coli* WQS of 125 per one hundred milliliters as a geometric mean based on not less than five samples equally spaced over a thirty day from April 1 through October 31. Achieving the wasteload and load allocations for the Galena River watershed depends on:

1) Nonpoint sources of *E. coli* being controlled by implementing best management practices in the watershed.
2) Continuing efforts to protect this watershed.

The next phase of this TMDL is to identify and support the implementation of activities that will bring the Galena River watershed in compliance with the *E. coli* WQS. IDEM will continue to work with its existing programs on implementation. In the event that designated uses and associated water quality criteria applicable to the Galena River watershed are revised in accordance with applicable requirements of state and federal law, the TMDL implementation activities may be revised to be consistent with such revisions. Additionally, IDEM will work with local stakeholder groups to pursue best management practices that will result in improvement of the water quality in the Galena River watershed.

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Table 2: NPDES Permits in the Galena River Watershed

Facilities with *E. coli* Limits

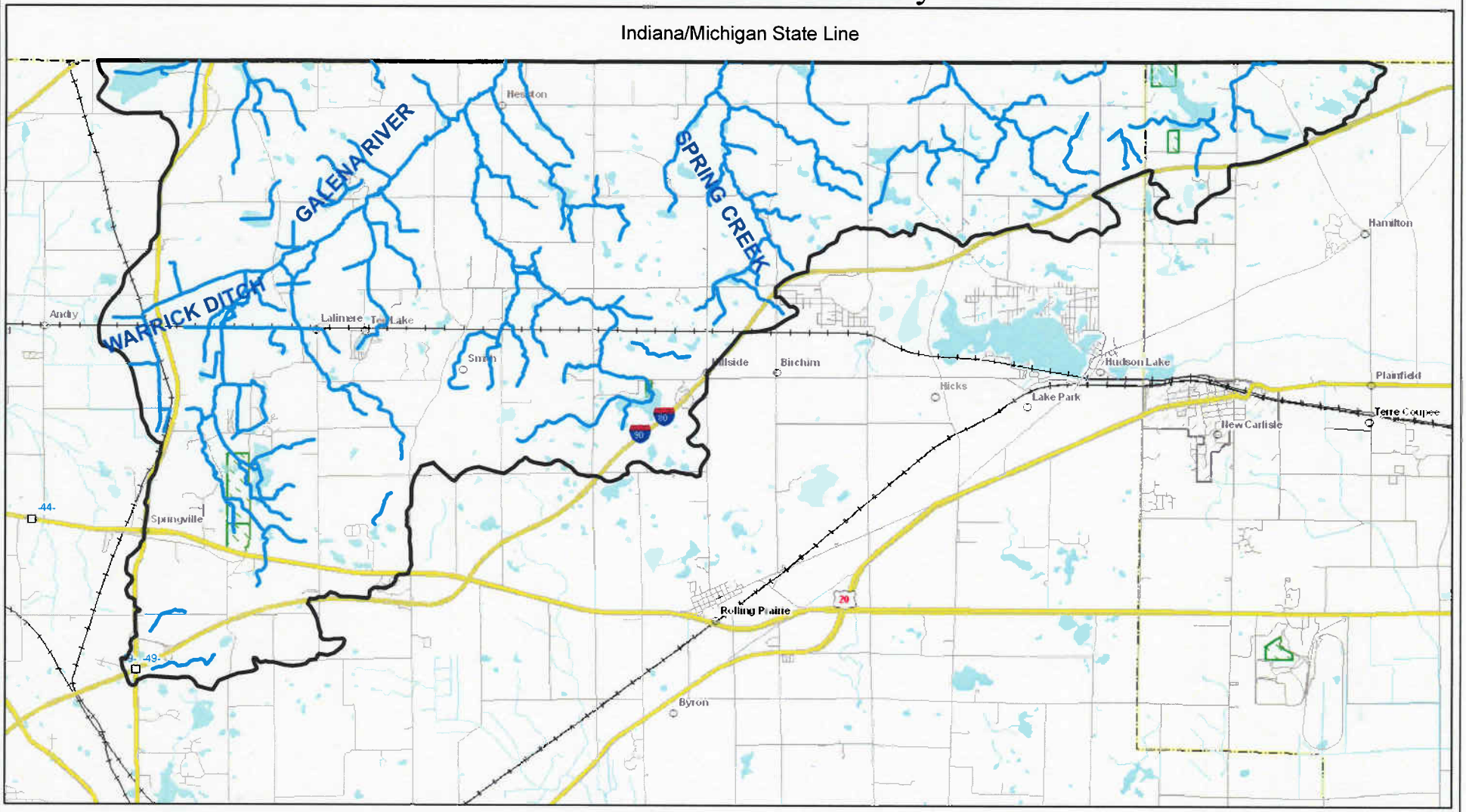
Permit No.	Facility Name Receiving Waters
IN0020931	TRCC Travel Plaza 3 WWTP (ITR Concession Company) Hog Lake

Facilities with Total Residual Chlorine Limits

Permit No.	Facility Name Receiving Waters
IN0039535	Woodberry Park, LLC (Pioneer Village MHP) Galena River
IN0036803	La Lumiere School, Inc Galena River via unnamed tributary

Figure 1

Galena River Watershed Study Area



0 0.5 1 2 Miles

0 0.5 1 2 Kilometers

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By:
Selena Medrano, Office of Water Quality
Date:03/06/2009

N
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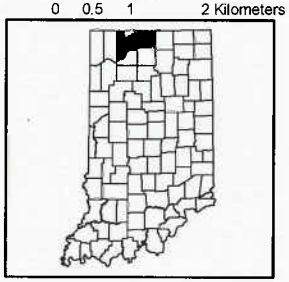


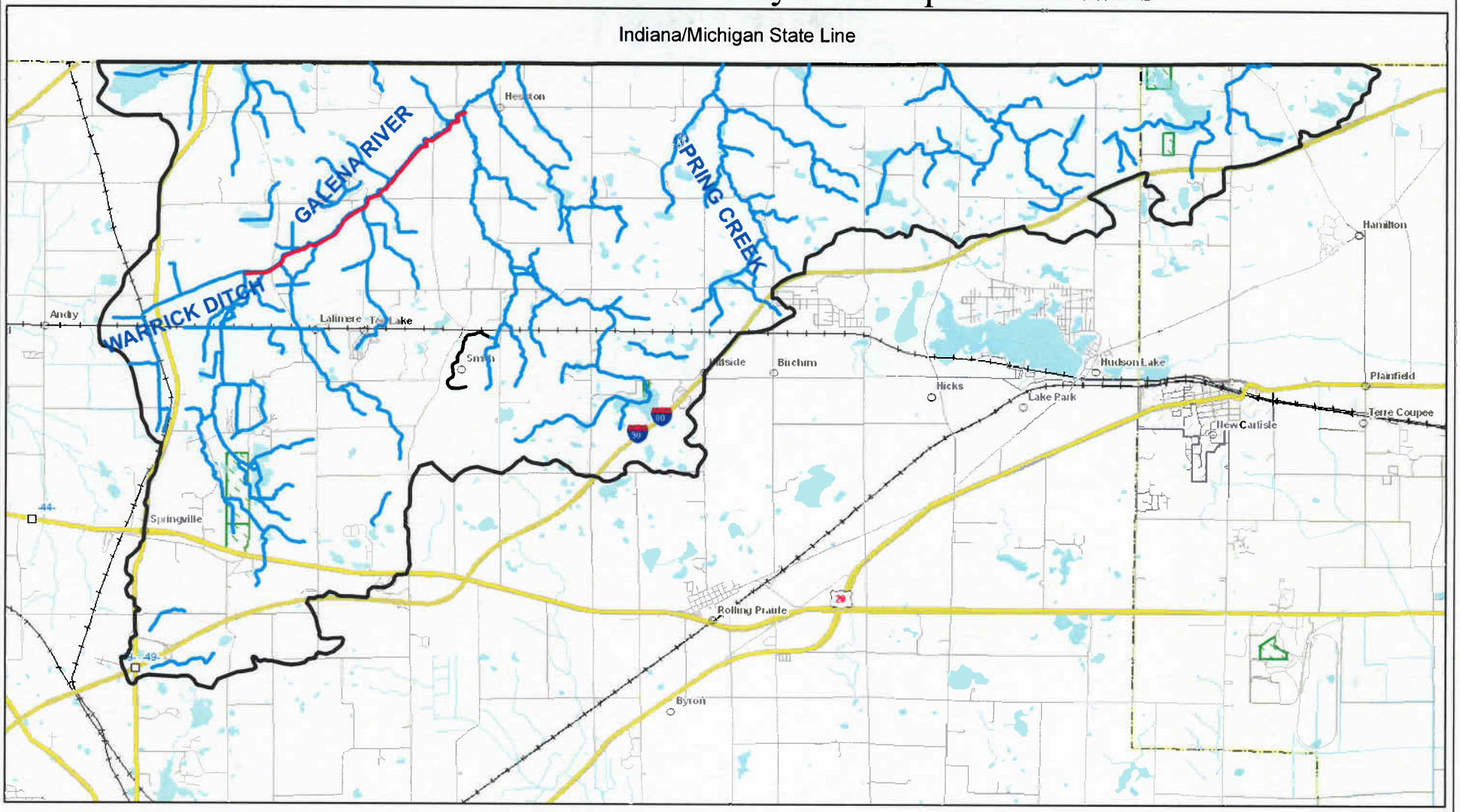
IDEM

Legend
- Galena Streams
- Galena Watershed Study Area

Sources:
Non Orthophotography
Data - Obtained from the State of Indiana Geographical Information Office Library
Map Projection: UTM Zone 16 N **Map Datum:** NAD83

Figure 2

Galena River Watershed Study Area Impaired Streams



This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By:
Selena Medrano, Office of Water Quality
Date:03/06/2009

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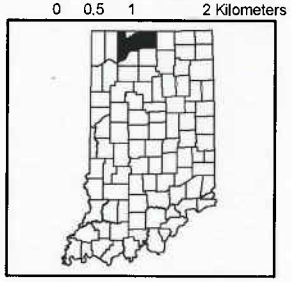
0 0.5 1 2 Miles
0 0.5 1 2 Kilometers



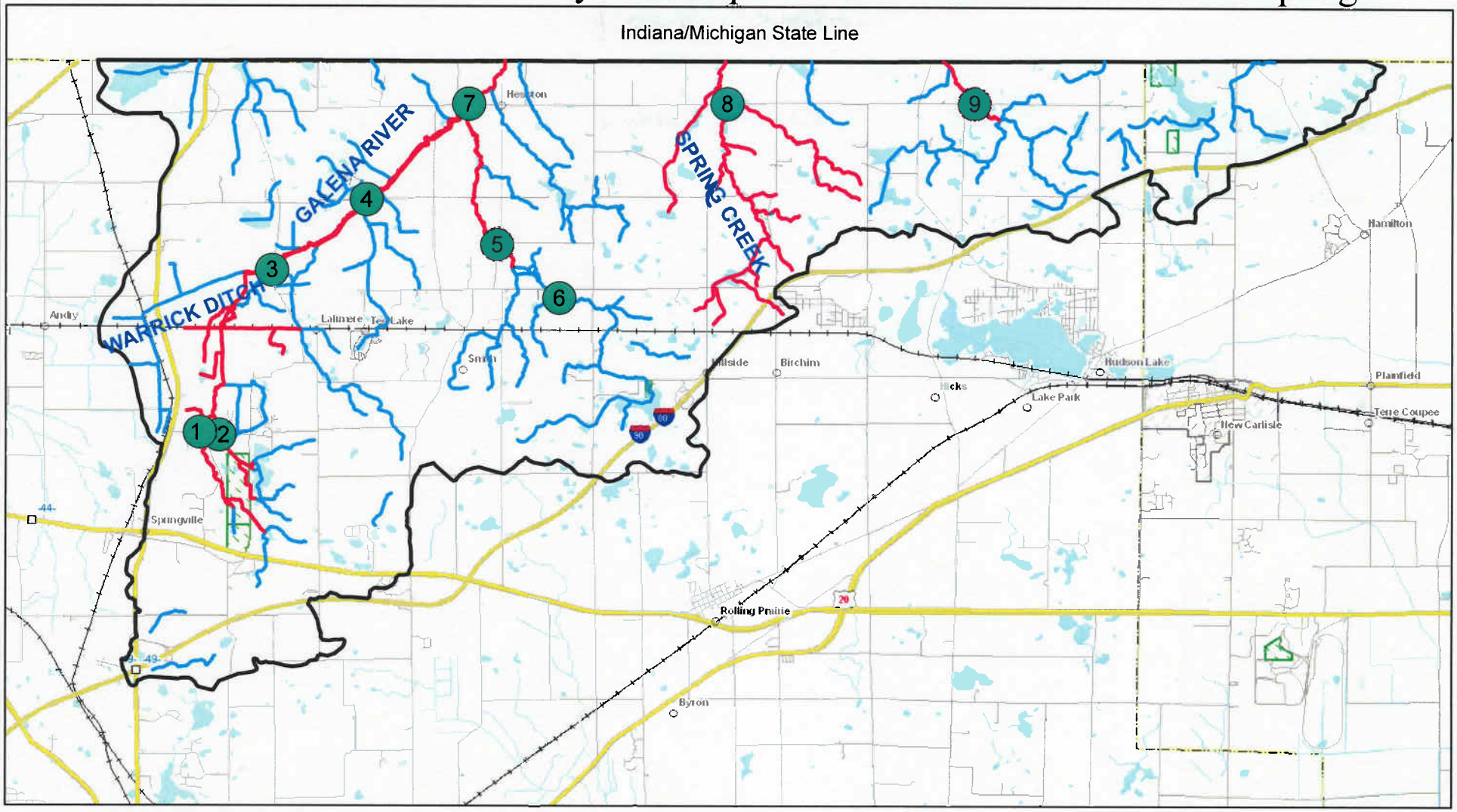
IDEM

Legend
- Galena Streams
- 2008 Impaired Streams
- Galena Watershed Study Area

Sources:
Non Orthophotography
Data - Obtained from the State of Indiana Geographical Information Office Library
Map Projection: UTM Zone 16 N **Map Datum:** NAD83

Figure 3

Galena River Watershed Study Area Impaired Streams Based on 2008 Sampling



This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By:
Selena Medrano, Office of Water Quality
Date:03/06/2009

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W E
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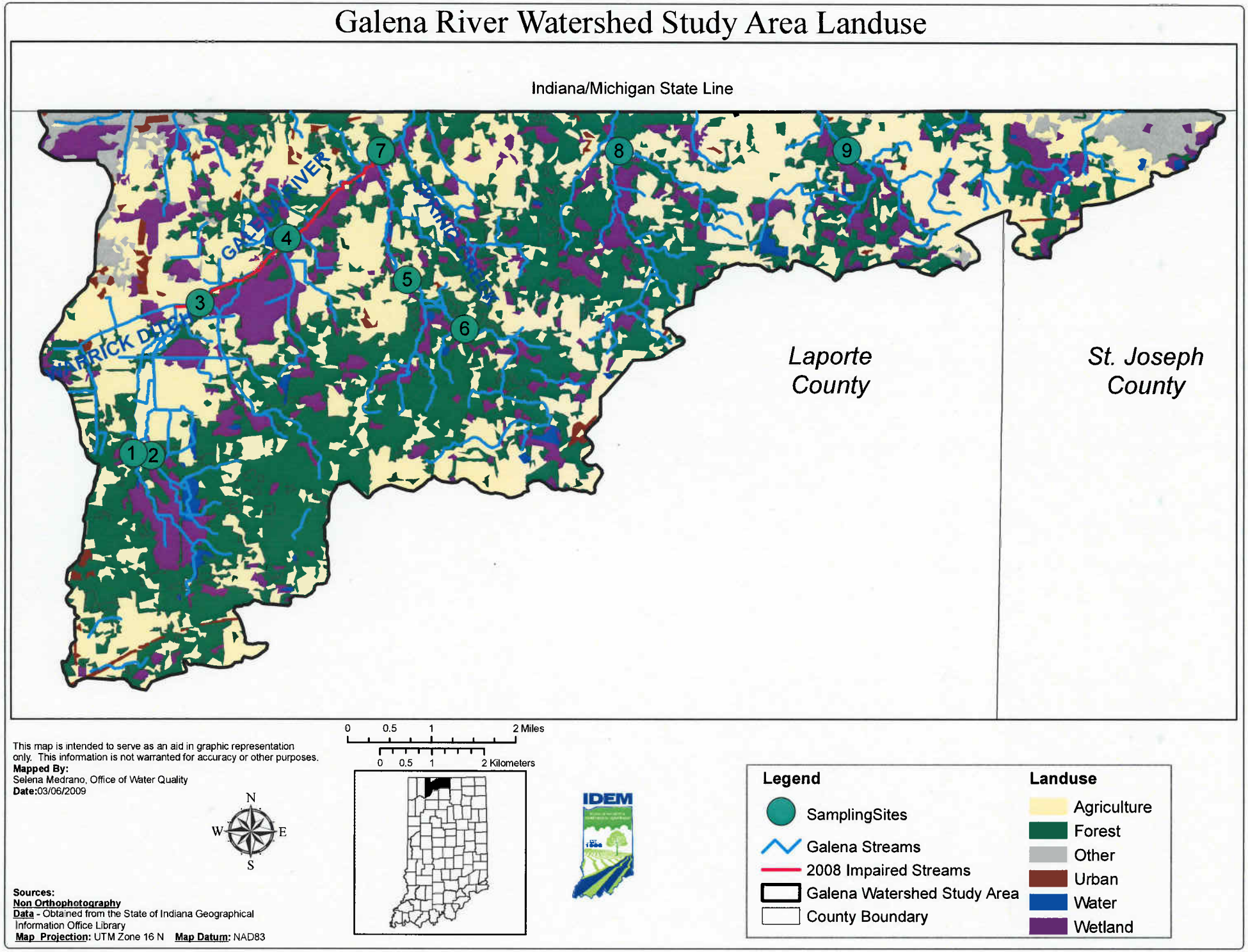
Sources:
Non Orthophotography
Data - Obtained from the State of Indiana Geographical Information Office Library
Map Projection: UTM Zone 16 N **Map Datum:** NAD83

IDEM

Legend

- SamplingSites
- Galena Streams
- Impaired Streams
- Galena Watershed Study Area

Figure 4


Galena River Watershed Study Area Landuse
Indiana/Michigan State Line
GALENA RIVER
PRAIRIE DITCH
1
2
3
4
5
6
7
8
9
Laporte County
St. Joseph County
This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.
Mapped By:
Selena Medrano, Office of Water Quality
Date:03/06/2009
N
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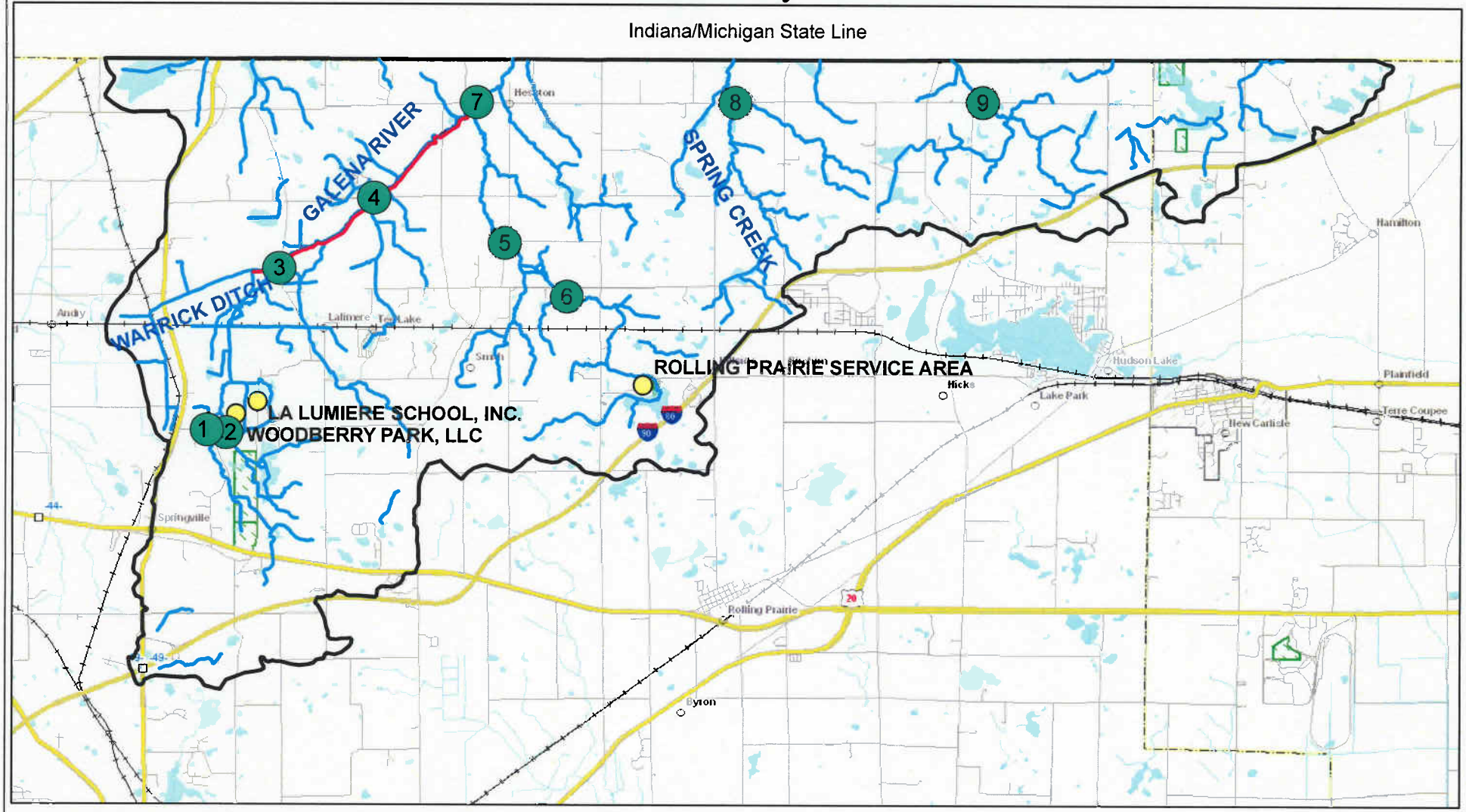
0 0.5 1 2 Miles
0 0.5 1 2 Kilometers
IDEM
Legend
SamplingSites
Galena Streams
2008 Impaired Streams
Galena Watershed Study Area
County Boundary
Landuse
Agriculture
Forest
Other
Urban
Water
Wetland
Sources:
Non Orthophotography
Data - Obtained from the State of Indiana Geographical Information Office Library
Map Projection: UTM Zone 16 N Map Datum: NAD83

Figure 5

Galena River Watershed Study Area NPDES Facilities



This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By:
Selena Medrano, Office of Water Quality
Date:03/06/2009

0 0.5 1 2 Miles
0 0.5 1 2 Kilometers

N
W E
S

IDEM

Legend
- NPDES Facilities
- SamplingSites
- Galena Streams
- 2008 Impaired Streams
- Galena Watershed Study Area

Sources:
Non Orthophotography
Data - Obtained from the State of Indiana Geographical Information Office Library
Map Projection: UTM Zone 16 N **Map Datum:** NAD83

Attachment A

Data for the Galena River Watershed TMDL

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Galena River Watershed 2008 Data

Site Number	Stream Name	Description	Lsite	Sample Date	E_ Coli (MPN/100mL)	Geometric mean	Alkalinity (as CaCO3) (mg/L)	Chloride (mg/L)
1	Galena River	CR 650 N	LMG100-0010	9/16/2008	248.1	613	132	28
				9/16/2008	214.3		131	29
				9/23/2008	686.7		199	41
				9/30/2008	866.4		231	47
				10/7/2008	1203.3		255	49
				10/14/2008	488.4		247	49
2	Galena River East	CR 650 N	LMG100-0008	9/16/2008	160.7	144	124	18
				9/23/2008	139.6		132	20
				9/30/2008	613.1		206	17
				10/7/2008	42.8		174	20
				10/14/2008	155.3		191	19
				10/14/2008	105		191	19
3	Galena River	Wilhelm Rd	LMG100-0012	9/16/2008	275.5	379	153	22
				9/23/2008	142.1		218	26
				9/30/2008	866.4		222	34
				10/7/2008	461.1		230	32
				10/14/2008	501.2		234	32
4	Galena River	CR 900 N	LMG100-0013	9/16/2008	307.6	288	145	17
				9/23/2008	159.7		227	20
				9/30/2008	816.4		223	29
				10/7/2008	261.3		236	25
				10/14/2008	307.6		238	24
5	Unnamed Trib E to Galena River	Fail Rd	LMG100-0014	9/16/2008	261.3	287	78	46
				9/23/2008	307.6		187	21
				9/30/2008	325.5		206	22
				9/30/2008	365.4		207	21
				10/7/2008	228.2		241	17
				10/14/2008	325.5		251	15

Galena River Watershed 2008 Data

Site Number	Stream Name	Description	Lsite	Sample Date	E_ Coli (MPN/100mL)	Geometric mean	Alkalinity (as CaCO3) (mg/L)	Chloride (mg/L)
6	Main Trib E to Galena R	CR 800 N	LMG100-0011	9/16/2008	206.3	116	44	50
				9/23/2008	73.8		111	32
				9/30/2008	129.6		134	38
				10/7/2008	63.8		206	28
				10/7/2008	59.1		206	29
				10/14/2008	166.4		236	23
7	Galena River	CR 1000 N	LMG100-0015	9/16/2008	613.1	297	132	21
				9/23/2008	172.3		220	19
				9/23/2008	193.5		220	19
				9/30/2008	686.7		222	26
				10/7/2008	172.5		236	22
				10/14/2008	185		238	22
8	Spring Cr	CR 1000 N	LMG100-0017	9/16/2008	686.7	383	146	13
				9/23/2008	435.2		269	23
				9/30/2008	344.8		276	23
				10/7/2008	146.7		286	23
				10/14/2008	547.5		285	23
9	Unnamed Trib to Spring Cr	CR 1000 N	LMG100-0009	9/16/2008	410.6	424	113	10
				9/23/2008	579.4		221	19
				9/30/2008	344.8		251	22
				10/7/2008	193.5		277	23
				10/14/2008	866.4		289	25

Galena River Watershed 2008 Data

Site Number	Coliforms (Total) (MPN/100mL)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	Phosphorus, Total (mg/L)	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TS (mg/L)
1	> 2420		< 0.1	0.2	0.04	30	288	0.6	280
	> 2420		< 0.1	0.2	0.04	34	251	0.8	279
	> 2420	234	< 0.1	< 0.1	< 0.03	35	333	0.4	351
	> 2420	274	< 0.1	< 0.1	< 0.03	39	397	0.4	413
	> 2420	273	< 0.1	< 0.1	< 0.03	41	404	0.5	434
	> 2420	265	< 0.1	< 0.1	< 0.03	44	400	0.5 (DJ)	432
2	> 2420		< 0.1	0.1	< 0.03	30	216	0.7	235
	> 2420	176	< 0.1	< 0.1	< 0.03	33	224	0.5	249
	> 2420	235	< 0.1	0.1	< 0.03	28	298	0.4	309
	> 2420	209	< 0.1	< 0.1	< 0.03	30	251	0.5	267
	> 2420	214	< 0.1	< 0.1	< 0.03	30	273	0.5 (DJ)	293
	> 2420	208	< 0.1	< 0.1	< 0.03	28	273	0.5 (DJ)	295
3	> 2420		< 0.1	0.8	0.04	90	361	1	402
	> 2420	387	< 0.1	0.6	< 0.03	114	473	0.8	499
	> 2420	306	< 0.1	0.4	< 0.03	82	445	0.5	485
	> 2420	317	< 0.1	0.4	< 0.03	91	420	0.5	454
	> 2420	372	< 0.1	0.5	< 0.03	105	449	0.5 (DJ)	492
4	> 2420		< 0.1	0.8	0.05	76	351	1.2	390
	> 2420	374	< 0.1	0.4	< 0.03	112	457	0.7	480
	> 2420	315	< 0.1	0.3	< 0.03	92	458	0.4	458
	> 2420	325	< 0.1	0.3	< 0.03	89	412	0.4	445
	> 2420	347	< 0.1	0.4	< 0.03	100	434	0.4 (DJ)	469
5	> 2420		< 0.1	< 0.1	0.04	12	188	0.7	201
	> 2420	234	< 0.1	0.2	< 0.03	19	265	0.4	288
	> 2420	207	< 0.1	0.2	< 0.03	25	300	0.4	314
	> 2420	250	< 0.1	0.2	< 0.03	26	300	0.4	324
	> 2420	268	< 0.1	0.3	< 0.03	27	315	0.5	336
	> 2420	304	< 0.1	0.2	< 0.03	28	322	0.3 (DJ)	347

Galena River Watershed 2008 Data

Site Number	Coliforms (Total) (MPN/100mL)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	Phosphorus, Total (mg/L)	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TS (mg/L)
6	> 2420		< 0.1	0.1	0.06	6.8	171	0.8	199
	> 2420	142	< 0.1	0.6	0.06	12	211	0.8	230
	> 2420	164	< 0.1	0.8	0.04	18	248	0.6	258
	> 2420	232	< 0.1	1.4	< 0.03	27	298	0.6	320
	> 2420	233	< 0.1	1.4	< 0.03	26	298	0.5	319
	> 2420	277	< 0.1	1.7	< 0.03	25	334	0.4 (DJ)	354
7	> 2420		< 0.1	0.6	0.05	65	339	0.9	349
	> 2420	354	< 0.1	0.4	< 0.03	100	429	0.4	443
	> 2420	354	< 0.1	0.4	< 0.03	99	427	0.4	449
	> 2420	332	< 0.1	0.4	< 0.03	89	440	0.4	450
	> 2420	324	< 0.1	0.3	< 0.03	76	401	0.3	427
	> 2420	354	< 0.1	0.3	< 0.03	88	412	0.4 (DJ)	445
8	> 2420		< 0.1	0.1	0.06	19	222	0.7	254
	> 2420	351	< 0.1	0.2	< 0.03	34	373	0.3	403
	> 2420	337	< 0.1	0.2	< 0.03	34	400	0.2	411
	> 2420	315	< 0.1	0.2	< 0.03	32	388	0.5	410
	> 2420	305	< 0.1	0.2	< 0.03	33	380	0.3 (DJ)	411
9	> 2420		< 0.1	0.1	0.08	14	178	0.8	207
	> 2420	276	< 0.1	0.3	0.03	19	314	0.5	335
	> 2420	312	< 0.1	0.3	< 0.03	24	364	0.4	384
	> 2420	319	< 0.1	0.4	< 0.03	27	373	0.4	396
	> 2420	352	< 0.1	0.3	< 0.03	24	378	0.3 (DJ)	413

Galena River Watershed 2008 Data

Site Number	TSS (mg/L)	DO (mg/L)	% Saturation	pH (SU)	Temperature (Degree C°)	Specific Conductance (µS/cm)	Turbidity (NTU)
1	8	8.69	101.3	7.73	21.42	415	24.5
	9						
	< 4	8.5	91.8	7.75	19.27	560	4.7
	5	9.61	97.7	7.73	15.93	651	12.3
	7	10.39	101.4	7.59	14.2	358	7.9
	< 4	9.03	94.5	7.72	17.43	691	8.5
2	6	8.9	92.5	7.45	18.95	495	19.5
	8	8.08	90	7.95	20.92	374	7.1
	4	9.87	100.4	7.75	15.6	490	5
	4	10.73	105.1	7.71	14.56	427	7.8
	< 4	9.86	100.8	7.81	16.46	468	4.7
	< 4						
3	19	8.38	90.4	7.46	19.31	542	21.7
	17	7.75	82.9	7.62	18.97	694	9.7
	10	9.46	94.1	7.65	14.96	692	17.3
	6	10.54	103.4	7.61	14.18	685	23.5
	8	9.72	99.1	7.72	16.26	716	13.3
4	16	8.59	91.3	7.4	18.12	516	19.7
	6	8.81	88	7.66	16.26	680	13.7
	7	9.84	96.8	7.7	14.5	667	6.7
	4	11.23	106	7.65	12.87	664	7.9
	< 4	9.51	93.9	7.74	15.38	690	6.9
5	8	8.27	90.3	7.65	19.98	331	43.8
	5	8.38	84.7	7.63	17.57	456	4.8
	5	9.66	96	7.64	14.5	504	5
	5						
	6	10.33	97	7.62	12.99	533	18.5
	< 4	10.03	99.9	7.69	15.36	552	4.9

Galena River Watershed 2008 Data

Site Number	TSS (mg/L)	DO (mg/L)	% Saturation	pH (SU)	Temperature (Degree C°)	Specific Conductance (µS/cm)	Turbidity (NTU)
6	35	8.99	96.5	7.6	18.83	287	17.5
	12	7.87	83.5	7.47	18.16	350	14.8
	6	8.21	81.8	7.5	15.24	419	5
	< 4	9.31	95.7	7.46	13.42	513	6.5
	< 4						
	< 4	8.35	80.6	7.51	14.12	561	5.5
7	28	9.54	94.5	7.92	17.35	389	15.9
	4	8.15	85.4	7.67	17.5	640	5.5
	4						
	5	9.44	92.9	7.72	14.6	645	9.7
	4	10.32	99.1	7.73	13.45	638	4.6
	< 4	10.06	101.4	7.8	15.88	662	5.9
8	20	8.93	92.6	7.62	17.37	368	13.5
	7	8.27	87.8	7.65	18.25	620	4.2
	4	9.09	89.2	7.66	14.36	638	8.6
	5	10.58	103.9	7.57	14.1	642	5.3
	< 4	8.83	88.7	7.72	15.67	644	4.8
9	16	9.47	97.9	7.81	17.24	290	16.5
	4	8.13	84.5	7.64	17.33	508	5.1
	4	9.85	94.2	7.68	13.87	578	3.4
	4	10.15	96.2	7.64	13.06	608	9.1
	< 4	10.39	102.9	7.71	14.86	639	3.7

Attachment B

Historic Data for the Galena River Watershed TMDL

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Project Name	Stream Name	Description	Lsite	Sample Date
2000 Corvallis	S Br Galena River	CR 900 N	LMG100-0001	6/7/2000
				8/8/2000
				10/4/2000
2000 E Coli	Galena River	Bridge on 125E, N of 900N, south of Hesston	LMG100-0004	7/25/2000
				8/1/2000
				8/8/2000
				8/15/2000
				8/22/2000

Project Name	Stream Name	Sample Date	Calcium (ug/L)	Chloride (mg/L)
2000 Corvallis	S Br Galena River	6/7/2000		21
		8/8/2000	82000 (QJ)	22 (J)
		10/4/2000		19
2000 E Coli	Galena River	7/25/2000		
		8/1/2000		
		8/8/2000		
		8/15/2000		
		8/22/2000		

Project Name	Stream Name	Sample Date	Copper (Total) (ug/L)	Cyanide (Total) (mg/L)
2000 Corvallis	S Br Galena River	6/7/2000	< 3	< 0.005
		8/8/2000	< 3	< 0.005
		10/4/2000	< 3	< 0.005 (HJ)
2000 E Coli	Galena River	7/25/2000		
		8/1/2000		
		8/8/2000		
		8/15/2000		
		8/22/2000		

Project Name	Stream Name	Sample Date	Lead (Total) (ug/L)	Magnesium (ug/L)
2000 Corvallis	S Br Galena River	6/7/2000	< 2 (J)	
		8/8/2000	< 2	28000 (QJ)
		10/4/2000	< 2	
2000 E Coli	Galena River	7/25/2000		
		8/1/2000		
		8/8/2000		
		8/15/2000		
		8/22/2000		

Project Name	Stream Name	Sample Date	Nitrogen, Nitrate+Nitrite (mg/L)	Phosphorus, Total (mg/L)
2000 Corvallis	S Br Galena River	6/7/2000	0.86	< 0.03
		8/8/2000	0.32	0.049

		10/4/2000	0.62 (HR)	0.072
2000 E Coli	Galena River	7/25/2000		
		8/1/2000		
		8/8/2000		
		8/15/2000		
		8/22/2000		

Project Name	Stream Name	Sample Date	TKN (mg/L)	TOC (mg/L)
2000 Corvallis	S Br Galena River	6/7/2000	0.53	4.4 (J)
		8/8/2000	0.67 (J)	3.2
		10/4/2000	1 (J)	5.2
2000 E Coli	Galena River	7/25/2000		
		8/1/2000		
		8/8/2000		
		8/15/2000		
		8/22/2000		

Alkalinity (as CaCO3) (mg/L)	Arsenic (Total) (ug/L)	Cadmium (Total) (ug/L)
220	< 4	< 1
220	< 4	< 1
180	< 4 (J)	< 1 (J)

Chromium (Total) (ug/L)	COD (mg/L)	Coliforms (Total) (MPN/100mL)
< 3 (J)	< 5	
< 3	16 (J)	
< 3	37	
		2419.17
		> 2420
		> 2420
		> 2420
		> 2420

E_ Coli (MPN/100mL)	Geometric Mean	Hardness (as CaCO3) (mg/L)
		180
		320 (QJ)
		30
285.1	750.98	
920.8		
686.7		
547.5		
> 2420		

Mercury (Total) (ug/L)	Nickel (Total) (ug/L)	Nitrogen, Ammonia (mg/L)
< 0.2	< 2	< 0.1
< 0.2 (J)	< 2 (B)	0.11
< 0.2	< 2 (J)	0.37

Selenium (Total) (ug/L)	Sulfate (mg/L)	TDS (mg/L)
< 3	130	410
< 3 (J)	88	440

< 3 (J)	98 (J)	360

TS (mg/L)	TSS (mg/L)	Zinc (Total) (ug/L)
490	7 (DJ)	< 10
470	8	< 10
470 (HJ)	36	10

Attachment C

Load Duration Curves and Precipitation Graphs for the Galena River Watershed TMDL

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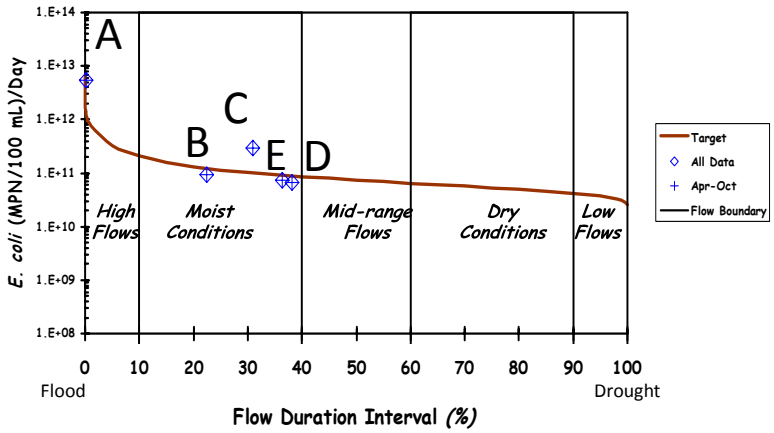
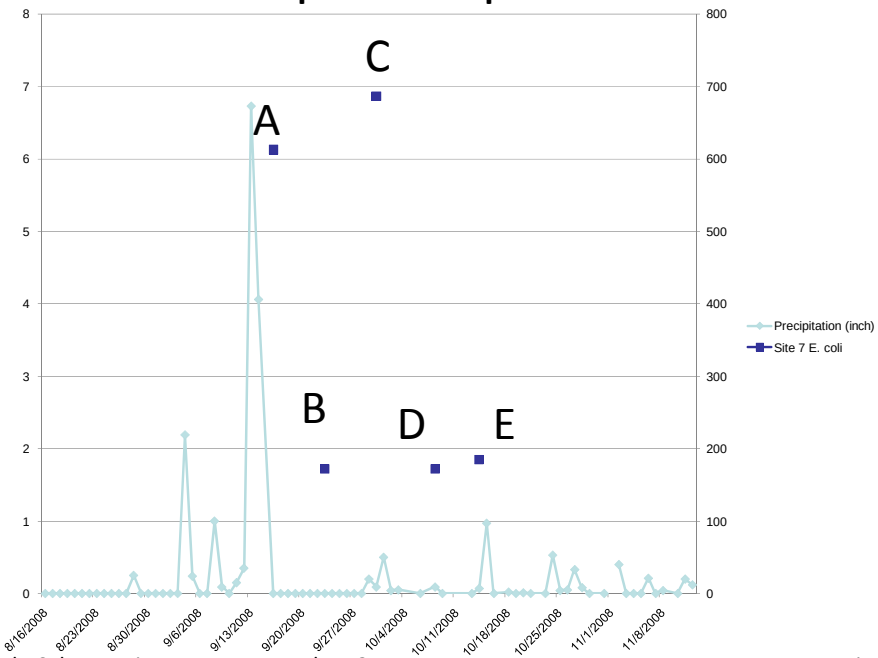
Galena River CR 1000 N
Site 7: LMG100-0015

Load Duration Curve

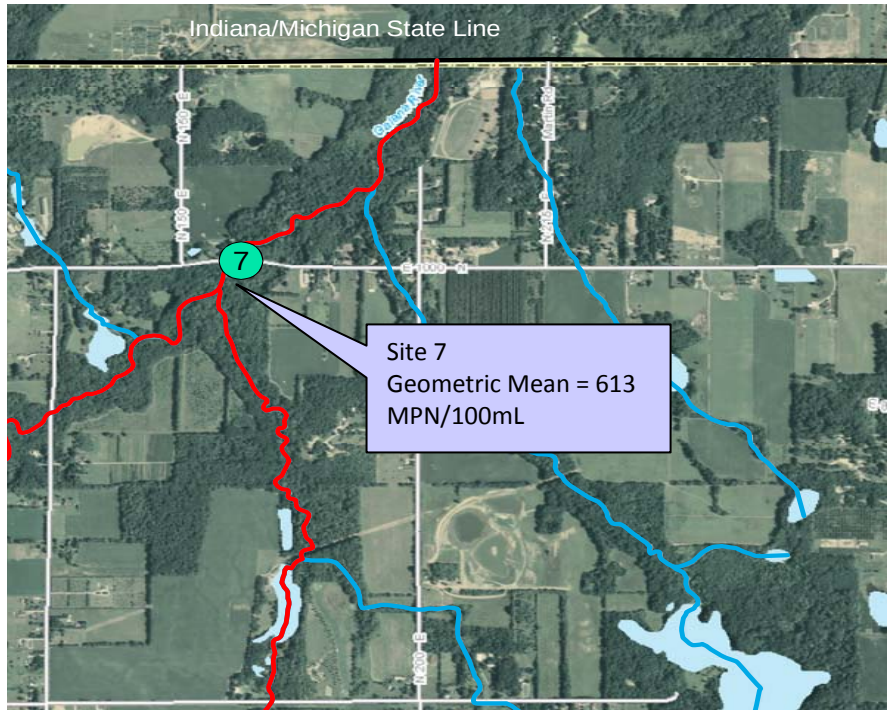


Precipitation Graph



Little Calumet River at Porter, IN Flow Gage.
LaPorte County Precipitation Station - State Climate Office

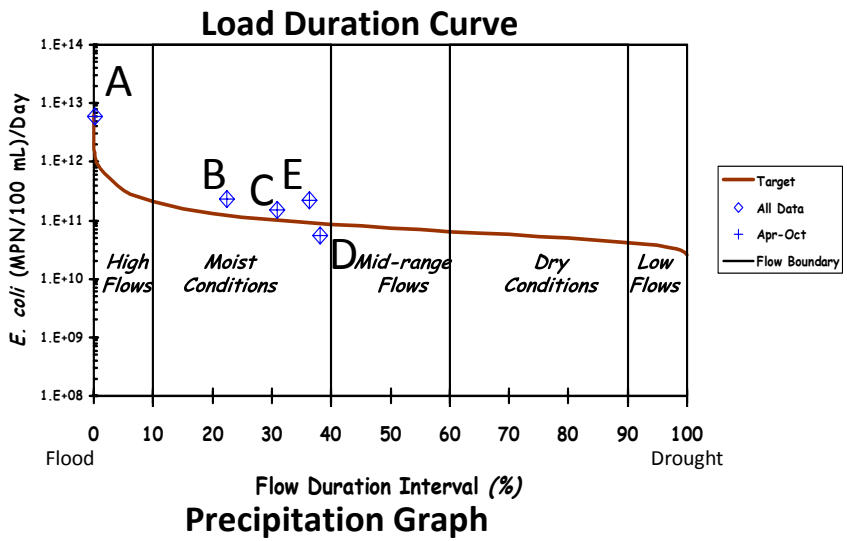
Drainage Area:
17.2 Square Miles

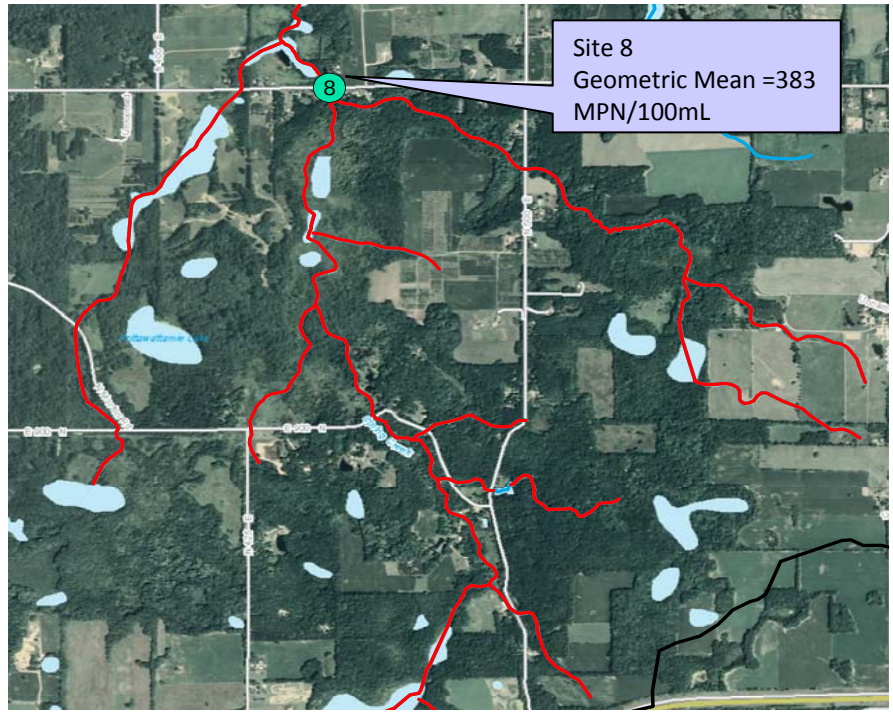


UPSTREAM

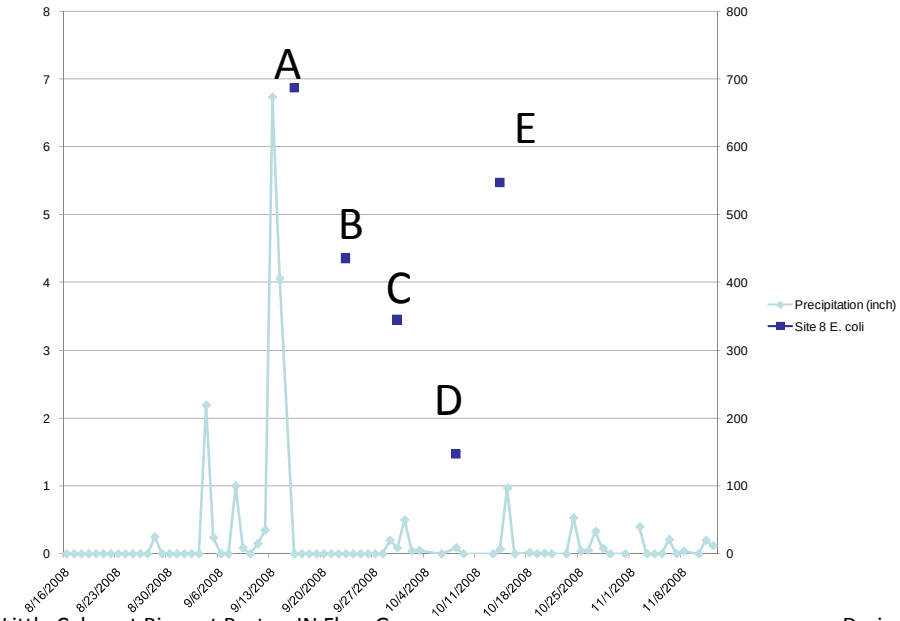
DOWNSTREAM

Spring Creek CR 1000 N
Site 8: LMG100-0017





Precipitation Graph



UPSTREAM

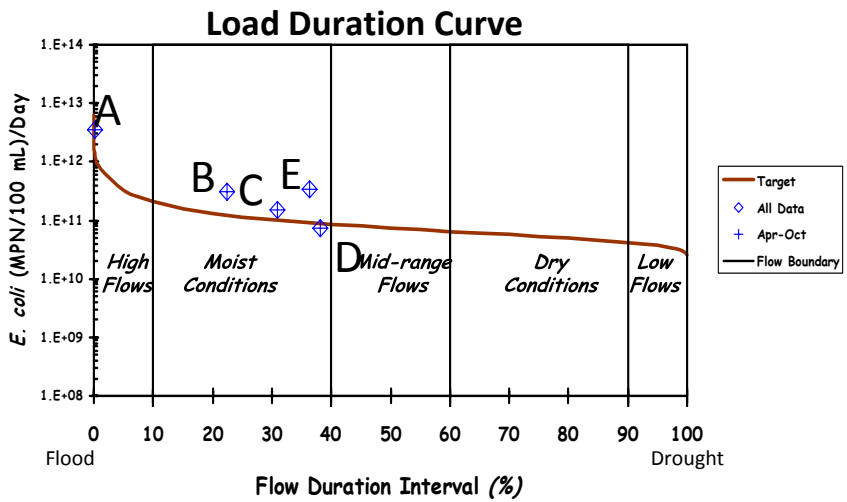
DOWNSTREAM

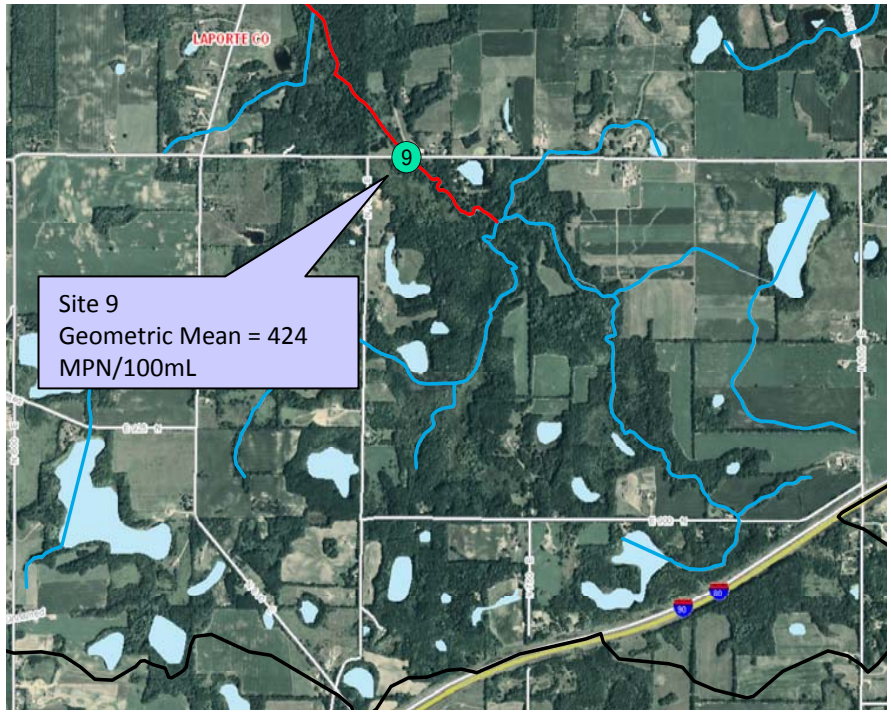
Little Calumet River at Porter, IN Flow Gage.
LaPorte County Precipitation Station - State Climate Office

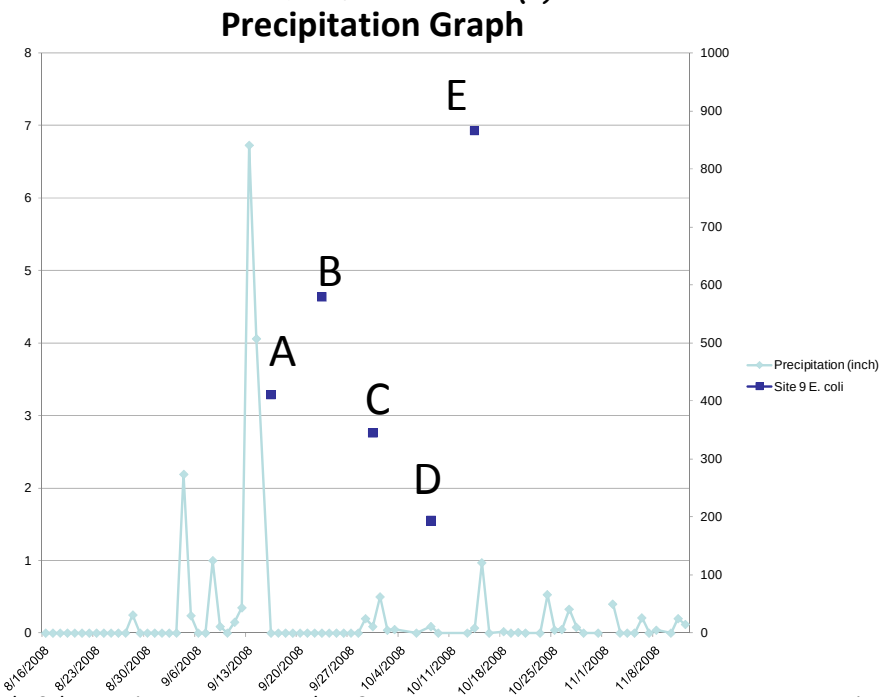
Drainage Area:
17.2 Square Miles

Spring Creek – Unnamed Tributary CR 1000 N

Site 9: LMG100-0009







UPSTREAM

DOWNSTREAM

Little Calumet River at Porter, IN Flow Gage.
LaPorte County Precipitation Station - State Climate Office

Drainage Area:
17.2 Square Miles

Attachment D

Load Reductions for the Galena River Watershed TMDL

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Site #	LSite	Stream Name	Geometric mean	Percent Reduction Needed
1	LMG100-0010	Galena River	613	79.61%
2	LMG100-0008	Galena River East	144	13.19%
3	LMG100-0012	Galena River	379	67.02%
4	LMG100-0013	Galena River	288	56.60%
5	LMG100-0014	Unnamed Tributary East to Galena River	287	56.45%
6	LMG100-0011	Main Tributary East to Galena River	116	N/A
7	LMG100-0015	Galena River	297	57.91%
8	LMG100-0017	Spring Creek	383	67.36%
9	LMG100-0009	Unnamed Tributary to Spring Creek	424	70.52%